OFFICE OF THE PRIME MINISTER'S SCIENCE ADVISORY COMMITTEE

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Address by Sir Peter Gluckman at the Maurice Wilkins Centre *Future Science Day*
'The future of science in New Zealand – opportunities for young scientists'

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Thank you for the opportunity to speak to you.

It should be apparent that science in New Zealand is undergoing quite a transition. The last major restructuring of the science system was a generation ago, and that was primarily grounded in the public sector reforms then in vogue – that is, with drivers somewhat different to those now in play. Twenty years ago it was by no means certain that an investment in science was an investment in the future, in a richer New Zealand. The reforms of that era were not primarily based on a public acknowledgement of the central role of science in economic, social and environmental prosperity and in assuring New Zealand's relevance to the world.

What is going on now is qualitatively different. Government has accepted that science is a core pillar of its economic growth and productivity agenda. This is not a matter of partisan debate. Science now gets strongly supportive comment in the media. And the business sector is starting to respond – we are seeing an increased willingness, and indeed a demand, by business to see a greater integration of science with other aspects of innovation.

The challenge is now to find the best path which links science to our national aspirations, to economic growth, to social development and to environmental protection. A few people are left stuck in the 1980s, not seeing science as a central part of the way ahead, and so we cannot be complacent. But any honest comparison to other small western advanced economies will demonstrate a tight relationship between greater investment in science by both the public and private sectors and economic growth and productivity enhancement. I have spoken at length about this previously, so I will not dwell on that here.

But equally the nature of science is changing. Science is less bound by traditional disciplinary boundaries. Science is dealing with levels of complexities and non-linear systems not considered previously. The bioinformatics explosion and the need to deal with large data bases, the realisation that non-coding RNAs create new layers of biological complexity, our attempts to model and predict the world's climate, are obvious examples of this. This is

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leading to dramatically new paradigms of doing research. Larger research teams, multiple disciplines, increasingly reliance on rapidly changing and expensive technologies.

But the questions that science is addressing also create real challenges for society – the conflation of the biological with the physical will lead to new forms of neural implants, regenerative medicine which could create impossible demands on the health sector, predictive biology will become more robust, the potential use of geo-engineering in the mitigation of global warming, the role of bioengineering in dealing with issues of food security, are all examples of whether rapidly emerging science will be in potential conflict with societal values. We have grossly underestimated the impact of technological developments such as the internet on our social structure, on how people get information and relate to each other. How do people distinguish between relatively reliable information, less reliable information and frankly misleading information on the net? These issues are real and change the nature of the relationship between the scientist and the community she or he lives in. These matters will get more intense over coming decades, and the need for scientists to be clear about their role in maintaining the social contract with the community will become greater. We have already seen this threatened and even broken in the confusion of issues in the climate change arena.

A related issue is who owns the data when the research is funded by the State. This was highlighted in the Muir Russell report, one of the many reports that followed the so-called "Climategate" affair a year ago. This is not a trivial issue and one that merits reflection. It is an issue that has many dimensions from the issue of IP to the issue of public interest, to the issue of vested interest and non-scientific agendas. This issue will come to the surface in the next decade – to a certain extent it already has in the filed court case over NIWA's climate records.

Perhaps the biggest shift however is that about how the public and private sector science systems should interact. When I trained nearly 4 decades ago, it was considered to be crossing to the dark side for a scientist to go from a university to the private sector, even in North America. I was in San Francisco soon after Genentech spun out of the laboratory next door and I well remember the controversies and tensions that emerged. In the US it has now changed dramatically – there is now an almost seamless interchange of good scientists from academia to business, and from business to academia. That an individual might spend formative years in the private sector then return to academic science is no longer seen as unusual. An individual is less likely to be penalized for doing so but there are still issues. We do need to work out how to give credit for time spent working outside the traditional model – equally we do need to protect and acknowledge the truly outstanding academics. We need a sharper focus on what defines value in a scientific career.

Sir Paul Nurse, incoming president of the Royal Society of London, Nobel laureate in Medicine or Physiology, and certainly a defender of and advocate for basic science, gave a speech in Kyoto a month ago at the Science Technology and Society Policy Forum in which he pointed out that the two biggest challenges to the future of science were trust and

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permeability. We have already talked about trust that the community must have in science. By permeability he was referring to the need for scientists to understand that the future lay in connecting science, business and government, not in creating walls around the academic enterprise.

The inwardly focused scientist may become much rarer, yet while we need to be careful to protect intellectual freedom and basic science it can be done in a much more permeable way. Basic and discovery science need not be entirely dislocated from the applied environment. Indeed it is noteworthy that many of our most distinguished basic scientists have also been those who have been outward looking. Sadly in New Zealand I worry that there is still an arrogance within some components of university-based research that has the potential to penalise a person who is more applied in their efforts and certainly there is evidence that time spent in the private sector can disadvantage them in the grant or promotion systems. I suspect that over time this will change, as it has elsewhere.

One reason that change will happen is that governments around the world are changing their expectations of the public science system. Governments are prepared to invest more in science where there is private sector uptake of that science and scientists, and the university system in general must encourage and accept greater rotation of individuals, whether on a full-time or a part-time basis, to industry, to other public research organisations and to government. There are small steps already in this direction. I suspect that government in New Zealand will have to introduce incentives to assist this to happen. I would hope many of you will have careers that span more than one of these sectors. Certainly the division between Crown Research Institutes and universities is rapidly closing as a result of the reforms of the CRI sector in the past year.

It is worth remembering the basic nature of our science system was established in the 1950s and 1960s and was very much a trickle down from the USA and UK systems. Those systems were developed in much larger economies and in the shadow of the enormous success of the physical sciences in supporting national efforts in the Second World War and in the cold war. In the United States in particular, it was readily seen that from a greater public investment in science came greater economic prosperity. Business leaders in the USA still emphasize this.

It is interesting that essentially every western nation even during the global financial crisis has increased substantively its goals for both public and private sector investment in science. In the 1970s and 1980s academic science was generally seen as largely the bailiwick of individuals and small groups, although gradually the role of big science and bigger groups and research institutes came into play. However most public sector science was driven by curiosity, whereas most private sector research was driven by strategy. There were of course exceptions – from the private sector, Bell Laboratories and IBM both produced Nobel laureates, and in the USA and in Europe strategically focused larger public sector institutes formed.

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Individual investigator-led research is still prized but increasingly we are seeing aggregations into larger groups with strategic vision underpinning even such research – the Centres of Research Excellence are examples of this being done successfully in New Zealand. Governments are expecting public science to support, feed into and promote private sector science. In some countries such as Singapore this is now specifically incentivised. The drivers beneath this trend are obvious, the implications are complex, it has changed the culture of science for many academics and for some, this is difficult to accept – but I suspect this trend is inevitable.

So where do I think science will go in NZ over the next 20 years. How things emerge will depend on many factors.

Firstly it is clear that New Zealand with only 4 million people cannot pretend to be world class and have critical mass in every area of science. I see little point in me-too or second rate science and we need to get more analytical of our efforts and up the level of peer review. Government has already focused its investment somewhat through the CRIs, which are sector led. How will more focus be achieved? There will have to be a mix of top down and bottom up mechanisms because much science has its application well removed from its initial domain. I do not think business-driven assessment is competent to judge discovery or early stage science, and scientific peer review must be strengthened not weakened. However, questions of pathways to impact will become more important, particularly beyond the initial stages of research.

But to do impactful science will require critical mass and multiple disciplines and so some form of selection will be needed. Will it be in the form of more CoRE-like structures or by some other mechanism? How will a balance be maintained between bottom up and business-led definition of need? Even if there is a move to greater critical mass there is a need to provide for individual investigator-led research to allow new players to be identified and supported. These are not easy issues in a small science system.

In all other small countries which use science well, there is also a greater level of physical clustering of universities, institutes and the private sector. We spread our activities broadly across New Zealand because of our 8 universities, our geography and our regional parochialism. It has made it difficult to differentiate the university sector, to potential national disadvantage. In a world based on knowledge we need to have high impact academic institutions. This lack of clustering puts the potential of a seamless interaction between the public and private sector science systems at a real disadvantage. I suspect over time there will have to be greater focus and aggregation.

Beyond that New Zealand has real disadvantages in our lack of an internal market, geographical position and deficient capital markets. How will we make our private sector more science intensive? It is more than government incentives – it is about getting a more innovative and entrepreneurial business model that recognises the real added and rather weightless value of knowledge. Let me give but one example. Currently we export two types

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of food – commodities such as milk powder and products with added value due to their perception by the consumer – venison would be such an example. Both rely heavily on science – science has played an enormous role in both our pastoral agriculture and food industries. The role of science in packaging and preservation cannot be underplayed. But where will the food industry in Asia be in 20 years time? Part of it will be volume based and we cannot compete there. But an increasing element will be based on the growing demand for foods with proven value in health protection and in particular in dealing with the explosion of non-communicable disease. There will be half a billion people in Asia with diabetes within two decades and not all can be managed by drugs – foods as either preventatives or therapeutics will become important. New Zealand is extraordinarily well placed to do the research that would lead to such products and they are products that will have real added value.

There are many other ways we can add value: industrial design adds weightless value. Our service sector provides a range of knowledge-based weightless exports and these are areas we have yet to fully exploit. Our future is in Asia. Asia values our capacities to generate knowledge. Asia has scale, capital and markets. Our business and academia have to look for new models that will allow the added value of science to be exported and returns made to the New Zealand economy. I suspect this will lead to New Zealand science not just building domestic multidisciplinary teams but also international teams.

But not all science is directly aimed at the productive economy. We must not forget the value of high quality defensive science. Look at what world class earthquake engineering delivered in Christchurch, and the events of the last week in the kiwifruit industry show how important bio-protection science is to our economy. It is worth reflecting on how we ensure adequate capabilities in such defensive science. And perhaps the one area we need to give greater focus is social science – they are woefully inadequately developed and under-exploited here. Indeed, in general ensuring how evidence is used in policy making is a matter of great concern to me and one I shall return to at a later date. I hope to see a far greater role for science within the business of government, as is the case elsewhere.

All in all, what I am suggesting is that over the next decade the shape of science in New Zealand will change dramatically. There will be a far greater range of careers in science than what we see now. And there will be challenges as the pace of technological change becomes faster. In many domains scientists will have to learn how to adopt new technologies, new frameworks, new domain interactions at a much faster pace.

The scientist of tomorrow will have to be able to communicate not just to other scientists but to the community and to business. Not every scientist can have the attributes to do this, and what this means is that teams with multiple talents and different personal attributes will become the norm. Team-based funding in one form or the other will become more dominant as will careers that span both the public and private sector.

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New Zealand will not thrive unless its science system is vibrant and outward looking. We need to get beyond 20 years of underinvestment and demonstrate the key role that science will play in our future – in social development, environmental protection, economic development and in ensuring our relevance as a nation in a world in which new knowledge is accumulating at an accelerating rate, bringing both challenge and opportunity.

Thank you.

ENDS.

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