OFFICE OF THE PRIME MINISTER'S CHIEF SCIENCE ADVISOR

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Can science and science advice be effective bastions against the post-truth dynamic?[1]

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What is the role of science, very broadly defined, as an institution in a world where trust in institutions, in elites and in experts appears to be in decline and the concepts of reliable knowledge and the distinction between fact and opinion now appear to be under threat? These questions cannot be addressed without engaging in the broader consideration of how science and scientists engage with society—what is the nature of that relationship, and how are the processes of societal decision-making changing?

I discuss these questions from the perspective of having being the Chief Science Advisor to the Prime Minister of New Zealand for the last 8 years. My primary role has been that of enhancing the use of evidence in policy formulation. I also chair INGSA, which is the global network focused on the complex and multi-dimensional nature of the science-policy interface. This network is engaged with over 70 countries and has close to 3000 members drawn from academia including the STS community, academies, professional bodies, practitioners from that interface, policy makers, and think tanks. INGSA has chapters in Asia, Africa, and Latin America, a knowledge centre led by James Wilsdon in Sheffield, a science diplomacy division currently being established and led by Vaughan Turekian, and hopefully soon a division for urban science advice led from here at UCL. The network has focused on promoting the importance of this interface and assisting in developing the skills and principles to underpin it. The network can be joined for free at www.ingsa.org — please do so.

The post-truth dynamic, which has recently become a fashionable descriptor, is neither new nor simply about alternate facts and political manipulation. It has always been there, but it now has a higher profile given the much broader shift in how

[1] Some of these comments are extracted from my address on Sept 26th 2017 to the Annual Conference of the Joint Research Centre in Brussels, available at http://www.pmcsa.org.nz/wp-content/uploads/17-09-26-European-Commission-Joint-Research-Centre.pdf

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information is developed, communicated and interpreted. It is about how the media have changed and largely lost the traditional role as filter of unreliable information. It is about how trust in institutions has been or is being undermined. It is about how trust in experts and elites has changed. The consequences and impacts are apparent, making this an urgent and needed conversation about how science and robust knowledge, very broadly defined, interact with the messy processes of societal consensus and policy-making.

I am reluctant to spend too much time on the causes of the post-trust, post-truth, post-expert, post-elite environment. Others in this audience are likely better qualified, but some comments seem justified. Inherently the post-truth phenomenon is nothing new – rulers, politicians, shamans and priests have, from time immemorial, manipulated facts, observations, and information to their ends. More recently commercial interests have done so too. Consider the history of margarine so well described in Callestous Juma's book *Innovation and its Enemies.* This was deliberate misinformation that the dairy lobby produced over a century ago. Or consider the well documented misinformation of the tobacco and energy industries over more recent decades. Each represents a situation where the confusion of information was aimed to produce policy outcomes of value to some group of stakeholders, and each represents a situation where science had an important role to play in reaching a societal consensus and in many cases still does.

While the temptation and ability to manipulate information is not new, there is clearly a new dynamic with a major shift in trust, integrity and relationships between the component parts of our collective societal decision-making. Added to this, the potential for harm to be generated by manipulated, misused or misinterpreted science is now so much greater, given our increasing reliance on technology. My central thesis is that well-brokered scientific knowledge can be a valuable bastion against the polemic that is implied in the post-truth terminology.

In this, there are multiple factors in play, but two seem to stand out.

First, the changing socio-political climate seems, at least in part, to be the result of a much more empowered and information-rich society, fuelled by interest groups, filtered by social media and reinforced by public polemic that has replaced dialogue on complex, essential, and often urgent issues, even while – ironically – seeming to open up a better space to have such dialogue.

Second, as Jasanoff and Simmett have recently pointed out, public facts will always be interpreted by individuals in the light of their social experience: the experience of many within the western democracies over the past decade has been one of loss or of missing out, which inevitably raises scepticism and disbelief.

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Thus what we have seen in global politics over the past year is a reflection of these factors and a symptom of more general social changes.

Digitalisation, in all its manifestations, is a major accelerant to the post-truth dynamic, and the consequences are full of paradox. It has led to the greater democratisation of information and empowerment of citizens. However, the impact on mainstream media has accelerated the news cycle, effectively shifting it from being a relatively trusted information broker into a filtering machine, made worse by the arrival of social media platforms and their use of AI to select the information and news we 'consume.' The pervasiveness and speed of communication is such that now anyone can wilfully or unintentionally distort science and facts, or interpret them in a different way, to the extent that we no longer know what a 'fact' is. Google has become the almost universal source of such 'facts' but there is no way of knowing without expert interpretation what is reliable or unreliable.

Indeed, this more open access to knowledge has led many to believe that there is no need for expert interpretation of information. Mainstream media have become more overtly polarised as they increasingly play to narrower segments of the populations. Social media have become the major source of 'news' for many, thereby requiring a greater effort to seek out a diversity of views. As we know from decision science, people like to have their views validated, and so we increasingly get our information from polarised media and social media that serve to further entrench our opinions. Steve Sloman and Philip Fernbach in their book *The Knowledge Illusion* point out the importance of peer groups in creating collective knowledge – but increasingly those peer groups are created from social networks self-selected for their similarities of view rather than a more diverse group meeting to create a village consensus. Such dynamics can drive debate to extremes rather than to compromise and consensus. The impact on democratic decision-making is palpable.

What we do not know or understand is whether the inexorable push of technology can be managed better in relation to its societal impacts. There are both optimists and pessimists on this question. The optimists believe that societies will adapt and that the transition to a world of AI, machine learning, virtual reality and the internet of things, not to mention the emergent life science technologies, will release huge benefits. The pessimists see greater societal disruption, shift of power to the platform companies and away from societal institutions, and risks to basic concepts like autonomy and privacy ahead. I do not have time today to discuss this at length but the post-expert, post-elite, post-trust dynamic will be shaped by, but also serve to shape these technologies. This may be as critical and urgent a conversation as climate change, but may be even more difficult to have, given the stakes involved.

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As Thomas Friedman has pointed out a few months ago in a column in *the New York Times,* the paradox of greater institutional transparency has been an increasing loss of trust in the institutions that are necessary for a cohesive and yet diverse society to function. It is clearly having an impact on the effectiveness and nature of democratic government processes. It has properly led to greater expectations on government by its citizens but at the same time made it harder to achieve the policies that are needed to do so.

In this climate, policy-making can easily become reduced to whose 'truth' gets out first and is best encoded in polemic, celebrity or Twitter. Yet trust in experts, institutions and robust evidence is needed for effective governance and societal functioning.

An increasing number of commentators are starting to ask the question: is the power of the platform companies undermining the authority and power of the Westphalian system of government on which modern representative democracy is based? This is a particularly troubling question at a time when good governance is more important than ever. We must do much better in addressing the global and local challenges of 10 billion people, climate change, food water and energy security, urbanisation, demographic change and so forth. This is the focus of my address tomorrow at the University of Sheffield, entitled *Will the Road to 2030 be Evidence-Paved?*

And so we come to the importance of knowledge and evidence in trying to ensure that the excesses of this changing environment are mitigated and that society and its decision-making are informed by relatively reliable and robust evidence. This might seem straight-forward but it is not.

Firstly, nearly everyone sees evidence in broader terms than science alone. Religion, tradition, observation, personal experience and anecdote are all forms of evidence. Citizens in any society will have a variety of worldviews that can create their own truths, reinforced by cognitive biases and the echo chambers of modern media and by subjective experiences in which the individual's actual experience can be more compelling than the voice of experts.

So should and does science have any claim to privilege as a source of knowledge? I am defining science here and elsewhere in this address in the broadest possible sense. Science is much more than a collection of technical facts. Rather, it is a mode of thinking encapsulated in the work of people ranging from Francis Bacon to Karl Popper and Thomas Kuhn, and which has evolved into a set of processes aimed to obtain relatively reliable understandings of the world around and within us, though these are nearly always provisional. In short, science is a mode of thinking that institutionalises a distinct form of critical analysis.

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What gives science any claim to privilege is its processes. Science is not without its challenges, however. It clearly is embedded in the values of society and in that sense it is political. It is an institution that has changed dramatically over recent decades. Nation states increasingly see science as a tool of national development and as public funding of science has increased, so too has the complexity of the interaction between science and politics and between science and interest groups including industry. This situation inevitably can create confusion and often contestation.

The size of the scientific institution has grown rapidly – several million scientific papers were published last year, and were of very mixed quality, impact and relevance. Predatory journals and conferences abound. Public science is now incentivised through the financial instruments of grants and contracts, employment and reward and through the pervasive and destructive instrument of the bibliometric disease of impact factors and H-indices that have followed the effective industrialisation of academic science – all in the name of alleged objectivity. Inherently these pressures have the potential to undermine trust in science as an institution and affect the behaviour of individual scientists.

This is the multidimensional "crisis in science" to which Andrea Saltelli, Silvio Funtowicz and others refer. These are not easy issues to address; institutional inertia, the relative lack of appreciation within the scientific community of the relationship between science and society, and between science and policy, the intertwining of scientific, national and international objectives, of economic and other interests and human factors make it easy to talk about the issues but not so easy to see meaningful ways ahead. The challenge we face in this context is how to reinforce the value of public science at its interfaces with society and policy.

As the agenda of science and the claims of science have expanded, the relationship between science and societal values has become more complex. In turn, this can undermine trust in science unless we are honest about the characteristics of science, the role of and the limits of science and how it is intertwined in many ways with the broader societal agenda. This is particularly so in the case of many of the issues that confront the policy community and society where, as Paul Cairney points out, the science is often incomplete and ambiguous at the very time that policy makers need to make decisions.

Science is not values-free, but robust science is about minimising the biasing effects of personal and societal values on the collection and analysis of information. The values inherent in science include choices about what matters to study and the methods to use and judgements over the sufficiency and quality of evidence on which to reach a conclusion. This latter dimension becomes critical in understanding the interaction between science and society. For example in the early days of the climate

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change and GMO debates, the focus was often on whether the evidence was sufficient on which to reach a conclusion. In this context, the precautionary principle came to be used as a tool for one side of the debate or another, often to justify inaction on the grounds that science could never actually 'prove' anything, only disprove. These are appropriate societal debates that can be informed by evidence, but the ensuing debates are largely not evidential and it is unfortunate when science is used as a proxy for values-based debates, which are appropriate to have but we should recognise them as such. The failure to do so further diminishes science.

Often when we have seen science compromised, it has been when personal values and cognitive biases have influenced its core processes. In this we have a delicate balance. Scientists are important societal advocates – we have seen that in much of the recent environmental progress. But there are also dangers when individual scientists go beyond the data to take their status as scientists as a licence to make personal advocacy claims.

We must take care in our understanding of the place and positioning of values within science. In contrast, the societal use of science is essentially a series of values-based judgements on the relevance and transparency of the evidence and whether to accept and use this knowledge. These are decisions made within the context of the inevitable framing of a wide range of worldviews, cognitive biases and other values-based considerations.

And yet my presumption is that better policy making is more likely when robust evidence is used wisely. The issues then become: how such science is generated; how it is communicated; and how it is taken up by the policy and political communities. These are not simple questions and are intimately dependent on the interactions between science and society – which are not monovalent – and between society and the political process.

Science and society have a changing relationship. Science is no longer isolated from but is now more embedded in society; hopefully we are seeing the end of the behaviour that Merton and Polanyi both described where they saw scientists as standing apart from society and behaving as if they were revealing truths from the altar of science.

Indeed many of the policy issues involving science involve interactions with public values and these are often in dispute. Such disputes are made much more difficult by the filtering and echo chamber effects of social and polarised media. The situation is becoming more challenging still because we now understand that entrenched views can actually be further polarised by just pushing more information at people.

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This is the world of post-normal science where complex and incomplete systems science interacts with values which themselves are contested. Yet societal decisions must be made and with some urgency. 'More research is needed' is not a cry that assists the policy maker in such circumstances, but well-brokered science that demonstrates an understanding of how it now relates to society can assist in defining a path ahead.

Post-normal science invites the questioning of the science by those who might dispute its provisional conclusions for political or ideological reasons. In this, too often the science becomes debated as a proxy for what should really be an explicit values-based debate. This invites a whole raft of strategies that can lead to excuses to delay and ignore the science for political advantage.

There is a paradox here. Many of the issues that give rise to societal dispute have their origin in advances in science and technology – industrialisation and the massive expansion of the global population led to climate change and many of the issues encapsulated in the Sustainable Development Goals.

To have an effective science-policy interface, science itself must have integrity, not only in how it is done but how it is communicated. Trust in science must be earned and this is endangered when scientists exhibit hubris or a lack of transparency. The training of scientists needs more than a token appeal to ethics and must extend to areas such as the philosophy of science, the relationship between science and society, science communication and societal understandings. Natural sciences need exposure to the social sciences and humanities, and vice versa.

So let us now explore the science-policy interface in more depth.

Science and its processes have a very different set of epistemic foundations, behaviours and objectives to those of policy-making. Policy-making in this context is largely about making choices between options that will affect different sets of stakeholders in different ways. Often the desired outcomes of policy-making are rather diffuse and inevitably lead to spill-over consequences, both positive and negative, many of which are unpredicted, reflecting the fundamental complexities of the open systems that are human societies. The reality of political decision-making is that many factors other than scientific evidence inform the decision-making by policy makers and politicians. They must consider dimensions of public opinion, electoral contract, stakeholder impact, fiscal impact, effect size, diplomatic considerations and so forth. Indeed, it is inevitable that these are the filters that have the most influence on a policy decision-maker. That is the inevitable outcome of a democratic form of government – we do not live in a Platonic technocracy.

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But if science is to have a greater role in informing policy formation, it therefore follows that a key part of being more effective is to concentrate on the interface between science and society. This is not about continuing with the assumption of dealing with knowledge deficits. Rather it is about working with society to enhance science capital, which requires multi-directional engagement. This is about doing what is essential to prevent the alleged 'crisis in science' escalating and that means the institution needs to take a hard look at itself. The bibliometric disease and its associated institutional behaviours must be addressed. More than that, we must seriously consider the prescription of the post-normal scholars: co-design, co-production and extended peer review – a prescription that has fundamental implications for how the institution of science will evolve. Yet there will be resistance and it will take time to find models that achieve this while protecting the inherent nature of science.

Science is messy – last year over 3 million papers were published in 30,000 allegedly peer reviewed journals; an increasing amount of science is appearing in other forms of publication; there is a complex interplay between different forms of science, many of which have limited relationships to other disciplines; there is a challenge of integrating reductionist and systemic approaches; and so on. Scientific consensus has a different meaning and process to other forms of consensus, which can add to the confusion.

Policy-making is also complex and messy. It is not the neat cycle sometimes described. Rather, it is a complex and ill-defined set of interactions between formal and informal players that form networks that coalesce around specific issues. Add to that decision-making is largely about risks and consequences. And while scientists may think in actuarial terms and probabilistically, publics most often perceive risk through experience or proximity, and politicians see risk electorally.

At this interface, scientific thinking and scientific input can assist policy-making in at least three ways:

First, it can lead to better understandings of systemic complexity and thus to the definition of problems. This is not a trivial statement. Systems thinking has become central to government policy-making in areas as diverse as social support, demographic change, education, environmental management, transport and energy supply. Inherently this leads to much contestation over cause and effect and thus where to intervene with policy solutions. Normative argument often fails, yet is often at the base of much political rhetoric and opinion. These views rather than facts often rule the public discourse. Science can both improve the understanding of the complexity of the systems and identify potential points to intervene.

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In those issues where governments need more than technical advice, the science is generally incomplete and often ambiguous. Almost certainly it is diffuse and of variable quality and relevance, inviting cherry picking and intentional or naïve misuse. Yet, well-brokered science advice that understands these issues can, despite uncertainties, aid governments in choosing between options.

Indeed the advent of big data and data analytics can help support systems analysis in areas such as environmental and social matters, by explaining likely causal pathways and likely points of intervention. But the issues associated with such approaches are multiple and complex and it would be a diversion to discuss them today[2]. Suffice to say that data without expert interpretation can be misleading and can be misused. Add to that the voluminous increase in the size of the science industry and the challenge becomes even larger.

Second, policy-making is the process of making choices between different options which affect different stakeholders to achieve one of a range of possible outcomes that may themselves be unclear and are likely to have spill-over effects of uncertain nature. When robust evidence is used to inform options, then the choice of option is more likely to have the desired effect because the decision maker understands the implications of any option. This is the core assumption of science advice. Note I am not saying that evidence makes policy, and indeed I avoid the term "evidence-based" policy making because of that implication. Policy will always be made based on many other inputs and considerations. Providing scientific advice cannot usurp the role of policy makers to consider these broader dimensions. To ignore this makes it more likely that the advice will be rejected.

Thirdly, science can help model then monitor and evaluate the intended and unintended effects of any policy position.

It should be obvious that a well-functioning science advisory ecosystem, provided it meets certain qualities, can enhance policy making even within the context of the post-trust dynamic. Indeed, I would argue a multivalent science advisory ecosystem is an essential and important protection against this post-trust dynamic. However, the reality is that few countries have effective scientific advisory ecosystems and when we look to the trans-national level it is even more inchoate. The need for direct and coordinated contact between these levels of scientific input into governance is obvious. Further science diplomacy is critical in this interaction and there is a clear

[2] A discussion of these can be found in my paper *Citizen-based analytics*, available at http://www.pmcsa.org.nz/wp-content/uploads/17-06-19-Citizen-based-analytics.pdf

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need for there to be quality input of science into foreign ministries as these have major decision making roles in the multi-lateral system – yet perhaps only 10 countries structurally connect science into their foreign ministries. These are issues I will expand on in Sheffield tomorrow.

Policy-making has also changed. The policy cycle is messier and faster and politicians increasingly react in ways that can reduce the chances for carefully analysed and robustly evidenced decisions. The impact of the internet and social media has changed the balance of interactions between the players and thus the need to support better decision making is even more critical. I see the role of the science advisory ecosystem as assisting both policy-maker and politician to understand what the evidence is saying and what it is not saying, and reduce the inherent risks in their policy decisions.

Science and policy-making are inherently different cultures with different visions, goals, timeframes and languages. Brokerage and interpretation in both directions is needed. The science community needs to understand what the policy-maker needs as much as the science needs to be presented appropriately to the policy-maker. There is now little doubt that navigating this interface requires a distinct set of skills for it to operate well. But the interface has many different dimensions and it requires a whole ecosystem to be engaged at the interface to provide the policy community and the political decision makers with what they need.

Central to this is the skill of brokerage, which I pointedly distinguish from advocacy. The scientific input into the interface must make sense of the morass of data and scientific claims in an objective manner, and distil it into understandable but not manipulated information to respond to the questions the policy makers may have put or should have put. It is not for the science advisory system to demand a particular solution, for all options involve values-based trade-offs. Because of this, the principle is emerging that science advice should inform rather than decide. This means defining what we know, the state of consensus, and equally what we do not know, the caveats on these statements, the options that emerge and the likely implications of any option. It must be conscious of the values dimensions that policy-makers must consider and point towards them but it must not usurp the policy-maker's role in doing so.

There are many institutions that would imagine a role at this interface but few that can do so in an effective manner. There are several dimensions that need to be considered: are they acting as knowledge generators, knowledge synthesizers, or knowledge brokers, or are they acting as advocates trying to shape a particular decision?

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Knowledge generators include academics, universities, public research institutes and industry but can include citizen scientists, indigenous peoples and others depending on the context.

Knowledge synthesisers include academies, expert panels and committees, regulatory scientists and agencies, think tanks, parliamentary offices of science or government institutions such as the Rathenau Institute in the Netherlands and What works units.

Knowledge brokers may be individual science advisors, academies, and specific advisory committees.

I will focus on brokerage to the executive arm of national governments because that is where most policy is developed in practice. Inputs at this interface come in one of two ways – through formal or informal means.

Formal advice can be generated in multiple ways: from a scientific academy or an expert committee, and it can be solicited or unsolicited. These distinctions matter in terms of how it will be likely received. Is it answering the question the policy-maker needs answered or is unsolicited advice being proffered in the generally vain hope of reception? Often such reports are more focused on demonstrating the expertise of the authors rather than meeting policy needs.

Core to increasing demand and thus to strengthening the interface is that the science community gets better at responding to policy needs. There are areas where science can really help. My own experience shows that different parts of government respond differently and at different paces. There is a critical role of science advice in emergencies. Many governments are increasingly relying on science to assist with risk assessment and risk management. Regulatory science is generally well accepted.

Timing matters too. Is the advice needed in an emergency, in the normal policy process which is always shorter than the electoral cycle, in response to an acute externality or is it about long-term planning? All involve different skills, arrangements and types of interaction. Moreover, there can be no assurance that the science provided by way of a formal report from an external source is not misinterpreted or corrupted through the complex processes of policy-making.

One mechanism that can reduce this risk is the presence of knowledge brokers sitting within the policy system – this is the core role of individual science advisors. Their role is of particular value at several points: the brain storming between policy-makers, politicians and others during which the initial framing often sets a policy direction in motion; and as a check on the options being considered and the evidential support or

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otherwise for each option as decision-making proceeds. They must also have the skill and the trust to be able to deliver the inconvenient truth to the policy-maker.

My personal view is that a science advisory ecosystem gets its inherent integrity from the interaction between and combination of external inputs married with those embedded within the system.

All this assumes that the policy-makers and politicians accept the importance of receiving robust advice and this is far from assured. One of the real challenges is to see science advisory mechanisms enhanced and this requires the politician to value them. I think the resistance in some places to internal and informal mechanisms, so as to protect the presumed role of academies, has not been helpful in this regard. Both formal and informal mechanisms are needed – they have very different roles.

New Zealand and the UK are two countries that have departmental science advisors. Their role in ensuring the quality of scientific input into departmental policy development is critical, for it is within ministries that much happens: policy analysis, policy research, contracting of internal and external research, option formulation, cabinet paper development etc. Academies cannot generally reach into these activities.

Critically the role is one of brokerage, not advocacy. The role is one of explaining the system, defining the knowledge that might inform each option and the consequences of each choice in so far as evidence informs these. Once the science advisor becomes an advocate for a particular course of action, their value becomes limited.

Arrogance and hubris by the science community are arguably the biggest enemies of science having an impact on policy. It is important that the limits of science are acknowledged, rather than science claiming to know every answer to everything. By respecting the role of the public, the policy-maker and the politician, science is more likely to have cumulative impact.

The complexity of the systems that policy-makers are dealing with also means there is a need for far more horizontal inclusiveness in how the science is generated and presented. Some parts of the scientific community can be remarkably filtered in their own understandings. The gap between social and natural sciences is often wide, but even within the natural sciences, blinkers are often worn. Again the science advisory system must be alert to this. Equally, policy-makers need to appreciate that Google is not a replacement for proper scientific input.

In all of this, the most important principle is trust. There must be trust between the politician and the advisory ecosystem, between the policy-maker and the ecosystem,

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between the public and the advisory interface, and between the scientific institution and the interface. This is a real challenge and requires individuals with scientific knowledge, an understanding of the policy process, and diplomatic skills.

While the terminology and the range of institutions that form part of the advisory ecosystem may vary, a competent coherent science advisory mechanism which has a high level of trust can be a critical part of protecting us against the worst excesses of the post-truth dynamic. As I have suggested, there is also is a need to look at the institution of science itself and how science interacts with society. Ultimately it is this that will influence whether the worst excesses of misinformation can be avoided.

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