VAUGHAN TUREKIAN AND PETER GLUCKMAN

Science Diplomacy and the Rise of Technopoles

During the era of increasing globalization, science diplomacy was a key tool for addressing global challenges. Today, among fracturing alliances, the field must evolve.

In the three decades after the Cold War ended, science diplomacy became an important component of the foreign policy toolkit. In particular, it became a key tool for responding to global challenges that involve science—including climate change and global development. Diplomacy's integration of science and technology expertise has reshaped how nations address such issues, fostering a more collaborative and informed international community. However, the conditions under which science diplomacy blossomed in an era of growing globalization are now changing. By contrast, in today's multipolar world of fracturing alliances, the influence of science and technology is increasingly tied to the advancement of individual nations' geostrategic and economic interests. In this new context, science diplomacy must evolve.

The development of modern science diplomacy

Although the origins of science diplomacy are often traced to the Cold War, its modern form began to take shape in the late 1990s, when US Secretary of State Madeline Albright undertook a broader reframing of US strategy and priorities after the Cold War. She asked the National Academy of Sciences to provide guidance on the role of science, technology, and health in US foreign policy. The role of science adviser to the secretary of state was created as a result, reflecting a shift in integrating scientific expertise into foreign policy and underscoring the increasing importance of science and technology in international relations. Parallel efforts to bolster science capacity in foreign ministries were undertaken worldwide as nations recognized that embedding scientific expertise within their diplomatic frameworks made them better equipped to participate in international negotiations, shape policy, and foster collaborations to address global challenges in fields including cybersecurity, biotechnology, and environmental policy.

At times, scientists themselves have played a role in foreign policy. During the Obama administration, for example, a long-standing scientific and professional relationship between US secretary of energy Ernest Moniz and head of Iran's Atomic Energy Organization Ali Salehi paved the way for both technical and diplomatic agreement. And after Russia's invasion of Ukraine in 2022, active engagement between Western and Ukrainian researchers worked to integrate Ukraine's science and innovation community into Western systems, including Europe's Horizon program.

Meanwhile, the nongovernmental sector's role in promoting science diplomacy has grown. In 2008, the American Association for the Advancement of Science established the Center for Science Diplomacy, which aims to promote better understanding and cooperation between countries through science and provides a framework for addressing global challenges such as climate change, pandemics, and food security. The center's success has inspired the creation of similar institutions, including the EU Science Diplomacy Alliance, to promote science diplomacy as a tool for the European Union's external actions.

Although science diplomacy was seen as a tool of large countries during the Cold War, by the 2000s some smaller countries started to use it to advance their own interests. Israel and Singapore leveraged their investment in science to attract multinational companies for economic advancement. In 2009, New Zealand appointed a science envoy to assist in developing relationships with other small, advanced economies with whom they'd otherwise had relatively little interaction. As a gateway to the Antarctic, New Zealand was able to provide logistics support for joint scientific expeditions as a way to smooth over tensions with the United States around nuclear policies. Rwanda also started to emphasize using science diplomacy to attract investment and expert assistance, leading the country to emerge as a continental leader in new technologies.

Emergent challenges

Today, one cannot look at the landscape of science diplomacy without recognizing that the era of globalization—and, with it, the commitment to global interdependence and cooperation on global science issues—is in retreat. Already, active conflicts in Ukraine and the Middle East are explicitly putting greater strain on traditional instruments of science collaboration, such as the International Institute for Applied Systems Analysis and the Arctic Council. But in a larger sense, the unstable state of this multipolar world constricts and changes the space that science diplomacy can operate in.

An underlying assumption of the era of globalization was that rules-based trade requiring cooperation between state actors would ultimately reduce global tensions and allow global action on common issues. But recently, as economies have become more intertwined, tensions have grown. And with the proliferation of technology, the interface between science, technology, economics, and security interests have tightened. Now that some emerging technologies cannot be considered independently from economic, defense, and security interests, relatively unsophisticated measures such as export controls may not be up to the task of protecting national interests. By 2024, the drive to open science was being replaced in political declarations from many countries with the mantra "as open as possible, as closed as necessary."

But even as countries have begun restricting scientific interchange, the world faces common, global challenges that science and technology must address. This obvious paradox points to weaknesses in the previous conception of science diplomacy and explains why responses to global issues such as climate change, sustainability, pandemics, and autonomous weapons have been inadequate. When science diplomacy becomes disconnected from critical national security and economic priorities, it can no longer influence policy. One of the criticisms of the Kyoto Protocol, which required ratifying nations to set individualized targets for greenhouse gas emissions reduction, was that it used an international agreement to drive domestic policy. Although the effort had some success in some countries, it encountered greater difficulty in the United States, where the domestic political consensus for climate action had not been resolved. Under such circumstances, one can build consensus internationally but fail to build it nationally—and national priorities inevitably carry the day.

These fault lines in traditional science diplomacy were significant, but they are now enlarged by new technologies that easily cross national boundaries. These include digital technologies—particularly the rapidly emerging advances arising from AI and large language models—synthetic biology, and the use of space and extraterrestrial resources. Quantum technologies with security and defense applications will likely create further challenges.

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Compounding this complexity is the role of transnational platform companies in developing and selling emergent technology. Some of these companies are successfully avoiding national regulations, which is challenging the role of nation states. They have found ways to take advantage of a weak and divided multilateral system that has failed to ensure oversight that benefits the planet and its citizens. Social media companies, for example, have been slow to comply with myriad EU rules, leading to the August 2024 arrest of the Telegram CEO in Paris. And Elon Musk, owner of Starlink, decided to override US interests in the Ukraine conflict, highlighting the power that individuals can now exert in what was traditionally an arena for state actors alone.

Finally, in an environment already in flux on many levels, China has shifted its position from being an active driver of collaboration in global science toward being a more independent and self-reliant science power. Indeed, China's shift shows the increasingly critical role that science and technology play in defining geostrategic positions.

The multipolar world is now defined as much by distinct approaches to technology and innovation as it is to ideology. We might even call such powers technopoles.

It is difficult to forecast where these trends will lead. The rise of populist, isolationist, or right-wing parties—in Europe or the United States—could change the landscape of scientific collaboration and diplomacy still further. And there is a possibility that conflict within regions could increase, destabilizing not only regional scientific collaboration, but also international bonds. Already, national budgets and priorities can be seen turning toward national security–focused economies, as in Europe's response to aggression from Russia and growing concerns with China. The highly anticipated competitive roadmap for Europe produced by former Italian prime minister Mario Draghi highlights such a priority shift.

Where will science diplomacy go?

As the conditions that gave rise to today's forms of science diplomacy continue to shift, the field must evolve. And as it does, it faces an inherent dilemma. Is the purpose of science diplomacy to narrowly promote a country's economic and security interests? Or is the purpose also to advance a global agenda—progress on issues such as climate change, pandemic prevention, and sustainable development—through science and science-based innovation by treating science as a global public good and which by advancing the global good advances every nation's interests? There is an explicit tension in these two different views of science diplomacy's future role. The fundamental challenge for the field is whether it can serve both these roles—and if so, how?

A further challenge for science diplomacy is that domestic science, economic, and national security policies can conflict with broader objectives related to the global commons. For example, research security policies are being elevated above common interests, including reducing carbon emissions—even among like-minded nations. New mechanisms are needed to better align global priorities with these research security policies. To accomplish this, science diplomats must find ways to bring a broader range of stakeholders into the discussion, including governments, business, and academia. As science diplomacy moves beyond the use of science to "build relations among geopolitical adversaries"—its traditional conception—it has the opportunity to play a new role in building partnerships and shared rules to achieve global objectives while respecting national priorities. As former science advisors from two different governments, we believe that science diplomats should begin to explore several avenues for resolving these tensions: the use of regional alliances, reconsideration of the roles of formal and informal science diplomacy, and building trust through institutions and shared rule-making.

Regional collaboration

One possible avenue for science diplomacy is to expand its purview beyond immediate national benefit to an expanded understanding of how the field can operate at what might be called *regional* levels. Here, regional is a loose term. There are real opportunities in working not only among neighbors, but also among allied nations with shared values and broader objectives. The recently completed AUKUS agreement provides an important example of the emerging use of technology partnerships among like-minded and like-valued countries. Under this agreement, which focuses on a trilateral security arrangement between Australia, the United Kingdom, and the United States, the countries will work together to develop next-generation submarines. A central pillar of this agreement addresses the technology partnership between the nations, which focuses on joint work in critical and emerging technology areas including artificial intelligence and autonomy, undersea capabilities, quantum technologies, advanced cyber, hypersonic and counter-hypersonic capabilities, and electronic warfare.

The AUKUS partnership could provide the template for a broader pan-Pacific partnership among like-minded and like-valued countries in developing a technologically based free trading block. This agreement also demonstrates a fast-developing paradigm for reconciling national security policy and diplomacy, international science and technology policy, and domestic research security. And although tensions remain among the stakeholders, such convergence will be critical for science and technology diplomacy to flourish under these circumstances.

The European Union's General Data Protection Regulations (GDPR) are another example of regional or allied science diplomacy initiatives. The GDPR reflects a values-led approach to technology regulation, and the regulations have influence well beyond Europe. Indeed, one way for philosophically like-minded countries to build cooperation in the science space is to expand on what they have in common.

Beyond track 1 and track 2

Another opportunity to make progress in this conflicted space is to consider the potential roles of different actors. Much academic discussion has focused on *track 1 diplomacy*, or formal diplomacy, suggesting that *track 2*, or informal, efforts were largely a spillover from scientific cooperation. However, the reality has been more nuanced. Sometimes projects initiated by track 1 players have been enacted by track 2 actors. During the Obama era, for example, the US National Academy of Sciences played an active role in mediating the intended rapprochement with Cuba. Conversely, track 2 activities have led to significant diplomatic achievements. The scientifically led

International Geophysical Year of 1957–58 resulted in the Antarctic Treaty. Track 1 and 2 approaches are not separate, but increasingly intertwined.

Inevitably, direct national interests will be primarily driven by the political processes determining economic and security policy. Domestic scientific communities strive to show their relevance to their national funders by supporting such efforts. But at the same time, it has been the global scientific community that has brought attention to climate change, biodiversity loss, pandemic risks, and many other existential threats which require concerted, collective action. In this narrowing window of opportunities to make progress on critically important global goals, track 2 science diplomacy may become even more necessary. For example, the activities proposed for the 2032 International Polar Year, which emphasizes involvement and coproduction of knowledge between a range of Arctic stakeholders, could help to reduce diplomatic tensions and build relationships.

A renewed emphasis on track 2, or a hybrid approach utilizing both tracks, would actually be returning to a role the international science community has often played in history. In the eighteenth century, for example, scientists worked across conflicted nations on issues of common interest, such as gathering measurements of the transit of Venus from multiple sites to estimate the solar unit. But in the current context of rapid change in science when inter-nation tensions are high, track 2 efforts could be an important tool.

In 2018, the organization became the ISC following the merger between the ICSU, which then represented the natural sciences, and its equivalent in the social sciences. Today the ISC's membership includes virtually all of the world's scientific academies and international scientific organizations across the Global North, South, East, and West, as well as across both the natural and social sciences. Worldwide, the ISC has promoted more transdisciplinary approaches in science to generate actionable knowledge in local contexts, while also considering how new technology regulation might be put in practice.

Recently the organization has taken a greater lead in track 2 diplomacy, particularly in connecting the global scientific community and the United Nations. For example, their work on policy lessons from the COVID pandemic involved partnerships with UN Office for Disaster Risk Reduction and the World Health Organization. The organization is also a core partner on UN initiatives such as the International Decade of Sciences for Sustainable Development. ISC works to bring greater equity to the global scientific commons by, for example, fostering the development of scientific voices in the Global South through the Pacific Academy of Sciences.

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Many other scientific bodies could take new and ambitious roles. For example, as the influence of the Antarctic and southern oceans in global climate becomes better understood, the Scientific Committee on Antarctic Research will be of growing importance. However, making the most of these opportunities for topic-specific or regional trust-building requires shifting resources away from business as usual toward deliberate and creative engagement.

Engaging with trusted brokers

Another historically proven way to balance national science goals with global ones while building trust can be found in the many institutions that are natural brokers in the space of international science. One example that demonstrates the evolving potential of these brokers is the International Council of Scientific Unions (ICSU), now known as the International Science Council (ISC). With origins in the late nineteenth century, during the Cold War the ICSU played an important role by sponsoring the aforementioned International Geophysical Year of 1957–58. Later, the ICSU cosponsored the Villach Conference, which led to demand for political action on climate change and thus the formation of UN Framework Convention on Climate Change.

Setting standards

Science and scientists have long played a pivotal role in setting the standards that are central to global trade and knowledge exchange. As the way that knowledge is generated and deployed becomes increasingly digitized, engaging international bodies on digital standards setting offers an opportunity to build global trust and interoperability. Organizations such as the World Data System and CODATA, which set standards for how data is aggregated, curated, and used, could be important

places to find common ground and reduce the risks of geostrategic conflicts undermining harmonization.

A focus on standards may also help span gaps between autonomous private-sector actors, the scientific community, and nation states. As the scientific enterprise is challenged by artificial intelligence—not just in the generation of knowledge but in its assessment and reporting—new forms of diplomacy are needed to bridge and coordinate among government, the science community, and corporations building and deploying AI. Coordinated standards-setting for AI presents an opportunity to avoid some feared negative outcomes from the technology, including digital inequities between the Global North and South and issues of privacy or copyright.

Another area where the scientific community's ability to harmonize standards could play an important role is the digital transition. If left to corporations and disparate governments, the process of digitization, now in its early stages, could create more division in the world. The scientific and standards-setting community has an opportunity to imagine what a global digital compact might look like. This compact could redefine the relationship between people and digital data and technology, and make commitments to future generations. Both formal and informal science diplomacy are required to address these issues.

Assuming a leading role

As the concept of science diplomacy matures, the field is becoming a central area for achieving diplomatic goals. However, the interface between science and diplomacy needs to become much more effective, moving beyond the vague concepts of international science cooperation and building bridges among countries in conflict, to more fundamental and substantial actions.

Science diplomacy has an important, even existential imperative to help the world reconsider the necessity of working together toward big global goals. Climate change may be the most obvious example of where global action is needed, but many other issues have similar characteristics—deep ocean resources, space, and other ungoverned areas, to name a few.

However, taking up this mantle requires acknowledging why past efforts have failed to meet their goals. The global commitment to Sustainable Development Goals (SDGs) is an example. Weaknesses in the UN system, compounded by varied commitments from member states, will prevent the achievement of the SDGs by 2030. This year's UN Summit of the Future is intended to reboot the global commitment to the sustainability agenda. Regardless of what type of agreement is signed at the summit, its impact may be limited.

The science community must play an active part in ensuring progress is in fact made, but that will require an expansion of the community's current role. To understand what this might mean, consider that the Pact for the Future agreed in New York City in September 2024 places "science, technology, and innovation" as one of its five themes. But that becomes actionable either in the narrow sense that technology will provide "answers" to global problems or in the platitudinous sense that science provides advice that is not acted upon. This dichotomy of unacceptable approaches has long bedeviled science's influence.

For the world to make better use of science, science must take on an expanded responsibility in solving problems at both global and local scales. And science itself must become part of a toolkit—both at the practical and the diplomatic level—to address the sorts of challenges the world will face in the future. To make this happen, more countries must make science diplomacy a core part of their agenda by embedding science advisors within foreign ministries, connecting diplomats to science communities.

As the pace of technological change generates both existential risk and economic, environmental, and social opportunities, science diplomacy has a vital task in balancing outcomes for the benefit of more people. It can also bring the science community (including the social sciences and humanities) to play a critical role alongside nation states. And, as new technological developments enable non-state actors, and especially the private sector, science diplomacy has an important role to play in helping nation states develop policy that can identify common solutions and engage key partners.

Vaughan Turekian *is executive director of policy and global affairs at the US National Academies of Sciences, Engineering, and Medicine. He was previously science and technology adviser to the US secretary of state.* ***Sir Peter Gluckman*** *is president of the International Science Council and director of Koi Tū: the Centre for Informed Futures at the University of Auckland. He was previously chief science adviser to the prime ministers of New Zealand and science envoy for the New Zealand Ministry of Foreign Affairs and Trade.*

RECOMMENDED READING

P. D. Gluckman, V. Turekian, R. W. Grimes, and T. Kishi, "Science Diplomacy: A Pragmatic Perspective from the Inside," *Science & Diplomacy* 6, no. 4 (2017): https://www.sciencediplomacy.org/sites/default/files/pragmatic_perspective_science_advice_dec2017_1.pdf

Royal Society and AAAS, "New Frontiers in Science Diplomacy: Navigating the Changing Balance of Power," (2010): https://www.aaas.org/sites/default/files/New_Frontiers.pdf