SCIENCE, SOCIETY AND OUR FUTURE

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Thank you for the opportunity to speak tonight. It is a pleasure as director of newly emergent think tank and research centre to continue to build a partnership with NZIER. Koi Tū: the Centre for Informed Futures is only three years old. We were intentionally set up to be non-partisan, transdisciplinary and systems-focused and to look at the longer-term dimensions of what we will confront as a society. A major asset for Koi Tū is its national and global network. In that regard, I am president of the International Science Council, the global NGO based in Paris bringing the world's academic academies and international scientific bodies together. Its major role is in the intercations between science, both natural and social, and the global community.

If Covid-19, climate change, and conflict have taught us nothing else, they have reminded us that economic development, environmental, social, and political health are intimately intertwined. Science, very broadly defined – including both the natural and social sciences – is key to understanding this nexus and to mapping our path ahead. And science-based innovation must be seen as far more than simply narrowly and directly focused on commercialisable products. Rather it must also consider many broader aspects of innovation, from how we manage the environment to how social services are applied and policies are set. Technological developments both empower such change and make the need so compelling.

Yet societies, including Aotearoa New Zealand, have an ambivalent and sometimes contradictory relationship with science. Generally, most of us respect it, like it when we need

it, and therefore mostly trust it. But that still leaves much room for debate, confusion, and contest. And science can sometimes be rather inconvenient when it challenges predetermined views or challenges interests.

Covid-19 and the development of the first-generation vaccines has shown the enormous potential that can come from effective scientific cooperation that spans the public and private sector and geopolitical boundaries. But there are caveats: first, the pandemic is far from over in its consequences. Second, it adds to an already very stressed system arising from economic, environmental and climate changes and, sadly now, international conflict: all creating existential risks for citizens and our planet.

And Covid-19 surfaced many other issues. The formal multilateral system was slow to respond and the use of evidence in policymaking was very patchy across countries. Preceding risk assessments had been generally ignored and the plurality of required inputs was often not obvious. Disinformation, the overt politicisation of science and the variable quality of science communication all affected the responses by governments. Most worrisomely, we saw how distrust in science became a partisan badge.

And trust in science has been undermined by disinformation and conspiracy theory, as exemplified by the promotion of public resistance to and fear of vaccination – a phenomenon perhaps not as severe in New Zealand as elsewhere but which cannot be ignored and still lingers.

Attitudes to science are never simple. For example, science has been denied by some who reject genetic manipulation, yet the same constituencies urge the world to accept the science of climate change. And the reverse case shows some parallels. But I acknowledge that these two cases are not equivalent. In the case of generic modification of crops, there can be philosophical or other reasons to reject the prospect, but nevertheless that is no reason to dismiss the science underpinning it. In the case of climate change, the very existential nature

of the risk should have overridden individual, commercial, and national interests, but instead debating the science diffused recognition of the urgency to act.

We must be honest; the very successes of science and its technological offspring, are not unequivocally positive. Climate change largely results from the development of industrial technologies. The broader sustainability challenges are in no small part due to public health advances leading to greater survival, longer lives and population growth. The paradoxes of how science is perceived go further; war and other dimensions of geostrategic tensions are places of technological competition. Given the pace of technological development, science an technology have become central to nationalistic and geostrategic narratives.

As a result of its potential misuse by state and non-state actors, regulation of rapidly emergent technologies is becoming a core challenge for our species. It can be argued that technologies are already fuelling a social well-being crisis that is becoming truly existential.

Such technological challenges are very difficult to address in a world of fractured technopoles where the USA, China and Europe are all taking different paths towards their views of the digital future. All societies especially small societies that do not have technological sovereignty, like New Zealand, are struggling with this challenge.

A danger is that science itself can be siloed – we saw that with Covid where, generally, the only loud voices came from a narrow group of experts at a time when so many more disciplines could and should have contributed – from behavioral science, from educational science, from the other social sciences, from mental health and so forth. The Global Covid report that I led on behalf of the International Science Council in partnership with the WHO and UNDRR entitled *Unprecedented and Unfinished* highlighted that there was a need for greater plurality of expert input, greater openness and better communication. It also identified an overall need for better use of risk assessment in policy responses – a particularly concerning issue that my Koi Tū colleague Anne Bardsley and I have previously written about in the New Zealand context, in a report entitled *Uncertain but inevitable: The expert-policy-political nexus and high impact risks.*

I have got this far without defining what science actually is. In fact, we must test the assumption that science is a global language, this is something that unexpectedly has become a focus in New Zealand in the last 12 months. In doing so, it is important to distinguish between science itself which is defined by core principles and the nature of science systems which must be contextual and relates to the societies in which science is conducted. In turn, the characteristics of science systems must be distinguished from the attitudes and behaviours of scientists who operate within these systems and the incentives that drive them.

The English word 'science' has been in use for at least 600 years. Still, the modern understanding of what is science has evolved a long way since the Enlightenment and, more recently, since the somewhat narrow Popperian view of falsifiability. Philosophers of science now define science by those characteristics that make it a special and distinct form of knowledge, which is systematically organised, is rationally explicable and subject to the scrutiny of peers. Notably, no other explanations, such as tradition, belief or the supernatural, are permitted. Science is therefore testable against reality and logic and subject to the open scrutiny of peers. This involves collective processes within the scientific community such as peer review, publications, bibliographic classification, literature search engines and so on.

As a result, science is not a fixed knowledge system, but one that is self-correcting and evolving. For example, it would be difficult to argue that most medicine of the 18th century was science. Indeed, evidence-based medical practice and systematic explanations of pathology really only emerged in the 20th century. Some domains we call social science have similarly evolved only in recent decades.

While this characterisation of science refers to the knowledge domain itself, we must recognise that it operates through a complex ecosystem of funding mechanisms and institutions, including universities, research institutes, the private sector, and the peer-reviewed publication system. Within this ecosystem and its stakeholers, there are indeed appropriately many values-based considerations – these include judgements on how much to

invest in science or its derivatives, what, who and how to fund, what to expect in terms of outcomes and how to assess these.

Peer review is at the heart of the system, but this itself is known to be imperfect and sometimes even flawed. Indeed, far greater attention needs to be paid to how we might sustain the quality and integrity of peer review and how it is conducted. This too needs to evolve as do the incentives that drive so much of how the science system operates.

Against this background, the diversity of domains and disciplines represented within the science system also adds challenges. Science systems themselves are evolving and need to evolve; for example, the emergence of team-based and transdisciplinary research.

And we must look to the scientists themselves; if they do not have integrity, there cannot be trust in their truth claims. Understanding of good scientific practice and ensuring its optimal transfer to the economic, policy and societal sectors depends on such integrity and on whether it provides relevant answers to real – if sometimes wicked – problems. We must recognise the 'inferential gap' between what scientists know and what they conclude. There is always a values judgement in play as to the sufficiency and quality of evidence on which to make a provisional conclusion. This must always be present and especially so, when science is used in a predictive manner.

Ultimately, no societal decision-making can be purely technocratic: values and interests are always engaged. In the very areas where policy and public decisions are needed, uncertainties and unknowns lurk – yet these can be glossed over. Here the rhetorical power of singular numbers cannot be ignored – they can be misleading given the underlying uncertainties and assumptions in any model or estimate. And scientists themselves too often forget these points, exhibiting hubris and dogmatism and imagine that they alone have the answers. The point is that science alone does not and should not make policy, but depending on how it is used, it can lead to better or worse policies and collective decisions.

Thus science, even with its distinctive characteristics, cannot exist in isolation from other knowledge systems, be they originating from religion, tradition, local knowledge, indigenous knowledge, or the tacit or learned knowledge acquired from different experiences. In every society, science lives alongside other knowledge systems and hopefully in dialogue with them. But it cannot be conflated with them.

It is these fundamental principles that allow science to claim its position as a global knowledge system given its evolution from many sources over the last few hundred years. The criteria defining science are common to science in every country and it is both wrong and political to infer that it is less than global. That is not to deny that science has not been used and misused as part of imperial endeavours.

Many in the developed world stand somewhat surprised that many countries have not been overtly critical of Russia's invasion of Ukraine. One reason is that a conflict in Europe is perceived as being more significant by the Global North than elsewhere. It can be asked what about the many gruelling conflicts in the Global South that did not receive similar attention? Too often science is seen in a similar vein. Even when research is conducted in the Global South it can be construed that this is for the benefit of the Global North. We have seen this perception in the call to 'decolonize science' – the very phrase indicates confusion between science itself, the science structures developed around it and the way science is applied.

The expression indeed reflects much politicalising and misinterpretation resulting from multiple agendas. Nevertheless, the call emphasises that science as a global good must be available to and be performed by all societies. It is an international language and endeavour. Science is not owned by any culture or society, even if it has been and still is misused by some.

Our recent national conversations show that there remains a need to be clearer about these matters, especially as science will be central to addressing the existential risks to our healthy

future. As we have discussed, whereas science is universal, its ecosystem will have diversity, given that science systems are embedded within the societies they serve. Science must recognise the essential contribution of other knowledge systems to a healthy society.

New Zealand has a proud, but generally poorly understood history in both discovery and applied research. Our primary sector, on which we so much depend, is built on decades of science, albeit being increasingly inhibited by current funding mechanisms and the ongoing demands of regulatory constraints. We are now facing the challenge of a biological future without the very technological tools needed to exploit it, while at the same time, needing to enhance our environment. What will be acceptable tradeoffs? And New Zealand science been contribnuted globally in other areas with major advances in medical science such as perinatalogy, engineering, conservation and biosecurity to name but a few.

But too often, government intervention sees the science system as being largely built around its seven Crown Research Institutes (CRIs). These are small by international standards, overlapping in focus and stranded between short-term commercial roles and long-term strategic goals. But a larger part of public sector science, broadly defined, occurs within the universities, yet the Productivity Commission in its report on higher education did not even consider their role in knowledge generation.

Importantly large domains of public-interest science require long-term research and cannot be measured in simple outputs and outcomes. Conservation, environmental and social science all fit these criteria. Yet, the system effectively puts caps on the levels of investment in such areas because the incentives are largely placed around short-term and/or direct economic gains. Ironically New Zealand's future will depend even more so into the future on the better use of environmental and social science. The risks of loss of social cohesion, for example, are real.

There is no integrated view of how the CRIs and the universities relate to each other. The university system persists with incentives that are largely outdated and over-gamed and are primarily viewed through a narrow vocational lens rather than understanding their role as a source of well-trained minds and people ready to enter the marketplace of ideas and new ideas, concepts and knowledge are at the heart of the university ethos. This policy absence has persisted for decades. Tertiary education no longer even has its own minister and indeed policy making does not lie with the Tertiary Education Commission. Contrary to this, many countries have successfully merged their ministries of science with higher education because the interface between them required integrated policy making.

We like to proclaim that we are a country committed to knowledge applied to the economy, the environment, and our social well-being. Every major politician for the past 25 years has announced that we need to invest in science, but the reality is that we invest in science at well below that made by other similar small, advanced economies; we will pay the price for this.

It has concerned me for decades that there is a startling lack of advocacy from the private sector about the need for New Zealand to have a more aggressive approach to public investment in public sector science. The international evidence is clear; a robust innovation sector will only grow when public sector R&D is adequately supported. A starting point would be to advance some new thinking by taking science out of MBIE, where it is smothered in a super-ministry and put in with higher education which is currently adrift within a ministry focused on understandable issues relating to compulsory education.

No country of 5 million people can develop all the knowledge and application it needs by itself. We thus need to be a much more active part of the global knowledge community. However, our international science commitments are small and often narrowly targeted. This situation underplays enormous opportunities intellectually, economically and as a form of soft diplomacy.

Science will have to be an essential aspect of the New Zealand diplomatic tool kit as it is for other countries as we move forward. Many new technologies are emerging that will have transnational economic, political, and strategic implications. At the same time, progress on the Sustainable Development agenda will increasingly depend on science, including the social sciences. Yet where are the development goals in our own national agenda and public discourse? Further, the ongoing emergence of new technologies that cross borders and very distinct technopoles will challenge us – diplomacy and trade without scientific underpinnings is unlikely to position us well. Science diplomacy is increasingly vibrant globally, yet it is of comparatively low priority.

The recent Green Paper from MBIE on the science and innovation system looked primarily at micro- rather than the larger issues that I have been discussing. This may be a lost opportunity. Clearly, there are some core issues for the New Zealand science and innovation system. We need to give greater recognition to the diversity of sciences including social science and to find a way to promote transdisciplinarity, as well as diversity in our knowledge workforce. Without conflating two distinct considerations, there is an obvious need for more Māori to enter science as well as to promote studies into our indigenous knowledge system, Mātauranga Māori, both in its own right and because, as I have said, no knowledge system sits in isolation.

As a nation we face a plethora of wicked problems that must call for science. To name but a few there is climate change, issues of water availability, energy futures, food futures, ageing population, growing global resistance to ruminant products, pandemics, declining ecosystems from the tropics to Antarctica, the challenges for our economy in a post digital world, the challenges presented by intergenerational inequity and disadvantage, the implications of multicultural society built on bicultural underpinnings, and emerging technologies affecting our position be in the world. These are some of the things we will face over the coming decades. To tackle them needs properly organised, well-funded and appropriately translated and applied science and supported by industry, public and policy.