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Science Diplomacy and Future Worlds

E. William Colglazier

Over the past decade, the use of scientific expertise to advance diplomacy has achieved a number of successes in furthering peace, security, and prosperity. Yet there have also been reversals in important areas that until recently had seen progress. Reviewing developments in arms control, poverty reduction, global health, science and innovation policy, climate change, sustainable development, science advice in foreign ministries, and relations between countries is instructive as we look to the future.

The setbacks have reminded science diplomacy optimists—and I am one—that politics is a more powerful force than science, at least in the short run. Scientists may have reasonable foresight in their areas of technical study, but they are not very good at predicting the future course of human events. Overall, diplomats and foreign policy academics have been less surprised by the precariousness of predicting "which world we will be living in" over the next decade. This was the lead topic in the July/August 2018 issue of *Foreign Affairs*, which presented six contrasting visions of a "grand narrative for an increasingly turbulent era": Realist World, Liberal World, Tribal World, Marxist World, Tech World, and Warming World.[1]

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It is unlikely that a single vision will dominate the next decade—more likely, insights from all six will be salient. Science diplomacy has a role to play in all these future worlds, and even a role in helping to identify other scenarios that may have been overlooked. By addressing societal challenges, science diplomacy can perhaps help shape each of these worlds for the better.

Successes and Setbacks of the Past Decade

Science diplomacy really got its start in the modern era after World War II over the issue of nuclear weapons. The scientists who engaged deeply on this issue with diplomats, security specialists, and foreign colleagues did not refer to these dialogues as science diplomacy, but indeed that is what they were. The Track II exchanges between Soviet and Western scientists over several decades were very helpful and influential in facilitating nuclear arms control.[2]

Around a decade ago, however, continued progress on nuclear arms control agreements between countries of the NATO alliance and Russia began to dissipate as a new cold war set in. Many factors contributed to this growing hostility, and the root causes are intensely debated. The Russians point to the enlargement of NATO along its borders, and the West points to Russian autocratic rule and aggression toward its neighbors. One casualty has been the previously robust influence of science diplomacy in addressing nuclear issues between Russia and the West. Both sides are now modernizing their arsenals and questioning each other's compliance with existing treaties (e.g., Intermediate-Range Nuclear Forces Treaty) and the merits of extending treaties with expiration dates (e.g., New Strategic Arms Reduction Treaty, aka New START).[3]

"Axis of evil" was the term used by President George W. Bush in his 2002 State of the Union address for Iraq, Iran, and North Korea.[4] In his view, each of these countries was pursuing weapons of mass destruction (WMD), exporting terrorism, and persecuting its people. Later in 2002, Undersecretary of State John Bolton, who is now President Trump's national security advisor, added three more nations to the rogue state list: Cuba, Libya, and Syria.[5] Science diplomacy has been pursued over the past decade with these six countries, but the efforts have generally been limited in scope and yielded mixed results.

The nuclear agreement between Iran and the P5+1 countries (the five permanent members of the UN Security Council and Germany), from which Trump withdrew the United States in May 2018, has been viewed by proponents of science diplomacy as a great success. Two scientists—the American Ernest Moniz and his Iranian counterpart Ali Akbar Salehi—were key in negotiating the technical details.[6] For fifteen years prior to the nuclear negotiation, nongovernmental scientists in the

United States and Iran had been actively engaged on nonnuclear science and engineering topics in an effort overseen by their science academies and encouraged by both governments.[7] The U.S. withdrawal from the nuclear agreement and the resumption of sanctions have created considerable uncertainty regarding the long-term viability of the deal. These actions by the U.S. government have also put a major damper on S&T engagement between the United States and Iran.

Before the restoration of U.S.-Cuba diplomatic relations, scientists from the two countries had limited engagement on topics such as marine sciences in the Caribbean and health threats from infectious diseases. In 2014, the AAAS, publisher of *Science & Diplomacy*, sent a high-level scientific delegation to Cuba and signed an agreement with the Cuban Academy of Sciences to pursue more active collaboration.[8] Among the members of the AAAS delegation was the deputy science and technology adviser to the U.S. secretary of state. When diplomatic relations were reestablished in 2015, the expectation was for greatly increased collaboration, and this was pursued by a number of U.S. scientific and research institutions, including the AAAS. Yet the actions of the Trump administration and the unexplained health problems of some American diplomats at the U.S. embassy in Havana have created additional obstacles. Nevertheless, scientific collaboration between American and Cuban scientists has continued and even expanded into new areas, although at a slower pace than originally envisioned when diplomatic relations were restored.[9]

In Iraq, after the 2003 overthrow of Saddam Hussein, the United States and other Western countries made an effort to engage in science and technology and strengthen the country's universities and research institutions. This capacity-building engagement has continued with modest U.S. government funding even with challenges due to the security environment of recent years.[10] With Libya, an exploratory effort in S&T engagement facilitated by the U.S. government was pursued in the period after Muammar Gaddafi gave up his WMD programs developing weapons of mass destruction, but not much was accomplished before the regime was overthrown in 2011 and the security situation deteriorated.[11] With Syria, the AAAS undertook missions pursuing science engagement, but that all came to an abrupt end when the civil war erupted, also in 2011.[12] With North Korea, the AAAS has continued to facilitate a geoscience collaboration on Mount Paektu with North Korean and British scientists, but prospects for an expansion of science engagement with the DPRK await positive developments in the nuclear negotiations between the U.S. and North Korean governments.[13]

President Barack Obama raised expectations for scientific collaboration in the developing world with his 2009 Cairo speech, in which he promised to "launch a new fund to support technological development in Muslim-majority countries and

to help transfer ideas to market."[14] He also promised to "open centers of scientific excellence in Africa, the Middle East, and Southeast Asia" and to "develop new sources of energy, create green jobs, digitize records, clean water, grow new crops."[15] The U.S. Agency for International Development created the Global Development Lab to harness technological solutions to development challenges and created the PEER program to facilitate scientific collaboration between U.S. and developing-country scientists.[16] The State Department appointed distinguished scientists and engineers to serve as U.S. science envoys to a number of countries and regions.[17] These initiatives were all well received, but the expectations created often far exceeded the funding supplied and, as a consequence, the results achieved. The U.S. government has continued to support a small program of scientific collaboration among Israeli, Palestinian, and U.S. scientists, but this effort has been kept relatively invisible to avoid political difficulties.[18] The Newton Fund, undertaken by the United Kingdom to support scientific collaboration between British and foreign scientists in developing countries, has proceeded at a larger scale and faster pace than many of the U.S. initiatives.[19]

Health, Environment, and Beyond

Science diplomacy has made important contributions on topical issues during the past decade. Global health stands out. Partnerships between governmental and nongovernmental public health experts with diplomats and political leaders helped deal with challenges such as HIV/AIDS in Africa through the President's Emergency Plan for AIDS Relief (PEPFAR), launched in 2003 by President Bush; the spread of infectious diseases such as the Ebola and Zika viruses, "bird flu," MERS, and "swine flu" through coordinated global responses; and the rise of antimicrobial resistance through new international programs.[20] The public health programs of governments and foundations, including their partnership through initiatives such as Grand Challenges, have included significant emphasis on harnessing science, technology, and innovation.[21]

Efforts by governments and foundations stimulated by the United Nations Millennium Development Goals and informed by science—combined with economic opportunities made possible by new technologies and accelerating innovation—have helped reduce extreme poverty and improve health. While much of the fall in poverty over the past decade is due to the economic growth in China and other developing countries, the spread of new technologies from the IT revolution, including the explosive growth of mobile phones and the internet, has provided fresh income-generating opportunities for many people in the least-developed countries.

The Paris Agreement on the climate, concluded in 2016, was another great success facilitated by science diplomacy. In this, the partnership of the worldwide scientific community and governments through the Intergovernmental Panel on Climate Change (IPCC) was a game changer.[22] The periodic IPCC reports not only influenced governments by synthesizing the current state of scientific knowledge on climate change with various degrees of certainty, but also provided what could be said from science and engineering about mitigation and adaptation options. The IPCC reports also helped galvanize favorable public opinion around the world. The Summary for Policymakers (SPM), involving IPCC scientists and governments working together in approving "the SPM line by line," is a unique collaboration aimed at strengthening the "science-policy interface."[23] Of course, the Paris climate agreement is only the beginning of what is needed, and it was made possible politically by the agreement between China and the United States and the skillful diplomacy of France.[24] The Trump administration's withdrawal from the agreement in 2017 was a significant setback, but the continuing efforts of U.S. states, cities, the private sector, and civil society will continue to address climate change while waiting for a new administration.

Looking a little deeper historically, the bilateral and multilateral engagement of nongovernmental scientific institutions on science policy and science diplomacy has increased dramatically over roughly the last thirty years. In the 1990s, the U.S. National Academies focused much international engagement on assisting foreign science academies and other scientific institutions to become more important advisors on policy issues with their own governments and societies. To this end, many expert studies covering a wide range of topics were conducted jointly with scientific institutions in Asia, Africa, the Middle East, Eastern Europe, and Russia.[25] The goal was not only for all the participating institutions to develop new insights and policy advice, but for the partner academies to become valued advisors to their own governments and thereby contribute to rational policy making rooted in scientific evidence. Two organizations comprising the world's science academies were created: the InterAcademy Panel focused on capacity building for science academies, including their role in advising governments and the public, and the InterAcademy Council focused on providing global science advice. They are now united in the InterAcademy Partnership (IAP).[26] Through the convening of regional and global meetings of science academies and through the conduct of expert studies, the IAP continues to carry out influential efforts at the request of the United Nations and foundations on a range of policy issues.

In 1999, the U.S. National Academies conducted two studies funded by private sources that informed the development of science diplomacy. The first of these, *The Pervasive Role of Science, Technology, and Health in Foreign Policy: Imperatives for the Department of State*, led to the creation of the Science and Technology Adviser

to the Secretary of State position.[27] The AAAS Science & Technology Fellowships program had already been placing young and midcareer scientists, engineers, and other experts on two-year assignments in the State Department as well as in other U.S. government agencies and Congress.[28] As commemorated by this journal issue, the AAAS created in 2008 its Center for Science Diplomacy and in 2012 its online journal, *Science & Diplomacy*.[29] During my term from 2011 to 2014 as science and technology adviser to the secretary of state, I interacted with many countries on S&T issues. Every one of them—from the most advanced to the least developed—articulated the same first priority in these dialogues: the urgent necessity of strengthening their domestic capacity in science, technology, and innovation. The purpose was to ensure the security, prosperity, and competitiveness of their society in our globalized interconnected world. This convergence in views made science diplomacy a useful tool for influencing countries' behaviors and actions.

Other nongovernmental organizations also became very active in utilizing scientific knowledge and expertise through international engagement to address policy issues and build science capacity. Two examples are the International Institute for Applied Systems Analysis (IIASA) in Vienna, which got its start in the 1970s to facilitate scientific collaboration between Western and Soviet scientists, and CRDF Global, which was created in the 1990s as a way of assisting former weapon scientists in the Soviet Union to transition to civilian scientific pursuits. Both institutions now work closely with scientists from many countries.[30]

International scientific organizations, notably the International Science Council (formerly ICSU) and UNESCO, have expanded their engagement on both science policy and science diplomacy.[31] A recent nongovernmental network created to facilitate science advice and diplomacy is the International Network for Government Science Advice (INGSA), which is holding regional and global meetings that attract a wide audience on these topics.[32] The idea of science advisors in foreign ministries has also taken off over the past decade. Now seven countries have such positions, and a number of others are considering enhancing the scientific expertise in their foreign ministries. A new network, called the Foreign Ministries Science and Technology Advisors Network (FMSTAN), has been created to help strengthen such science and diplomacy infrastructure.[33]

A second influential National Academies study published in 1999 was *Our Common Journey: A Transition toward Sustainability*, with this title echoing the famous Brundtland Commission report of the previous decade, *Our Common Future*.[34] The newer report addressed the role of science, technology, and innovation for moving toward a more sustainable world. It emphasized creating a partnership between scientific communities and societies that would engender a journey of learning and doing, adaptive management and social learning, in addressing

global goals. As the study stated, "Any successful quest for sustainability will be a collective, uncertain, and adaptive endeavor in which society's discovering of where it wants to go is intertwined with how it might get there." It also reinforced using knowledge "intelligently in setting goals, providing needed indicators and incentives, capturing and diffusing innovation, carefully examining alternatives, establishing effective institutions, and, more generally, encouraging good decisions and taking appropriate actions."[35]

This study contributed to the thinking that helped lead the UN to emphasize the importance of strengthening the science-policy interface to harness science, technology, and innovation (STI) for sustainable development. The role of STI became a key part of the UN 2030 Agenda, ratified in 2015 by 193 member states, including the United States. The Technology Facilitation Mechanism was created, and charged with conducting an annual Multi-stakeholder Forum at the UN for addressing the role of STI for achieving the seventeen Sustainable Development Goals (SDGs).[36]

The role of diplomacy in advancing the worldwide scientific and technological enterprise has also received increased attention over the past decade. Science is a globalized endeavor, and scientists and research institutions in many countries are contributing significantly to advances in S&T. Science communities in nearly every discipline, including in the advanced countries, have recognized that staying in the forefront in science requires engaging with the best scientists and facilities throughout the world. Enlisting diplomats to reduce or remove obstacles to international scientific engagement has become a priority for scientific communities everywhere.

Looking Back to Move Forward: Early Efforts to Imagine the Twenty-First Century

In 1997, the U.S. National Academies of Sciences and Engineering, along with the Institute of Medicine, prepared a series of papers under the title *Preparing for the 21st Century*.[37] At the time, I was executive officer of the National Academy of Sciences and National Research Council. This group of six papers addressed critical issues requiring U.S. attention in the coming decades. The topics included science and engineering research, health, education, environment, technology, and human behavior. The concluding recommendations were sensible, but they focused almost exclusively on domestic issues.

This visioning effort by the National Academies missed anticipating or even trying to understand what was happening internationally that could affect the U.S. situation. In retrospect, this oversight is surprising given the heavy involvement of

the Academies throughout that decade in collaborations on science policy, science advice, and science diplomacy with scientific, engineering, and medical institutions in many other countries. After the September 11, 2001, terrorist attacks, it became abundantly clear that international issues would have a dominant impact on U.S. politics, policies, and actions over the next decade and beyond.

As it turned out, two of the most influential studies carried out by the National Academies in the first decade of the twenty-first century dealt with responding to international issues: namely, the threat of terrorism and the challenge of worldwide economic competitiveness. These reports were *Making the Nation Safer: The Role of Science and Technology in Countering Terrorism and Rising above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*.[38] A failure to address the full implications of international trends, these contents made clear, would prevent the U.S. from dealing successfully with our domestic challenges.

When I served as science and technology adviser to the secretary of state, I was quite attracted to several initiatives aimed at predicting future worlds, including possible implications of the S&T revolution on foreign policy. The most significant effort was a series of reports undertaken by the National Intelligence Council (NIC), the hub for the U.S. intelligence community. Every four years, the NIC produces a major foresight effort called Global Trends.[39] Each unclassified report is released shortly after the U.S. presidential election and briefed to the incoming president. And each report, looking out two decades into the future, explores "how trends and choices of note might intersect to create different pathways to the future."[40]

The Global Trends project has sought to "employ rigorous foresight methods, learn from ever more diverse perspectives, and maximize its policy relevance."[41] Before beginning on the fifth installment, the NIC commissioned a review of previous reports to highlight any blind spots or biases. The reviewers cited several challenges, including the need for a greater focus on the U.S. role in the international system, further discussion of crises and discontinuities, increased attention to ideology, and deeper exploration of second- and third-order consequences.[42]

The fifth report, released after the 2012 election, was titled *Global Trends 2030: Alternative Worlds*.[43] It identified four megatrends: (1) individual empowerment facilitated by the IT revolution, growth of the middle class, and a drop in poverty; (2) power shifting to networks and coalitions in a multipolar world; (3) demographic changes, with 60 percent of the world's population living in cities along with more aging countries and increased migration; and (4) greater demand for resources at the food, water, energy nexus. The game changers were identified as the crisis-prone global economy, the so-called governance gap, the potential for increased conflict, the wider scope of regional instability, the impact of transformative and

disruptive technologies, and the role of the United States. Four potential worlds were analyzed, with the "most plausible worst-case scenario" being the increased risk of interstate conflict as the U.S. draws inward and globalization stalls.[44]

The sixth NIC report, released after the 2016 election, was called *Global Trends: Paradox of Progress*.[45] Communicating the belief that "long-term thinking is critical to framing strategy," the report reexamines "key assumptions, expectations, and uncertainties about the future."[46] The use of the term *paradox* in the title reflects the authors' view that "the achievements of the industrial and information ages are shaping a world to come that is both more dangerous and richer with opportunity than ever before. Whether promise or peril prevails will turn on the choices of humankind."[47]

The major trends identified are: (1) the wealthy are aging, the poor are not; (2) the global economy is shifting; (3) technology is accelerating progress but causing discontinuities; (4) ideas and identities are driving a wave of exclusion; (5) governing is getting harder; (6) the nature of conflict is changing; and (7) climate change, environment, and health issues will demand attention. Rising tensions are envisioned in the near future amid the prospect that the "emerging global landscape is drawing to a close an era of American dominance...so, too, perhaps is the rules-based international order that emerged after World War II."[48] Three scenarios explore how trends and choices might intersect to create different pathways to the future: (1) a long period of slow or no growth creating challenges to governments as popular pushback to globalization increases and political instability grows; (2) emerging tensions created by competing major powers seeking their own spheres of influence; and (3) an era of diminished capacity of national governments that opens space for companies, advocacy groups, charities, local governments, and networks using IT to meet growing public expectations for services.

The report ends on an optimistic note in postulating that "shared vulnerabilities and the need for global approaches—such as climate change and expanding terrorist threats—might induce states to increase their resiliency."[49] The Sustainable Development Agenda of the UN and the Framework Convention on Climate Change, enacted in 1994, are seen as positive steps to advance broad strategic goals through cooperation between governments and public-private partnerships. The report emphasizes in its conclusion that "the most resilient societies will also be those that unleash the full potential of individuals."[50]

The other foresight efforts with which I had some interaction while at the State Department were a series of unclassified workshops and dialogues sponsored by intelligence agencies involving a number of countries. These focused primarily on the implications of major scientific and technological advances. The workshops

were fascinating. But in retrospect, I am struck by how much was not anticipated, especially regarding the implications of social media being manipulated by pretend accounts and foreign adversaries, influencing political developments and elections and resulting in the phenomenon now known as "fake news." It is obviously very hard to predict all the implications of disruptive technologies.

In drafting this editorial, I found on my shelf a book published in 1998 titled *Which World? Scenarios for the 21st Century*, by Allen Hammond.[51] I don't remember ever reading it. The author, trained in science, envisioned three scenarios: Market World, Fortress World, and Transformed World. A few excerpts from his description of Fortress World for the industrialized countries, written twenty years ago and looking terribly prescient today, are provided below.

Fortress World

"The U.S. economic boom continued for a few years into the new century but did not lead to social progress. The failure to extend free-trade agreements was ascribed to a growing fear of job loss by unions representing low-skilled workers and the openly isolationist sentiments of the religious right, which had become an increasingly dominant force in the Republican Party. Innovation slowed and recessions reappeared."

"The result was even sharper economic divisions between rich and poor... The political debate over immigration intensified. One presidential candidate promised to lower quotas for legal immigration and to 'fence off' the country's southern border."

"European political deadlock continued into the new century. Economic union had been achieved, but economic reform had not. The European Union's complex regulations...discouraged business innovation. The ranks of the unemployed were a fertile recruiting ground for populist politicians building right-wing parties. The politicians crusaded against foreigners, who they accused of taking European jobs and importing crime, and against the European Union itself...Europe still seemed a haven for many in the poorer countries of south-central Europe, the Middle East, and North Africa, and illegal immigration continued to rise despite all efforts at interdiction."

"As the economic crisis deepened, ultraright parties increasingly attracted mainstream voters who were fed up with political paralysis and drawn to the parties' xenophobic and antigovernment message...Two events heightened Europe's sense of anxiety, gloom, and isolation...Yielding to pressures from both right and left, the European Union adopted stiff tariffs...triggering a trade war

with the United States that rapidly escalated: Japan and many Southeast Asian economies gradually followed...The United States, sensing victory, threatened to pull out of NATO."

"The second event was the Islamic fundamentalist uprising that swept across North Africa, triggering a mass exodus of people fleeing the violence...Flotillas of small boats overwhelmed Spanish and Italian naval patrols...Ultraright parties were swept into office, often as part of coalitions...They demanded the reimposition of internal border controls within the European Union."

"With economic growth stalled in Europe and anemic in Japan and the United States, economic leadership effectively passed to Asia, where the Chinese economy continued to boom...Without U.S. leadership, the late-twentieth-century effort to gain international agreement on measures to protect the climate went nowhere. By 2020, however, the effects of an altered climate were inescapable."

Source for these excerpts is Allen Hammond, Which World? Scenarios for the 21st Century *(Washington, DC: Island Press, 1998), 232–35.*

Although Fortress World was only one of three scenarios envisioned by the author—and not everything did he get exactly right (e.g., the United States is threatening a trade war, not Europe)—his farsightedness in these passages can only be described as extraordinary. He concluded his dystopian portrait by offering a measure of hope: "Pessimistic scenarios are depressing. But they are cautionary tales, not predictions—they need not happen if societies take steps to alter their trajectories."[52] With much of Fortress World having already taken shape, however, it is hard to be very optimistic unless one truly takes the long view.

New Initiatives Seeking to Anticipate and Influence the Future World

Efforts directed at the future are often, as with the National Academies' Preparing for the 21st Century, intended primarily to influence actions to be taken. Two recent examples are worth looking at: one examines pathways from scientific modeling that describe the transformations needed to achieve a desirable future and the second, darker case uses a novelist's tools to paint a realistic scenario wherein events spin out of control, leading to massive casualties from a nuclear conflict.

The report produced by The World in 2050 (TWI2050) initiative, *Transformations to Achieve the Sustainable Development Goals*, is in my view a major contribution from the worldwide scientific community toward solving our global challenges.[53] This

research initiative—launched by the IIASA, the Sustainable Development Solutions Network, and the Stockholm Resilience Centre—brings together a network of more than 150 scientists, modelers, and analysts worldwide. The purpose has been to develop "pathways toward sustainable futures and the policy frameworks needed for implementing the SDGs, and more importantly, for achieving the needed transformational change."

Like many such reports written by scientists, this one is quite verbose, but the fundamental conclusion provides an eloquent vision of what these researchers believe must be done. The report sees six key transformations as essential: (1) implementing advances in human capacity through further improvements of education and health care; (2) implementing responsible consumption and production, allowing us to do more with less; (3) decarbonizing the energy system while providing clean and affordable energy for all; (4) achieving access to nutritional food and clean water for all while protecting the biosphere and the oceans; (5) transforming our cities with smart infrastructure, high-quality services, and a light environmental footprint; and (6) ensuring that the digital revolution is a powerful driver of change to support sustainable development.

The TWI2050 report helps reinforce three areas that I believe are critically important in empowering scientists to help decision makers and the public deal with our major challenges. My perspective has been influenced by two decades of helping oversee the expert studies of the U.S. National Academies of Sciences, Engineering, and Medicine to inform policy choices and actions by the U.S. government and American people. The three areas are: (1) engaging with decision makers and stakeholders to produce road maps on how STI can achieve global and national goals; (2) providing scientific input on the global constraints needed to ensure a stable and resilient earth system; and (3) advising on the implications of rapidly advancing technologies that can be both disruptive and transformational for societies, offering opportunities and challenges.

In preparation for grimmer outcomes, a striking initiative seeking to influence public perceptions and government behavior is the "speculative novel" by arms control analyst Jeffrey Lewis, *The 2020 Commission Report on the North Korean Nuclear Attacks against the United States*.[54] His novel sticks to real events up to the date it went to press in August 2018. The author then weaves a detailed story that reaches a crisis stage in March 2019 with the downing of a South Korean airliner mistaken as a bomber by North Korea. This leads to a pinprick retaliatory strike with six South Korean missiles on two sites, an air force headquarters and a villa within the compound of leader Kim Jong-un. A subsequent tweet by President Trump is interpreted by North Korea as an imminent invasion. That prompts the use of nuclear weapons by North Korea on South Korea and Japan, where U.S. troops and

weapons are based, resulting in massive casualties. As the United States responds militarily with massive conventional weapons but not nuclear weapons, North Korea launches ICBMs with nuclear warheads against sites in Hawaii and the U.S. mainland in a desperate attempt to get Washington to back down. Millions of casualties occur in South Korea, Japan, the United States, and North Korea. The North Korean government and leadership are destroyed, but the impact on the U.S. civilian population in four major cities is devastating. The U.S. government, under President Mike Pence, creates the commission that issues the report on the causes of this calamity and how it could have been avoided.

As compared to dry policy reports, novels and movies portraying such fictional but realistic events can create a much more graphic picture for the general public of what might happen if world events spin out of control of leaders, diplomats, and generals. Whether that will inspire public servants, scientists, and citizens to take action remain to be seen.

Future World Envisioned by Foreign Policy Experts in 2018

The July/August issue of *Foreign Affairs*, as noted earlier, presented six separate visions of the future world. The foreign policy experts who wrote these articles offer cogent and persuasive arguments describing the fundamental forces and trends that they believe will shape the future. It is worth considering the role of science diplomacy in each of these trajectories.

Realist World

The Realist World scenario focuses on great-power politics, anchored in the view that "the course of the coming century will largely be determined by how China and the United States manage their power resources and their relationship."[55] The rise of an economically and militarily mighty China under authoritarian rule, expanding its sphere of influence, challenges U.S. dominance of the "liberal international order" that has defined the last half-century. How the two countries react will be crucial for potential outcomes.

Science diplomacy played a significant role in the renormalization of relations between the two countries in the 1970s and 1980s, facilitating increased scientific collaboration and training of a whole generation of Chinese scientists. China's massive investments in science and technology and its desire to dominate the high-tech industries of the future will likely stimulate a U.S. reaction. The policies and strategy that the United States pursues will involve many aspects of STI and national security policy. Science diplomacy will have an important part in the evolution of this relationship.

Liberal World

While worrying about the rise of illiberal forces and leaders, the Liberal World authors go on to argue that "it is too soon to write the obituary of liberalism as a theory of international relations, liberal democracy as a system of government, or the liberal order as the overarching framework for global politics."[56] This vision emphasizes the resilience, pragmatism, values, and adaptability of liberalism, including its ability to foster reforms to address its deficiencies and to develop cooperative efforts with illiberal states to solve global problems. The challenges that the liberal order faces today, this piece contends, are not greater than what has been faced and overcome before.

Further, the status of liberals as "heirs to the Enlightenment project of technological innovation" emphasizes the importance of STI to both the appeal and the resilience of the liberal order.[57] Science diplomacy is an effective means of utilizing one of the central strengths of the liberal order to advance its values and policies around the world.

Tribal World

The Tribal World piece emphasizes that humans are "tribal animals" and that "the identities that matter most—the ones people will lay down their lives for—are not national, but ethnic, regional, religious, sectarian, or clan-based."[58] This vision ascribes some of the worst blunders in U.S. foreign policy to a lack of understanding of "the power of more primal group identities."[59] To be sure, American politics now reflects deep currents of tribalism.

Because "political tribalism thrives under conditions of economic insecurity and lack of opportunity," a partial antidote requires implementing policies and actions that address the root causes.[60] This prescription includes harnessing STI to help achieve the shared goals of all the tribes. Science diplomacy, if employed effectively, could facilitate this cooperation, thereby moderating the effects of tribalism in domestic politics as well as international relations.

Marxist World

The Marxist World prognosis references Karl Marx's prediction that "capitalism's internal logic would over time lead to rising inequality, chronic unemployment and underemployment, stagnant wages, the dominance of large, powerful firms, and the creation of an entrenched elite whose power would act as a barrier to social progress."[61] Marx also opined that "improvements in labor productivity created by technological innovation would largely be captured by the owners of capital" and

"technology would eliminate jobs."[62] After World War II, advanced democracies reformed capitalism through social policies in ways that brought about "high growth, increasing productivity, rising real wages, technological innovation, and expanding systems of social insurance..."[63] Now the trends are different. The recent decade makes some of Marx's concerns and predictions look eerily prescient.

The challenge for liberal democratic societies is to implement social policies to "tame the excesses of capitalism" while maintaining the dynamism of markets. That will require ameliorating inequality and job loss from automation and tapping STI to help achieve societal goals including increased prosperity and well-being for all people.

Tech World

The Tech World analysis holds that the arc of history really changed with the Industrial Revolution and "the immense economic growth...made possible" by scientific discoveries and technological inventions.[64] According to this worldview, what historians "teach and write about the geopolitics of the nineteenth century are mere footnotes to the Industrial Revolution...the same thing is likely to be true when we—or our robot descendants—write the history of the digital revolution in the twenty-first."[65] The combination of artificial intelligence, big data, robotics, supercomputers, gene editing, nanotechnology, and other innovations will affect and disrupt—positively and negatively—all aspects of human endeavor. AI-driven mass unemployment and anthropogenic climate change are viewed here as two of the most critical developments of the twenty-first century. An upside is seen in the possibility that AI "might well solve the problem of climate change."[66]

While that claim about AI may seem far-fetched, the potential for STI to generate new solutions to global challenges and to advance options to "leapfrog" certain diplomatic obstacles hindering progress is real. Science diplomacy has again a serious role to play, which in this case would be helping anticipate the implications of rapid scientific and technological change and helping inform policies at the national and global levels that can maximize opportunities and minimize negative consequences.

Warming World

"Climate change matters more than anything else," the Warming World piece contends, and is the one threat that will "test the international system in new and unpredictable ways."[67] This vision perceives a rise in international tensions and conflict, especially in developing countries over water, and suggests that the

response of countries "to the effects of climate change may sometimes prove more consequential than the effects themselves."[68]

The actions of China and the United States are "central to the global response," as occurred with the Paris Agreement, despite the ultimate U.S. withdrawal. Advances in STI, including partnerships between the scientific and political communities—as with the IPCC—are essential to developing viable policies and solutions. The STI community will continue to be an indispensable agent for mobilizing political will at the global, national, and subnational levels. Science diplomacy will be at the center of all these responses.

Shaping the Future World

The debate over whether the world is getting better or worse often pits the contrasting visions of optimists versus pessimists. While I usually side with the optimists, like Steven Pinker, the recent political disruption caused by the rise of autocratic populists in democratic countries, especially in the United States, has forced me to appreciate the perspective of critics like Nassim Nicholas Taleb, the author of The Black Swan.[69] As one reviewer put it, "Taleb has responded to Pinker's optimism by distinguishing between 'thin-tailed' historical trends—picture the trailing ends of a bell curve—which are likely to continue indefinitely, and 'fat-tailed' ones, which retain their capacity to surprise."[70] The Realist World author from the *Foreign Affairs* issue expresses the dilemma this way: "Straight-line projections are perilous...history tells us nothing about the future except that it will surprise us."[71]

With that dose of humility, what can one say about the relevance of science diplomacy for the coming decade? All six future world scenarios illuminated in *Foreign Affairs* imply ways for science diplomacy to contribute. Even so, this suite of scenarios may still have overlooked a significant trend in international relations facilitated by the scientific and technological revolution. I believe this trend could produce an optimistic scenario that deals with key challenges identified by the other six.

As I learned from my experience in the State Department, every country in this globalized, hyperconnected world recognizes the necessity of building strong STI capabilities. They see these capabilities as being in their national interest to ensure security and prosperity. The diplomats at the United Nations have also realized that harnessing STI is essential for achieving the seventeen SDGs, which represent social, economic, and environmental aspirations nationally and globally. Because of the predilection of nations to act in their own interest, the twenty-first century

has the potential to produce many more knowledge-based economies that view STI as pivotal for their future.

Science diplomacy then becomes a common mechanism for dealing with the challenges envisioned by Realist World, Liberal World, Tribal World, Marxist World, Tech World, and Warming World. Specifically, science diplomacy can help: (1) manage relations between the United States and China; (2) advance the values of the liberal order; (3) deal with root causes of tribalism; (4) achieve societal goals that capitalism misses; (5) maximize the opportunities and moderate the challenges associated with technological advance; and (6) solve critical global challenges like climate change.

A recent op-ed in the *New York Times* was titled "Science Alone Won't Save the Earth. People Have to Do That."[72] While I certainly agree with this sentiment, I was surprised that the perceptive author did not seem to recognize that the world's political leadership had indeed started talking about what kind of planet we want to live on. The future we want is represented by the seventeen Sustainable Development Goals of the UN 2030 Agenda. Drawing on STI is essential to making progress. While the ultimate success of the 2030 Agenda will be determined by the detailed decisions people make and the actions they take over the next decade, the SDGs are a great gift in helping us aim at a desired future. The scientists and diplomats who practice science diplomacy can aid in that journey.

Endnotes

1. "Which World Are We Living In?" special issue, *Foreign Affairs* 97, no. 4 (July/August 2018), https://www.foreignaffairs.com/articles/2018-06-14/which-world-are-we-li....
2. Micah D. Lowenthal, *Science Diplomacy for Nuclear Security*, special report (Washington, DC: U.S. Institute of Peace, 2011), https://www.usip.org/sites/default/files/SR_288.pdf.
3. David E. Sanger and William J. Broad: "As U.S. Demands Nuclear Disarmament, It Moves to Expand Its Own Arsenal," *New York Times*, May 14, 2018, https://www.nytimes.com/2018/05/14/world/trump-nuclear-savannah-river.html, and "To Counter Russia, U.S. Signals Nuclear Arms Are Back in a Big Way," New York Times, February 4, 2018, https://www.nytimes.com/2018/02/04/us/politics/trump-nuclear-russia.html; Neil MacFarquhar and David E. Sanger, "Putin's 'Invincible' Missile Is Aimed at U.S. Vulnerabilities," New York Times, March 1, 2018, https://www.nytimes.com/2018/03/01/world/europe/russia-putin-speech.html.
4. George W. Bush, State of the Union address, January 29, 2002, https://web.archive.org/web/20111011053416/http://millercenter.org/presi....
5. John Bolton, "Beyond the Axis of Evil: Additional Threats from Weapons of Mass Destruction," Heritage Foundation, May 6, 2002, https://www.heritage.org/defense/report/beyond-the-axis-evil-additional-....
6. Richard Stone, "Iran's Atomic Czar Describes the Art of the Deal," *Science* 349, no. 6249 (August 2015): 674–75, http://science.sciencemag.org/content/349/6249/674.full?sid=3a48be27-341....
7. National Academies of Sciences, Engineering, and Medicine, *U.S.-Iran Engagement in Science, Engineering, and Health (2010–2016): A Resilient Program but an Uncertain Future* (Washington, DC: National Academies Press, 2017), and *National Research Council, U.S.-Iran Engagement in Science, Engineering, and Health (2000–2009): Opportunities, Constraints, and Impacts* (Washington, DC: National Academies Press, 2010).
8. Kathy Wren, "Science Diplomacy Visit to Cuba Produces Historic Agreement," American Association for the Advancement of Science, April 30, 2014, https://www.aaas.org/news/science-diplomacy-visit-cuba-produces-historic....
9. "AAAS-Cuba Partnership in Health Diplomacy Celebrated in Release of 'MEDICC Review' Special Edition," American Association for the Advancement of Science, July 6, 2018, https://www.aaas.org/news/aaas-cuba-partnership-health-diplomacy-celebra....
10. "U.S.-Iraq Higher Education Partnerships Program," International Research & Exchanges Board, https://www.irex.org/project/us-iraq-higher-education-partnerships-program.
11. I was a member of the 2006 delegation to Libya led by Undersecretary of State Paula Dobriansky and aimed at exploring opportunities for U.S.-Libya science cooperation. See U.S. Department of State, "Under Secretary Paula Dobriansky Leads Senior U.S. Delegation to Libya: An Effort to Build Science and Technology Cooperation," July 10, 2006, https://2001-2009.state.gov/r/pa/prs/ps/2006/68783.htm.
12. Edward W. Lempinen, "Syria-U.S. Science Diplomacy Yields Agreement to Seek Collaboration in Water, Energy, Agriculture and Other Fields," American Association for the Advancement of Science, March 23, 2009, https://www.aaas.org/news/syria-us-science-diplomacy-yields-agreement-se....
13. Nadia Ramlagan, "International Collaboration Detects Signs of Molten Rock below Mt. Paektu," American Association for the Advancement of Science, April 14, 2016, https://www.aaas.org/news/international-collaboration-detects-signs-molt....
14. White House, "The President's Speech in Cairo: A New Beginning," https://obamawhitehouse.archives.gov/issues/foreign-policy/presidents-sp....
15. Ibid.
16. U.S. Global Development Lab, https://www.usaid.gov/GlobalDevLab; Partnerships for Enhanced Engagement in Research, http://sites.nationalacademies.org/pga/peer/index.htm.
17. U.S. Science Envoy Program, https://www.state.gov/e/oes/stc/scienceenvoy/.
18. "MERC Funding Process," Middle East Regional Cooperation Program, https://www.usaid.gov/where-we-work/middle-east/merc-funding-process.
19. Newton Fund, http://www.newtonfund.ac.uk.
20. Josh Michaud, Kellie Moss, and Jennifer Kates, "The U.S. Government and Global Health Security," Henry J. Kaiser Family Foundation, November 1, 2017, https://www.kff.org/global-health-policy/issue-brief/the-u-s-government-... "Antimicrobial Resistance," World Health Organization, http://www.who.int/antimicrobial-resistance/en/.
21. Grand Challenges, https://grandchallenges.org/#/map; Global Grand Challenges, Bill and Melinda Gates Foundation, https://gcgh.grandchallenges.org.
22. Intergovernmental Panel on Climate Change, http://www.ipcc.ch/index.htm.

23. IPCC 2014, *Climate Change 2014: Synthesis Report: Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, ed. Core Writing Team, R. K. Pachuri, and L. A. Meyer (Geneva: IPCC, 2014), viii, http://www.ipcc.ch/report/ar5/syr/.
24. Raphaël Ollivier-Mrejen, Pierre Michel, and Minh-Hà Pham, "Chronicles of a Science Diplomacy Initiative on Climate Change," *Science & Diplomacy*, June 2018, http://www.sciencediplomacy.org/perspective/2018/chronicles-science-dipl....
25. For specific reports, visit the National Academies Press at https://www.nap.edu and enter the country of interest into the search bar.
26. InterAcademy Partnership, http://www.interacademies.org.
27. National Research Council, *The Pervasive Role of Science, Technology, and Health in Foreign Policy: Imperatives for the Department of State* (Washington, DC: National Academies Press, 1999).
28. Science & Technology Policy Fellowships, American Association for the Advancement of Science, https://www.aaas.org/program/science-technology-policy-fellowships.
29. Center for Science Diplomacy, American Association for the Advancement of Science, https://www.aaas.org/program/center-science-diplomacy.
30. International Institute for Applied Systems Analysis, http://www.iiasa.ac.at; CRDF Global, http://www.crdfglobal.org.
31. International Science Council, https://council.science; "Science for a Sustainable Future," UN Educational, Scientific, and Cultural Organization, https://en.unesco.org/themes/science-sustainable-future.
32. International Network for Government Science Advice, https://www.ingsa.org.
33. Foreign Ministries Science and Technology Advisors Network, https://www.ingsa.org/chapters/fmstan/. The U.S. State Department does not currently have an appointed or acting science and technology adviser to the secretary of state, but the office continues to function with an acting deputy.
34. National Research Council, *Our Common Journey: A Transition toward Sustainability* (Washington, DC: National Academies Press, 1999). For the Brundtland Commission paper, see *Report of the World Commission on Environment and Development: Our Common Future*, http://www.un-documents.net/our-common-future.pdf.
35. Ibid., 3.
36. UN Sustainable Development Knowledge Platform, https://sustainabledevelopment.un.org.
37. National Academies of Sciences, Engineering, and Medicine, *Preparing for the 21st Century: Science and Engineering Research in a Changing World* (Washington, DC: National Academies Press, 1997).
38. National Research Council, *Making the Nation Safer: The Role of Science and Technology in Countering Terrorism* (Washington, DC: National Academies Press, 2002); and National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, *Rising above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (Washington, DC: National Academies Press, 2007).
39. See the series home page, https://www.dni.gov/index.php/global-trends-home.
40. National Intelligence Council, *Global Trends: Paradox of Progress*, January 2017, p. x, https://www.dni.gov/index.php/global-trends-home.
41. Ibid., 70.
42. National Intelligence Council, *Global Trends 2030: Alternative Worlds*, December 2012, https://www.dni.gov/files/documents/GlobalTrends_2030.pdf; see "Track Record of Global Trends Works," included with the introductory letter from the NIC chairman.
43. Ibid.
44. Ibid., p. ii.
45. National Intelligence Council, Paradox of Progress, https://www.dni.gov/files/documents/nic/GT-Full-Report.pdf.
46. Ibid., vi.
47. Ibid., ix.
48. Ibid., ix.
49. Ibid., 66.
50. Ibid., xi.
51. Allen Hammond, *Which World? Scenarios for the 21st Century* (Washington, DC: Island Press, 1998).
52. Ibid., 235.
53. The World in 2050, *Transformations to Achieve the Sustainable Development Goals* (Laxenburg, Austria: International Institute for Applied Systems Analysis, 2018), http://pure.iiasa.ac.at/15347.
54. Jeffrey Lewis, *The 2020 Commission Report on the North Korean Nuclear Attacks against the United States* (Boston: Mariner Books, 2018).
55. Stephen Kotkin, "Realist World," *Foreign Affairs*, July/August 2018, 10–15, https://www.foreignaffairs.com/articles/world/2018-06-14/realist-world.
56. Daniel Deudney and G. John Ikenberry, "Liberal World," *Foreign Affairs*, July/August 2018, 16–24, https://www.foreignaffairs.com/articles/world/2018-06-14/liberal-world.

57. Ibid., p. 17.
58. Amy Chua, "Tribal World," *Foreign Affairs*, July/August 2018, 25–33, https://www.foreignaffairs.com/articles/world/2018-06-14/tribal-world.
59. Ibid., 26.
60. Ibid., 33. Unfortunately, racism, as one of the root causes of tribalism, is especially hard to eradicate.
61. Robin Varghese, "Marxist World," *Foreign Affairs*, July/August 2018, 34–42, https://www.foreignaffairs.com/articles/world/2018-06-14/marxist-world.
62. Ibid., 35.
63. Ibid., 36.
64. Kevin Drum, "Tech World," *Foreign Affairs*, July/August 2018, 43–48, https://www.foreignaffairs.com/articles/world/2018-06-14/tech-world.
65. Ibid., p. 43.
66. Ibid., p. 48.
67. Joshua Busby, "Warming World," *Foreign Affairs*, July/August 2018, 49–55, https://www.foreignaffairs.com/articles/2018-06-14/warming-world.
68. Ibid., 53.
69. Steven Pinker, *Enlightenment Now: The Case for Reason, Science, Humanism, and Progress* (New York: Viking, 2018); Nassim Nicholas Taleb, The Black Swan: The Impact of the Highly Improbable (New York: Random House, 2007).
70. Joshua Rothman, "Are Things Getting Better or Worse?" *The New Yorker*, July 23, 2018, https://www.newyorker.com/magazine/2018/07/23/are-things-getting-better-....
71. Kotkin, 15, https://www.foreignaffairs.com/articles/world/2018-06-14/realist-world.
72. Erle C. Ellis, "Science Alone Won't Save the Earth. People Have to Do That," *New York Times*, August 11, 2018, https://www.nytimes.com/2018/08/11/opinion/sunday/science-people-environ....