



OFFICE OF THE PRIME MINISTER'S SCIENCE ADVISORY COMMITTEE

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Good evening, Minister Mapp, distinguished colleagues, distinguished officials, ladies and gentlemen, I would like to thank Richard Shaw for inviting me here and the Oxygen Group, in conjunction with MoRST and He Waka Tangata, for hosting this Running Hot conference. I am primarily an entomologist and have spent most of my career at Lincoln in AgResearch and its precursor organisations, most recently as Chief Scientist. Much of this has been working on the suppression of some of our worst exotic forage pest species using biological control agents. I have also had the odd excursion into science policy and strategy. More latterly, I have developed a strong interest in ways to enhance New Zealand's border biosecurity and am currently the Executive Director of a multi-organisational Centre of Research Excellence called Better Border Biosecurity, or "B3".

About a year ago, the Chief Science Adviser to the Prime Minister, Professor Sir Peter Gluckman, asked if I could assist part-time and I currently spend 30% of my time as his strategist. I advise mainly on environmental issues and CRIs as Sir Peter's background has been very much in the biomedical area, particularly paediatric medicine. I am pleased to be here this evening on his behalf. Anyway, thank you for the opportunity to give this talk. I was asked to be funny and provide uncensored opinions delivered in 'a witty manner and sprinkled with one-liners'. Maybe the general idea is that I should become the Paul Henry of the science system. There are severe dangers in trying to be witty; apart from the almost certain prospect of failure there is also the certain probability of causing offence...especially about a subject as serious as science.

So, if you don't mind, I'll say a few earnest words about science, New Zealand's need for it and the need to advocate for it. Besides, science in New Zealand is nothing to joke about; over the years there have been occasions when I have seen science unravel and careers of well-trained people fall to pieces for the wrong reasons. The level of competition and micromanagement became absurd and in my view the only thing that improved was the quality of the bids. This has now been well recognised and I applaud Dr Mapp, Sir Peter, scientists, including the National Science Panel and officials who in the last year have had the gumption to get a grip and are now working so hard to turn things round.

There are many facets to being involved in science. I spent years immersed in weevil seasonality and physiology. I thought, and still think, that it is fantastic. In fact I still fiddle around with it under the radar. However I must say that any public involvement I have had in science has been a whole lot more to do with things related to career stability and the value of scientists and their careers, rather than the glorification of science itself. There never has been a shortage of monuments to the triumphs of international and national scientific endeavour and to be honest I have been slightly bored with all that aggrandisement.

However, a month ago I visited a museum in Berlin celebrating 300 years of German science. I felt I should go rather than wanted to. I imagine there would be thousands of drawers of pinned out butterflies. Anyway the exhibits were absolutely fantastic, including the immediate and grim presence of an iron-lung. There was also great social irony in what I saw. For example, there was a room full of stuff around the mad 19th century pursuit of physiognomy and human morphometrics, whereby parts of the human anatomy were measured all around the world and vast data bases assembled to show how human worth was somehow correlated to human appearance. There were velvet-lined mahogany cases of beautifully made German precision callipers for measuring facial features, hair-colour comparators, plaster casts of African bushmen, maps of the world showing the distribution of blondness, and God knows what else. The results were published in what were then serious academic journals and well-bound books. It seems to me that it was the quality of the effort, rather than the science itself that gave these types of studies such pseudo-science legitimacy and illusion of scholarship. In the same room was a fantastic large blueprint the insides of a V2 Rocket drawn in think by Von Brun and nearby a note-book of Einstein's stuffed full of huge equations complete with ink-blots and smudges. All in one room.

This is only some of what I saw, but by the end I realised that I am indeed deeply interested in what science is and what it has been, warts and all. To me at least, I cannot think of a more interesting area of endeavour. There has been frustration in my career, but I would not have swapped for anything and now I think that New Zealand is on the brink of serious scientific engagement. Things like the earthquake and the recent threats of bird and swine flues continue to focus the attention. This is all good because, in the end, we have to have scientific information to sort things out. Really there is no other way, be it medicine, social policy, ecology, or increasing the productivity and value of an economy.

Speaking commercially, it is not enough to have a country full of business-savvy entrepreneurs with the ability to translate ideas into innovations. We need a foundation of R&D capacity and the raw basic and applied research to feed it. Actually we are doing OK. New Zealand scientists are productive — internationally speaking we have one of the highest rates of publications per research dollar spent. The recently released Global Competitiveness Index, produced by the World Economic Forum, currently ranks the quality of New Zealand's scientific research institutions 14th of 139 countries and listed this factor as one of our competitive economic advantages. This is a tribute to our educational infrastructure as our scientists. So what can we do better?

I will make a few comments skimming over some areas of interest and then finish talking about individual scientists' values and aspirations especially as these pertain to the Oxygen Group.

Firstly, we need to support our science ecosystem

A major role of government is to correct market failure. This includes making investment in the research ecosystem that feeds the pipeline leading to widget-focused innovation further down the track. This type of investment is not the sort we can palm off to private enterprise. As a nation we need to accept that it is generally not possible to accurately predict the economic return on individual research projects prior to actually doing the research. In fact some will fail. Heroic failure must be celebrated. Conversely failure based on indolence is a different matter. Officialdom must be sensitive to the difference. The value of science is very difficult to measure in monetary terms, because most of the benefits are not in the form of a direct and measurable contribution to GDP, but rather in the form of spillovers and positive externalities.

As an enthusiastic PhD student, I spent three years of my youth measuring weevil ovaries. My research didn't lead to the creation of a single widget, but it did contribute to the control of a significant agricultural pest in New Zealand. I'll come back to that at the end. Sir Peter spent several similarly widget-free years exploring the mechanisms that control fetal growth, without initially realising that his findings would contribute to new strategies to improve child health in the developing world. Similarly, some research allows us to maintain our current position in the face of new threats –such as research into biosecurity or new classes of antibiotics. Sometimes it isn't possible to accurately determine the value of these types of research projects, even retrospectively. New Zealand's emerging research strengths currently appear to lie in areas such as water technologies, earthquake engineering, efficient agricultural production in the face of climate change and nanotechnology.

Secondly, we need to structure and manage our science system to elicit greater value, rather than to retain greater control

New Zealand's science system has been one of the most competitive and fragmented, and least strategic, in the world. We are a small country and we have hard questions we need to ask ourselves. We cannot operate a science system as if we were a big country. The funding tools we use, how we prioritise, how we link science to impact through real business growth, through impact on social organisation, on enhancing our environment will differ for a country of 4 million to those found in jurisdictions 10 or 100 times bigger.

We need to structure and incentivise the science system so scientists can work together, rather than competing. We have had to support the overheads and transaction costs for 8 Crown Research Institutes and 7 Centres of Research Excellence. Funding was then structured so they are also competing head-on with 9 Universities for what is essentially core funding. This has been exhausting to all parties and is unsustainable. Worse, it has taken away valuable time and money from actual research effort.

We need to concentrate on managing the science system, not the science itself. Trying, for example, to predict the best balance of basic and applied research is a waste of valuable time and resources because the needs change constantly through the research process. Set the priorities, for example through a national economic strategy, and securely fund scientists to the work in those areas. Judge them on results...over time. Let scientists lead science processes. The research process can take unexpected turns and the scientists who are actively researching in various areas are best placed to work out how to react to these. You may get researchers frantically measuring weevil ovaries or extracting uterine hormones. And that might not seem very relevant to your world if you're an operations manager, policy writer or business owner. But science is a different process from manufacturing and retail. If the research is occurring in an area that is economically important, past experience strongly indicates that your investment in that research will generate favourable returns.

Thirdly, we need to increase private R&D investment levels

I have heard this throughout my career and agree completely with it. The reason that this issue has stuck around it that the underlying causes are very complex, as are the solutions. Again I salute those of all stripes who are working on this issue.

The proliferation of the great needs therefore great opportunities, for problem-centred research

If the work of 17th and 18th century scientists enabled the Industrial Revolution to take place, and the 19th and 20th centuries heralded the Medical Revolution, the 21st and 22nd centuries could well see an Environmental Revolution. Climate change, population growth, ageing populations, habitat destruction and invasive species pose significant challenges that the next few generations of scientists will be called on to help address. As will increased requirements for water, food and carbon-free energy in an increasingly fragile world. The connotations of this are negative, and, given what's at stake, rightly so.

But there are also exciting opportunities for those far-sighted enough to see them and bold enough to grasp them. New Zealand may be one of the few countries in the world that **doesn't** currently have a national economic strategy targeting environmental technologies. But such opportunities still exist. Take water technologies, for instance; this is one of the two areas that the Singaporean government has targeted as a way of achieving economic growth. In general, New Zealand is fortunate to have abundant clean water. This is not the case in most other countries. Even living in Canterbury, one becomes acutely aware of issues surrounding water usage and management.

I recently spoke at a Water New Zealand's Annual Conference at this were many bright people in New Zealand working very hard to develop both technical and policy solutions. The potential market for technologies that use water more efficiently alone is huge. Developing ways to prevent water pollution is becoming increasingly important in everything from farm management and sewage treatment to road construction and urban design. Working out how

to clean up contaminated surface and aquifer water in large volumes would save lives in some countries, and transform them in many more. From a business perspective, it has to be asked what in 20 years will New Zealand be selling to the world that will earn thousands of millions of dollars – not tens of millions, because we cannot keep up with that. The answer must be that we will be, increasingly, selling added value and this added value comes from clever minds. We will sell food not as a commodity, but as something that has real added value because we will have demonstrated properties that provide undoubted health benefits. We will sell electronics and manufactured goods, not because they are cleverer than someone else's version, but because we will have added value through clever design.

We will sell services because of the added value of our earthquake engineering skills or because of the skills of our environmental scientists. This is what our future must be – to do so will require shifting our comfort zone and will demand that we get stuck into scientific research. I believe that science is now well recognised as a foundation pillar of economic growth by the current New Zealand government, the World Economic Forum, and many others. It is important to recognise that it is a whole lot more than being nice-to-have. Neither is it some kind of cost-centre. The emerging science, business and political leaders in this room face great challenges, but also great opportunities. This is your time. This is your challenge. And New Zealand has a lot to gain if you are successful.

Actually, your country needs you...I have every reason to expect that the professional scientists in the Oxygen Group bent on developing respectable CVs. This is essential. Your science CV is really the passport that permits employment, science options, peer esteem and fulfilment. A good CV opens doors internationally. That CVs are potent probably explains enthusiasm for their fraudulent adjustment but I won't go on about that here. Indeed, burnish your track records; any agency that expects scientists not to focus on such pursuit is dreaming. It won't retain them. If you will permit me though, I think there is definitely more to it than glamorous CVs. The singular pursuit of glory through academic and sometimes arcane scientific achievement is in my view at not the whole story at least here. New Zealand is where many of you have trained and apparently chosen to live. New Zealand is not one of the large, albeit currently stressed, OECD economies. And, as I mentioned earlier, we cannot do and support everything; in fact, we do <0.5% of the world's research.

There is good cause to think about doing research in areas that really matter to New Zealand. Very significantly, this does not mean abandoning basic/discovery work, but rather more relates to where such work may be done. It is not just about the New Zealand good; it is about personal fulfilment as well. By way of illustration, and at the risk of boring you, examples help. As a DipSci student in the Zoo Department at Otago University I fiddled around trying to understand the life history of some virtually unknown little flies called psychodids that tend to hang around bathroom drains. The last person to work on them before me was a German scientist in 1956. Anyway, I had a great time that culminated in the discovery that, for adaptive reasons, the pupae of the New Zealand species evolved plastron gills, rather than breathing tubes, and these allow them to live underwater.

I was beside myself with excitement and so were about three other people in the world, two of whom were my parents. Conversely, as mentioned above, for my PhD I again fiddled around with bugs -this time measuring the ovaries of the Argentine stem weevil. I didn't really know why I was doing this, but I was getting data. Anyway, in the end I discovered this species goes into photoperiodically-induced hibernation. For a whole lot of applied reasons this turned out to really matter. The difference was that this time I had made a contribution to sorting out a pest that at that time was costing the New Zealand pasture about \$200 million a year. This time the level of peer-interest was markedly different because I was working albeit in a very basic and rather undirected way, on something that causes real New Zealand trouble. At the same time this work appeared in the publication '*Nature*'.

Personally, I think that any sort of work, be it discovery or applied on New Zealand as a place, New Zealand problems, or New Zealand opportunities, rather than simply working on what comes to hand, is likely to lead to great satisfaction for reasons additional to CV development. Besides, this may be theoretical because as I said I am not convinced that the country can or even should support vast tracts of non-aligned scientific exploration. All of this is a long-winded way of saying that, as well as developing your CVs, give some thought to New Zealand.

Communication is the same. When I was a kid people used to drone on about how this matters. Rubbish I thought. Science is all about having a good memory and being good at maths. Yes that matters, but nothing matters more than being able to explain what you are doing or what you want. Again New Zealand-funded scientists really could do well by explaining to people (and each other) what they are doing. Sir Peter Gluckman and Ken McNatty are masters at this. Actually it was Rutherford who said if you can't explain to the cleaning-lady what you are doing, then you shouldn't be doing it. I am sorry he said cleaning-lady and not cleaning-person. It wasn't his fault.

Finally I would like to come back to the career thing. New Zealanders do not trust government scientists. Is this because we have been constantly trawling for money and are seen to do anything for money? I think so, partly at least. Is it because we have been too busy to bother to explain what we are doing? I think so, partly at least. With the changes that are now going on to the science system whereby science itself is vested with its own responsibility to make good judgements for New Zealand, I think that there is every opportunity, through good science communication and proper advocacy for science that it will recover its role at the centre of New Zealand's future understanding and progress. This is not just nice to have; it is essential for the future of New Zealand and its people. So what do you think?

Thank you.

ENDS.