***EXPANDING THE DIPLOMATIC TOOLKIT: the further evolution of science diplomacy***

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The transit of Venus only happens every 200 years or so, and then it happens twice over 8 years before another long gap. As Johannes Kepler in the 17th century suggested, If the transit of Venus is measured from two different points on Earth at the same time, then parallax could be used to estimate the distance from the Earth to the Sun. This was something which the scientists of the 17th and 18th centuries desperately wanted to know. So, despite considerable tension between the French and the British and other European powers, in 1761 scientists agreed to collaborate by sending expeditions to two very distant parts of the world to measure the transit of Venus – the exact time that it took for the planet to move across the Sun. Unfortunately it was cloudy in key places and so the experiment failed.

Then in 1769, the French and the British – despite just having ended the Seven Years' War – decided again to embark on what may be the first true international scientific cooperation. And part of that was James Cook being sent to Tahiti to measure the transit of Venus. It was sunny enough in Tahiti, as it was elsewhere, and the transit time was measured and the subsequent calculation of the astronomical distance has turned out to be remarkably accurate.

But as all New Zealanders know, Cook – having been instructed to deliver the transit of Venus at Tahiti – had Admiralty orders to then sail south to find *Terra Australis*. And 250 years ago in October, he landed on a beach on the east coast of New Zealand's North Island. This was the third so called "discovery" of New Zealand, after the Māori had discovered it some 800 years earlier, and Abel Tasman had rediscovered it a hundred years earlier than Cook. But Cook's rediscovery was the impetus for the European settlement of New Zealand.

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So, what started off as an international scientific collaboration ending up being what was then a proto-form of science diplomacy, with science being the 'cover' for what was the diplomacy of the 18th century – finding new lands to claim for colonial European powers. In this way, international scientific collaboration, with the basic goal of advancing knowledge, was followed by a form of science diplomacy, where the basic goal was to advance diplomatic and strategic interests of the colonising country.

**Defining science diplomacy**

In my mind, and that of Vaughan Turekian – who was Chief Science Advisor to Secretary Kerry and then Secretary Tillerson, and with whom I continue to collaborate on thinking about the future of science diplomacy – it is important to say that most international science cooperation cannot be seen as primarily an effort at science diplomacy. As a generalisation, ministries of science and research funders support international science activities primarily to advance knowledge itself, and while such efforts may have a diplomatic spinoff, this is not their motivation. In contrast, ministries of foreign affairs have clear diplomatic objectives, some of which can be advanced through science. These may overlap but in general we see rather distinct objectives in many countries in the efforts of ministries of science and foreign affairs. For the purposes of this discussion, Vaughan and I define science diplomacy as the intentional use of science, or scientific cooperation, to advance the diplomatic interests of a country.

Traditionally, science diplomacy has been seen mostly as a strategy for large countries – the United States, Britain, and the Soviet Union – to project their influence and soft power. But what we've seen in the last 20 years is the recognition that small countries can use science diplomacy to their advantage[2], and do so whether they are a developed country or a developing country.

**The phases of modern science diplomacy**

We can think about modern science diplomacy in three phases, although we think we are now entering a fourth.

The first phase was that built around the two World Wars; countries on both sides of the conflict used science to give themselves technological advantage. Science diplomacy was part of that: one example

[2] Peter D. Gluckman, Stephen L. Goldson, and Alan S. Beedle, "How a Small Country Can Use Science Diplomacy: A View from New Zealand," *Science & Diplomacy* 1(2) (June 2012). http://www.sciencediplomacy.org/perspective/2012/how-small-country-can-use-science-diplomacy.

was the 1940 Tizard Mission when Britain realised that it was in some trouble and yet could not yet get America to enter the War. Britain had advanced science that could help the war effort, but could not do so by itself. Henry Tizard, a proto-science advisor to the UK government, came up with the proposal of transferring the knowledge to the Americans, giving them Britain's scientific secrets and seeing what they could do with it. And out of that emerged the technology of radar and a whole lot of other critical inventions including, in part, the Manhattan Project. This became a very intentional strategy of the Churchill government – to show the Americans that Britain had ideas but could not develop them, and by giving them to the Americans and allowing them to develop those ideas, there would be value in time for the British when America eventually joined the war.

After the Second World War, we saw the second phase of science diplomacy with the emergence of a whole raft of new institutions, such as the UN system and global financial institutions, and then the start of the Cold War. During the Cold War, science diplomacy was used quite intentionally to try and reduce tension between the super powers and sustain some relationships. One of the best examples is IIASA (International Institute of Applied Systems Analysis), which was formed when Alexei Kosygin and Lyndon Johnson both agreed to put funding into an institute located near Vienna, to do work on complex systems like the water, energy and food nexus. This impressive institute now has about 30 member countries supporting it and doing work which remains critically valuable in addressing the issues of the Global Commons. Another big breakthrough at the time was the Antarctic Treaty. In the middle of Cold War tensions, the two super powers – supported by New Zealand, Australia, Britain and a few other countries – agreed to a Treaty which has been well sustained and now involves many more countries; Antarctic would only be used for peaceful purposes, not for military bases or resource exploitation, and in fact would essentially be governed by science. During the Cold War there were also intentional efforts, particularly from America and the Soviet Union, to sustain relationships by finding areas of science which were not militarily-related and in which the scientists could be encouraged to talk to one another.

Then things started to change. With the end of the Cold War we saw growing focus on the global challenge, with the Millennium Development Goals and now the Sustainable Development Goals. We started to see the appearance of Science Advisors or Envoys in a few foreign ministries. The first was in the United States, followed by the United Kingdom, then Japan and a few other countries. And for the first time, people started to talk about science diplomacy as a specific subset of diplomacy.

But the question now arises: are we moving into a fourth phase? We are clearly moving geostrategically into a world that is post-globalised but remains highly interconnected, and yet at the same time the rules-based global order appears to be degenerating, and sustainability issues are becoming critical. So, at the very time when we need science more than ever to deal with the Global Commons – climate change, energy security, water and food security – we're dealing with the breakdown, or the potential breakdown, of the international partnerships for doing so. And in parallel we're seeing the rise of post-trust, nationalism, and even a level of anti-scientism. While science is going to be more important than ever to deal with the issues of the Global Commons, the system for doing so through governments may be in some trouble. So what we're seeing is a growing reliance on non-governmental approaches. I shall return to this later.

**The evolution of science**

We must also remember that science has also been evolving. Science is now much more systems-based and is increasingly international – about 40% of all scientific papers have more than one country of origin in the authorship – and science is moving into what some would call the post-normal phase. Jerry Ravetz and Silvio Funtowicz introduced the term *post-normal science*[3] to describe complex science where there are unknowns, and no matter how much knowledge is gained there will still be significant unknowns, and this science interfaces with public values that may well be in dispute themselves. Such situations immediately put science and public values into a difficult partnership where there may be potential disputes about the science intersecting with values that are contested between different people. And if you think about where much science now has a major role – whether it be on environmental issues, social issues, or economic issues – you see these tensions in play all the time; the science is uncertain, the values it interfaces with are in conflict, and societal consensus can be difficult. Furthermore, other things are also changing science: a greater diversity of those funding and doing science, massive changes in publication practice and incentives operating, increases in private sector R&D, the rise of data science, and all that follows from that.

**Categorising science diplomacy**

In 2009 the Royal Society (London) and the American Association for the Advancement of Science held a meeting in Wilton Park in the UK to promote the idea of science diplomacy as a particular discipline in

[3] Silvio O. Funtowicz and Jerome R. Ravetz, "Science for the post-normal age," *Futures* 25(7): 739-755 (1993) https://doi.org/10.1016/0016-3287(93)90022-L

its own right. They came up with a taxonomy to describe the different components of science diplomacy: diplomacy for science, science for diplomacy, and science in diplomacy[4].

Diplomacy for science describes the role diplomats sometimes play to promote science. This is particularly the case with the big science projects; one could not have had an International Space Station, the Large Hadron Collider in CERN, or the Square Kilometer Array without diplomatic involvement.

Earlier I described science for diplomacy, when science was intentionally used as a diplomatic tool in relationship management. More recently in the Obama era, science played an important role in the rapprochement between Cuba and the USA[5].

And then there is a critical role for science *in* diplomacy itself – a nuclear arms treaty is meaningless without verification science, and science has a central role to play in reaching agreements on how to address challenges such as climate change. Indeed while scientists play a critical role in meeting many of the Sustainable Development Goals, it is the diplomats that play the decisive roles in the general assemblies of global agencies. Thus, better progress will be made when there is close partnership between diplomats and scientists. It is a strong argument for formal science structures within ministries of foreign affairs.

But there are problems with this taxonomy, even though this taxonomy has been widely used in academia. It does not deal with a number of issues, such as science in trade, science in developmental aid, or the Global Commons issues. It does not deal with the reality that 70% of the world surface is not jurisdictionally controlled[6]. And it was becoming clear, at least to Vaughan, myself (I was appointed Special Science Envoy to the NZ Ministry of Foreign Affairs and Trade from 2012–2018) and our co-authors, that that taxonomy did not really help a Ministry of Foreign Affairs; there wasn't enough specificity in it for a Ministry to know what to do.

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[4] Royal Society and AAAS, "New frontiers in science diplomacy: Navigating the changing balance of power," January 2010, London: The Royal Society. https://royalsociety.org/~/media/Royal_Society_Content/policy/publications/2010/4294969468.pdf

[5] Sergio Jorge-Pastrana, Marga Gual-Soler, and Tom C. Wang, "Promoting scientific cooperation in times of diplomatic challenges: sustained partnership between the Cuban Academy of Sciences and the American Association for the Advancement of Science," *MEDICC Review* 20(2): 23-26 (April 2018). https://www.medicc.org/mediccreview/pdf.php?lang=&id=626

[6] Peter D. Gluckman, "Science diplomacy: Opportunities and challenges for small countries," (speech) 11 June 2015. https://www.pmcsa.org.nz/wp-content/uploads/Speech_Science-Diplomacy_Trieste-June-2015-final.pdf

Therefore, together with Robin Grimes who was then the Science Advisor to the Foreign Ministry (FCO) here, and Teruo Kishi who is the Science Advisor to the Foreign Ministry in Japan, we suggested a more utilitarian taxonomy that might be of greater value from the point of view of a foreign ministry[7]. Foreign ministries primarily exist to use diplomacy to advance a national interest, and they can do so for one of three reasons: it is of direct national interest to them; there is a bilateral interest with one or two countries generally in the region; or there is a global interest and they have a vested interest in the Global Commons being addressed. And so we parsed science diplomacy using these three intentionalities.

**Science diplomacy for direct national interest**

In relation to direct national interest, a country may be trying to project its voice, its influence, its soft power or its reputation. A recipient country may be wishing to attract donor attention. Therefore science diplomacy clearly plays a major role in promoting national self-interest in all sorts of ways. Indeed ambassadors frequently use visiting scientists as ways to increase profile, open doors, or find commercial opportunities. For small countries it can be a very powerful way of expanding a small diplomatic footprint – that is, it can expand the number of relationships that a country could have.

But there are also other ways that science diplomacy has direct national interest.

Governments use science a lot in protecting their economic interests, be it in trade or attracting skills and technology. Many disputes in the WTO are resolved through science. The longest ever running dispute in trade lasted 84 years, between Australia and New Zealand, over apples. Australia insisted that New Zealand apples could not be imported because of the risk of a fruit fly, despite the fact there had never been fruit flies found to be endemic in NZ. This went on for 84 years as Australia tried to protect its apples from competition against the beautiful apples that NZ produces, and we had to take Australia to the WTO trade dispute processes using science to show, using DNA technologies, that NZ apples are not contaminated with fruit fly. The then-Australian Prime Minister Julia Gillard finally ate an NZ apple on television in response to a wager from the then-NZ Prime Minister, John Key.

[7] Peter D. Gluckman, Vaughan Turekian, Robin W. Grimes, and Teruo Kishi, "Science diplomacy: a pragmatic perspective from the inside," *Science & Diplomacy* 6(4) (December 2017). http://www.sciencediplomacy.org/article/2018/pragmatic-perspective

There are national needs that science diplomacy fills. A developing country will have a shortage of scientific resources and skill sets that can be assisted through science diplomacy. A developed country, on the other hand, will tend to want to advance their interests through attracting the best scientists and technologies to their shores. NZ is a small country and we have to share access to some R&D technologies; most notably we pay for access to cyclotrons based in Australia. We actually give money to the Australians, so we can do our science!

Science has a critical role to play in protecting national security, and this too spills over into science diplomacy, particularly as cyber issues have emerged. It is worth recalling that the origin of formal systems of science advice in major countries was in the security sector.

**Science diplomacy for mutual interests**

And then there is science diplomacy for bilateral or joint common interests. The boundary between this and direct national interest is not absolute. One place where it is most obvious is where resources cross boundaries. For example in the triangle of forests bordering Uganda, Rwanda and the Democratic Republic of Congo there are only 800 mountain gorillas left. Those countries work closely together to maintain the integrity of that mountain gorilla population. There are good things being done in conservation all through Africa, across boundaries and between countries that would not normally be working together.

Biosecurity is another area where science diplomacy is important; think of the issues in Europe regarding African Swine Fever as that virus is moving from the East, from China through Russia and into Poland, where Denmark is actually considering erecting a fence barrier to isolate its important commerical piggeries. The infectious diseases scientists, biosecurity agencies and diplomats of Europe are working increasingly closely on this issue. New Zealand and Australia have worked very closely together for years to maintain a common border in terms of their biosecurity needs, to mutually protect our agricultural industries.

Countries have all sorts of shared scientific agencies where diplomats and politicians have agreed to effect shared authority, such as the European Food Safety Authority and many other European Commission regulatory agencies. NZ and Australia have a common food safety agency to regulate the food industry across the two countries. In the Pacific, there is the Pacific Commission which donor countries have supported to provide science and technical services to Pacific Island States in areas like

climate change, fisheries management, public health and so forth. In the Caribbean, CEDMA, the Caribbean states shared emergency authority, does a critical job in hurricane prediction and management. Many countries have shared crises, such as Ebola and the ash cloud from the volcanic eruption of Eyjafjallajökull.

**Science diplomacy and the global commons**

There are many important issues where there is global interest, and the battle sometimes involves persuading a country that it is in their national interest to support the global interest. Climate change is the obvious example and the effort to get an effective global accord is not yet complete. The Sustainable Development Goals provide other examples such as protection of the marine environment. Indeed, arguably the first treaty to address the issues of the Global Commons was the Montreal Treaty on reducing CFCs to protect the ozone layer.

Obviously these categorisations are nothing more than a heuristic, and any action can be seen through different lenses. Let me give the example of an issue moving from direct national interest to global interest. NZ's economy is based on tourism on one hand, and milk production on the other. About 50% of our emissions come from agriculture, and indeed we are the highest per capita producer of methane in the world – our cows fart and belch a lot. Ireland produces about 30% of emission from agriculture, but no other *developed* country has a similar profile of high agricultural emissions. Thus, until recently, emissions from agriculture were largely seen as a developing world problem, despite the fact that 20% of global emissions came from agriculture. In 2009 there was some early evidence of high-end consumer resistance to New Zealand products in Europe on the basis of their carbon footprint. However, the science of methane production by cows, sheep, or goats is complex and was beyond our capacity to address on our own. On the side of the famous Copenhagen (COP15) Meeting on Climate Change, NZ proposed that a global effort should be set up to look at agricultural greenhouse gas emissions. In 2010, I chaired a roomful of science leaders from some 30 countries to discuss a structure to deal with this challenge, while diplomats and officials considered a partnership model in the room next door. The goal was to promote a global scientific effort on agricultural greenhouse gas emissions. The result was the Global Research Alliance on agricultural greenhouse gases[8], to which NZ provides a small secretariat, that now involves 57 countries including all the major food producers. The Alliance has multiple research streams coordinated by different countries, all based on collaborative science that has shown great

[8] https://globalresearchalliance.org/

promise. What started as a domestic national interest soon converted to a global effort on an issue of Global Commons.

Another important area for science diplomacy are the ungoverned spaces. I have already discussed the Antarctic. Other ungoverned spaces include the 70% of the world that is marine (outside of economic zones); space (although the current space treaty system is compromised by military and private sector interests); the seabed, which is increasingly contested and exploitation is starting and soon commercialised; and the internet. In many ways, science is the commonality across all these areas, and indeed science may provide the most cohesive and coherent way of thinking about these issues.

**Science diplomacy and emerging technologies**

Science diplomats are facing another set of potential challenges, namely the geostrategic consequences of new technologies. We cannot ignore the fact that emergent technologies in the digital world are compromising national jurisdictional power: tax avoidance is in some ways easier, regulating pornography is now almost impossible, the dark web and cryptocurrencies create avoidances, slander and libel laws have effectively disappeared. Jurisdictional power is being changed in many ways. The power of the platform companies and the control of data create further existential challenges to national authority. Indeed, Denmark has gone so far as to appoint an ambassador to Silicon Valley, although that office is primarily related to their innovation agenda. Cyber security has emerged as a new discipline, and Governments, companies and universities are having to spend a fortune on it. Autonomous warfare is growing as a reality, but attempts to get a Treaty in place to deal with it have failed. There are all sorts of issues about social media and platform companies, and a new set of threats will emerge from life sciences technologies, as discussed later.

I don't think you can underestimate this issue of digitalisation in its broadest sense – what it is doing to the power of nation states, how they are manipulating each other or can be manipulated, how it is changing the way our citizens think, how it is influencing the liberal democratic profile, and so on. And I think this is a space where science diplomacy is needed. At the moment we have not got there; it is still very much a political discussion, like the Christchurch Declaration, which proposes to limit the livestreaming of terrorist events such as the horrific event in Christchurch. But there are greater, more fundamental issues here that, in my mind, are going to be the bigger threat to society.

Last year, along with the International Network for Government Science Advice, I co-authored a report for the OECD on understanding wellbeing in the context of rapid digital transformations.[9] The paper pointed out that at every level of society – whether the individual, the individual in relation to other individuals, how families work, how communities work, how nation states work – this inevitable progress toward digitalisation is changing things. Whether it is changing things for the better or the worse depends on what domain we are considering and one's own individual values and world view. But it is creating fundamental changes in areas like our sense of privacy, our sense of autonomy, our agency, the relationship between the citizen and the nation state, and also putting democracy under some pressure. And the need to apply social sciences to diplomacy to understand these global trends is a matter for all countries. In some countries these issues are reflected in growing nationalism with flow-on to the diplomatic domain. In terms of the geostrategic instability that exists in a multipolar world, if the citizens are dissatisfied with their political masters then the risks of instability are even greater. And so I think the issues of science diplomacy, and social science in diplomacy, will grow much greater.

The other consequence which I separate out and think is equally important is truth decay, or what is sometimes called post-truth. It is of course not new; since the first priests and shamans existed perhaps 10,000 years ago, and certainly since the first rulers existed 5–7,000 years ago, people in power have always manipulated truth. What has changed is the ability, the pervasiveness, and the speed at which you can do this. And manipulators exist in all sorts of forms, from the nation state to an individual. That people can now have a career as an 'influencer' on Instagram highlights how subtle manipulation can be in different ways. But part of higher level manipulation can be to undermine confidence in science itself. And it has not just been about climate change; you can see it with the anti-vax movement of the present time, and in the debates about GM organisms. It is because science is interfacing – to use post-normal terminology – with values that are contested, that this is a growing issue.

Why do I raise these issues in the context of science diplomacy? They are not issues that can be left just to domestic policy. I think the changing global attitude of citizens, how they behave with each other, how they use *ad hominem* attacks, and how the digital world can undermine democratic processes have diplomatic dimensions beyond the obvious issues of state sourced manipulation. Deep fakes, that is

[9] Peter Gluckman and Kristiann Allen, "Understanding wellbeing in the context of rapid digital and associated transformations: implications for research, policy and measurement. A discussion paper," Auckland: International Network for Government Science Advice, 2018. https://www.ingsa.org/wp-content/uploads/2018/10/INGSA-Digital-Wellbeing-Sept18.pdf

highly credible appearing images, videos and recordings made by computer to mimic pseudo-reality, create real security and diplomatic risk. These issues are no longer theoretical; they are real, and diplomats will need to be thinking a lot about how verification of some messaging is actually achieved.

There are other dimensions of new technologies foreign ministries will need to consider. What if some country now decided that the only way to deal with climate change was by a putative geo-engineering technology? What if we need geo-engineering to thrive and survive? We don't have processes in place to deal with that. Synthetic bacteria may soon be all over the place; although they are currently still confined to the lab, eventually there will be a reason for their release into the environment. Bacteria, whether developed for benign or malignant reasons, may well cross boundaries. And genetically modified insects have already been released into the environment, although the technology of meiotic gene drive is still very immature. Still, if such mosquitos are developed and released in one country and their neighbour does not want them, what issues will emerge? Bacteria and mosquitoes don't carry passports. I will not repeat my discussion on the digital technologies, but how will foreign ministries engage in such issues? They need to be thinking far more about the technological horizon.

To summarise, science diplomacy is going to be so much more important for foreign ministries than it has been in the past. I would argue that foreign ministries must take a broader view and invest more in science diplomacy, as it will be a critical part of the diplomatic toolkit[10].

[10] The International Network for Government Science Advice (INGSA) is the major organisation interested in science diplomacy and science in policy (https://www.ingsa.org). Membership is free. It has about 5000 members from over 100 countries, including scientists, policy makers and diplomats. One divisions of INGSA is Science Policy in Diplomacy and External Relations (SPIDER), which is specifically focused on how science and diplomacy interact. INGSA also provides administrative support to the Foreign Ministries Science and Technology Advice Network (FMSTAN), which comprises countries that have units of science within their foreign ministries.