Science in a global perspective – challenges ahead
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Sir Peter Gluckman ONZ KNZM FRSNZ FMedSci FRS on the occasion of being awarded an Honorary Doctorate
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Robust knowledge should be a critical input to decision-making at every level of society and policy making; the core tenet of science advice is that the appropriate use of germane knowledge is more likely to lead to more effective choices between options. Indeed, there are always options – even the decision to do nothing is itself an option. Science is probably best defined as a set of processes designed to develop relatively reliable and testable knowledge about the world around and within us. There are many kinds of science, and I do not like the distinction between natural and social science, but at their heart there is the need for verification, and for minimizing the effects of biases during the collection and analysis of data. It is these processes that separate scientific knowledge from other sources of evidence such as belief, anecdote and informal observation. That said though, we would be naïve not to acknowledge the role that values play in science; this particularly pertains to the judgments made about the sufficiency and quality of scientific evidence. And we must not draw boundaries between types of science such as natural, data, technological and social science. These combine to form a continuum that is becoming increasingly important.

Here I will address the challenges that science must help to address in the global context. I do so as the previous science advisor to the New Zealand Prime Ministers over the past decade and as Chair of the International Network for Government Science Advice (INGSA), as President-elect and Chair of the Committee on Science Planning for the International Science Council (ISC), and as Director of a newly formed think-tank and research centre in the University of Auckland called the Centre for Science in Policy, Diplomacy and Society (SciPoDS).

But before progressing this conversation, we need to look at science itself, for science is changing and that itself creates challenges for science and scientists and their institutions. As Dan Sarewitz pointed out in his important essay, *Saving Science*, science progresses in many ways because of advances in technology. Until Antonie van Leeuwenhoek invented the microscope in the 17th century, the concept of a cell was not viable. And it has been the rapid development of computation which has enabled sciences to move from compiling isolated observations to a systems-approach, and being able to move from linear to multidimensional analysis. Increasingly, sciences are able to be applied to better understand whole systems, from social to environmental. Yet a feature of all these systems is their open nature, and to this, complexity is added via the multiple levels of knowledge acquisition and analysis, from the gene to the whole society in the case of human health. Yet inevitably, no matter how much research is done, there remain unknowns. Thus, some aspects of the body of science may be contested on scientific grounds, whereas others become contested and can become part of proxy debates because the systems of interest inevitably intertwine with

public values and these values, at least in democracies, are inevitably the subjects of dispute and ideology. In many ways this is the real challenge of science – the more useful it is for society, the more likely it is to be entangled with politics. And the time frames of science and politics are very different. This is the domain of post-normal science, a concept that this university has done so much to advance.

But science faces other global challenges. Public science has in some senses been effectively industrialized through its often rather narrow focus on bibliometric measures – an effect created by the incentives governments and academia have placed on public science. Solutions lie in looking at these incentives. Do we really need more than 3,000,000 scientific papers a year in more than 30,000 journals, most of which have minimal if any impact? We must be honest and ask how much science is done primarily for the interests of the individual's own career, rather than genuinely seeking to advance knowledge frontiers or to address the global good. And as scholars in this university and elsewhere have pointed out, the incentives in play have done much to generate issues of quality control and reproducibility. We need to look much more innovatively at how we assess research and make judgements on it and those who perform it. Many issues flow: the challenge of open science, the challenge of information and data access, and the challenge of how to promote multi and transdisciplinary rather than siloed research – research is increasingly team-based while most incentives are individually directed. Funders, governments, academies and the scientific community need to think about the way ahead. And there are other challenges: gender equity, advancing knowledge and creating knowledge institutions in developing countries, and how to marry science with other epistemologies. A particular opportunity in my own country is how to best and equitably use the unique understanding, values and knowledge of our indigenous Māori people.

Over 70% of global R&D occurs in the private sector. This in itself is not bad – all said and done, everyone in science has interests, albeit not necessarily financial. But issues of trustworthiness emerge because of such interests. Sadly, there is a long history of manipulated and biased interests arising from the interaction between private sector-supported science and society. The institutions such as peer review and transparency of open data that hopefully give some confidence in public science can have a more limited role in the private sector. Yet we increasingly rely on private sector knowledge for much direct and indirect public good. My research group at Auckland University, SciPoDS, is thinking through what kind of institutions might be created to give greater and deserved confidence in private sector science.

The issues of confidence in knowledge are not just restricted to the private sector or problems related to the quality of science. Increasingly the environment created by the transformed way we communicate and disseminate via digital means allows for the manipulation of information, reliable or otherwise. It is obvious that we live in a world of increasingly contested facts – facts that can be distorted for reasons of power, ideology or interest. And the manipulators range from State actors to influencers on social media. While knowledge has likely been manipulated for purposes of power

and control from the beginning of organized society perhaps 10,000 years ago, what is now different is the speed, pervasiveness and the compelling influences of information disseminated via the digital media. As the issues of sustainability and societal resilience become more intense, the issue of what is real and what is not could become the ultimate existential threat to the effective use of science in the public arena.

The 2019–2021 Action Plan recently released by the International Science Council highlights three domains where global science action is needed. These are addressing sustainability, accommodating the digital transition, and the need for more effective use of science for policy at all levels of governance and in societal decision-making – an issue of growing complexity in a world where science is increasingly contested and knowledge more easily manipulated. These three domains frame key challenges we face at a global level, to which I would add a closely related fourth – namely the threats to societal resilience and social cohesion now obvious in many countries.

The pressing challenges of sustainability are well-rehearsed: climate change and its many impacts; biodiversity collapse; food and water security and a growing human population with expectations that highlight the major issues of global inequity. Such issues are encapsulated in various ways within the Sustainable Development Goals and Agenda 2030, but progress on them remains disappointing. As the recently released UN Global Sustainability Development Report prepared for the recent General Assembly makes clear, science and science advice must take a more central role. The report highlights the need to understand systemic interactions, because the reality is that any future progress will require choices to be made, and with this there are some very complex interactions – some synergistic, some antagonistic – within the SDG targets. An example of this is the issues that arose for food security with the use of corn in the drive to promote biofuels a decade ago. Scientists are certainly required to assist the policy community to understand such interactions at a level of granularity that allows contextual decisions to be made. This is why the ISC and INGSA are co-leaders of a project to create a toolkit for policy makers, experts and communities. The aim of this project is primarily to improve co-evaluation of interactions, such that more holistic decisions can be made about pathways ahead.

Parenthetically, we need to do far better in comprehending and discussing concepts of trade-offs generally. Can we sustain food production to support 10 billion people with a reduced carbon, phosphate, nitrogen and water footprint without adopting a variety of new and maybe controversial technologies? Perhaps we can, but probably not. Yet these sorts of decisions can be inhibited by short-term political expediencies associated with superficial claim and counterclaim. We definitely need to find better ways to have conversations on such issues.

There is also a need to understand competing development agendas. For many people the growth and sustainability paradigms are not compatible. Much of the contention in the politics of sustainability will not disappear until greater alignment of various intentions is achieved. Finally, most transformations need to be understood in terms of context. Most solutions must be local,

owned by local populations and designed as such. These are all reasons why the concept of sustainability science must grow and become truly trans-disciplinary

And this brings me to an issue that concerns me greatly, which is the relative lack of effective structures with which to link science to the policy community, particularly in the international arena. Few countries have formal science advisory systems that are effective and responsive. Academies can provide digested analyses, but rarely can they impact on the critical phases of the policy process when ideas first form. Perhaps only 20 countries, mainly in the Anglophone and developed world, have effective mechanisms to do this in an independent manner. And at the international level the problem is intensified, made worse by the reality that at the very time the global challenges continue to grow, the international order is in trouble. While each UN agency may have some form of scientific input, it is very variable and certainly not coordinated. Further, in the UN system where decisions are ultimately made by diplomats representing their countries, there are few formal links between foreign ministries and science advisory mechanisms.

At the 2017 STI forum to support the SDGs, a plea was made to encourage countries to develop science advisory mechanisms, and likewise, for the UN to build an effective science advisory mechanism. This call occurred again in recent discussions regarding the SAMOA pathway for small island developing states. Early steps towards creating such mechanism were started by the previous UNSG but have since been abandoned. In my view this represents an urgent deficit that must be remedied if progress on the issues of the global commons is to be accelerated.

But let me move on to the challenge of rapid technological innovation. I have already hinted at some of the issues that the digital transformation brings. This transformation is but one, albeit dramatic, example of the challenges that our unique abilities as humans have created. In our ability to cumulatively innovate, we are now seeing what is effectively a runaway cultural evolution where new technologies are emerging at a very rapid rate. What is distinctive here is both the pace of technological advances but, in particular, their pervasiveness.

Over thousands of years, we have invented ingenious ways to gain mastery over our environment. The ability to communicate, accumulate knowledge collectively, and build on previous innovations has enabled us to change nature. Such innovation has allowed us to thrive. However, the trouble with such innovation is that we can seldom go back and undo it. We invent, embrace, and exploit new technologies to modify our environment. Then we modify technologies to cope with the resulting impacts. But these developments are now happening at such a pace that traditional approaches to regulation and regulatory science to manage technological developments are becoming overwhelmed. Our invention of fossil fuel-based technologies has -- and still is -- driving climate change; our inventions in public health, medicine and urban technologies have resulted extraordinary population growth, and with this environmental degradation and biodiversity loss. Thus, the pace of cumulative and pervasive innovation has now reached a point where these innovations are increasingly affecting our behaviour, biology, and society. To provide nourishment

for a growing population, humans have developed methods to process and preserve food, but easy access to such energy-dense foods results in obesity. To protect ourselves from dangerous pathogens we have embraced cleanliness and invented antibiotics, but this has led to rising rates of allergy and antibiotic-resistant bacteria. Overall, we must now figure out how to function in the world that we have so drastically modified.

But I must focus a few remarks on the digital environment we have created. While have we embraced such technology because it assists us with communication, business and information access, our INGSA report to the OECD has also pointed out that the digital environment has also had impacts on us as individuals, on our social lives and the established institutions of civic society. Significantly, this includes the relationship between the citizen and the State. Moreover, there is growing evidence of the role of digital technology in driving mental health concerns, especially in young people. The anonymity of the internet has exposed base behaviours and attitudes that religion and civic society had long suppressed. And we are only at the beginning of the digital transformation that will influence every part of our existence.

Our ingenuity has changed not only our world, but also ourselves. This is the subject of my new book written with my long-term colleague Mark Hanson that is coincidentally published today. Allow me to make an advertisement for it – it is called *Ingenious; The Unintended Consequences of Human Innovation* and is published by Harvard. It takes both an evolutionary and public policy perspective on these issues.

The question thus becomes: what is our future as a species? Will we passively allow such technologies to fundamentally change who we are, how we relate to each other and how society is organised? This may even embrace the transhumanist vision that some futurists have. Can democracy as we know it survive the manipulative environment that has been created? Could we face the world that Orwell foresaw in his dystopian novel, or an alternate equally dystopian view that Aldous Huxley described in his novel? I am not a pessimist nor a Luddite. The reality is that we must learn to live with our capacities to develop technologies and celebrate much that they deliver. But we also need to find new ways to evaluate rapidly evolving technologies in ways that recognise the interests of society in this world of rapid change. Psychological resilience, both individual and collective, will be essential and that will depend heavily on how we reform and restructure education to promote those needed non-cognitive skills that emerge in the early years of life.

And this brings me to one more challenge that science must embrace. We need to think much more about the relationship between knowledge, technology, society and policy making. This demands a much closer embrace between social science, the humanities, the data and the natural sciences. Societal resilience is critical to our survival. This can be defined as the ability of a society to adapt or transform positively in response to significant disruptions or threats to its wellbeing, which may or may not, be anticipated. But the biggest risk to our resilience will be a loss of social cohesion, a threat that our post-truth, post-trust and digital world has made more likely. The institutions of

governance which are critical to a safe and secure society and the institutions of expertise are particularly threatened in this environment. They will have to evolve to accommodate the new circumstances. To date science and universities as institutions, despite their rather elite characteristics, have been largely immune from any decline in respect. But we cannot be complacent. We have a critical role as researchers to explore what is going on; we also have an obligation to be agile and evolve in such a way that we can best contribute to protecting liberal democracy in whatever form it evolves into.

Thank you.