



OFFICE OF THE PRIME MINISTER'S SCIENCE ADVISORY COMMITTEE

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Thanks

I thank the Vice Chancellor for this opportunity; this is the first speech that I have given as the Prime Minister's CSA and it is appropriate to give it in a University that was founded to give scientific impetus to our cornerstone agricultural industry.

I have a character trait that many of you will be aware of — I like to say it as it is and so I will be saying some things that may leave some of you a little uncomfortable but there is no point beating around the bush.

New Zealand is at a cross roads — not just because of the financial tsunami but because we have seen our relative standard of living slipping for at least two decades. And we seem to have forgotten that science and technology have played a key role in our development to date and must be central to where we want to be.

I face the challenge of a role which has already had many expectations placed upon it from many quarters, in a country that has arguably had a historical and perhaps growing ambivalence towards science and its role and value to the country. That ambivalence has many sources but I will suggest to you that part of it has arisen because of how the science community itself acts and operates and I shall return to this argument later in my talk.

The expectations on me are daunting and the perspectives of the many constituencies that will impact on my role are very varied. Let me start by making some superficial comments on each of these constituencies.

The constituencies

Firstly, the science community: clearly there are all sorts of hopes from individual researchers and academics. Generally they perceive that science is in the doldrums: bright young New Zealanders are simply not entering science in the numbers they should be, the science community is fractious and morale is declining. Uncertainty abounds. NZ cannot sustain competitiveness if science and scientists continue to be marginalised and my appointment is hopefully a step in the right direction. I thank the PM for the confidence he has had in appointing me.

Secondly, the interests of the provider institutions in the science system are different to those of the scientists themselves. Indeed it can be argued that the science system is now effectively focused on incentivising and protecting institutional health rather than knowledge gains although, of course, these institutions only exist because they are the core structural components for knowledge gain. By way of example consider the inter-institutional gaming and positioning that goes on over FRST bidding and gets in the way of collaborations.

Third: The political community: there is always a danger that such a role as I now have can become a dumping ground for intractable unsolvable problems or become the whipping boy for decisions that have another rationale. I do not think that will happen.

A key part of the role of the CSA in the UK since the time of Lord May as Chief Scientist has been to promote the role of science in informing policy development. Particularly in the UK this has received great impetus and there is now an independent and very competent science advisor placed in virtually every department of state. In addition cabinet protocol is to ensure that tendered advice is independent and evidence based. A select committee is about to report on ways to strengthen the nature of that advice. Additionally, John Beddington, the current British CSA has started a process of reviewing the scientific quality of such advice.

Scientific advice is but one component of policy formation and maintaining the integrity of my role requires that I restrict myself to providing high quality scientific advice and hopefully achieving a role for science in policy making which it currently does not have.

Next: The community of officials has questions about investing in science that are not dissimilar to that of many politicians and indeed a number of business leaders. Fundamentally these boil down to one critical question: In NZ, is science an indulgence or is science at the core of our future

development? And if it is then is science delivering optimally or not? I put this question in sharp focus because it is the question I need to address. Much of the second part of this address is going to be focused on considering this vital question.

The community is the core stakeholder: In 2003, the community came close to a transformational attitude to science with the knowledge wave conference but that momentum was lost. Compared to most advanced countries we are terribly served by the media in NZ with respect to science. There is little true reporting of NZ science. Right now a few top scientists persist in promoting public scientific understanding, yet when they do so they are very well received. Paul Callaghan comes to mind as do the efforts of the Liggins Institute with its LENS programme.

There is no doubt that media are part of the problem but also potentially central to any progress. Currently science is naïvely presented as a series of breakthroughs rather than something of non-linear progress. Outliers are poorly understood. I fear the journalists are going to see the CSA as the source of instant ability to address every issue from the risk of volcanic eruptions in Auckland to swine flu. Right now the general quality of science reporting in NZ is terrible by international standards; there is no coherent attempt to explain the issues of the day or to explore what NZ science is delivering. I could give anecdote after anecdote about how poorly we have been served.

The other key stakeholder is the business community: we have few large scale industries in NZ beyond Fonterra with whom I met with this morning; we are largely a nation of small and medium sized businesses. But NZ business must be innovative to survive and thrive, and innovation is based on new knowledge, although new knowledge is not just about new scientific discoveries. Indeed it is more often about the passage of knowledge from one domain to another or the combination of extant knowledge across two domains. Unfortunately the nature of the NZ business cycle means that most business is focused on short-term technology transfer rather than the longer term application of knowledge to produce quantitative shifts in our productivity. We also need to recognise that science leads to new industries, beyond just reinforcing the old.

There are a number of tensions in this relationship and the perspectives, depending on whether you are a scientist or a business leader, are very different: basic versus applied research, investigator-led innovation push or company-led scientific pull. There are very different views on how publicly funded research should be translated into the business community. I see I have an important role in acting as a translator across this divide. Ultimately achieving consensus here is essential to know how best to

invest the government's research dollars. In September I will be conducting a workshop to try and bridge these views.

I can see a significant number of issues and practical solutions that could make investigator push much more effective. If we do not address the barriers we ourselves have created as scientists, then the shift towards an even greater belief in "pull" as the best way of investing scarce public dollars will grow. I cannot believe that will be an effective strategy — pull should not need public investment at the expense of push.

But for me the main stakeholder must be the Prime Minister: to whom I report and have regular meetings. The establishment of the role by John Key suggests that there is a willingness on the ninth floor of the Beehive to explore how science can better help transform NZ to a socially, environmentally and economically stronger nation. Everyone in this room believes that science has a central role in our future, a role that in the past has been particularly manifest in this University in its service to the country's bio-economy but a role that has been less apparent for the past three decades. We need to understand why.

Role of CSA

So what is the role of the Chief Science Advisor and what is it not? There is both advantage and disadvantage in having to create a role where none existed before. And it is somewhat daunting.

Many advanced countries now have CSAs — in general their roles are either similar to mine or they also act as the chief executive of the science funding systems. I want to emphasise that I have no role in the operation of the system and will not become a conduit to those that do — my primary role is different and must be distinct — that is to give the PM strategic and operational advice.

The Prime Minister and I have agreed on five primary domains of activity. In each case the work programme has been agreed between us.

The first is to advise on matters of science policy in areas where the Prime Minister specifically requests. It is certainly not my role to get into the operational aspects of the Ministry of RST or indeed the other Ministries that have science-related budgets: agriculture, environment, health, education, social welfare etc. If NZ is to use science transformationally, we need to have a united understanding on what science can do, how it should do it and why. This needs to be reflected in policies that transcend individual agencies and ministries. Much of this work will be informal rather

than formal but we will be announcing some specific activities in the coming weeks. I do see the need for an overarching and aligned science and innovation policy, one that transcends the ministries as science is far broader in its implications than the matters covered by MoRST, and I hope to have some influence on its development.

Secondly, I have a role of advising on specific matters related to science. In general this will be in the form of formally commissioned reports that will summarise the evidence base to suggest a specific mode of action, for example the work we are currently doing on methamphetamines, or secondly where new scientific developments create either opportunity or risk. An example of the second might be the impact of stem cell biology and regenerative medicine on the economy and healthcare costs. I hope my role will be limited to situations where my independence and hopefully high public respect can add value beyond what can come from departmental or sectoral advice.

The third: the public understanding of and engagement with science particularly with young people. I believe that the widening gulf between science and society is a critical issue. It is one that underlies many of the recent contentious debates such as stem cells and now folate. Science can be jargon ridden and sold wrongly by scientists (who, by dint of circumstance, are essentially using the media for lobbying purposes). Scientific debate can be confusing, as typified by global warming, and it can be arrogant, often forgetting that there are other dimensions to understanding the human condition. If science is to be at the heart of transforming NZ then its participants must do much better in this regard. Many in the science community may have seen President Obama's recent speech to the National Academy of Sciences. In this he challenged everyone of the academicians to spend time in the high school classroom. In common with this, a specific brief I have is to encourage more children to see science in their future. All I can do is persuade you that such a contribution merits your time although your employing organisations may not yet see that as a priority.

Fourth: International relationship building. Already I have seen the manifest goodwill shown by the UK and Australian Chief Scientist Offices. The UK office is large and well staffed by excellent analysts who can greatly assist. Harold Varmus, Nobel Laureate, former head of the NIH and now co-chair of Obama's council of scientific advisors has pointed out that science can be an important diplomatic tool. NZ has to punch above its weight on the world scene and the quality of its science can greatly assist. Generally such a strategic opportunity has not been exploited. Possibly this is just beginning to emerge in Singapore and Korea.

Much of science is an international activity — we will be left behind if we do not engage better in such initiatives — in many cases it will be the only way we can go to scale both in the science itself but more importantly in its exploitation.

Fifth: I can serve as a conduit of alerts that might arise where scientific progress shows either opportunity or threat. But I emphasise that I will not be a lobby for individual science projects. But where scientists see something emerging that they think policy makers need to be aware of, I can and will serve that role.

How the office will operate

All this is a tall order for a very small unit — a little bit of my time and two policy analysts. If the office proves its value it will grow. Clearly in much of what I do I will be relying on associations with the scientific community. In particular where the reports are technical I will be pulling working groups together to advise on them. I will insist that all such reports are also peer reviewed before they are both given to the PM and made public. I am not a polymath with universal knowledge — my role is to ensure a high quality of advice. I already have a regular series of meetings with the PM, members of DPMC, the Minister of Science and the heads of MoRST and FRST, and the President of the Royal Society, Business NZ and I will obviously meet with key players across ministries and the provider sector. The level of goodwill is high and I am optimistic.

Why the role was established

Although the role was heralded in the National Party manifesto before the last election, this role is not political. The issues relating to science and its role must operate on a time-base that transcends the political cycle. Science is clearly a major component of the solutions to the issues facing this country — those of social, economic and environmental security. I would contend that our best asset — namely the collective brain power of NZ — is being poorly used to advance the country.

On the other hand, science and technology create challenges — as an example think of the potential impact of the cost of regenerative medicines on the economy. Scientific advances can create uncertainty for those who do not live and breathe science and there is often also a credibility gap between the claims of science, at least as portrayed in the media, and its actuality.

My role is to provide high quality scientific advice, and how that is translated into policy depends on many other factors. Scientific knowledge is not just facts, it is also the process of how those facts are obtained, analysed and digested.

Science can often suggest approaches that are in conflict with conventional wisdom, both that of other scientists and that of the public and politician. In my view scientists must not only produce the science, they must also communicate to the public in a way that changes the conventional perspective. Often that can be hard, when that conventional wisdom is caught up with folk understandings of science — an issue that has been exploited many times. It will always be difficult for politicians and policy makers to move beyond conventional and folk understandings. It is even more difficult in the biological and environmental sciences where science is dealing with the reduction in uncertainty rather than the production of certainty. Hence my belief that the public understanding of science is so important. Scientific progress can come into conflict with the mores, culture and even ethical values of society. However familiarity reduces the fear of science and things can then change.

Then there is the Agency and Treasury view — just because it makes sense scientifically it may not be economically logical when put up against other approaches or priorities: the cost/benefit analysis needs to consider these other dimensions. Finally the political apparatus must consider a range of dimensions that accommodate the drivers, ideology and coalitions that make up a democracy. We are seeing that now playing out with respect to folate. Science has not done a good job here.

The fundamental challenge is to ensure that the scientific evidence is placed appropriately within this decision-making chain. Without proper initial assessment of the evidence, there are risks of inappropriate policy development at senior political level. This is why the UK and Obama's White House are putting so much emphasis on the role of science advisors.

Too often, science has been excluded from proper input into policy development and political decision making. To give but one example it is useful to consider alcohol legislation and the lowering of the age of access. This example avoids partisan politics inasmuch that it is the subject of conscience votes in our Parliament. Any proper compilation of the biomedical and social science literature would have revealed robust data about the ensuing risks that have since been realised. But the science community never collated and presented the analysis in a way that would have made our legislators get beyond polemic and bias.

The big question and challenge for science in NZ

Now I must turn to two big elephants in the room; ones that the science and policy communities have really failed to corral.

The first is to really ask the question — what is the purpose of public investment in New Zealand science — or put it another way — what should NZ expect from its investment in science?

This is not as easy a question to answer, and you might find that comment surprising coming from an individual whose whole life has been committed to publically funded research in NZ and has been both proud of his contribution and is absolutely convinced that science can do so much more for New Zealand's transformational future. But the science community has basically worn out its credibility in pleas to 'just give us more money' without addressing the question of why the State should do so. For various reasons, a good number not of their own making, the science community has simply slipped into a format of desperation and frustration and begging. In turn this has resulted in a set of platitudinous responses with allusion to vested interests and institutional and job protection. Compounding this has been the argument that public investment in industry support has more potential benefit than investment in public sector research. This rancorous muddle now has to be tackled head on and I see my role as raising the quality and clarity of the dialogue to a much higher level.

Put it simply and by way of illustration — in the last budget, the government made a significant injection into science despite the fiscal tsunami we currently face. But one very senior politician, not the Prime Minister I hasten to add, asked me outright — "what are we going to get for that investment?" I challenge each of you to get beyond platitudinous rhetoric and come up with an answer that is compelling and that in turn might compel greater investment and can start this country on a transformational path.

So why do I regard this as the most important question for the NZ science community and perhaps one of the most important questions for New Zealand's future and the most important question I could ever address?

New Zealand is only four million people — remote in physical terms from the major intellectual powerhouses of the world — we are only the size of a Sydney or Melbourne. We have a complex internal geography — our public research effort is split over seven major centres if we include Nelson and in about 20 major research organisations with a poor history of collaboration and indeed an unhealthy and intense sense of competition. So to address the minister's question: there are two extreme possible answers.

The first is that research as intellectual enquiry is primarily nothing more than a way of supporting scholarship in ensuring an educated population and that it has qualities that are seen as central to being a first world culture — just like investing in museums and the ballet. Beyond this and providing a basic infrastructure to deal with some specific issues like ensuring the capacity to monitor the environment and to protect the population, indigenous research does not really add to the potential for NZ to develop, for a country like NZ can rely on imported knowledge and the primary investment should not be in science but assisting technological development. Clearly this is not a view I have any sympathy with at all, but while I may have exaggerated it slightly, it is a view with surprisingly broad traction and I suspect is the basis of our historically poor levels of investment.

The second approach is what I absolutely believe, is that science will be the mainstay of the transformation of New Zealand, indeed it is the only way we can make a quantum leap in productivity, it is the only way we can address the many challenges we will face. However this answer has many dimensions and we have to dissect these and build a non-rhetorical set of arguments that must inform a national consensus.

The difference between the two extremes has enormous implications for the future of this country's science system, both qualitatively and quantitatively.

The problem is that most of the arguments that have been advanced relating to the transformational answer have, perhaps naïvely, been based on simple extrapolation from those used at the time of Vannevar Bush's "science as an endless frontier" (he was Franklin D Roosevelt's chief science advisor) to justify the massive investment in American science. There is no doubt that for the USA and for all the major industrialised economies that investment in R&D is directly linked to economic growth and also to political dominance. But is such an extrapolation valid for a little nation like NZ? We cannot compete in every domain of research on our own and expect to out-compete the global effort. But other small countries have manifestly been able to use investment in research to promote economic and social development — Singapore, Israel, Denmark, Sweden, Finland, Switzerland are obvious examples. Indeed, we have no other option — we are short on resources other than our intellect by which we can transform our economy and we need to learn from these small advanced economies and apply their approaches. This may not sit well with a number of beliefs and traditions of the scientific community. For example we cannot expect four million people to be good at every domain and the issues of how we prioritise in science investment can be uncomfortable and disruptive.

Linked to this argument is that of how research gets translated to economic growth. It is interesting that in the UK there is growing evidence that science investment at the regional level does have enormous impact on the local economic growth — the best evidence being in Scotland, a place which has many analogies to NZ.

But science is much more than economic growth driven simply by transfer to extant or new industries. While the focus has increasingly been on direct transfer through patents and technology, because that is the easiest to understand, so much more benefit has been and will be via the common good. This is well demonstrated in agriculture where science transfers to the farmer not through patents and quantifiable exploitation but through common knowledge leading to changes in farming practice, be it new breed lines or new forms of husbandry, biological control of pests etc.

But examples go far beyond agriculture to all aspects of social development — research can greatly enhance the quality of return in our health, education and social welfare systems, to name a few. Science can have enormous value in sustaining our environment.

The Royal Society in London is about to release a report showing that basic research has enormous flow-on effects to the service industry in areas as diverse as banking and retail, through disciplines as diverse as mathematics and ICT to social science research. The leverage of this less quantifiable gain can be enormous.

There is an even more fundamental reason — we need to see a change in the whole attitude of NZ if national productivity is to rise, whether we are scientists or farmers or factory workers. We need to see that a knowledge economy is not just something we should be proud of, but that the innovative culture it creates can pervade every aspect of our lives.

These issues of course raise the question as to what extent should research push development or industry pull it. In my judgement there has been a lot of naïve thinking in this area, simply because of the different time-lines. The role of research in transforming NZ is a long game and that requires both push and pull. In my view transformational research is generally built around individuals and we need a process to identify where research leaders will emerge who can make a difference and will be valued as such, not just within the science community but more broadly. The lack of a career developmental path for entrepreneurial scientists is a clear gap. Companies need to see that science can add value not just in a operational but in a strategic sense. Just as engineers have made a critical role as members of company boards, scientists can also provide a new way of thinking.

Science has many more upsides for NZ — it can transform how we approach problems of society, it can protect our environment, it can lead to new industries, some small, some perhaps large, it can add to our standing in the world, it can change our national psyche and in doing so reinvent us in a way that can improve our productivity.

I need your help in mounting these arguments and welcome your input — I hope my email runs hot.

The second elephant

But there is a second elephant in the room, and in pointing to this pachyderm, I expect some of you will experience an elevation in your blood pressure and cortisol levels.

We are only four million people — about 20 research providers with a strong history of competition between them — this is reinforced by perhaps the most competitive research funding system in the world — one exquisitely designed to put young people off entering science. We also have a funding system full of perverse incentives and a lack of an overarching innovation policy that means we do not ever act as “NZ Inc”. If we do not, and if we persist with a set of processes appropriate for the UK or the USA, our poor performance and the scepticism of the policy maker will be reinforced. Any expert in economics, game theory or research funding strategy will tell you that small systems are riddled with vested interest, conservatism, and a focus on competition at the individual level to the manifest detriment of a strategic approach. We must find strategies and models that get beyond these limitations and allow NZ research to really move forward.

We have important national resources that are not made available to the whole research community because of this competition, to the obvious detriment of the enterprise. We have replication and duplication where it is unnecessary. We have institutions where the internal competition is destructive. We insist on an egalitarian approach that gives equal weight to many disciplines and makes it hard for new ones to emerge. We are reluctant to focus the research effort. We fund second rate research and pretend it is first rate in our egalitarian drive. We have a research system that is more driven by peer review than any other in the world but that ignores the inevitable conservative compromise that comes with peer review within a small system. We have too many funding sources and yet no ability to sustain research at the one place where NZ has a true competitive edge — that is at the interdisciplinary boundaries. Innovation arises at these boundaries — yet the funding system with its vested interests effectively makes such research impossible. Yet it is particularly in small countries that interdisciplinary research is possible — it is what brought me

back to NZ. Only when we sort through these issues can we expect policy makers to have a clear view of how science will transform NZ. These are issues that the scientific community really has to own, and not just be passive and importuning about.

The CRIs and the universities have different structures, ownerships and missions. But together they make up the bulk of the publically funded science system. We need to be certain that the system and their missions are aligned in such a way for maximal value of the Crown's investment.

Given that Steve Maharey is here, I think it appropriate to point out that the Centres of Research Excellence (CoREs) are perhaps the brightest innovation of the last ten years as they are the one structure that gets beyond many of these issues. It is pleasing to note that there is strong bipartisan support for this initiative, but it is one not without tension as CoREs transcend the traditional institutional focus that dominates the NZ system.

Scale

Another key issue is how should NZ take research to scale. We have a very small capital community. We have already seen many lost opportunities, particularly in the biotechnology sector, because of the inability of NZ to invest to scale. It appears that generally our technology transfer activities are not working well although there are some success stories — the reasons for this need analysing. To give but one example — scientists will not think strategically *de novo* if they see no upside for themselves in doing so — there are now very confused behaviours across universities and CRIs. The system itself creates some of these barriers.

The funding systems also inhibit strategic thinking — it is not clear how any of the current funding tools can encourage intellectual high risk strategic research of the type that can lead to paradigmatic breakthroughs.

As President Obama pointed out, infrastructure is the core scientific capital and as yet we in NZ do not have a process for the coordinated development of infrastructure — our parochialisms can impede it. As the knowledge explosion grows, the role of advanced bioinformatics will become the key to use of biological information yet the system has delivered a rather trivial isolated and replicated capacity in this area. We cannot sustain competitiveness using this model.

We should compare ourselves to Singapore — it has the same population, same number of scientists funded by the state, and a not dissimilar investment in operating expenditure per scientist — but a

far greater and coordinated infrastructural spend. But not every area of science is supported at the highest level — they have identified areas to focus major research effort upon while supporting academic research across all domains.

In most domains we cannot go to scale on our own — that is why a greater investment of effort and, yes, dollars in stable international partnerships will be important. I suspect that for most of our scientific contributions, exploitation will require partnerships around the globe and I would suggest that we have a real advantage in seeing Asia as the key point of entry. Our investment, diplomatic and scientific communities need to work together here.

Only when we address these questions at a high level can we start to see operational ways to improve the contribution of science to New Zealand. None of these issues are black and white — the Crown and indeed the public need to be convinced that science can do so much more for NZ than it has to date — it needs to see that NZ research can make a difference — and that it can and will transform NZ.

The science community needs to reflect on these issues as much as the various arms of government. I would like to see science at the centre of a national transformation exercise but this must be one that reflects NZ as a very special place. If we do it right then the potential is enormous, if we are not ready to work together to confront these two elephants in our room, then little can be expected to change.

I am optimistic — but science is complex, it is opaque, we tend to exaggerate and resort to hype and rhetoric. The political establishment needs to be convinced. I think it is willing to be convinced, but past behaviours have induced a high level of scepticism. Every one of you has something to contribute to reversing that perception and beginning the transformation.

Thank you very much.