OFFICE OF THE PRIME MINISTER'S SCIENCE ADVISORY COMMITTEE

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Sir Peter Gluckman's opening address at NIWA's *'Degrees of Possibility; igniting social knowledge around climate change'* workshop, Wellington

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My colleague John Beddington, who is chief scientist in Britain, uses the metaphor of 'the perfect storm' to describe the conflation of food security, water security, energy security and climate change arising from the interacting influences of a growing global population which will reach 9 billion by 2050. All that increase will occur in populations in developing or least developed countries, which have the justifiable expectation of economic advancement. Against this background we have other factors in play: environmental degradation and the effects of warming on changing ecosystems.

But I would extend the metaphor. Human technology led to population growth and has also generated other burdens: For the first time in our history as a species, more than 50% of us live in cities. The implications for inter-human dynamics are poorly understood. For example, there is ample evidence that the human brain evolved to cope with about 150 people – how much do our rates of antisocial behaviour and mental illness reflect the pressures of this increased population density?

What we now eat is a long way from what we evolved to eat. As a result of our modern high-energy diet we face an epidemic of obesity, diabetes and heart disease – not only in developed countries but also in developing countries where the epidemic arising from the nutritional transition is even more acute and urgent. Both India and China now each have over 100 million people with diabetes, and that disease is appearing at relatively young ages with enormous implications for the economy and health care systems of those and other developing countries.

And we have not understood the impact of the new technologies of communication and particularly the information and social networking available on the internet. They change the way people think and interact. Indeed they change the nature of authority and of relationships. We have hardly begun to think about the social implications of these technologies, but they cannot be ignored.

We have not had a conflation of issues like this in the past: Populations will not acquiesce to food insecurity, water insecurity and energy insecurity, particularly when inequity abounds. The risks of regional and sub-regional conflict are multiplying.

We need to consider these issues at multiple levels: we need to think about it at the level of the planet, by region, by nation and by locale. We tend to focus on the global but in many ways the first impacts will be at the local level. A few days ago in the Antarctic I met a scientist from California who was studying ocean acidification. She made the point that even subtle acidification can affect shellfish calcification. Areas of particular risk were those where there were deep ocean upswellings as colder water contains more CO_2. The north-east coast

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of the USA and bits of New Zealand are at particular risk and she sees the oyster fishery collapsing early with its impacts on the small towns that are totally dependent on that industry. She is not being an alarmist – there may already be early evidence of shell thinning. The question then becomes can more resistant strains of oyster be identified as an adaptionary response, as mitigation seems unlikely given the long ocean cycle time for CO_2?

And this highlights the enormous challenge in how we respond to these issues. In general, responses can be one of three kinds: first, denial and delay, which is understandable at a human level - in many ways that denial has similar elements to what a person who has been diagnosed with a severe illness might have – it's too hard, it's too complex and the treatment is unpalatable; second, mitigation in which we try to reduce the magnitude of the change, for example by controlling greenhouse gas emissions; and third, adaptation, where the response is to try and cope with the change, for example by finding crop varieties that can withstand a degrading climate. The issues of Copenhagen have put more emphasis on adaptation including technological and geoengineering solutions, but I think the need to sustain the mitigation approach is obvious especially as an agriculturally trading nation.

The science of climate change has some unique aspects. While other historical sciences use one set of observations to hypotheses testable on an independent set. But climate science has no second planet to study and use of it to predict the future. And it involves complex non-linear systems. In such models, predictions may have high levels of uncertainty, making the science easier to reject or ignore. Uncertainty also invites exaggerated claims.

The issue of public engagement and understanding is therefore a challenge and will grow. But if we fail to engage the public on these complex issues, then the more likely it will be that the necessary solutions will fall victim to vested interests and contestation of dogma.

We do not live in a Platonic society where the pronouncements of scientists are taken as authoritative, and conveying an understanding to the public is complex. Science is a "**process"** – science is not just about facts, it is a sceptical process by which the validity or otherwise of knowledge about the natural world becomes convincing.

For many years science was dominated by the physical sciences whereby science, mechanics and mathematics combined to produce a rather linear view of science – science was about achieving certainty. But such deterministic science has now been augmented with ways to handle non-linear and dynamical systems, probabilities and understand the confidence limits around uncertainty. And as in other complex systems, there are aspects of climate science we are very certain about, an increasing amount we are pretty certain about, and much we have yet to better understand.

So in the gap between the scientist and community there are inevitable tensions that inhibit finding solutions. These may be geopolitical in nature – an example would be the north-south divide in debates over control of greenhouse gas emissions. Why should less developed nations be denied the capacity to use high density energy consumption to grow their economies when climate change has its origins in the energy consumption patterns of the north? Getting beyond this is a real challenge for the diplomatic community.

Other tensions come from the rejection of the science. In understanding those who reject the scientific consensus it is important to distinguish between those who are genuinely questioning the science, and there appears to be only about 2% of climate change scientists who in any way do, and those who are really debating the response to it. In most part it is the

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latter that is the primary driver of the current controversy – although the debate often takes the form of creating scientific confusion. The impending NIWA court case is such an example.
The tensions can also be ideological in nature, for example the Republican/Democratic debate over climate change in the US Senate. Here the ideology is complex and caught up in libertarian and even religious perspectives. The ideological debate in many cases cannot be separated from the economic vested interests that are clearly in play. Those with a libertarian ideology do not accept that the State should control how they live their lives, particularly when the actions required will not, in their view, impact for a generation or so. The economic libertarian believes growth is paramount and if there is a problem then technology will eventually solve it. There seems to be some irony in accepting that science may solve a problem but that it cannot correctly identify the problem.

Others accept that the world is warming but do not think there is any need for immediate action to mitigate it, at least any action that might affect their economic position, and they justify this view by appearing to deny the science.

Other tensions can be more philosophical – for example, a debate is already emerging in some countries between those with strong green ideals and those who argue that ensuring food security will require the use of GMOs with higher yields or with the ability to grow where the environment is degraded – for example in salinated soils.

It is worth noting that climate science is but one example where the interface between science and society exposes different agendas and world views and these latter differences, rather than the science itself, becomes the point of focus. We have seen it in the past regarding the link between smoking and cancer, and creationism and evolutionary biology – to name some obvious examples.

Acceptance of anthropogenic global warming brings with it the acknowledgement that both immediate mitigation and eventual adaptation are necessary. While there is hope in the long-term for adaptionist technological solutions such as carbon sequestration or other forms of geoengineering which will now be incorporated into the next IPCC report, immediate mitigation requires regulatory approaches including the use of incentives that shift people towards reducing fossil fuel use and thus emissions.

Technological choices will have to be made to address these multiple issues, and conveying to the public an understanding of the inevitable balance of risk and benefit of any action will also challenge the scientific and political leadership. However the counterfactual of an inadequate scientific and technological effort is obvious.

The media is both part of the problem and essential to a way forward. The modern media like controversy – they feed off it. Entertainment is more important for most media outlets than information transfer. In their desire to appear balanced, they give equivalency to each side of a scientific argument when there is in fact a broad consensus on one side and not much more than individual opinion on the other.

The issue is how to communicate complex science. The public needs to understand these issues as they will determine how society will respond. However it is not clear how this can be achieved given that the internet has largely destroyed the means to distinguish reliable from unreliable information.

Most scientists are not well trained in public communication, some try and debate as if it is a scientific debate when the agenda of the protagonists is almost always very different. Many

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scientists get angry and defensive in this situation and this raises suspicion. Some scientists also worry that release of raw information will be an invitation for a wave of uninformed interrogation and harassment. This is a real conundrum – we live in an open society – information is now made widely available and should be.

Politicians then have to judge what actions they should take to manage the risk, because this is essentially an exercise in risk management, we all exercise that when we choose to take out insurance. Given that the scientific consensus is that the risk of significant consequences is very high and is growing, it is important that consensus is reached at every level. The challenge for science and technology, and in that I include the economic and social sciences, is to help that process.

Thank you.

ENDS

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