Reliable Scientific Foundations: International Best Practice and the New Zealand Experience

Alexander Gillespie*

This article is about the development of best international practice and the New Zealand experience in the formation of scientific advice, from which robust policy decisions can be based. While solid progress has recently been made in this area in New Zealand, there is still considerable work to be done.

1. INTRODUCTION

Science is a candle in the dark. It is the only discipline that can provide robust foundations for policy formation. Although it must never be allowed to govern alone, it must be at the table of decision-making as the shared and verifiable findings of science allow understandings and cooperation that progress can be built upon. This is especially the case with environmental issues. To get science to this position required the creation of influential advocates who ensure that the principles of authenticity and integrity, transparency and peer review are all built into the scientific processes. This article seeks to examine what these principles are, and to take one example of their applicability, how they have been applied in New Zealand.

2. THE VALUE OF SCIENCE

We live in a world of rapid change. The demands of the hundreds of parts which make up the environmental, social and economic challenges of sustainable development in the 21st century are unprecedented. The questions and

*Professor of Law, University of Waikato, Hamilton, New Zealand. Email: azg@waikato.co.nz.

solutions that this generation need answered and offered are unlike anything that humanity has ever had to deal with previously. This is despite the fact that complexity, uncertainty, the rapid evolution of knowledge, and risk and/or reward sits behind every option.[1]

In this world, science is a candle in the dark in helping provide both answers and solutions. Science provides reliable, objective and verifiable knowledge that can tell us what exists, or what is possible. Unlike all other forms of human intellectual activity such as religion or myth, science has a unique capacity to help inform decision-makers, as it alone can change and its foundations are refutable. Ideas based around beliefs which are immune from the challenge of falsification because they are justified by faith or dogma are not science. Science works by having explanations and/or understandings that are refutable (and can be pulled down and rebuilt if proven faulty) irrespective of whether decision-makers want them to be or not. With this bedrock, science helps identify, measure, review, assess and evaluate options. Without this bedrock, policy-makers risk making decisions which are missing some of the only information which can be shown to be intellectually robust. Sir Peter Gluckman, the Chief Science Advisor of New Zealand, elaborated:[2]

> [T]he use of high quality information and evidence should be at the base of such decision making. Decisions made in the absence of informed background material are, by definition, made on the base of belief and dogma; they are less likely to be effective and efficient, and can entrench policies which may be of little value. … [G]ood information and evidence provide an important base for a rational assessment of options weighed up against those other criteria that politicians and their supporting policy advisors should consider. … [I]n the 21st century one must be very wary of decision-making processes that make assumptions about beliefs, but are not prepared to look at the knowledge base before decisions are made.

Critically, however, science does not, and should not, be the sole decision-making factor. Science is only one step in decision-making. Although it should have a privileged position, equally important positions in the decision-making process are ethics and politics. Winston Churchill summed up this relationship when he quipped, "scientists should be on tap, not on top".[3]

1 A Gillespie *The Long Road to Sustainability* (Oxford University Press, Oxford) (forthcoming).

2 Sir Peter Gluckman "Towards Better Use of Evidence in Policy Formation — An Address to the Institute of Public Administration New Zealand/Institute of Policy Studies" (Office of the Prime Minister's Science Advisory Committee, Wellington, 1 June 2011) at 3 and 4–5.

3 Winston Churchill as noted in M Rogers "The European Commission and the

3. SCIENCE AS POLICY GUIDANCE IN AN IDEAL WORLD

Although science was one of the obvious bedrocks to the industrial revolution, its value to helping solve problems and build cooperation at the international level was not fully recognised until after the Second World War, when the pursuit of science became an objective within the new United Nations system, with the formation of the United Nations Educational, Scientific and Cultural Organization (UNESCO) through which "the intellectual and moral solidarity of mankind"[4] was aimed for. The International Geophysical Year (1957–58), a "scientific Olympics of sorts"[5] involving 60,000 scientists (and an army of amateurs) from 67 countries in a worldwide enterprise of data collection, analysis and exchange followed, as did the Antarctica Treaty of 1959, in which the peaceful pursuit of cooperative international science became a foundational goal to achieve both learning and peace.[6]

This model, of science and conservation being interlinked at the international level, then proceeded apace, accelerating in the last decades of the 20th century as the necessity to have clear shared transboundary scientific understandings of common challenges became accepted by the international community. This broad acceptance was first achieved at the 1972 Stockholm Conference on the Human Environment, and then at every following United Nations gathering in 1982, 1992, 2002 and 2012.[7] The international community came to increasingly embrace this view after shared, transboundary scientific

Collection and Use of Science and Technology Advice" in J Lentsch (ed) *The Politics of Scientific Advice* (Cambridge University Press, Cambridge, 2011) at 115; also K Prewitt *Using Science as Evidence in Public Policy* (National Academy Press, Washington, 2012) at 4.

4 UNESCO Constitution, preamble.

5 C Collis "Antarctica and the International Geophysical Year" (2010) 75 GeoJournal 387; D Belanger "The International Geophysical Year in Antarctica: Uncommon Collaboration, Unprecedented Results" (2004) 30 Journal of Government Information 482.

6 E Castilla "The Institutional Production of Science in the 20th Century" (2009) 24(6) International Sociology 833; C Collis "The Historical and Political Geographies of the International Geophysical Year" (2008) 34(4) Journal of Historical Geography 555; E Chalecki "How Science Informs American Diplomacy" (2008) 19 Diplomacy and Statecraft 1; M Peters "The Rise of Global Science" (2006) 41(2) European Journal of Education 225; P Petitjean *Sixty Years of Science at UNESCO* (UNESCO, Paris, 2006) at 46; H Rozwadowski "Internationalism, Environmental Necessity and National Interest" (2004) 42(2) Minerva 127.

7 Stockholm Declaration, principle 20, point 6 of the 1982 Nairobi Conference; principle 9 from the 1992 Rio Declaration; and ch 31 of Agenda 21. For the 2002 World Summit on Sustainable Development see para 36; and for the 2012 Rio+20 see para 48. See generally A Gillespie *Conservation, Biodiversity and International Law* (Elgar, London, 2013) ch 5.

understandings of common problems, such as with air pollution in both Western Europe and North America, provided the foundations for which legal agreements could be reached.[8] This momentum increased even further when the global (as opposed to regional) breakthrough success in providing a clear scientific consensus, from which international agreement could then be reached, was followed with the problem of the so-called "ozone hole" where unprecedented collections of scientists (150 from 11 countries) were brought together to understand the problem.[9]

This success of the international collection of scientists put to work to understand ozone depletion was then replicated again, albeit at an even greater scale, with the Intergovernmental Panel on Climate Change (IPCC). Here, an international body to examine the knowledge and uncertainties regarding climate change was established in 1988.[10] To address this problem, an assessment body was tasked to independently, and neutrally, "assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change".[11] To date, the IPCC has provided substantive assessments in 1990, 1992, 1995, 2001, 2007 and 2014. Each report has fielded teams of hundreds of prominent scientists from around the world, and then been peer-reviewed by an equal or greater number of experts.[12] For

8 K Torseth "Introduction to the European Monitoring and Evaluation Programme and Observed Atmospheric Composition Change Since 1972" (2012) 12 Atmospheric Chemistry and Physics 5447; J Engel "Science-Policy Data Compact: Use of Environmental Monitoring Data for Air Quality Policy" (2005) 8 Environmental Science and Policy 115; G Sundqvist "Recovery in the Acid Rain Story: Transparency and Credibility in Science Based Environmental Regulation" (2003) 5(1) Journal of Environmental Policy and Planning 57.

9 S Andersen "Lessons from the Stratospheric Ozone Layer Protection" (2015) 5 Journal of Environmental Studies and Sciences 143; T Hickmann "Science-Policy Interaction in International Environmental Politics: An Analysis of the Ozone Regime" (2014) 16(1) Environmental Economics and Policy Studies 21; R Grundmann "Ozone and Climate: Scientific Consensus and Leadership" (2006) 31(1) Science, Technology, and Human Values 73.

10 World Meteorological Organization *Proceedings of the World Climate Conference* (WMO No 537, Geneva, 1979); U Hans "Climatological Research: An Interdisciplinary Study" (1978) (30 Nov) New Scientist 691; Anon "Political Thaw Leads to Cooperation on Climate" (1987) (17 Dec) New Scientist 4; Anon "Greenhouse Scientists Seek A Breather — To Build Up Steam" (1988) (5 Nov) New Scientist 25.

11 Principles Governing the IPCC Work, as approved at the 14th session of the IPCC, 1998, and amended at the 21st session in 2003, para 2; M Grubb "Purpose and Function of the IPCC" (1996) 379(6561) Nature 108.

12 Report of the 2nd COP, Geneva, 1996, *Proceedings* FCCC/CP/1996/15 (29 October 1996) at 31; A Shaw "Science Policy Models Within the IPCC" (2004) 48 Philosophy Today 84.

example, the 2014 report was written by 831 author-experts (with 60 per cent of these being new to the IPCC), followed by peer review by 559 others. With each conclusion, the certainty with which the IPCC speaks heightens, although there are always cautions with their bottom lines.[13]

4. REALITY

The reality of dealing with science in policy formation has been something different to the idealised world painted above. At the national and regional levels, evidence began to accumulate that science could also be manipulated so as to maintain profit margins or prevent the formation of new environmental rules. This was evident in the cases of the detrimental impacts of lead (especially in its ambient form) in the environment;[14] the smoking of tobacco;[15] and the production of asbestos.[16]

13 R Moss "Reducing Doubt Under Uncertainty: Guidance for IPCC's Third Assessment" (2011) 108 Climatic Change 641; D Bray "The Scientific Consensus of Climate Change Revisited" (2010) 13 Environmental Science and Policy 340.

14 D Rosner "Building the World That Kills Us: The Politics of Lead, Science and Polluted Homes, 1970 to 2000" (2016) 42(2) Journal of Urban History 323; G Markowitz *Lead Wars and the Fate of America's Children* (University of California Press, Berkeley, 2013) at 17–24, 97–95, 168–178; W Kovarik "Ethyl-Leaded Gasoline: How a Classic Occupational Disease Became an International Public Health Disaster" (2005) 11 International Journal of Occupational and Environmental Health 384; H Needleman "The Removal of Lead from Gasoline: Historical and Personal Reflections" (2000) 84 Environmental Research 20; J Nriagu "Clair Patterson and Robert Kehoe's Paradigm of 'Show me the Data' on Environmental Lead Poisoning" (1998) 78 Environmental Research 71.

15 S Otto *The War on Science* (Milkweed, NY, 2016) at 19; A Russell "Uruguay, Philip Morris and WHO's Framework Convention on Tobacco Control" (2014) 29(2) Medical Anthropology Quarterly 256; L Dorfman "Cigarettes Become a Dangerous Product: Tobacco in the Rearview Window" (2014) 104(1) American Journal of Public Health 37; A Brandt "Inventing Conflicts of Interest: A History of Tobacco Industry Tactics" (2012) 102(1) American Journal of Public Health 63; H Weishaar "Global Health Governance and the Commercial Sector: Tobacco Company Strategies to Influence the WHO Framework Convention on Tobacco Control" (2012) 9(6) PLoS Medicine e1001249; H Mamudu "Tobacco Industry Attempts to Obstruct the WHO Framework Convention on Tobacco Control" (2008) 67 Social Science and Medicine 1690; D Michaels *Doubt is Their Product* (Oxford University Press, New York, 2008) at 79–96; B Fox "Framing Tobacco Control Efforts Within an Ethical Context" (2005) 14(2) Tobacco Control 38; R Kluger *Ashes to Ashes: America's Hundred-Year Cigarette War, the Public Health, and the Unabashed Triumph of Philip Morris* (Vintage, NY, 1997) at 35–75.

16 W Henrik "The Global Health Dimensions of Asbestos" (2016) 42(1) Scandinavian Journal of Work, Environment and Health 86; O Ogunseitan "The Asbestos Paradox: Global Gaps in the Translational Science of Disease

Even where there was not an overt manipulation of science, it often fell into disrepute due to an overall lack of public confidence in science (and policy-makers) because they failed to provide robust responses with strong foundations to pressing public health concerns. This was particularly evident with the bovine spongiform encephalopathy (mad cow disease) outbreak in Britain.[17] These problems were multiplied at the international level, where evidence started to appear that some countries had actively manipulated science to achieve national goals,[18] while in other areas, large amounts of pressure were put on existing scientific bodies, such as the IPCC, in an attempt to suppress and/or undermine them.[19]

Prevention" (2015) 93(5) Bulletin of the World Health Organization 359; K Takashi "Asbestos: Use, Bans and Disease Burdens" (2014) 92(11) Bulletin of the World Health Organization 790; K Ruff "Rejecting Science Based Evidence and International Co-operation" (2014) 20(2) Canadian Foreign Policy Journal 131; M Greenberg "The Defence of Chrysotile, 1912–2007" (2008) 14(1) International Journal of Occupational and Environmental Health 57; J McCulloch and G Tweedale *Defending the Indefensible: The Global Asbestos Industry and its Fight for Survival* (Oxford University Press, Oxford, 2008); L Braun "Scientific Controversy and Asbestos: Making Disease Invisible" (2003) 9(3) International Journal of Occupational and Environmental Health 194.

17 G Hickey and others "Managing the Environmental Science-Policy Nexus in Government" (2013) 40(4) Science and Public Policy 529; R Doubleday "Science Policy: Beyond the Great and Good" (2012) 485(7398) Nature 301; E Fisher "Food Safety Crises as Crises in Administrative Constitutionalism" (2010) 20(1) Health Matrix 55; D Butler "Slow Release of Data Adds to BSE Confusion" (1996) 380(6573) Nature 370.

18 Y Ivashchenko "Too Much is Never Enough: The Cautionary Tale of Soviet Illegal Whaling" (2013) 76(1) Marine Fisheries Review 1; A Elzinga "The Rise and Demise of the International Council for Science Policy Studies as a Cold War Bridging Organization" (2012) 50(3) Minerva 277; S Holt "Historical Perspectives: Science, Politics and Economics in the International Whaling Commission" (2011) 37(3) Aquatic Mammals 420; B Bengtsson "The 1948 International Congress of Genetics: People and Politics" (2010) 185(3) Genetics 709; N Roll-Hansen "Wishful Science: The Persistence of T.D. Lysenko's Agrobiology in the Politics of Science" (2008) 23(1) Osiris 166.

19 A McCright "The American Conservative Movement's Success in Undermining Climate Science" (2010) 27(2) Theory, Culture and Society 100; D Michaels *Doubt is Their Product* (Oxford University Press, Oxford, 2008) at 191–198; Anon "EPA Censorship" (2008) (3 May) New Scientist 6; Anon "What Wasn't Said" (2007) (27 Oct) New Scientist 4; Anon "Censors Exposed" (2007) (3 Feb) New Scientist 7; S Blumenthal *How Bush Rules: Chronicles of a Radical Regime* (University of Princeton Press, NY, 2007) at 7; C Mooney "An Inconvenient Assessment" (2007) 63(6) Bulletin of the Atomic Scientists 40; C Mooney *The Republican War on Science* (Basic, NY, 2006) at 17–24, 56–89, 99–106; Editor "The Politics of Science" (2004) 11(10) Natural Structural and Molecular Biology 907; Editor "Bush Accused of Power Abuse Over Science" (2003) 424(6950) Nature 715; G Markowitz "Politicizing Science: The Case of the Bush Administration's Influence" (2003) 24(2) Journal of Public Health Policy 105.

In New Zealand, the experience with science and public policy was, in part, a reflection of what was happening elsewhere with the status of the discipline being repeatedly damaged. In addition to spill-overs with all of the above debates occurring, there were also debates about folic acid supplementation of bread to combat spina bifida,[20] and the benefits of fluoride in the public water supply.[21] There were also prominent concerns about species management, in which conflicting scientific opinions became the topic of public debate.[22]

Aside from these specific problems, more insidious difficulties were found to be undermining the value of scientific advice in New Zealand. These difficulties began to become apparent as a subset of issues around larger concerns pertaining to the overall quality and value of policy advice that the government was procuring, over all areas (and not just scientific). A 2010 review showed that there were wide variations in the efficiency of policy advice development between agencies, and there was considerable scope for improvements in efficiency. The report also called for, inter alia, a shared approach by agencies for knowledge management; the routine publication of data and research findings (especially on "big questions"); and that agencies institute "a quality management process for policy analysis and advice". Finally, it added that "advice on significant issues should be developed using accepted standards … to assemble evidence within a culture of analysis, open debate and peer review".[23]

The 2010 review was then supplemented by a further review by Sir Peter Gluckman, who had been appointed as New Zealand's Chief Science Advisor in 2009. His report in 2011 reflected a general theme that there seemed to be a "silo" type effect occurring within New Zealand, where there was little to no communication across (and within) the public and private science providers,

20 L Houghton "A Country Left Behind: Folic Acid Food Fortification Policy in New Zealand" (2014) 127(1399) The New Zealand Medical Journal 6.

21 D Menkes "Health Effects of Water Fluoridation: How Effectively Settled is the Science?" (2014) 127(1407) The New Zealand Medical Journal 84; AJ Spencer "New, or Biased, Evidence on Water Fluoridation?" (1998) 22(1) Australian and New Zealand Journal of Public Health 149.

22 R Francis "Data Weighting in Statistical Fisheries Stock Assessment Models" (2011) 68(6) Canadian Journal of Fisheries and Aquatic Sciences 1124; R Hilborn "The Cost of Overfishing and Management Strategies for New Fisheries on Slow Growing Fish: Orange Roughy in New Zealand" (2006) 63(10) Canadian Journal of Fisheries and Aquatic Sciences 2149; P Starr "Contested Stock Assessment: Two Case Studies" (1998) 55(2) Canadian Journal of Fisheries and Aquatic Sciences 529.

23 G Scott and others *Improving the Quality and Value of Policy Advice: Findings of the Committee Appointed by the Government to Review Expenditure on Policy Advice* (The Committee, December 2010) <http://www.treasury.govt.nz/statesector/policyexpenditurereview/report-repa-dec10.pdf> at 6.

resulting in some instances of overlapping yet uncoordinated research priorities.[24] He explained:[25]

> This is a major deficit in New Zealand where we have no real community of science advisors. … Their relationship to management is unclear and their input into the collective research needs of government is non-existent. … [There is] very little or no rotation between the state sector, the private sector and universities, and even where there are scientifically qualified staff within departments they are remote from the actual progress within their disciplines. There is little quality control on departmental research. Frustration abounds at the dislocation between evidence and policy formation …. There is no standard process for research purchase; there is no register of what research is done; and best practice approaches to peer-review both on starting the research and reviewing its conclusions do not exist.

He also recorded instances of science not being independent, being used for advocacy more than brokerage, and said, "[t]here have been too many examples where appealing to apparently confused science masks what is in fact a policy or ideological debate … [a]t times the dominance of ideological rhetoric has inhibited the ability of the public to obtain such information".[26] Sir Peter Gluckman's second report in 2013, which was built upon a survey of 17 government agencies, continued to build a case for concern. In this instance he found in some instances:[27]

> [S]taff attitudes towards the use and analysis of data to develop a policy case were disappointing … some officials had limited understanding of the scientific process of knowledge production, or were uncertain about it. In addition, they were not clear on how research-based evidence could be used to support policy processes. Rather, it seemed that some preferred to work from their own beliefs or rely on their own experience.

24 Office of Science and Technology Policy *Scientific Integrity: Memorandum for the Heads of Executive Departments and Agencies* referred to in Sir Peter Gluckman *Towards Better Use of Evidence in Policy Formation: A Discussion Paper* (Office of the Prime Minister's Science Advisory Committee, Wellington, April 2011) at 6.

25 Sir Peter Gluckman "Towards Better Use of Evidence in Policy Formation — An Address to the Institute of Public Administration New Zealand/Institute of Policy Studies" (Office of the Prime Minister's Science Advisory Committee, Wellington, 1 June 2011) at 9.

26 Office of the Prime Minister's Science Advisory Committee *The Role of Evidence in Policy Formation and Implementation: A Report from the Prime Minister's Chief Science Advisor* (OPMSAC, Wellington, September 2013) at 10.

27 At 17.

5. THE "HONEST BROKER"

Against such concerns, a determined effort arose to try to regain the public confidence of science and, especially, in both building and reinforcing a privileged position for science within policy-making.[28] The core of this effort has been to create institutional mechanisms by which science can be an "honest broker" by which (as much as possible) objective advice can be given and relied upon by decision-makers, and not dismissed as being partisan, quack or relative. This type of "honest broker" should provide quality and neutral scientific advice (not advocacy) on which decision-makers (national, regional and international) can plot the way forward.[29]

This vision has been adopted by many scientific groups which have all gone to great lengths to create codes of conduct, designed to promote the integrity and quality of science, scientific processes and the scientific record. The key international bodies active in this area include, inter alia, the InterAcademy Council,[30] the International Council for Science,[31] the OECD,[32] the Standing Committee on Responsibility and Ethics in Science,[33] the European Science Foundation,[34] and

28 S Otto *The War on Science* (Milkweed, NY, 2016) at 24–27, 151–167, 413–428; J Suhay "The Politics of Science" (2015) 658(1) The Annals of the American Academy of Political and Social Science 6; R Park *Voodoo Science: The Road from Foolishness to Fraud* (Oxford University Press, Oxford, 2000); S Rampton *Trust Us, We're Experts* (Penguin, NY, 2001) at 13–32, 45–53, 60–70; S Jasanoff "Beyond Epistemology: Relativism and Engagement in the Politics of Science" (1996) 26(2) Social Studies of Science 393.

29 P Gluckman "The Art of Science Advice to Government" (2014) 507(7491) Nature 163; R Pielke *The Honest Broker: Making Sense of Science in Policy and Politics* (Cambridge University Press, Cambridge, 2010) at 1–9, 12–15, 14–17, 37–42, 135–145; A Keller *Science in Environmental Policy: The Politics of Objective Advice* (MIT Press, Cambridge, 2009) at 169–184; S Beck "Towards a Reflexive Turn in the Governance of Global Environmental Expertise" (2014) 23(2) GAIA 80; J Scott "Policy Advocacy in Science: Implications for Conservation Biologists" (2007) 21 Conservation Biology 29.

30 InterAcademy Council *Responsible Conduct in the Global Research Enterprise* (IAC, Netherlands, 2012).

31 ICSU *Promoting the Integrity of Science and the Scientific Record* (ICSU, 2008); K Evers *Standards for Ethics and Responsibility in Science* (ICSU, 2001).

32 OECD *Best Practices for Ensuring Scientific Integrity* (OECD, Paris, 2005).

33 SCRES *Standards for Ethics and Responsibility in Science: An Empirical Study* 27GA/02/12.4.1 (SCRES, 2001).

34 The European Science Foundation *The European Code of Conduct for Research Integrity* (ESA, Brussels, 2008).

amongst a number of national bodies both the American National Academy[35] and the British Royal Society.[36]

In terms of policy, at the domestic level, governments are increasingly using advisory councils/committees, national academies, learned societies and associated networks. They are also establishing chief scientific advisors, so that premier scientific advice can be given directly to the top echelons of government. These positions, with the first being established in the United States in 1957, have been copied in many countries.[37]

In subsequent decades, national governments have gone much further in advancing independent science in policy-making. One of the best contemporary examples of this type of approach occurred in the United States following the administration of George W Bush, in 2009, when former President Obama issued a memorandum instructing the Director of the White House Office of Science and Technology Policy to develop recommendations "for Presidential action designed to guarantee scientific integrity throughout the executive branch". The President contrasted his approach with that of the previous administration, lamenting that "we have watched as scientific integrity has been undermined and scientific research politicised in an effort to advance predetermined ideological agendas". His goal was to "ensure that federal policies are based on the best and most unbiased scientific information … [and] that facts are driving scientific decisions, and not the other way around".[38] The result was the Memorandum for the Heads of Executive Departments and Agencies, as issued by the Director of the Office of Science and Technology Policy at the end of 2010. This required all government agencies to "ensure a culture of scientific integrity. Scientific progress depends upon honest investigation, open discussion, refined understanding and a firm commitment

35 The National Academy *Responsible Conduct in Research* (National Academy, Washington, 1995).

36 The Royal Society *The Concordat to Support Research Integrity* (Royal Society, London, 2012).

37 CSAs have been appointed in Britain, Australia, Cuba, the Czech Republic, India, Ireland, Malaysia and New Zealand, as well as the European Commission. For the full array of domestic options and adoption see J Wilsdon, K Allen and K Paulavets *Science Advice to Governments: Diverse Systems, Common Challenges* (Briefing Paper for the Conference on Science Advice to Governments, Auckland, 28–29 August 2014) <http://ingsa.org/wp-content/uploads/2014/08/Science_Advice_to_Governments_Briefing_Paper_25-August.pdf>; also M Cassman "The Evolution of a Science Advisory Body in the Federal Government" (1991) 34(3) Principles in Biology and Medicine 439; G Zuckerman "Science Advisers and Scientific Advisers" (1980) 124(4) Proceedings of the American Philosophical Society 241.

38 Barack Obama as noted in H Kitrosser "Scientific Integrity: The Perils and Promise of White House Administration" (2011) 79 Fordham Law Review 2395; also Editor "Use, Not Abuse, of Science" (2011) 7 Nature Physics 183.

to evidence." Of particular importance are "ensuring that selection of candidates for scientific positions in the executive branch are based primarily on their scientific and technological knowledge, credentials, experience" and "ensuring that data and research used to support policy decisions undergo independent peer review by qualified experts, where feasible and appropriate". Clear standards governing conflicts of interest and adopting appropriate whistleblower protections were also required. Finally, agencies were requested to "expand and promote access to scientific and technological information by making it available … to the public".[39]

In many ways, former President Obama was reflecting a change that began to occur at the international level at the end of the 20th century. Evidence of this can be seen with Agenda 21 which called for "a strengthening of the codes of practice and guidelines for the scientific and technological community" that would "build up the level of esteem and regard for the scientific and technological community and facilitate the 'accountability' of science and technology".[40] Agenda 21 also emphasised the importance of "the independence of the scientific and technological community to investigate and publish without restriction and to exchange their findings freely",[41] but added that, "the various strands of public opinion [were to be] represented".[42] The World Summit on Sustainable Development in 2002 had participants pledge themselves to, with regard to scientific issues, "examine issues of global public interest through open, transparent and inclusive workshops to promote a better public understanding of such questions".[43] Ten years later in 2012 at the Rio+20 gathering the international community agreed to "promote the science-policy interface through inclusive, evidence-based and transparent scientific assessments, as well as access to reliable, relevant and timely data in areas related to … sustainable development".[44]

These international calls were also echoed loudly within leading areas of international science, such as the IPCC, which was found to have been in breach of some of its rules. Accordingly, its rules and adherence to them were carefully scrutinised and then underlined to ensure that the IPCC remained a multilayered process of inclusion (not restricted to government-linked scientists), and there was a tightly structured writing process, designed to "ensure genuine

39 <https://www.whitehouse.gov/sites/default/files/microsites/ostp/scientific-integrity-memo-12172010.pdf>.
40 Agenda 21, ch 31, para 8.
41 Chapter 31, s 1.
42 Chapter 31, s 8.
43 *Plan of Implementation* in Report of the World Summit on Sustainable Development A/CONF.199/20 para 108.
44 United Nations Conference on Sustainable Development (Rio+20) *Agenda Item 10 Outcome of the Conference: The Future We Want* A/CONF.216/L.1* (2012) para 76(g).

controversies are reflected adequately in the text of the Report", with the lead authors obliged to "aim for a range of views, expertise and geographical representation".[45] All written expert and government review comments are meant to be made available to reviewers on request and retained in an open archive. Specific rules apply for non-peer-reviewed literature, which is also meant to be "easily accessible and to ensure that the IPCC process remains open and transparent".[46] All of these rules were sharpened after gaps in the use of non-peer-reviewed materials and censoring of sceptics led to a full review of the practices of the IPCC.[47]

6. GUARDIANS

When all of the rhetoric in this area is distilled, four principles become apparent if science is to become an "honest broker" in policy formation. However, before these can even be achieved, it is necessary to establish guardians within the official infrastructure (ideally within every ministry which has an overlap with scientific work) who can uphold the principles. While many governments have moved in this direction with the appointment of senior scientific advisors both within important ministries and as overall science leaders with direct influence upon the primary decision-makers, the practice is far from absolute, and even

45 Principles Governing the IPCC Work, as approved at the 14th session of the IPCC, 1998, and amended at the 21st session in 2003, Appendix A, Procedures for the Preparation, Review, Acceptance, Adoption, Approval and Publication of IPCC Reports, Annex 2, Procedure for Using Non-Published/Non-Peer-Reviewed Sources; M Hulme "What Do We Know About the IPCC?" (2010) 34(5) Progress in Physical Geography 705.

46 Principles Governing the IPCC Work, as approved at the 14th session of the IPCC, 1998, and amended at the 21st session in 2003, Appendix A, Procedures for the Preparation, Review, Acceptance, Adoption, Approval and Publication of IPCC Reports, s 4, paras 7, 8, 9, 10.

47 L Kosolosky "Peer Review is Melting Our Glaciers: What Led the IPCC To Go Astray?" (2015) 46 Journal for the General Philosophy of Science 351; E Hellsten "The Creation of the Climategate Hype" (2015) 25(4) International Research 589; J Ravetz "Climategate and the Maturing of Post-Normal Science" (2011) 43 Futures 149; R Keohane "The Ethics of Scientific Communication Under Uncertainty" (2014) 13(4) Politics, Philosophy and Economics 343; S Beck "The IPCC Under the Public Microscope" (2012) 7(2) Nature and Culture 151; R Grundman "Climategate and the Scientific Ethos" (2011) 38(1) Science, Technology, and Human Values 67; F Pearce "Stand and Deliver your Climate Data" (2010) (19 Dec) New Scientist 4; InterAcademy Council *Climate Change Assessments, Review of the Processes and Procedures of the IPCC* (IAC, Netherlands, 2010) at 3–10; Editor "Full and Frank Disclosure" (2010) (9 Jan) New Scientist 5; Editor "No Trust" (2010) (17 July) New Scientist 3.

when it has been achieved the voices of these guardians have at times been either silent, sacked or suppressed due to larger political objectives.[48]

Whilst inevitably the position of the guardians as scientific advisors to decision-makers is based around considerations of both trust and access — things that are very difficult to legislate — some systematic matters are easier to fix but often avoided. For example, in New Zealand, the Inspector-General of Intelligence and Security,[49] the Commissioner of Police,[50] and even the Parliamentary Commissioner for the Environment[51] are legislated to be independent and given both secure tenure and well-resourced budgets to achieve their objectives. Conversely in New Zealand, the position of Chief Science Advisor has no formal terms of reference, no foundation in legislation, no guaranteed tenure, and no formal budget.

Despite the fragility of the position at the highest level, the Chief Science Advisor has been instrumental in trying to place and secure scientific leaders with authority, within relevant government ministries and departments. The appointments of Departmental Science Advisors to major government departments to address multiple functions (such as curating expertise, critically appraising scientific gaps and inputs, and standard setting) with enhancing departmental use of evidence in policy formation and evaluation, and then to create an interacting community of science advisors, has been one of the foremost goals of the Chief Science Advisor. In this regard, evidence of success is starting to accumulate, as the number of Departmental Science Advisors has grown from zero in 2009 (although there were some existing but often undefined positions in this area) to 10 by 2017.[52]

48 D Tupper "Censoring Government Scientists and the Role of Consensus in Science Advice" (2015) 16(3) EMBO Reports 263; Editor "Advising the UK Government" (2009) 375(9715) The Lancet 612; C Dyer "MPs Call for Review into Government's Treatment of Scientific Advisers" (2009) 339 British Medical Journal 1; Editor "The Science of Government" (2007) 370(9605) The Lancet 2069.

49 Inspector-General of Intelligence and Security Act 1996.

50 Policing Act 2008.

51 Environment Act 1986.

52 P Gluckman *Enhancing Evidence-Informed Policy Making: A Report from the Prime Minister's Chief Science Advisor* (Office of the Prime Minister's Science Advisory Committee, July 2017) at 8–9 [*Enhancing Evidence-Informed Policy Making*]; Office of the Prime Minister's Chief Science Advisor *Briefing Note: The New Zealand Science Advisory System* (2015).

7. FOUR PRINCIPLES

The first principle to make science an "honest broker" in policy-making is that all scientific work must be **robust**. To be robust it must be both **authentic** and be **created with integrity**. One of the foremost tools to achieve these goals is to **remove conflicts of interest**. This means that science must be done and recorded honestly, without fraud or deception or influenced by conflicts of interest (as in where interests external to the science, such as financial ones, corrupt the motivation or decision-making of the individual in question). From the importance of scientific progress in general, through to the building of reliable foundations for decision-makers at all levels, the intellectual integrity of the scientific pursuit is the foremost principle.[53]

Within New Zealand, the clear understanding is that all government departments have minimal standards, and these are that they must be fair, impartial, responsible and trustworthy.[54] However, beyond the generic principles, it falls to each entity on how to deal with specific areas such as how to achieve these goals in the areas it governs. In terms of the authenticity and integrity of science, the trend in New Zealand is one of accepting the importance of these principles. This trend ranges from individual ministries making public pronouncements about science and its integrity being central to their work,[55] through to specific laws which mandate it. The most recent example of the latter is the 2015 Environmental Reporting Act, by which the emphasis of "informed decision-making" being based upon "robust information"[56] is very clear as part of a process by which the information is trustworthy, "fair and accurate".[57]

53 J Tollefson "Earth Science Wrestles with Conflict of Interest Policies" (2015) 522(7557) Nature 403; Y Gingras "The Emergence and Evolution of the Expression of 'Conflicts of Interest' in Science: A Historical Overview" (2008) 14(3) Science and Engineering Ethics 337; Anon "Faking It" (2006) (28 Jan) New Scientist 5; Anon "Tarnished Repute" (2006) (18 Feb) New Scientist 7; K Sheldon "Conflict of Interest in Science" (2004) 11(2) Accountability in Research 100; D Runkle "Conflicts of Interest in Science" (1989) 246(4934) Science 303; E Braxton *Perspectives on Scholarly Misconduct in the Sciences* (Ohio State University Press, Ohio, 2000) at 139, 160–175; D Resnik *The Ethics of Science* (Routledge, London, 1998) at 53–56; R Bell *Impure Science: Fraud, Compromise, and Political Influence in Scientific Research* (Reed, New York, 1992) at 3–17.

54 State Sector Act 1988. For the overall Code of Conduct see <http://www.ssc.govt.nz/upload/downloadable_files/Code-of-conduct-StateServices.pdf>.

55 See, for example, Ministry for Primary Industries *Science Strategy* (MPI, Wellington, 2015); also K O'Connor and G Hicks *Department of Conservation: Science Counts* (DoC, Wellington, 2011) <http://www.doc.govt.nz/documents/science-and-technical/science-counts-2011-web.pdf>.

56 Ministry for the Environment *Environmental Stewardship for a Prosperous New Zealand* (MfE, Wellington, 2014) at 8.

57 Environmental Reporting Act 2015, ss 15 and 16.

Despite this trend, there is clearly room for improvement on this topic in New Zealand.[58] The largest problem in this area appears to be conflicts of interest. The general "shared pool" problem internationally, of relatively small communities of specialists in which the circles between those giving, advising or reviewing advice are often tight and frequently interchangeable, is magnified in smaller communities such as New Zealand, in which conflicts of interest can appear.[59] The way that this has been dealt with, so far, moves between informal and formal mechanisms. In terms of informal controls, authenticity, integrity and removal of conflicts of interest is an accepted principle within the Royal Society of New Zealand's Code of Professional Standards and Ethics.[60]

In terms of formal controls, some government departments, such as Standards New Zealand (operating within the Ministry of Business, Innovation and Employment [MBIE]), have exemplary rules, as anchored in the Standards and Accreditation Act of 2015, on how to spot and prevent conflicts of interest.[61] Similarly, within the fisheries division of the Ministry for Primary Industries, the management of all forms of conflicts of interest within both science working groups and technical advisory groups has become very robust.[62] In other instances, it is peppered throughout a sequence of supporting documents. For

58 In terms of improving overall quality the PMCSA's 2013 address highlighted the five areas for improvement. These were: quality and accessible data; robust and accessible data collection and analytical instruments; critical awareness of analytical assumptions and choices, and of theoretical perspectives that underpin the research methodology; understanding the limitations of even the most robust evidence; and adjusting expectations of certainty and being able to manage uncertainty. Office of the Prime Minister's Science Advisory Committee *The Role of Evidence in Policy Formation and Implementation: A Report from the Prime Minister's Chief Science Advisor* (OPMSAC, Wellington, September 2013).

59 Sir Peter Gluckman *Towards Better Use of Evidence in Policy Formation: A Discussion Paper* (Office of the Prime Minister's Science Advisory Committee, Wellington, April 2011) at 9–10; D Scranney *Report of the Workshop on Science Quality Assurance and Peer Review* (as held at the Ministry of Fisheries, 10 June 2010) at 8–9, 12–13; K McComas "Conflicted Scientists: The 'Shared Pool' Dilemma of Scientific Advisory Committees" (2005) 14(3) Public Understandings of Science 285.

60 The 2012 Royal Society of New Zealand Code of Professional Standards and Ethics <https://royalsociety.org.nz/who-we-are/our-rules-and-codes/code-of-professional-standards-and-ethics/royal-society-of-new-zealand-code-of-professional-standards-and-ethics-in-science-technology-and-the-humanities/>.

61 See the Standards and Accreditation Act 2015; also Standards New Zealand *General Guidance on Conflicts of Interest in New Zealand Standards Developments Committees* (MBIE, Wellington, 2016).

62 See Ministry for Primary Industries *Terms of Reference for Technical Advisory Group (TAG) Future of Our Fisheries* (MPI, Wellington, 2016); also the 2017 Membership and Protocols for all Science Working Groups both of which are available from the MPI.

example, with the Department of Conservation the importance of dealing with conflicts of interest is clear within the New Zealand Conservation Authority and on matters of compliance but elsewhere is harder to find.[63] It is due to such differences that one of the calls in this area has been for standard protocols to be established across all areas of government to ensure that expert scientific advice should be politically neutral, focused on data and its unbiased interpretation, explicit about what is known and what is not, and, critically, free from conflicts of interest.

The second principle is that those engaged in the scientific process of advising decision-makers should be the **leading experts** in their respective fields. However, the scientific groups assembled to help this process should not be based only upon those who agree with each other. Groups should seek to be as inclusive as possible, including, where possible, respectable **dissenting views** of other experts. For example, in the United States, it is required that all committees which provide advice to the federal arms of government must possess a membership which is "fairly balanced in terms of the points of view represented and the functions to be performed by the advisory committee".[64] Dissenting voices should not be excluded, but rather, engaged, reconciled, or recorded as different (and explained why the differences occur). As the key criteria is being an expert, the sourcing of this expertise should be wherever these people are found, including governmental, academic, non-governmental and/or commercial sources.[65]

Peer review is the third step of quality assurance for science. A peer review is a rigorous review and critique of a study's methods, results and findings by others in the field with the requisite training and expertise. According to the International Court of Justice, a lack of peer review suggests that "the scientific output … appears limited".[66] This limit is not proof of bad science, but it is not evidence of good science. That is, peer review is, without doubt, a process which has problems and failures, particularly if the reviewers are exclusionary, biased, or unable to do a fair review. The list of critically important scientific papers that peer-reviewed journals have rejected by peers goes at least as far

63 Department of Conservation *National Compliance Strategy, 2017–2020* (DoC, Wellington, 2016); also Department of Conservation *Policy and Procedure for Managing Conflicts of Interest* (DoC, Wellington, 2012).

64 Federal Advisory Committee Act Pub L No 92-463, Oct 6, 1972, 86 Stat 770, § 5(b)(2) (1972, reprinted 1994).

65 C Carrozza "Democratising Expertise and Environmental Governance: Different Approaches to the Politics of Science" (2015) 17(1) Journal of Environmental Policy and Planning 108; D Pestre "Science, Political Power and the State" in J Krigge (ed) *Science in the Twentieth Century* (Routledge, London, 2002) at 61–77.

66 *Whaling in the Antarctic (Australia v Japan: New Zealand intervening)* [2014] ICJ Rep 226 at [219].

back as the rejection of Edward Jenner's report on the first vaccination against smallpox by the editor of *Philosophical Transactions* in 1796. Hundreds of famous discoveries have followed the same route, despite being trashed by their peers. In these situations, the invisibility and power that reviewers possess may not lead to the best outcomes. It is due to such limitations that approaches to peer review, via the setting of standards on both the peers and the review process, have been undertaken. These refinements have been necessary, as despite the limits of peer review there is no better way to vet science to ensure that appropriate contemporaries review it. Although this is not a guarantee of quality, it is a critical tool in quality control, and accordingly the requirements to use it are increasingly formalised (as in, it is mandatory) in a number of settings.[67]

In New Zealand the practice of peer review within science policy is not uniform, and different practices range from poor to excellent (with the fisheries division within government in the exemplary basket, after three decades of impressively evolving standards).[68] Even where peer review is accepted in principle, within New Zealand it is often watered down with debates over whether it needs to be done externally (as in, outside of ministry, and preferably international), and whether it needs to apply to all scientific knowledge or only that which is complex, novel and/or contentious. A further difficulty is that due to being a small country there is a limit on how many people of calibre can do peer review, and as with conflicts of interest noted above, there is often a revolving door between those being awarded work and those doing peer review. Due to these problems, it has become clear that New Zealand could benefit from a wider standard of peer review across most sectors.[69]

67 L Bornmann "Evaluation by Peer Review in Science" (2013) 1(1) Springer Science Reviews 33; A Penney *Review of International Guidelines for Science Quality Assurance and Peer Review* (Ministry of Fisheries, Wellington, 2010) at 2–4; A Scott "Peer Review and the Relevance of Science" (2007) 39(7) Futures 827; Editor "Revolutionised Peer Review" (2005) 8(4) Nature Neuroscience 397; J Gans "Rejected Classic Articles" (1994) 8(1) Journal of Economic Perspectives 165.

68 P Mace "The Evolution of New Zealand's Fisheries Science and Management Systems Under the ITQ" (2014) 71(2) ICES Journal of Marine Science 204; P Mace and M Vignaux (eds) *Fisheries Assessment Plenary May 2014 — Supplement: A Celebration of 30+ Years of Fisheries Science* (MPI, Wellington, 2014).

69 P Gluckman *Enhancing Evidence-Informed Policy Making: A Report from the Prime Minister's Chief Science Advisor* (Office of the Prime Minister's Science Advisory Committee, July 2017) at 18–19; D Scranney *New Zealand Government Agencies Questionnaire Summary for Science Information Quality and Peer Review Processes* (2010), copy in possession of the author; D Scranney *Report of the Workshop on Science Quality Assurance and Peer Review* (as held at the Ministry of Fisheries, 10 June 2010), copy in possession of the author.

The final principle is **transparency**. According to the International Court of Justice, although "a lack of transparency … does not necessarily demonstrate that the decisions made with regard to particular research items lack scientific justification",[70] evidence of transparency is indicative of procedures with greater integrity. Thus, scientific investigations should be undertaken in the open as much as possible, or as Agenda 21 suggested, all such scientific research should be based upon the "full and open communication of the findings of the scientific and technological community"[71] and a "full and open sharing of data and information among scientists and decision makers".[72] This last point is important, as transparency requires not only the deliberations, but also the raw data, to be accessible for review.[73] The last facet necessary to ensure transparency is that protections need to be established for "whistleblowers", both in general, and in scientific areas in particular, for people who, from within an organisation or process, provide evidence, in the public interest, of the wrongdoing of that organisation.[74]

New Zealand also has a good understanding of the importance of transparency within the science and policy-making framework. With regard to the issue of whistleblowers, their protection has been evident since the Protected Disclosures Act of 2000. Here, in theory, the Act protects whistleblowers by promoting the public interest via facilitating the disclosure and investigation of matters of serious wrongdoing in or by an organisation and by protecting the employees who make the disclosures of information about serious wrongdoing within an organisation.[75]

With regard to the wider issues of transparency, it seems that New Zealand is doing relatively well, especially given the inherent limits of peer review

70 *Whaling in the Antarctic (Australia v Japan: New Zealand intervening)* [2014] ICJ Rep 226 at [195].

71 Agenda 21, ch 31, para 2.

72 Chapter 31, paras 4(e) and 3(a).

73 L Lyon "Transparency: The Emerging Third Dimension of Open Science" (2016) 25(4) LIBER Quarterly 153; R Tuval-Mashiach "The Importance of Transparency in Qualitative Research" (2016) (Oct) Qualitative Psychology 17; Editor "Towards Transparency" (2014) 7 Nature Geoscience 777; A Florini "The End of Secrecy" (1998) 111 Foreign Policy 50; D Resnik *The Ethics of Science* (Routledge, London, 1998) at 58–59.

74 L Haven "Myth and Reality of Whistleblower Protections" (2011) 13(3) Public Integrity 207; M Blume "Keeping up Scientific Standards" (2009) 459(7247) Nature 645; E Reich (2009) "Whistleblowers at Risk as Science Fails to Correct Itself" (2009) 460(7258) Nature 949; P Latimer. "Whistleblower Laws: International Best Practice" (2008) 31(3) University of New South Wales Law Journal 766.

75 Protected Disclosures Act 2000.

within relatively small communities of specialists.[76] While Sir Peter Gluckman has emphasised the need to provide greater transparency regarding the use of research-informed data (or its absence) with respect to complex and controversial areas of decision-making where the public is directly or indirectly consulted,[77] it is clear that some exemplars already exist in New Zealand, such as with the Ministry of Fisheries. Here, transparency and openness to public scrutiny at all stages, particularly during peer review and when reporting information, and inclusion of industry, scientists, environmental NGOs and others, including even non-technical experts in the science working groups (with the latter given their own protocols in 2017, with rules for chairs and members, as well as data retention and its access), is considered uppermost.[78]

8. CONCLUSION

Science is the only discipline that can provide robust foundations for policy formation. Although it must never be allowed to govern alone, it must be at the table of decision-making as the shared and verifiable findings of science allow understandings and cooperation that progress can be built upon. This is especially the case with environmental issues, at both the domestic and international levels. However, in the current age, there is often a distrust of science and/or it is kept in a subsidiary position when dealing with policy problems. To get science to this position, international best practice would suggest that the creation of influential advocates around decision-makers is required. It is these people who ensure that the principles of authenticity and integrity, transparency and peer review are all built into the scientific processes.

In the case study of New Zealand, it appears that the goal that all government ministries must receive fair, impartial, responsible and trustworthy advice, which would include science, is clear. It also clear that the principles of authenticity and integrity, removing conflicts of interest, transparency and the use of peer review are highly valued in some settings. However, such principles are not universally applied, and the country would benefit from having a type of

76 D Scranney *Report of the Workshop on Science Quality Assurance and Peer Review* (as held at the Ministry of Fisheries, 10 June 2010) at 8–9, 12–13.

77 Office of the Prime Minister's Science Advisory Committee *The Role of Evidence in Policy Formation and Implementation: A Report from the Prime Minister's Chief Science Advisor* (OPMSAC, Wellington, September 2013) at 6–7.

78 Ministry of Fisheries *Research and Science Information Standard for New Zealand Fisheries* (Ministry of Fisheries, Wellington, 2011); also P Mace and A Penney *Overview of New Zealand's Fisheries Science Peer Review Process* (Ministry of Fisheries, Wellington, 2010). The 2017 Membership and Protocols for all Science Working Groups is available from the MPI.

protocol in which these principles were made clear in all departments engaged in, or with, science. Similarly, the country would also benefit from entrenching the positions of both Chief Science and Departmental Science Advisors, in terms of security of tenure and guarantees of their independence, in a way which is akin to the position of other senior non-partisan advisors to government.