OFFICE OF THE PRIME MINISTER'S SCIENCE ADVISORY COMMITTEE

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'Interaction between science and policy: an essential driver for integrity and performance in New Zealand's environment and economy'

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Good afternoon everyone and thank you for asking me to this session.

I am actually an applied entomologist and had a really good time for about 15 years in the MAF Research Division and then MAF Technology before it was turned into AgResearch. I have a debt of gratitude to MAF for putting me through half of my MSc and then my PhD at Lincoln. Those who were then my bosses were great leaders and seemed particularly tolerant of the foibles of the callow neophyte I was then. People like Peter O'Hara, Robin Scott, Russ Ballard, David Joblin, Bill Kain, Rod East and many others were remarkably patient, encouraging and constructive. Indeed, MAF made such an imprint on me that when I am tired or distracted or both, I occasionally still refer to AgResearch as MAF, which is embarrassing for everyone particularly at meetings.

As I said, I have spent much of my career at Lincoln working on the suppression of some of our worst exotic forage pest species using parasitoid biological control agents. Linked to this more latterly, I have developed an interest in ways to enhance New Zealand's border biosecurity and now work 70% of my time as the Executive Director of a multi-organisational grouping called Better Border Biosecurity, or 'B3'. About 18 months ago, the Chief Science Adviser to the Prime Minister, Professor Sir Peter Gluckman, asked if I could assist part-time, so I spend the remaining 30% of my time as his Strategist. I advise mainly on agricultural and environmental issues and matters relating to CRIs.

I took on the biosecurity job with the strict instruction that I, along with Better Border Biosecurity's 22 full time science equivalents, were to develop a very close partnership with MAF. This suits me fine. In fact, there seems to be some kind of Karmic symmetry in finishing up being close to MAF again. Further, I believe that such a mission should now be a good deal easier with the CRI Taskforce's stated expectation that the CRIs should primarily work for New Zealand and its industries. I'll come back to this in further detail later.

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The Better Border Biosecurity research effort is relevant to this address, so I thought that I had better quickly summarise what it is. It is a very close partnership between New Zealand science and operational end-users, particularly MAF. Its research is recognisable as having strategic utility for biosecurity operations. B3's composition is quite complex: there are four science organisations (Plant & Food Research, AgResearch, Scion and the Bio-Protection Research Centre) and four end-user partners (Ministry AF, Environmental Risk Management Authority New Zealand, Department of Conservation and the Forest Owners' Association). We have about 80 science people involved (amounting to about 22 FTEs) and a budget of $6.5 million per annum. We have five themes (risk assessment, pathway risk management, diagnostics, surveillance, and eradication and response) with 17 projects. The science is 85% strategic with a small amount of support for operational purposes. We are nationally distributed but with a focus at Lincoln University.

For the rest of the time I thought I would discuss the implications for MAF of what has become known as post-normal or complex science, discuss how this impinges on the New Zealand policy and government operational environment, and then against such background, describe what we have learned so far from the Better Border Biosecurity partnership with MAF.

The challenge of post-normal science for MAF

Science in much of the last two centuries has been dominated by the linear observation stuff taught in schools; hypothesis development and the testing and re-evaluation of these hypotheses and so on to produce scientific facts that are associated with increasing certainty. For example, what is the speed of light, when is the next eclipse, or are birds the descendants of dinosaurs? As a result, science was authoritative, definitive and largely accepted by the public. This was very much the case after World War II and went on well into the 1960s. Actually, an early example of challenge was Rachel Carson's work on the dangers of misuse of pesticide.

Anyway, since the advent of quantum physics and the explosion of data-intensive biological science and ecology, along with massive computer power, most of our science no longer fits the old reductionalist paradigms easily or neatly.

We are now increasingly grappling with complex systems with many feedback loops and interactions. This is not just about simple measurement error; rather, it is about incomplete knowledge with which to tackle the dimensions of complexity. The effects of confounding interactions cannot be precisely predicted; in such cases, science has had to be developed to deal with probability, prediction and risk. Such endeavour is based on the use of models that incorporate what is known and what is uncertain and are subject to ongoing revision and refinement. This kind of science has been termed post-normal or complex science. In other words, post-normal science seeks an assessment of probabilities and generally a reduction in levels of uncertainty. This is the stuff of the grand challenges we face today such as water security, biosecurity, climate change, and indeed the fraught world of Import Health Standard development.

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As a result of this shift, I might say also that science today is less about scruffy but brilliant individuals working alone and doing amazing things; rather, it is now much more about integrated teams of specialists, sophisticated equipment, databases and inspired leadership. Such rather messy multi-factorial analytical science is extremely important and we cannot get away from it. Indeed, one of the problems with it is that it allows science detractors and deniers to cherry-pick components of the ideas that must feed into probabilistic analysis and then use them to dismiss the entire framework and understanding built up. This has been very apparent over the last couple of years with respect to climate change; we have also recently had similar stuff to deal with around seismology and earthquake prediction. At its worst, such iterative model development has been put forward by some of the nay-sayers as examples of science and scientists not knowing what they are doing.

The other feature of post-normal science is that there is an important interaction with people's values and beliefs. Such interaction creates enormous difficulties and it is easy for scientists to forget that the scientific process is designed to try and overcome individual bias and belief. Look at recent scientific debates that have affected your sector. Where does the science end and where do values emerge as the key determinant? In a narrow sense GM foods are safe, as is food from cloned animals. However, at least for some New Zealanders, science still does not address the issue around the need for 'natural' processes and scientists must not be arrogant enough to think that their view outweighs that of the community – it doesn't.

With post-normal science, an additional factor arises and this is the issue of how much uncertainty is acceptable when deciding whether the science should form the basis of an action or policy? Such decisions are never value free. Values do not compete with, or supplant evidence, but determine the importance of inductive gaps left by the evidence. Thus the key question becomes; when is a particular body of scientific work adequately 'sound' to serve as the basis of policy? One must ask how much evidence is sufficient? How much uncertainty is acceptable? What are the risks associated with an erroneous conclusion? When is a particular study reliable?

I believe that this is a very large part of what MAF has to do. An example that may resonate for some of you was the aerial spraying of the painted apple moth. I was on the technical advisory group and, quite reasonably, the decision-makers and the public were seeking assurances of success. In the first instance, we simply could not give such comfort and kept having to push back. At the time, I feared that this may have been mistaken by some anxious officials as some sort of scientist ineptitude or worse, churlishness. Clarity did indeed emerge later with the combination of effective data collection using an extensive trapping regime and multivariate modelling systems that considered both biotic and abiotic factors. In the end it was a great outcome for science, operation and policy.

As I said, with all of this, understanding the limits of science becomes even more important. Indeed, science cannot provide certainty in many situations and science cannot be used as a

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sole proxy for more complex discussions involving community values. For issues such as genetically modified organisms, climate change or even incursion eradication attempts, if scientists wish to act as advocates for a value-driven or belief-driven position, then they cannot act as true scientific communicators with any more validity than when a non-scientist pronounces with certainty on a scientific matter.

Complicating all of this, has been the vast expansion in electronic communication, associated changes in the media industry and resulting changes in investigative journalism. These have the potential to combine as a clear recipe for potential miscommunication. What becomes clear in such an environment is that good communication is essential to deal with matters of public interest. However, this is occurring against a background of scientists being poorly trained to communicate, a public with variable scientific literacy and media that are increasingly unfiltered and having lost their role of discerning reliable from non-reliable information. Again, the painted apple moth event highlighted much of this.

So how can we ensure that the public has the information necessary to reach a consensus on matters where science has something to contribute? The public clearly likes science. Science and technology stories are some of the best read on newspaper websites and the scientific blogosphere is very active, albeit often compounded by the interplay with other agendas. However, the content of most local media stories about science is one of hype and breakthrough and unbalanced reporting.

I hasten to add that I do not think this is the fault of the media alone. Clearly, many scientists overplay their hand and overstate the implications of their work – they have their own motives for doing so, whether it is to get attention or to impress a potential funder or donor. Maybe MAF has seen evidence of this? Likewise, the media have their own motives – which is to sell stories, or in many cases in the blogosphere, to influence opinion. Co-incident with this shift in the nature of science has been greater public access to information of varying reliability via the internet that has resulted in greater expectation by the public to be engaged.

A further danger is that science can become the proxy for a values debate which is essentially independent of the science. An example is the apparent debate about whether or not there is anthropogenic climate change. Most of that debate is not really about the existence of climate change – rather it is a proxy for a public and political values debate about economics and intergenerational equity. I believe that over the years there have been examples of similar goings-on with transgenics and so forth. Public confusion has abounded around probability, and with that, vanishingly small probabilities such as those when dealing with horizontal gene transfer. Indeed, any possibility, irrespective of how remote, can lead to immediate societal fear of calamity. That said though, this does not preclude consideration of issues around events with low probability but appalling consequences; foot and mouth disease or zoootic influenza outbreaks come to mind straight away.

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Importantly, such science requires expert advisers to be sophisticated in the way that they communicate with policy makers and have a dialogue with the public. They must be explicit about the assumptions, limitations and uncertainties underlying the evidence and present technological options in ways that allow the full range of their possible benefits or adverse effects to be appreciated. I will allude briefly to this again with reference to B3.

Thus to summarise this comment on post-normal science, given that such science will increasingly play a more authoritative role in public decision-making, its responsibility for the implications of inductive error which can lead to premature action or persistent inaction will increase. Indeed, failure to recognise the implications of this responsibility has generated deep tensions for the understanding of science by modern society. But this does not mean that the role of science as the authoritative body to which one should turn for knowledge is generally questioned. What is questioned is which science is adequate for the job, or which scientific experts are to be believed by policy makers and the public.

Comment on the relationship between science and policy

As I have said, many, and indeed probably all, of MAF's areas of responsibility fall squarely into this post-normal science category and I hope that this becomes fully recognised.

As mentioned, you are constantly confronting beguiling areas of science and policy interaction such as climate change, biosecurity, water security and fish stock assessment. Moreover, this goes on under the unblinking gaze of public and industry scrutiny. Maybe you feel rewarded in that what you do in these areas is of immediate and immense importance to New Zealand industry, the public and this country's reputation. Irrespective though, you do not have the luxury of academic peroration.

Actually, based on my now fading memory of MAF before the early 1990s science reforms, I think MAF's job got harder with the then migration of much of its former research science capability into the CRIs. While there were probably national benefits to be gained from the separation of science purchasers from science providers, other things happened. I believe that contact between policy-making and science eroded, and with that, the need to deliver evidenced-based policy and operational decision-making got more difficult. Further, CRI financial pressures meant that scientists seemed to become rather badly-dressed funding lobbyists and conversely the world of officialdom became remote and confused about how to deal with the science community. To me this was about the worst thing that could have happened and resulted in bouts of unhelpful gainsaying.

Thankfully all of these problems were well recognised a couple of years ago by the CRI Taskforce and, amongst other things, the reforms emphasised the critical role of CRI science in supporting the New Zealand and industry good. It is partly for that reason I applied for my job with Better Border Biosecurity because I wanted to see if we could get it to work in the new environment.

From a broader perspective than Better Border Biosecurity, it is timely that the Prime Minister recently released a discussion paper entitled *Towards better use of evidence in*

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policy formation: a discussion paper. This was developed by Sir Peter Gluckman and seeks to promote discourse that will lead New Zealand to better apply evidence-based knowledge and research across all domains of public endeavour. In doing this work, he consulted with his counterparts overseas and it was generally noted internationally that addressing this issue is very much to the fore, particularly in this increasingly complex and interconnected world.

The challenges are multiple: to identify what research and information is needed to determine appropriate sources of such knowledge, to interpret the validity, quality and relevance of the knowledge obtained, and to understand how that knowledge can improve consideration of policy options and policy formation while being cognisant of the changing nature of science and increasing complexity. These issues confront all sectors of the public service.

In all of this it is important to separate as far as possible the role of expert knowledge generation and evaluation from the role of those charged with policy formation. These are definitely not the same things. A purely technocratic model of policy formation is not appropriate in that knowledge is not, and cannot be, the sole determinant of how policy is developed. New Zealand is a modern democracy, and government has the responsibility to integrate dimensions beyond that which science can contribute, including societal values, public opinion, affordability and diplomatic considerations. Further, with issues like biosecurity responses, there is real and unusual pressure on MAF to make decisions in the absence of quality or complete information.

Many policy decisions can also have uncertain down-stream effects and scientifically-based ongoing evaluation is needed to gauge whether such policies and initiatives should be sustained or revised. But, irrespective of these limitations, policy formed without consideration of the most relevant knowledge available is far less likely to serve the nation well.

Also as I have said, there are limits to scientific knowledge and to the scientific approach; governments and their advisors must be aware of such limitations, otherwise science can be misused to justify decisions that should legitimately be made on the basis of other considerations. Conversely, this limitation cannot be used as a reason to avoid the application of scientific findings where such knowledge can help to define or resolve the range of options for the policy maker.

Concluding remarks

I introduced Better Border Biosecurity at the beginning of this talk because I sincerely hope that it may represent a way of achieving what is sought under the terms of the CRI Taskforce. In part, the review seeks to close the gap between New Zealand's science and policy functions. At the same time, biosecurity is also a great example of a complex area of public policy and operations that is supported by post normal science with all of its complexity and uncertainty.

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There are many challenges associated with leveraging more value from Better Border Biosecurity's interaction with MAF, but it has to be recognised that nothing could be more virtuous than New Zealand's biosecurity agency working closely with a science group specifically established to assist with the improvement of the quality of New Zealand's border biosecurity system. There surely can be no philosophical, cultural or political objection to such a goal. Furthermore, the task is far easier than elsewhere. We are a small country and within the science and policy environment there really are few degrees of separation. Neither are we saddled with a complex hierarchy of competing organisations involving federal and state departments.

As mentioned, Better Border Biosecurity is primarily focused on enabling the New Zealand government agencies, particularly MAF, to improve the cost-effectiveness of this country's biosecurity system. Within Better Border Biosecurity there is deliberately less emphasis on industry end-user groups. The reason for this is that the focus is on the border. Obviously, incursions may unpredictably affect all sectors, so specific attention to one sector when all sectors may be vulnerable is not particularly logical. Secondarily, I fear that, should Better Border Biosecurity develop contractual relationships with individual sectors, it would then risk giving advice that is at variance to MAF's position. That said however, the New Zealand Forest Owners' Association has been and remains a strong financial and moral supporter of Better Border Biosecurity since its inception several years ago.

To date the progress in getting the partnership going has been good. Many of the earlier impediments have been dealt with. However, the challenge is by no means over and all parties will need to continue to deal with erstwhile entrenched attitudes that have built up in what has been a complex and difficult environment for science and MAF.

Without exceptionally close interaction, the prospects for uptake of science and technology for operational advances are very much reduced. MAF's biosecurity officials must know the science that is going on and how it may be translated into benefit for New Zealand biosecurity. Conversely, the science community can only ensure ongoing relevancy through close communication and real buy-in by its MAF counterparts. MAF must be ready and able to defend what B3 is doing.

This really is the stuff that is being called for in Sir Peter's paper on evidenced-based policy and by Bill English who continues to seek increasing value for money from the public service. I note that the title of this conference is '*Across the value chain; integrity and performance of New Zealand's environment and economy'*. I think that interplay of science with policy and operations is fundamental to this value chain.

Right now there is real opportunity for both MAF officials and the leaders of the science community to take the initiative to work together to reinvigorate the essential role that MAF plays across its range of activities; border biosecurity being just one example.

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I for one really want this new opportunity for science and MAF to work well for New Zealand. We are in the same boat and have the same fundamental goals. An inability to get this job done does not bear thinking about.

Thank you

ENDS.

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