UNIVERSITÀ DEGLI STUDI DI PADOVA

DEPARTMENT OF POLITICAL SCIENCE, LAW

AND INTERNATIONAL STUDIES

Master's degree in

European and Global studies

Science Diplomacy, The Past and Future of International Diplomacy;

Management of Global Crises

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A.Y. 24/25

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ABSTRACT

Science diplomacy as a concept encompasses more than the words science and diplomacy signify on their own. During the tumultuous period between the Second World War, The Cold War and the dawn of the millennium, a vast array of scientific, technological, and medical advances were made. This is the period in which science diplomacy came into full force. It is critical to make the distinction that science diplomacy does not exclusively refer to wartime diplomacy or nuclear weapon negotiations. In examining the rich but not often labeled historical illustrations of science diplomacy, as well as modern case studies I will show that science diplomacy is a key part of past, present and future international diplomacy. In doing so, I will also analyze and critique the role of science diplomacy in international diplomatic relations. Case studies of penicillin development, CERN, COVID-19, and the climate crisis are presented. With an emphasis on the Global South and the decolonization of science diplomacy, my aim is to bring the complex history, accomplishments, and failures of science diplomacy into focus. With the goal to inform policymakers, political actors, and researchers about the possibilities and limitations of science diplomacy, I examine the question: is science diplomacy an effective tool in the management of global crises?

Keywords:

Science Diplomacy; COVID-19; Climate Change; Climate Crisis; Global South; Decolonization; Global Crises; International Diplomacy; Multilateral Diplomacy; South-South Cooperation

Science diplomacy as a concept encompasses more than the words science and diplomacy signify on their own. A 2009 interview of Vaugn Turekian, "then-director of the AAAS…[stated] that science diplomacy is 'the use and application of science cooperation to help build bridges and enhance relationships between and amongst societies, with a particular interest in working in areas where there might not be other mechanisms for engagement at an official level.'"[1] In 2010, The Royal Society along with the American Association for the Advancement of Sciences (AAAS) published some of the first working definitions for various types of science diplomacy; this document outlined three ways that science diplomacy interacts with policy: "informing foreign policy objectives with scientific advice (science in diplomacy); facilitating international science cooperation (diplomacy for science); [and] using science cooperation to improve international relations between countries (science for diplomacy)."[2] These intersections are a starting point for bringing science diplomacy into focus, despite it being a long-running part of diplomacy in practice, it lacked official recognition by name until the 2000s, and came into common parlance in academia in 2010. Simone Turchetti et al explain "a joint Royal Society/AAAS meeting coined the three definitions of science diplomacy that have proved most durable, namely science in diplomacy (use of experts in diplomatic relations), diplomacy in science (mobilizing diplomats in the pro- motion of transnational scientific projects); science for diplomacy (using science as "soft power" or political capital in foreign affairs)."[3]

Economics professor and former attaché of science and technology on behalf of France Pierre-Bruno Ruffini makes a key contribution to defining science diplomacy, illuminating its history, and providing more literature specifically dedicated to this important subject with his book *Science and Diplomacy* published in 2017. He explains that the intersection of science and diplomacy, "is a variation of a more familiar theme, the meeting of science and political power," and that the relationship between science and diplomacy are not confined to exist only in the international sphere of politics and science.[4] Additionally, Ruffini cautions against classifying science diplomacy as primarily a wartime phenomena. He suggests that science and foreign

[1] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017): 11, https://doi.org/10.1007/978-3-319-55104-3.
[2] AAAS & The Royal Society, "New Frontiers in Science Diplomacy. Navigating the Changing Balance of Power.," *Royalsociety.org*, January 2010: *v,* https://royalsociety.org/-/media/Royal_Society_Content/policy/publications/2010/4294969468.pdf.
[3] Simone Turchetti et al., "Introduction," *Historical Studies in the Natural Sciences* 50, no. 4 (September 2020): 326, https://doi.org/10.1525/hsns.2020.50.4.323.
[4] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017): 8, https://doi.org/10.1007/978-3-319-55104-3.

policy achieve more in, "richness and complexity," in times of peace than in the comparatively, "intense" times of war.[5] It is critical to make the distinction that science diplomacy does not exclusively refer to wartime diplomacy or nuclear weapon negotiations. Though it may be perceived as such, the science of science diplomacy is not a synonym for war or military. The science in question also holds space for academics, researchers, scholars, scientists. These are the civilians who, in peacetime, make the rich collaborations and contributions to science diplomacy possible.[6] All of the roles mentioned are important in science diplomacy, as well as the role of policymakers, Sandra López-Vergès et al. highlight that "As we have seen with the Covid- 19 pandemic, science cannot substitute politics, and scientists should not take the role of elected officials. Science and evidence are not the only factors to consider in decision-making, and policymakers must constantly balance competing interests from all sectors of society."[7] Using science diplomacy doesn't magically solve issues of political tensions and policy problems, but it can be used to help demystify scientific data, a frequent area of concussion for policymakers and diplomats and thus empower politicians, policymakers, and diplomats to make better, more effective decisions. E. William Colglazier wrote during the pandemic that "Dealing with this powerful adversary [COVID-19] illustrates what can be lost if the science advisory systems at the national and global levels are flawed and political leaders do not listen to highly expert scientific advice. Of course, politicians have to include other factors besides science in their decisions, but ignoring science until a crisis is a prescription for disaster."[8] Bridging the gap between scientific data and policy decisions is a major goal of science diplomacy. The lens of science diplomacy is from the point at which diplomacy and science meet; Ruffini asserts that "addressing the relationship between science and diplomacy is addressing science diplomacy, which is situated, to start with, in the particular field of international relations where the interests

[5] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017): 9, https://doi.org/10.1007/978-3-319-55104-3.
[6] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017): 9, https://doi.org/10.1007/978-3-319-55104-3.
[7] Sandra López-Vergès et al., "Closing the Gap between Emerging Initiatives and Integrated Strategies to Strengthen Science Diplomacy in Latin America," *Frontiers in Research Metrics and Analytics* 6 (April 12, 2021): 6, https://doi.org/10.3389/frma.2021.664880.
[8] E. William Colglazier, "Response to the COVID-19 Pandemic: Catastrophic Failures of the Science-Policy Interface," Science & Diplomacy, April 9, 2020, https://www.sciencediplomacy.org/editorial/2020/response-covid-19-pandemic-catastrophic-failures-science-policy-interface.

of science and those of foreign policy intersect."[9] Arnaldi adds that "Nonetheless, the positive values of science never fully obscure the reality of international power relations."[10]

Science is often interdisciplinary, especially science that challenges the existing knowledge, organization, or pushes the boundaries of a particular field. "Science diplomacy is a very broad and blurry concept, but this ambiguity is part of its attractiveness...as it helps to navigate the inherent tension between addressing common issues and advancing national interests"[11] Whereas political interactions are often bound and restricted by several layers of historical, cultural, economic nuance, diplomacy, especially science diplomacy, allows an arena for interaction and cooperation with the goal of a shared benefit. The outcomes of science diplomacy cooperation can even be altruistic at times, serving a greater good for all of humankind, not simply a strategic economic or political arrangement between two parties. There is a large opportunity for multinational cooperation within science diplomacy that also supports the building of relationships between countries that may not be on good diplomatic terms in the political sphere. By allowing their scientists to cooperate on projects, all parties can contribute to important scientific work and interact in a space that isn't charged with political tension or bias.

The pursuit of scientific knowledge usually requires a combination of funding or economic interests (in a practical sense), social or cultural interests (a large group of people stand to learn/benefit from the knowledge to be gained), and/or political interests- and the benefit of employing science is that "science has a lot more autonomy than the economic sphere."[12] There is a long and extensive historical framework of science diplomacy. The title of "science diplomacy" being relatively young adds to the sense of its newness, but it was often obscured under the shadow of other fields. Though it may be seen as a "new" field, it existed in practice throughout history, emerging during the Second World War and the Cold War. Near the end of World War II, "it became clear in the United States that the role that science would be called to play in foreign policy would no longer be limited to its links with the military."[13] The period of

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[9] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017): 2, https://doi.org/10.1007/978-3-319-55104-3.
[10] Simone Arnaldi, *Science Diplomacy. Foundations and Practice.* (Edizioni Università di Trieste, 2023): 23, https://www.researchgate.net/publication/372860870_Science_diplomacy_.
[11] Leo Eigner, "The Promise and Paradox of Science Diplomacy," *CSS Analyses in Security Policy* 326 (July 2023): 2, https://doi.org/10.3929/ethz-b-000619331.
[12] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017): 15, https://doi.org/10.1007/978-3-319-55104-3.
[13] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017): 64, https://doi.org/10.1007/978-3-319-55104-3.

World War II made obvious the need for diplomatic relations more than ever; the landscape of war and weapons had changed dramatically since the first World War and with the atomic bomb becoming actualized, the need for science diplomacy became all the more pressing, as the future of the global population would be influenced by the decisions made by the most powerful nations.

The relative youth of science diplomacy as an academic field of study should not limit our consideration of earlier contributions that took place in spite of a lack of vocabulary defining it as such. The official recognition of a field of study can happen decades after people start studying it in practice, as existing fields blur lines and venture into multi-disciplinary areas of study. The institutional recognition of an emerging field and new terminology requires some time to earn the distinction of being worthy of study and of funding. Limiting our scope of study to the 2010s and beyond would be a huge disservice to understanding the deeper historical roots that serve as a foundation and set a precedent for the efficacy of science diplomacy. "While science itself may be apolitical, research and development in areas of Science and Technology (S&T) is often highly politicised, with countries keeping a firm eye on their scientific investments and on any potentially lucrative results."[14] It pays to be informed about the developments of foreign countries; both to make sure that they are not outpacing the capacities at home, and to be aware of where their interests lie, helping to anticipate future actions. However, it is not all espionage and intrigue, "as a global endeavor, scientific knowledge, processes, and objectives provide a common ground as well as solutions that frees politics from its local context and competitive concerns."[15] Scientists are less bound by political tensions in the way that diplomats potentially can be, therefore they are able to be more free to cooperate and share information with cohorts from diverse countries with different perspectives. Free from the fear of making a political misstep, scientists are more flexible in their cooperative capacities as their work is not seen as politically motivated, but rather empirically motivated in an effort to answer scientific questions. Geun Lee and Kadir Ayhan analyze the role of non-state actors in diplomacy and postulate that "relationship-building is a long-term effort and non-state actors have proven more successful in building and maintaining relationships due to their advantages such as their

[14] Vaughan C Turekian et al., "The Emergence of Science Diplomacy," in *WORLD SCIENTIFIC EBooks* (World Scientific, 2014): 5, https://doi.org/10.1142/9789814440073_0001.
[15] Leo Eigner, "The Promise and Paradox of Science Diplomacy," *CSS Analyses in Security Policy* 326 (July 2023): 3, https://doi.org/10.3929/ethz-b-000619331.

credibility based on neutrality (universality), expertise and behavioral relationships; not being trapped in short-term span of political policymaking and being on equal footing with their stakeholders."[16] In a gray area where diplomacy is floundering between two or more contentious states, science diplomacy can help bridge the gap between hostile governments, restricted political actors, and the ability to make a step of progress that is beneficial in some way to all parties. Krige and Barth caution that "in practice, though, the place of science in diplomacy will be contested, especially since the uncertainties that go with doing "good science" will sometimes require an international posture that is tentative, flexible, and open to change, and so not necessarily congenial to diplomats."[17] Of course, science diplomacy is only available as a tool to those governments that are willing to foster and support its use. Eiger reminds us that "in short, the political will to find and implement scientific solutions remains a central factor in science diplomacy."[18]

The sometimes unexpected partnership between science and diplomacy has roots in the past, especially around the time of WWII, "After the war…the international bonds between scientists, and the collaborative practices that expressed them, provided a preestablished platform for the integration of science and scientists into foreign affairs."[19] In the same crucial period, following, "the devastating use of the atomic bomb…scientists became increasingly proactive in efforts to reduce conflict."[20] In 1955 a manifesto was published by a few scientists encouraging fellow scientists of all political beliefs to discuss the potential of the newly developed nuclear weapons.[21] Norman Neureiter, former scientific advisor in Washington DC who joined AAAS in 2004, was interviewed by Jeremy Hsu of livescience.com in 2001, when he explained that science diplomacy is, "an intentional effort to engage with other countries where the relationship is not good otherwise…The science allows you to deal with non-sensitive issues that both sides

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[16] Geun Lee and Kadir Ayhan, "Why Do We Need Non-State Actors in Public Diplomacy?: Theoretical Discussion of Relational, Networked and Collaborative Public Diplomacy," *Journal of International and Area Studies* 22, no. 1 (2015): 72, https://www.jstor.org/stable/43490280.

[17] John Krige and Kai‐Henrik Barth, "Introduction":, *Osiris* 21, no. 1 (January 2006): 17, https://doi.org/10.1086/507133.

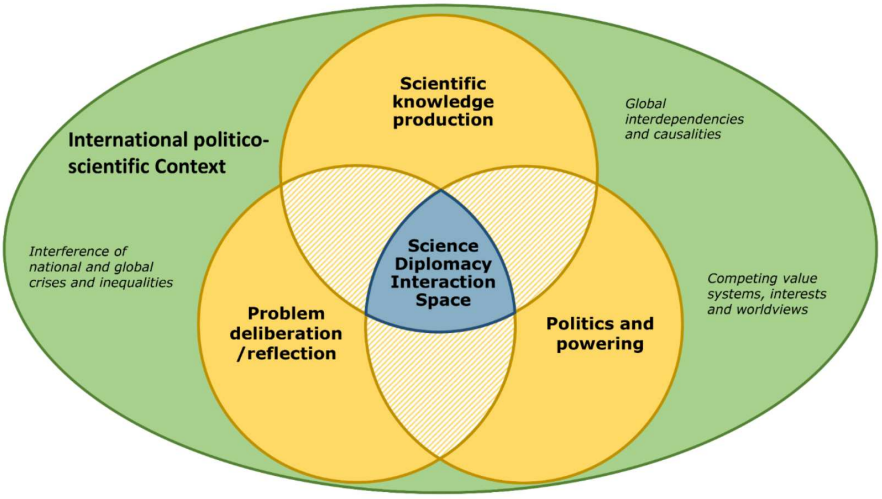
[18] Leo Eigner, "The Promise and Paradox of Science Diplomacy," *CSS Analyses in Security Policy* 326 (July 2023): 4, https://doi.org/10.3929/ethz-b-000619331.

[19] John Krige and Kai‐Henrik Barth, "Introduction":, *Osiris* 21, no. 1 (January 2006): 3, https://doi.org/10.1086/507133.

[20] AAAS & The Royal Society, "New Frontiers in Science Diplomacy. Navigating the Changing Balance of Power.," *Royalsociety.org*, January 2010: 1.

[21] AAAS & The Royal Society, "New Frontiers in Science Diplomacy. Navigating the Changing Balance of Power.," *Royalsociety.org*, January 2010: 1.

can work on together for the good for all."[22] This sort of strategy to establish amicable contact between two parties is something regularly used by psychologists to foster communication and rebuild some level of trust where the ability to communicate has otherwise stopped because of disagreements or a lack of shared perspective between family members, for example. It may still be critical, politically and economically, for countries with a contentious history to communicate and negotiate. "International science cooperation is mainly concerned with the advancement of scientific discovery *per se*, while the central purpose of science diplomacy is often to use science to promote a state's foreign policy goals or inter-state interests."[23] John Krige recalls Alan Waterman's remarks to the congressional commission during the Korean war, ""The development of some of the most vital weapons in our armament stems from open, unclassified fundamental scientific research abroad. Radar, the atomic bomb, jet aircraft, and penicillin were perfected in the United States on the basis of discoveries and research in foreign countries to which we were given ready access.""[24]



Graphic source: Laure-Anne Plumhans, Elke Dall, and Klaus Schuch, "Study on Austrian Actors, Networks and Activities in the Field of Science Diplomacy. Bringing Austrian Science Diplomacy to the next Step: Challenges, State of Play and Recommendations.," repository.fteval.at, September 1, 2021, https://repository.fteval.at/id/eprint/582/.

[22] Jeremy Hsu, "Backdoor Diplomacy: How U.S. Scientists Reach out to Frenemies," livescience.com, April 8, 2011, https://www.livescience.com/13638-science-diplomacy-soft-power.html.
[23] Vaughan C Turekian et al., "The Emergence of Science Diplomacy," in *WORLD SCIENTIFIC EBooks* (World Scientific, 2014): 6, https://doi.org/10.1142/9789814440073_0001.
[24] John Krige, *American Hegemony and the Postwar Reconstruction of Science in Europe*, *Google Books* (MIT Press, 2008): 69, https://books.google.it/books/about/American_Hegemony_and_the_Postwar_Recons.html?id=Oekybw092moC&redir_esc=y.

Science *for* diplomacy has been characterized as a soft power, as originally described by Nye[25] and later discussed by many authors. "International science cooperation tends to be driven by individuals and groups, whereas science diplomacy, while it may derive from the efforts of individuals, often involves a state-led initiative in the area of scientific collaboration."[26] "Soft power describes the "power of co-optation" by which a country can exert influence by playing the seduction and persuasion, its objective being to bring others to share its values, to reproduce its models, to "think like it.""[27] In 1990, Joseph Nye wrote an article that defined the term "soft power." He explains that the power wielded by nations on an international stage underwent an evolution in the 20th century. "Traditionally the test of a great power was its strength in war. Today, however, power used in diplomacy is losing its emphasis on military force and conquest that marked earlier eras. The factors of technology, education, and economic growth are becoming more significant in international power, while geography, population, and raw materials are becoming somewhat less important."[28] In 2017, decades after Nye first wrote about soft power, Ruffini explains that "science diplomacy is part of soft power, and so are the international promotion of national language or cinema, etc."[29] According to Turekian et al. citing Nye, in its ability to influence leverage between countries, "Science diplomacy is a significant generator of *soft power* (Nye, 2004) — that potent form of attraction that harnesses national image, reputation, and brand."[30]So, if soft power is the most valuable political tool of the 20th and 21st centuries, can we be sure that science diplomacy is, indeed, a part of soft power? Nye also claims that " Proof of power lies not in resources but in the ability to change the behavior of states."[31] This statement rings true even more strongly in the 21st century, with newer tools like social media being employed to subtly influence the actions and opinions of entire groups of people. In 1990, Nye foresaw the huge impact of information on our lives in the 21st century; "Information becomes power, especially before it spreads. Thus a capacity for

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[25] Joseph S. Nye, "Soft Power," *Foreign Policy*, no. 80 (1990): 153, https://doi.org/10.2307/1148580.
[26] Vaughan C Turekian et al., "The Emergence of Science Diplomacy," in *WORLD SCIENTIFIC EBooks* (World Scientific, 2014): 6, https://doi.org/10.1142/9789814440073_0001.
[27] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017), 13, https://doi.org/10.1007/978-3-319-55104-3.
[28] Joseph S. Nye, "Soft Power," *Foreign Policy*, no. 80 (1990): 154, https://doi.org/10.2307/1148580.
[29] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017), 15, https://doi.org/10.1007/978-3-319-55104-3.
[30] Vaughan C Turekian et al., "The Emergence of Science Diplomacy," in *WORLD SCIENTIFIC EBooks* (World Scientific, 2014): 5, https://doi.org/10.1142/9789814440073_0001.
[31] Joseph S. Nye, "Soft Power," *Foreign Policy*, no. 80 (1990): 155, https://doi.org/10.2307/1148580.

timely response to new information is a critical power resource. With the rise of an information-based economy, raw materials have become less important and organizational skills and flexibility more important."[32] "By its relationship with armament and defense policies (especially in nuclear and aerospace industries), science is historically linked to hard power."[33] In spite of this historical association, there has been a change in the perception of science, and diplomacy heightens the importance of a "knowledge society"[34] revealing a "growing interdependence between science and diplomacy in foreign policy of states."[35]

Upon examination of the history of science in diplomatic relations, science diplomacy may seem to be a small category of diplomacy, but funding, political interests, and power on a global scale are all inherently tied to scientific capabilities; hence the elevation of the importance of science diplomacy in modern, global, science and tech-dependent societies. Since the second World War, there has been an increase in "multilateral diplomacy," aided by the emergence of the United Nations as a central organization for diplomacy and cooperation.[36] The extensive geopolitical impact and newly minted weapons of mass destruction used in World War II made it clear that a move toward multilateral diplomatic relations would be necessary for the increasingly globalized world. According to Turchetti, "Left out of atomic information sharing, the Soviets certainly resented the other allies for boasting the merits of a grand alliance while being selective in making "science diplomacy" agreements. Their sense of disappointment and betrayal may even explain the increase of Soviet-led espionage activities."[37] Per Lord and Turekian, in modern diplomacy as of the 2000s, "Old-fashioned diplomacy between governments, while necessary, is no longer sufficient."[38] They assert that soft power and less conventional methods of diplomacy will take a more important role in the future of diplomacy.

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[32] Joseph S. Nye, "Soft Power," *Foreign Policy*, no. 80 (1990): 164, https://doi.org/10.2307/1148580.
[33] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017): 14, https://doi.org/10.1007/978-3-319-55104-3.
[34] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017): 14.
[35] Philippe Lane, *Présence Française Dans Le Monde. L'action Culturelle et Scientifique*, *SHS Cairn.info* (2024; repr., La Documentation française, 2016): 55, https://shs.cairn.info/presence-francaise-dans-le-monde--3303331954262?lang=fr. Note: translation by Ruffini in *Science and Diplomacy* (2017).
[36] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017): 6, https://doi.org/10.1007/978-3-319-55104-3.
[37] Simone Turchetti, "The (Science Diplomacy) Origins of the Cold War," *Historical Studies in the Natural Sciences* 50, no. 4 (September 2020): 430, https://doi.org/10.1525/hsns.2020.50.4.411.
[38] Kristin M. Lord and Vaughan C. Turekian, "Time for a New Era of Science Diplomacy," *Science* 315, no. 5813 (February 9, 2007): 769, https://doi.org/10.1126/science.1139880.

Turekian et al. explain that, "Throughout the second half of the 20th century, science played many important roles in diplomacy."[39] Scientists and historians of science and technology John Krige and Kai-Henrik Barth explain that "in the first two decades after World War II, the United States was determined to use scientific and technological collaboration as an instrument to contain nuclear proliferation, assisting in building the strength of its allies but also channeling their resources along nonnuclear paths as far as possible."[40] As early as the World War II era, it became clear to governments, especially the United States government, that it was a worthwhile endeavor to focus on shaping other countries interests and pursuits. Once nuclear capabilities were possible and in the hands of various global powers, the stakes were too high to ignore the importance of science diplomacy and other soft negotiation techniques. Direct political action was often seen as too direct or perceived as a threat, so using science diplomacy to persuade adversaries became an extremely desirable alternative. The cycle continued after World War II and was brought out of the shadows. According to John Krige, "International scientific exchange gained further urgency in a postwar world that was dedicated to the elimination of racism, nationalism, and xenophobia in Europe. Science was seen as having a key cultural role to play as a bearer of liberal democratic values."[41] By some, science was perceived to be a potential solution to the hatred and bigotry that led to the events of WWII. The United States sprung into action promoting scientific exchange, they stood to gain a great deal of knowledge by mining the scientific minds of European nations. Even in the 1970s "it was a recognition in US policy circles that the globalization of science diplomacy was a long-term concern requiring a dedicated effort to study the phenomenon and understand its global extent."[42] The fact that it was openly discussed in the 1970s by political advisors means that this phenomenon existed behind closed doors for likely decades prior to becoming open knowledge; the U.S. government tends to be tight lipped regarding issues of national security. Throughout the 1970s, change was afoot, "the emerging multipolar reality of international science and technology meant adjusted strategies for

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[39] Vaughan C Turekian et al., "The Emergence of Science Diplomacy," in *WORLD SCIENTIFIC EBooks* (World Scientific, 2014): 8, https://doi.org/10.1142/9789814440073_0001.

[40] John Krige and Kai‐Henrik Barth, "Introduction," *Osiris* 21, no. 1 (January 2006): 12, https://doi.org/10.1086/507133.

[41] John Krige, *American Hegemony and the Postwar Reconstruction of Science in Europe*, *Google Books* (MIT Press, 2008): 12, https://books.google.it/books/about/American_Hegemony_and_the_Postwar_Recons.html?id=Oekybw092moC&redir_esc=y.

[42] Sam Robinson et al., "The Globalization of Science Diplomacy in the Early 1970s: A Historical Exploration," *Science and Public Policy* 50, no. 4 (June 9, 2023): 755, https://doi.org/10.1093/scipol/scad026.

Cold War Superpowers, European interests, and the socialist world and new if tenuous opportunities were present for recently independent countries."[43]

"The Cold War can be regarded as a period when interactions between science and foreign affairs asserted themselves, even if no one spoke of science diplomacy at that time."[44] The Cold War is an excellent example of science diplomacy in action before it was known as such. During this tumultuous period between the second World War and the dawn of the millennium, a vast array of scientific, technological, and medical advances were made. Surrounding such advances was a high level of secrecy for the protection of proprietary assets and potential advantages against allies. The United States and the Soviet Union caused a polarization of much of the world during this tension-filled time. The Space Race provided an especially poignant example of science diplomacy during a period of unprecedented modern tension. Leo Eigner, researcher of science and technology policies, writes that, "during the Cold War era of détente, science diplomacy was explicitly used as a foreign policy instrument."[45]

In May 1972, US president Nixon met with Soviet Premier Kosygin to sign an agreement about the creation of a common docking system.[46] This agreement would later allow the Apollo-Soyuz test project to come to fruition in 1975. In the early 1970s, this was quite a surprising development coming from two countries that were sworn and hostile enemies for decades. "The scientific ethos of objective experimentation through trial and error has broad appeal: it promotes merit (through peer review); openness (through publication); and civic values and citizen empowerment (through the encouragement of respect for diverse perspectives).[47] "In many ways, the Cold War period initiated the beginnings of science diplomacy, as states used scientific collaboration to build bridges and connections despite the existence of great political tensions."[48] The science diplomacy seen through the Cold War showed the world that there was a path forward even in the most dire and politically charged geopolitical situations. According to

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[43] Sam Robinson et al., "The Globalization of Science Diplomacy in the Early 1970s: A Historical Exploration," *Science and Public Policy* 50, no. 4 (June 9, 2023): 755, https://doi.org/10.1093/scipol/scad026.
[44] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017): 6.
[45] Leo Eigner, "The Promise and Paradox of Science Diplomacy," *CSS Analyses in Security Policy* 326 (July 2023): 2, https://doi.org/10.3929/ethz-b-000619331.
[46] John Uri, "50 Years Ago: The United States and the Soviet Union Sign a Space Cooperation Agreement - NASA," NASA. (May 23, 2022) https://www.nasa.gov/history/50-years-ago-the-united-states-and-the-soviet-union-sign-a-space-cooperation-agreement/.
[47] Vaughan C Turekian et al., "The Emergence of Science Diplomacy," in *WORLD SCIENTIFIC EBooks* (World Scientific, 2014): 4, https://doi.org/10.1142/9789814440073_0001.
[48] Vaughan C Turekian et al., "The Emergence of Science Diplomacy," in *WORLD SCIENTIFIC EBooks* (World Scientific, 2014): 8.

Turekian et al. “an advisor to then-Secretary of State Henry Kissinger states to *Science* magazine that ‘[the secretary of state] thinks that America’s ability to contribute money and run the world in the old fashioned way … is now over. What we can contribute — and what the world wants — is our technological capabilities’ (Wade, 1974).”[49] By the 1970s the shift to technology as the most powerful tool was in full effect. The world had entered into a more diplomatic, globalized reality where soft power would be the preferred method to incite change and build agreements. Of course, wars did not cease to happen, but with the global knowledge of just how powerful atomic weapons are, leaders in every powerful nation sought other means of negotiation and diplomacy before resorting to nuclear attacks. If paired with something as critical to people’s quality of life globally as the advancement of science and technology, international relations can expect to have a smoother journey on the way to successful negotiations and relationships with other countries. In addition to modern vaccine development, there are many historical examples of scientific cooperation under the umbrella of science diplomacy. In the time of the Cold War, “scientific organizations were an important conduit for informal discussion of nuclear issues between the United States and the Soviet Union.”[50] In modern times, “science [still] offers alternative channels of engagement.”[51]

Dados and Connell describe the Global North/South terminology as referencing “an entire history of colonialism, neo-imperialism, and differential economic and social change through which large inequalities in living standards, life expectancy, and access to resources are maintained.”[52] The terminology of Global North and Global South emerged in the middle of the 20th century. The Global North refers to Europe, North America, Australia and New Zealand, typically. Regions that developed rapidly during the industrial revolution and whose economies and governments historically generated the most capital and wielded the most power on a global scale. According to Derya Büyüktanir Karacan and Pierre-Bruno Ruffini, the Global South “...designate[s] all emerging and developing countries, most often located in the Southern

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[49] Vaughan C Turekian et al., “The Emergence of Science Diplomacy,” in *WORLD SCIENTIFIC EBooks* (World Scientific, 2014): 7, https://doi.org/10.1142/9789814440073_0001.
[50] AAAS & The Royal Society, “New Frontiers in Science Diplomacy. Navigating the Changing Balance of Power.,” *Royalsociety.org*, January 2010: *v.*
[51] AAAS & The Royal Society, “New Frontiers in Science Diplomacy. Navigating the Changing Balance of Power.,” *Royalsociety.org*, January 2010: *v.*
[52] Nour Dados and Raewyn Connell, “The Global South,” *Contexts* 11, no. 1 (February 2012): 13, https://doi.org/10.1177/1536504212436479.

Hemisphere and home to approximately 80 per cent of the world's population."[53]The balance is shifting as economies like China have become competitive with those in the Global North, but for academic purposes, these broad categories are helpful to make observations on a global and regional level. Büyüktanir Karacan and Ruffini go on to explain that "the countries of the Global South have two common characteristics. The first is economic: overwhelmingly, their level of development, as measured, for example, by GDP per capita, is lower than that of the countries of the Global North, where wealth and power are concentrated. In particular, their national S&T system is less developed. The second characteristic is geopolitical: these countries, most former colonies, are often dominated in global power relations while reluctant to align themselves with one or other of the powers of the developed world. Each of these dimensions is essential to understanding Global South perspectives on SD."[54] These two key elements help define and categorize the challenges faced by countries in the Global South. In chapters three and four I will elaborate further on the relationship between science diplomacy, the Global North and the Global South. Dados and Connell add that the term "[Global South] is one of a family of terms, including "Third World" and "Periphery," that denote regions outside Europe and North America, mostly (though not all) low-income and often politically or culturally marginalized."[55]

The power balance between the Global North and the Global South in the 20th century remained dramatically polarized even with imperialist powers losing their firm grip in many former colonies. At the same time, the concept of globalization was taking hold and the lives of people around the world became more connected as information, communication, and culture became easier to share rapidly. Robinson et al. posit that "the underlying condition of this historic globalization was the increasing importance of the Global South in science diplomacy. In this, there was consternation, even disruption, for hegemonic powers."[56] Change was afoot, and new governments were finding their voice on a global stage; "Between 1945 and 1960, three dozen new states in Asia and Africa achieved autonomy or outright independence from their

[53] Derya Büyüktanir Karacan and Pierre-Bruno Ruffini, "Science Diplomacy in the Global South—an Introduction," *Science and Public Policy/Science & Public Policy* 50, no. 4 (June 13, 2023): 743, https://doi.org/10.1093/scipol/scad028.
[54] Derya Büyüktanir Karacan and Pierre-Bruno Ruffini, "Science Diplomacy in the Global South—an Introduction," *Science and Public Policy/Science & Public Policy* 50, no. 4 (June 13, 2023): 743.
[55] Nour Dados and Raewyn Connell, "The Global South," *Contexts* 11, no. 1 (February 2012), https://doi.org/10.1177/1536504212436479.
[56] Sam Robinson et al., "The Globalization of Science Diplomacy in the Early 1970s: A Historical Exploration," *Science and Public Policy* 50, no. 4 (June 9, 2023): 755, https://doi.org/10.1093/scipol/scad026.

European colonial rulers."[57] There was a massive shift in power where many formerly colonized countries gained independence in a short time. Nye explains that "throughout history, anxiety about decline and shifting balances of power has been accompanied by tension and miscalculation."[58] A statement as true today as it was 200 years ago. Suddenly, following World War II, many nations had new governments, some effective and elected, others came to power after lengthy civil wars. These new nations often had vast natural resources and poor economic starting points, thus their shift to self governance and the change of the geo-political landscape affected international relations at large.[59] In 1990, Joseph Nye warned that "all major states will have to confront the changing nature of power in world politics."[60]

The approach I will take to answer my research question will be one of systematic review of existing literature, analysis of the current framing of science diplomacy, and an assessment of its practical application. The challenge in analyzing an emerging academic field of study is that much of the relevant literature exists under the umbrella of other fields of research, so finding the texts needed can be more of an investigation than a simple search in a as would be the case for more established fields of study. In the case of science diplomacy, its long existence in practice does not translate to many texts specifically dedicated to the field. Fortunately, there exists the work of the AAAS/Royal Society, Pierre-Bruno Ruffini, and Vaughn Turekian as a baseline that serves to anchor the field as a proper phenomenon in its own right. Their work, along with many others, paves the way for the establishment of science diplomacy as an important area of academic study- one that shapes and influences the political, social, and cultural sphere. I will also review literature from the fields of political science, diplomacy (especially WWII and Cold War periods), history of science and technology, and international relations. By casting a broad net, I ensure that I capture the complexities and nuances of science diplomacy and paint a more accurate picture by taking multiple perspectives. Using a diverse set of vantage points will also allow me to better show that science diplomacy is more than just isolated examples of science within diplomacy- it is a topic in and of itself worthy of analysis; with resulting global political implications to show for it. Science diplomacy carves out its own unique space connecting

[57] Office of the Historian, "Decolonization of Asia and Africa, 1945–1960," Office of the Historian, 2019, https://history.state.gov/milestones/1945-1952/asia-and-africa.
[58] Joseph S. Nye, "Soft Power," *Foreign Policy*, no. 80 (1990): 153, https://doi.org/10.2307/1148580.
[59] Office of the Historian, "Decolonization of Asia and Africa, 1945–1960," Office of the Historian, 2019, https://history.state.gov/milestones/1945-1952/asia-and-africa.
[60] Joseph S. Nye, "Soft Power," *Foreign Policy*, no. 80 (1990): 156.

scientific cooperation with diplomatic relations. Pierre-Bruno Ruffini writes that states have been using science diplomacy, "for decades," but the term was not in existence until around the year 2000, and the lack of literature is an obstacle for studying this emerging field.[61] "The concept of [science diplomacy] seems to be a moving target, a concept with loose boundaries that is increasingly used as a catch-all concept in different fields."[62]

In spite of science diplomacy being considered an emerging field of research, I will examine the historical context of science diplomacy through case studies to illuminate its relevance in an international political sphere. In order to establish a clear framework for defining science diplomacy, I will evaluate it as a critical tool for diplomatic relations between states. My aim is to demystify science diplomacy and demonstrate its use as a tool for enhancing diplomatic relations between states is effective. My research question: Is science diplomacy an effective tool for global crises? I will emphasize the COVID-19 pandemic and the climate crisis as my main points of focus. Additionally, I will propose predictions and suggestions for the future practice of science diplomacy, especially involving the Global South.

CHAPTER 2: Historical context: Penicillin, the Manhattan Project, CERN

There are a plethora of examples illustrating the intersection and interdependence of science with other fields. I will focus on a few examples under the umbrella of science diplomacy. Nuclear research and the race to create an atomic bomb is commonly viewed as a starting point for science diplomacy, but I will argue that there is an excellent earlier example. Firstly, the research and development of penicillin, which predated the development of the atomic bomb and the research included in the Manhattan project.

Alexander Fleming made the discovery of penicillin in 1928, but it wasn't isolated as a pure form until 1940 by Howard Florey and his team of scientists at Oxford. Meanwhile, in 1935, Prontosil was announced as a cure for "serious infections."[63] This was one of the first sulfanilamide (frequently called "sulfa") containing drugs to be discovered. As far as the scientific community was concerned, sulfa drugs continued to be a medical professional's best choice in curing a wide range of illnesses, a quickly discovered solution to the problem of "bad"

[61] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017): 9.
[62] E. Epping, "Lifting the smokescreen of science diplomacy: comparing the political instrumentation of science and innovation centres." *Humanit Soc Sci Commun* 7, 111 (2020): 2, https://doi.org/10.1057/s41599-020-00599-4.
[63] David P. Adams, "The Penicillin Mystique and the Popular Press (1935-1950)," *Pharmacy in History* 26, no. 3 (1984): 134, https://www.jstor.org/stable/41109501.

bacteria in the body, and a result of the germ theory of disease emerging in the late 19th century.[64] After many years of little or slow progress in the cultivation of penicillin by Florey and his team, enough progress was made to merit in depth analysis of penicillin as a therapeutic medication in patients. The scientists needed help in order to efficiently produce enough of the drug to study its dosage and effects against a variety of bacterial infections. The British government did not agree with the researchers' assertion that mass production of penicillin was a priority since they were already under strain to keep up with wartime production efforts, so the team approached the U.S. department of agriculture for the task. Florey used a connection to a former colleague at Oxford "The War Production board realized the importance of penicillin" and large-scale production began in facilities in the United States in 1943.[65] After being ignored by the scientific community for years as a fluke discovery and labeled as impossible to produce in adequate quantities, penicillin faced a shift in attitudes, both professional and public, which was also fueled by the drug's growing media coverage in the early 1940s. American newspapers had lauded the alleged miracle drug as an advantage that the allies could rely on to bring more of their troops home, and ultimately a part of the widespread attitude that the United States and its allies were bound to be victorious.[66] The fact that penicillin was being produced in American facilities for distribution to allied forces surely struck a chord with citizens of the United States and fueled their sense of benevolent superiority. There was a near mythical heralding of the drug as well as a willful ignorance of its potential negative effects in some patients. "The way in which popular magazines presented penicillin to the American public was entirely different from the coverage the sulfas received… as the years went by penicillin's pristine image remained unstained," in contrast to the increasingly critical reporting on sulfas.[67] Penicillin was again portrayed as "liquid gold" by its critical role in the film *The Third Man,* by Carol Reed, starring Orson Welles, in 1949. Wells plays Harry Lime, around whom a murder investigation is centered throughout the film. Lime is accused of having been involved in the underground market for penicillin during WWII. Stealing vials of penicillin from military hospitals in Vienna, diluting

[64] David P. Adams, "The Penicillin Mystique and the Popular Press (1935-1950)," *Pharmacy in History* 26, no. 3 (1984): 134, https://www.jstor.org/stable/41109501.
[65] Anthony Julius Scibilia, "Being Prometheus in 1943," *Pennsylvania History: A Journal of Mid-Atlantic Studies* 80, no. 3 (2013): 443, https://www.jstor.org/stable/10.5325/pennhistory.80.3.0442.
[66] David P. Adams, "The Penicillin Mystique and the Popular Press (1935-1950)," *Pharmacy in History* 26, no. 3 (1984): 136.
[67] David P. Adams, "The Penicillin Mystique and the Popular Press (1935-1950)," *Pharmacy in History* 26, no. 3 (1984): 136.

the drug, and reselling it on the black market, was a criminal phenomenon in the WWII era and is referenced in *The Third Man*. (Image below from *The Third Man*, Carol Reed, 1949.)

American audiences (as well as those internationally) were captivated by the espionage and intrigue surrounding the story of illegal trading, smuggling, and black market reselling of Penicillin in Austria during the second World War. "In July 1943, the War Production Board made plans for widespread distribution of penicillin stocks to Allied troops fighting in Europe. Then scientists worked round-the-clock to prepare for an ultimate goal: having enough to support the D-Day invasion."[68] At the end of 1942, enough penicillin was available to treat fewer than 100 patients. The plan for production was a success and "by September 1943, however, the stock was sufficient to satisfy the demands of the Allied Armed Forces."[69]

The discovery and production of penicillin for medical use was a long and winding road that nearly failed to come to fruition at several stages. Discovered by Scottish scientist Alexander Fleming in 1928, Penicillin was originally deemed too difficult to produce in large enough quantities to perform scientific tests of efficacy in patients. The scientific community paid almost no attention to Fleming's published paper in 1929 about the discovery of penicillin, and he diverted his attention to other scientific pursuits. The attempt to study penicillin by a handful of other scientists on Fleming's team was abandoned, due to the, "highly unstable" nature of the mold from which penicillin would be extracted; it seemed to be a waste of resources and effort

[68] Diane Bernard, "How a Miracle Drug Changed the Fight against Infection during World War II," *Washington Post*, (July 11, 2020) https://www.washingtonpost.com/history/2020/07/11/penicillin-coronavirus-florey-wwii-infection/.
[69] Robert Gaynes, "The Discovery of Penicillin—New Insights after More than 75 Years of Clinical Use," *Emerging Infectious Diseases* 23, no. 5 (May 2017): 850, https://doi.org/10.3201/eid2305.161556.

for a possibly fruitless endeavor.[70] Then, the world spun into chaos as the second world war began. The desperate and immediate need for antibacterial drugs in wartime is how penicillin became an unlikely hero in a time of tragedy. The drug played an important role as an instrument of international science diplomacy. International cooperation and science diplomacy in World War II provide an insight to the early stages of globalization that can help scientists, diplomats, and policymakers practice careful, strategic, and effective international relations decisions in the future. "A globalizing world has eroded the old dichotomy between science and diplomacy, and helped to facilitate the emergence of science diplomacy whereby scientific collaborations among nations are necessary to tackle increasingly common challenges."[71]

Penicillin was initially discovered by Scottish physician and microbiologist Alexander Fleming in a somewhat accidental manner while working in St. Mary's hospital in London. After discovering the eventual miracle drug, Fleming found himself unable to convince his peers of the importance of his discovery, of which there were two main problems: first, the difficulty in producing large enough quantities to study and second, the fact that he had not been successful in isolating the main compound. His contemporaries were unimpressed and dismissed Fleming's claims of having discovered an important fungus with huge potential for medical use. Almost abandoned as a medicine because it was extremely difficult to produce in adequate quantities to test for medical use, penicillin took an unconventional path into the spotlight. In studying lysozyme, a protein with antimicrobial properties found in tears, saliva, and mucus, Ernst Boris Chain eventually directed his attention to other antimicrobial substances, one of which was penicillin.[72] It is unclear what exactly sparked Howard Florey's interest in penicillin, but there is speculation by Sir Henry Harris, a scientist who studied under Florey in the early 1950s, that Chain was the catalyst. Together with Norman Heatley and others, the team at Oxford was determined to produce enough penicillin to enable them to isolate it, and they eventually succeeded.[73] Since British pharmaceutical companies were already busy manufacturing drugs for the war effort and the government was in a particularly conservative period, Florey's team was

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[70] H. Harris, "Howard Florey and the Development of Penicillin," *Notes and Records of the Royal Society of London* 53, no. 2 (May 22, 1999): 244, https://doi.org/10.1098/rsnr.1999.0078.
[71] Vaughan C Turekian et al., "The Emergence of Science Diplomacy," in *WORLD SCIENTIFIC EBooks* (World Scientific, 2014): 3, https://doi.org/10.1142/9789814440073_0001.
[72] H. Harris, "Howard Florey and the Development of Penicillin," *Notes and Records of the Royal Society of London* 53, no. 2 (May 22, 1999): 246.
[73] H. Harris, "Howard Florey and the Development of Penicillin," *Notes and Records of the Royal Society of London* 53, no. 2 (May 22, 1999): 248.

refused help for mass production in Britain.[74] The tedious process of producing enough penicillin to be used on patients put an enormous strain on the Oxford lab, where the team had resorted to using all kinds of vessels for growing their liquid gold- even using bedpans on loan from another department of the hospital at one point. Florey and Heatley traveled to the United States from England in July of 1941 to ask for help from American drug companies.[75] This international cooperation resulted in a high volume of penicillin being produced and distributed to allied troops, thanks to the larger facilities and capabilities of drug companies in the United States, combined with the research and determination of scientists working in the United Kingdom. Because the United States had not yet joined the war, resources could be allocated to production of penicillin on a scale unimaginable compared to what had been produced at Oxford. Peter Neushul explains that in studying the governmental effort to produce penicillin, "most either overlook entirely or at best minimize the important role played by scientists at the U.S. Department of Agriculture's Northern Regional Research Laboratory (NRRL), where mass production of penicillin first became a reality. Even less attention is given to the War Production Board's role in building penicillin production facilities and encouraging research…[The board's funded research led] to the development of the first *Penicillium* 'super strains.'"[76] Building on the research of scientists in the United Kingdom, scientists at the U.S. Department of Agriculture were able to produce mass quantities of high quality penicillin which would go on to provide the allied soldiers with a huge advantage

Advertisement for penicillin in Life Magazine by an unknown artist, August 14, 1944 issue. *Image: National World War II Museum*

[74] Robert Gaynes, "The Discovery of Penicillin—New Insights after More than 75 Years of Clinical Use," *Emerging Infectious Diseases* 23, no. 5 (May 2017): 851, https://doi.org/10.3201/eid2305.161556.
[75] Anthony Julius Scibilia, "Being Prometheus in 1943":, *Pennsylvania History: A Journal of Mid-Atlantic Studies* 80, no. 3 (2013): 443, https://doi.org/10.5325/pennhistory.80.3.0442.
[76] Peter Neushul, "Science, Government, and the Mass Production of Penicillin," *Journal of the History of Medicine and Allied Sciences* 48, no. 4 (1993): 372, https://www.jstor.org/stable/24623264.

in World War II. The use and availability of penicillin saved thousands of soldier's lives, who may have otherwise died from treatable wounds or illnesses. According to Harris, "without Fleming, no Chain or Florey; without Chain, no Florey; without Florey, no Heatley; without Heatley, no penicillin."[77] From its happenstance discovery and tenuous route to isolation and production to a miracle drug for allied troops, the journey of penicillin is an excellent expression of science diplomacy, even at a time when the term was not yet used. Penicillin had a serendipitous discovery and path into the public consciousness. It is also of note that penicillin's success and cultivation was due to the passion of a few scientists who ventured out of their own country to ask for help from an allied government (the United States, in this case) in the production of their important wonder drug. The story of penicillin is as curious as it is unlikely to have been discovered; it is an example that science diplomacy doesn't exclusively happen in meetings by officials representing member states in European offices.

The Manhattan Project:

The Manhattan project is another example of international cooperation using science diplomacy. According to Claessens, "the aim was to develop a specific new technology through research (the atomic bomb in the case of Manhattan)... by mobilising considerable resources and extensive international cooperation…The Manhattan Project was clearly intended to ensure the United States was the first country to possess the atomic bomb and in doing so to winning the race against the Third Reich. The Manhattan Project was developed in secret" with cooperation from the United Kingdom and Canada.[78] The United States and its allies were determined to create an atomic bomb before the Soviet Union could do so. This would be a huge display of power and technological prowess and secure their position as the most powerful nation, at least for a time. "The acceleration of research that followed led the United States to engage in the construction of the atomic bomb: this was the Manhattan Project, conducted with the participation of the United Kingdom and Canada."[79] The period immediately following World

[77] H. Harris, "Howard Florey and the Development of Penicillin," *Notes and Records of the Royal Society of London* 53, no. 2 (May 22, 1999): 249, https://doi.org/10.1098/rsnr.1999.0078.
[78] Michel Claessens, *Beyond Technology Diplomacy*, *Copernicus Books* (Cham: Springer International Publishing, 2023), 214, https://doi.org/10.1007/978-3-031-37762-4_16.
[79] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017), 21 https://doi.org/10.1007/978-3-319-55104-3.

War II was a moment of transition in the world. A perfect time for a shift of the status quo. Zaidi argues that this moment was seized by scientists looking to increase their public authority.[80] "In wartime discussions, Manhattan Project scientists considered questions such as the impact of the bomb on warfare, international relations, and international diplomacy. How would society be transformed by atomic energy, and what sort of regulations and laws would be required to regulate it?"[81] After several decades of very public displays of scientific expertise and participation in the political discourse, Zaidi explains that by the 1970's scientists were not only out of the political discourse, but sometimes not even trusted by the public on narrow scientific matters within their own specialty.[82] Ruffini describes the tensions at play as such: "As the processes of science are performed, scientists are confronted with the reality of national rivalries: the entry into the atomic age and the Manhattan Project provided the strongest illustrations. Because science does not exist in a weightlessness state above society, but is intended to become one with society in order to promote its progress through its applications, science enters the field of power relationships, which are orchestrated on the international scene by foreign policies of states."[83] Scientists walk a line between contribution to their scientific field in the pursuit of knowledge and appealing to national interests, as funding often comes from government sponsored programs or policies. Having the government's support allows scientists to engage in more expensive, time consuming, and often important research. The Manhattan Project was one such case. In the modern era, "scientists' participation in science diplomacy is usually considered to be diplomacy through scientific action: that is, scientists participating in scientific research and cooperation, and scientists speaking on scientific research, data,and conclusions."[84] And this is often the case, as the role of scientists is usually limited in terms of political influence. Zaidi asserts that "that broader configurations of scientific diplomacy are possible andimaginable, and

[80] S. Waqar H. Zaidi, "Scientists as Political Experts: Atomic Scientists and Their Claims for Expertise on International Relations, 1945–1947," *Centaurus* 63, no. 1 (January 18, 2021): 27, https://doi.org/10.1111/1600-0498.12362.
[81] S. Waqar H. Zaidi, "Scientists as Political Experts: Atomic Scientists and Their Claims for Expertise on International Relations, 1945–1947," *Centaurus* 63, no. 1 (January 18, 2021): 19-20.
[82] S. Waqar H. Zaidi, "Scientists as Political Experts: Atomic Scientists and Their Claims for Expertise on International Relations, 1945–1947," *Centaurus* 63, no. 1 (January 18, 2021): 27.
[83] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017), 31.
[84] S. Waqar H. Zaidi, "Scientists as Political Experts: Atomic Scientists and Their Claims for Expertise on International Relations, 1945–1947," *Centaurus* 63, no. 1 (January 18, 2021): 27.

that one in which scientists were publicly accepted as authorities on broader political and diplomatic matters actually existed for a brief moment."[85]

CERN:

Following World War II, "in the spirit of reconciliation, large research infrastructures, like CERN (1954) or the European Southern Observatory (1962), were built to unify scientists and diplomats from multiple backgrounds around a common, peaceful enterprise with long-term commitments."[86] Krige asserts that "there has been extensive work done on the place of science and technology in the postwar reconstruction of Europe."[87] In the aftermath of WWII, another key example of science diplomacy exists in the creation of CERN. The European Organization for Nuclear Research (CERN) is an excellent representation of multinational science diplomacy that was born in the aftermath of World War II. "Created by 12 European countries in 1954 under the auspices of UNESCO, in a period marked by a strong desire for peace and for the development of European institutions, CERN has made it possible to restore bridges between nations that were eroded by the fractures of history."[88] Ruffini adds that "CERN was established…for two main reasons. The first was to make it an instrument for strengthening the ties between the nations which had harshly fought against one another" during the Second World War, as well as to, "[create] a research capacity in Europe in fundamental physics that would compete with the US."[89] Katharina E Höne and Jovan Kurbalija argue that as an exceptional and long term example of science diplomacy and cooperation, CERN balances CERN illustrates that "...the tension between promoting peaceful relations and addressing global goals on the one hand and strategic and national interests on the other. However, rather than trying to resolve this tension, we argue that it is precisely within this tension that science diplomacy unfolds."[90]

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[85] S. Waqar H. Zaidi, "Scientists as Political Experts: Atomic Scientists and Their Claims for Expertise on International Relations, 1945–1947," *Centaurus* 63, no. 1 (January 18, 2021): 27, https://doi.org/10.1111/1600-0498.12362.

[86] Leo Eigner, "The Promise and Paradox of Science Diplomacy," *CSS Analyses in Security Policy* 326 (July 2023): 2, https://doi.org/10.3929/ethz-b-000619331.

[87] John Krige and Kai‐Henrik Barth, "Introduction":, *Osiris* 21, no. 1 (January 2006): 4, https://doi.org/10.1086/507133.

[88] Simone Arnaldi, *Science Diplomacy. Foundations and Practice.* (Edizioni Università di Trieste, 2023): 23, https://www.researchgate.net/publication/372860870_Science_diplomacy_.

[89] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017),:94.

[90] Katharina E Höne and Jovan Kurbalija, "Accelerating Basic Science in an Intergovernmental Framework: Learning from CERN's Science Diplomacy," *Global Policy* 9 (November 2018): 71, https://doi.org/10.1111/1758-5899.12589.

CERN remains a prime example of the power of science diplomacy to unite formerly contentious states and foster cooperation in research and development on neutral grounds. "…there is a tendency to gloss over the tensions at the heart of the concept between a commitment to promoting peaceful relations and national and strategic concerns. CERN offers an excellent example of the entanglements between both."[91]

CERN and organizations like it, according to John Krige, "constituted supranational spaces not just metaphorically and symbolically, but also in bricks and mortar. One of the main reasons why the founders of CERN insisted that it be built on neutral soil in Switzerland was to indicate the strictly civilian nature of what was done there and its detachment from the immediate national industrial or military interests of any of the member states."[92] Geographically, CERN was also able to connect researchers during the Cold War when tensions were especially high by providing neutral grounds for cooperation. The location of the organization in Europe, and in Switzerland particularly, gave it two huge advantages; "CERN was thus at once squarely in the Western camp and an international laboratory, open to visitors from the Communist bloc."[93] Speaking at the 2024 ExPoSTEAM conference, Pierre-Bruno Ruffini emphasized that scientific exchanges are seen as being "on the right side of the agenda" politically, and that when relations between states harden, science and academic channels are the last to be impacted, and once tensions thaw, "they are the first to reawaken."[94] He goes on to say that scientific cooperation is often a part of the "warming of political and diplomatic ties," citing the US and the USSR during the Cold War period.[95] Höne and Kurbalija explain that"…focusing on diplomacy as a process of negotiating interests, it is useful to show exactly what interests are being negotiated and by what means in the case of CERN's science diplomacy."[96] CERN

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[91] Katharina E Höne and Jovan Kurbalija, "Accelerating Basic Science in an Intergovernmental Framework: Learning from CERN's Science Diplomacy," *Global Policy* 9 (November 2018): 67, https://doi.org/10.1111/1758-5899.12589.

[92] John Krige, *American Hegemony and the Postwar Reconstruction of Science in Europe*, *Google Books* (MIT Press, 2008): 188, https://books.google.it/books/about/American_Hegemony_and_the_Postwar_Recons.html?id=Oekybw092moC&redir_esc=y.

[93] John Krige, *American Hegemony and the Postwar Reconstruction of Science in Europe*, *Google Books* (MIT Press, 2008): 188.

[94] Pierre-Bruno Ruffini, "Does Science Diplomacy Keep Its Promise?," Presentation (Science Diplomacy week ExPoSTEAM, University of Padua, October 22, 2024), https://www.youtube.com/live/8HV8zeiW-Pg?si=rpWQzNUmNlJqh-Mt.

[95] Pierre-Bruno Ruffini, "Does Science Diplomacy Keep Its Promise?," Presentation (Science Diplomacy week ExPoSTEAM, University of Padua, October 22, 2024).

[96] Katharina E Höne and Jovan Kurbalija, "Accelerating Basic Science in an Intergovernmental Framework: Learning from CERN's Science Diplomacy," *Global Policy* 9 (November 2018): 68.

represents "the vision of a laboratory that sees science as an opportunity to contribute to the dialogue amongst researchers from countries that, in other areas, would find it difficult to share common projects."[97]

In light of the multitude of functions of science diplomacy, it is clear that it should not be confined to exclusively belonging under the umbrella of soft power. "Science diplomacy is one of the forms by which diplomacy expresses itself, and similarly takes place in the context of relations between sovereign nations."[98] Diplomacy, like much of modern politics, has seeped into many other aspects and takes more diverse forms than it had previously. "Science is neither inherently political nor ideological," thus it makes a complimentary partnership with diplomacy in the appropriate context.[99] "At the crossroads of the world of science and the world of diplomacy, a country's science diplomacy is underpinned by three principles of action, which are its fundamentals: attraction—cooperation— influence."[100] Nye wrote in 1990 that "given the changes in world politics, the use of power is becoming less coercive, at least among the major states. The current instruments of power range from diplomatic notes through economic threats to military coercion. In earlier periods, the costs of such coercion were relatively low. Force was acceptable and economies were less interdependent."[101] Almost 35 years ago, a trend towards soft power and more subtle diplomacy tactics was emerging. These themes still feel familiar in a modern political climate. In 2004, Nye revisited the idea of soft power and defined it as "the ability to get what you want through attraction rather than coercion or payments…Hard power, the ability to coerce, grows out of a country's military and economic might. Soft power arises from the attractiveness of a country's culture, political ideals, and policies. When our policies are seen as legitimate in the eyes of others, our soft power is enhanced."[102] Soft power is even more insidious today as the use of the internet and social media is more integrated than ever into the social fabric of most people's lives. This subtle yet constant influence can weigh heavily, albeit often unconsciously. Lord and Turekian explain that, "Old-fashioned diplomacy between

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[97] Simone Arnaldi, *Science Diplomacy. Foundations and Practice.* (Edizioni Università di Trieste, 2023): 137, https://www.researchgate.net/publication/372860870_Science_diplomacy_.
[98] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017), 43.
[99] Vaughan Turekian, "The Evolution of Science Diplomacy," *Global Policy* 9, no. 3 (November 2018): 4, https://doi.org/10.1111/1758-5899.12622.
[100] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017), 43.
[101] Joseph S. Nye, "Soft Power," *Foreign Policy*, no. 80 (1990): 167, https://doi.org/10.2307/1148580.
[102] Joseph S Nye, "Soft Power and American Foreign Policy," *Political Science Quarterly* 119, no. 2 (June 2004): 256, https://onlinelibrary.wiley.com/doi/abs/10.2307/20202345.

governments, while necessary, is no longer sufficient."[103] The AAAS and royal society explained in 2011 that, "a more complicated and disaggregated diplomatic system is taking shape."[104]

Science diplomacy *can* operate as soft power, under the right circumstances, like multinational collaboration on the development of penicillin, an antibiotic that would benefit humanity long after the war had ended. However, science diplomacy is also relevant in power dynamics that are not in the realm of soft power. For example, cooperation on nuclear weapons like the Manhattan project would not be considered soft power. I argue that science diplomacy operates within soft and hard power, depending on the context. Access to the internet, constant global communication with smartphones, and instant news updates are all conducive to an updated understanding of what diplomacy is and means for the world today. "The tools, techniques, and tactics of foreign policy need to adapt to a world of increasing scientific and technical complexity."[105] Science diplomacy is an umbrella term which also covers techno-science diplomacy.

Tech and its integration into most of the world population's daily lives has a profound impact on the political global landscape. The effects of even small choices by citizens are tracked and used in algorithms that influence economic, political, social and cultural decisions. The reverse is also true. Important political decisions made by a state have effects on individuals that may be felt more quickly than in a pre-internet world; this is especially obvious with an autocratic government. For example, Russia invading Ukraine in February 2022 had far-reaching effects beyond the immediate physical consequences of a war involving civilians. Sanctions were placed on Russian banks, products, and travel routes were stopped by airlines between Russia and the EU- Russian citizens were obliged to fly through Turkey in order to enter the EU, and for Russian citizens, issuance of new Schengen visas was suspended from September 2022. Tensions between Russia and western countries were heightened in a way reminiscent of the Cold War as Russia contested sanctions placed on their citizens and economy as a result of the Russian invasion of Ukraine.

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[103] Kristin M. Lord and Vaughan C. Turekian, "Time for a New Era of Science Diplomacy," *Science* 315, no. 5813 (February 9, 2007): 769, https://doi.org/10.1126/science.1139880.
[104] AAAS & The Royal Society, "New Frontiers in Science Diplomacy. Navigating the Changing Balance of Power.," *Royalsociety.org*, January 2010: 3.
[105] AAAS & The Royal Society, "New Frontiers in Science Diplomacy. Navigating the Changing Balance of Power.," *Royalsociety.org*, January 2010: *v.*

Science diplomacy is the frontier of establishing cooperative relations between contentious states. The constant global interest in developing and advancing science, medicine, and technology is a potential catalyst for cooperation where it would otherwise seem impossible. The COVID-19 pandemic presented an urgent global challenge unprecedented in the last few centuries. The pandemic added increased pressure to global geopolitical circumstances, especially related to digital communication between states and their citizens. "the role of communication and information in geopolitics has shifted in the last decade to the intensifying global process of datafication of economy and society."[106] Pierre-Bruno Ruffini explores the nuance and power dynamics of research and its relevance in the political sphere in his book *Science and Diplomacy*. He writes that diplomacy can be defined as having "national sovereignty as a starting point," resulting in either cooperative research involving multiple nations promoted by diplomats, or in "international scientific relations facilitat[ing] diplomatic relations."[107] The International Council of Scientific Unions in 1931 and the founding of CERN in 1954 are excellent and early examples of international scientific cooperation. The cooperation in the research, production and distribution of penicillin in the Second World War is unique in comparison to the two examples mentioned above. The umbrella of science diplomacy is large and it can accommodate, support, and welcome international research in unorthodox ways. Research cooperation, whether scientific or not, is more flexible than dealings in politics, business, or economics. Gluckman explains that as of 2016, "...investment by governments in research and development has generally risen, and one consequence of this increased investment has been a much more utilitarian perspective on the role of science from publics and politicians alike."[108] The financial tie to successes and failures of science diplomacy initiatives perhaps creates more concern for the well-being of these projects. "An increasing component of science diplomacy is directed at achieving common scientific understandings between policy makers in different jurisdictions. For example, science plays a critical role in sustaining the global trade

[106]Alison Gillwald and Véronique Wavre, "Rerouting Geopolitics: Narratives and the Political Power of Communications," *Global Transformations in Media and Communication Research*, (December 24, 2023): 27, https://doi.org/10.1007/978-3-031-29616-1_2.
[107] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr. Springer Cham, 2017): 129. https://doi.org/10.1007/978-3-319-55104-3.
[108] Peter D. Gluckman, "Science Advice to Governments," Science & Diplomacy, June 9, 2016, https://www.sciencediplomacy.org/article/2016/science-advice-governments.

system and resolving trade disputes and in dealing with many trans-boundary resource-management issues."[109]

Ruffini emphasizes that there is a "link between science and business" due to technological advances, but one critical distinction he makes about international research is that, "scientific issues are perceived as less immediate and less stringent than economic issues."[110] The issues faced by scientists have a more abstract, less definite timeline or weight to the average person. Economic and financial issues are more easily and quickly measurable quantitatively, thus perceived as more tangible, relevant, imposing. Science as a field covers many facets of scientific study and allows for more ambiguity in the mind of the public. Additionally, it often involves interdisciplinary work and cooperation, especially when new technologies or cutting-edge research is being pursued. The inherent flexibility of science easily fills the metaphorical box it is meant to fill in a given situation, regardless of the size, shape, or specifics of that particular context. Of course, science is not necessarily as simple or narrow as it is often perceived, and science does require funding to be pursued, which can be felt in technological disparities between the Global North and South over the last century. Though it should be noted that the Global South has been able to improve their technological capabilities in more recent decades. The terms Global North and Global South have a colonial legacy but became popularized in the 20th century. Dados and Connell aimed to define the scope and basic history of the terms Global North and South in 2012, writing that "European colonial expansion provided the historical context that underpins the way we use these terms now."[111] Starting in the 1950s and 60s "Developing countries (mainly former colonies), began to articulate the idea of a Global South whose interests conflicted with those of the industrialized powers, both capitalist and communist—cutting across Cold War divisions."[112] Though framing the world through a dichotomous lens removes some of the nuance required to understand complex geopolitical realities, this helps us make a broad distinction between the difficulties and interests facing a particular region. "The use of the phrase Global South marks a shift from a central focus on

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[109] Peter D. Gluckman, "Science Advice to Governments," Science & Diplomacy, June 9, 2016, https://www.sciencediplomacy.org/article/2016/science-advice-governments.
[110] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr. Springer Cham, 2017): 15. https://doi.org/10.1007/978-3-319-55104-3.
[111] Nour Dados and Raewyn Connell, "The Global South," *Contexts* 11, no. 1 (February 2012): 12, https://doi.org/10.1177/1536504212436479.
[112] Nour Dados and Raewyn Connell, "The Global South," *Contexts* 11, no. 1 (February 2012): 12.

development or cultural difference toward an emphasis on geopolitical relations of power."[113] Echeverría et al elaborate on the Global South and its place in international cooperation; "The cooperation between countries located in the Global South is not new; this form of cooperation began to become dynamic in the mid-20th century after the emancipation of countries that were colonies of countries of the North."[114] The relationship between the Global North and South will be examined more thoroughly in chapters three and four.

Ruffini asserts that "there is no science diplomacy without a direct relation to the interests of governments, in one way or another."[115] Government support and framework provide critical elements for the functioning of science diplomacy in a modern world. By nature, science diplomacy is an interdisciplinary process which requires cooperation of multiple actors in order to be effective. "Diplomats pursue and deliver international policy objectives on behalf of governments, and it is that connection to the state which sets diplomatic practice apart from the international lobbying, advocacy and public relations activities engaged in by businesses and civil society actors."[116] Scientists engaging as or with diplomats function in a similar way, the connection to the state may be less rigid in scientists than in diplomats, but under the umbrella of science diplomacy, the link between scientists and their governments remains a stable feature. "[Science Diplomacy] is a crucial, if under-utilized, specialty within the diplomatic constellation that can be used to address global issues, enhance cooperation between countries and leverage one country's influence over another."[117] Since many of the global crises facing us today are related to or solved by science, this further cements the place of science diplomacy as a key tool for improving the lives of people around the world and helping enhance diplomatic relations simultaneously.

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[113] Nour Dados and Raewyn Connell, "The Global South," *Contexts* 11, no. 1 (February 2012):12, https://doi.org/10.1177/1536504212436479.
[114] Luisa Fernanda Echeverría, Karina Elizabeth Aquino Valle, and Claudia Natalie Widmaier Muller, "Science Diplomacy and South-South Cooperation for Emergency Response: The Case of COVID-19 Pandemic in Latin America," *Jurnal Sosial Politik* 6, no. 2 (October 10, 2020): 168, https://doi.org/10.22219/sospol.v6i2.11647.
[115] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr. Springer Cham, 2017): 129.
[116] Vaughan Turekian, "The Evolution of Science Diplomacy," *Global Policy* 9, no. 3 (November 2018): 4, https://doi.org/10.1111/1758-5899.12622.
[117] Vaughan C Turekian et al., "The Emergence of Science Diplomacy," in *WORLD SCIENTIFIC EBooks* (World Scientific, 2014): 5, https://doi.org/10.1142/9789814440073_0001.

Chapter 3: Science Diplomacy in the Global South, COVID-19 & Climate Case Studies

Over the last few decades, there has been a shift in the function and pervasiveness of science diplomacy - developing countries increasingly participating, becoming more important as populations grow exponentially, economies become more competitive with those in the Global North, and quality of life improves in countries like China and India. Ruffini asserts that "...while large European countries, considered individually, compete to attract talents, they also increasingly engage together in research programs funded by the EU. India and China—emerging scientific powers in Asia, whose expatriate brainpower resources are important—stride into the logic of competition and develop their appeal primarily towards their scientific diaspora."[118] The COVID-19 pandemic also provided an unusual context to examine the contributions of the two most populated nations on earth (China and India), as they faced unique challenges in national public health on a scale not seen before; they are both a part of the Global South as well, adding elements of complexity to their use of science diplomacy, funding, and infrastructure. Colglazier highlights the delay and fumble by national healthcare systems around the world throughout much of the pandemic; "That so many advanced countries with highly capable science advisory ecosystems had failures and were unable to act wisely and early is astounding. This outcome is especially surprising since the worldwide public health community was very much aware of the threat of pandemics."[119] He adds that this is especially surprising after the global "...experience with 2003 SARS, MERS, Ebola, Avian Flu, and knowledge of pandemics throughout history."[120] One of the first challenges during the pandemic was the polarization of people about how much caution should be taken to avoid the spread of the virus, some in favor of stricter isolation measures promoted following the science or the data in order to tackle the crisis; Maani and Galea warn that "the adoption of science as categorical imperative overstates the role of science in the nuanced and fundamentally moral and political nature of decision-making, while also alleviating decision-makers from the responsibility for difficult

[118] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017): 43 https://doi.org/10.1007/978-3-319-55104-3.
[119] E. William Colglazier, "Response to the COVID-19 Pandemic: Catastrophic Failures of the Science-Policy Interface," Science & Diplomacy, (April 9, 2020), https://www.sciencediplomacy.org/editorial/2020/response-covid
[120] E. William Colglazier, "Response to the COVID-19 Pandemic: Catastrophic Failures of the Science-Policy Interface," Science & Diplomacy, (April 9, 2020).

moral and political choices."[121] This statement highlights the delicate balance science diplomacy needs to maintain between scientific fact and diplomatic reality. There is also a risk of politicians wrongly justifying policy decisions using scientific data (however vague or specific that data may be). "Through defining and choosing which branches of science, or streams of evidence, to prioritize, politicians can under the appearance of science justify a wide variety of positions."[122]

The COVID-19 pandemic provided an unusually far-reaching global crisis that tested modern global healthcare systems as well as international scientific cooperation. Within about a one year period, nearly every country on earth saw citizens infected by the virus, and countries large and small grappled with the increasing strain put on existing healthcare infrastructures. Javed and Chattu emphasize that "this pandemic has reaffirmed that disease outbreaks do not respect geographical borders or the status of development. They can be handled with sure success only if nations work together by focusing on the shared interests in global health as the rationale and prioritizing health and health security by governments in their national plans as well as for the international health development."[123] Colglazier posits that the initial lack of cooperation and decision paralysis shown by governments early in the pandemic led to far worse outcomes; "If all governments had acted early and in unison, the public health and economic impacts would have been far less. This global pandemic is the first truly global crisis in history, affecting virtually every person on the planet at approximately the same time."[124] The pandemic was a poignant reminder that disease affects everyone in the world, regardless of their geographical location, especially in an age of such extensive globalization, travel, and interconnectedness. However, we see from the handling of the pandemic that it affects those in the Global South to a higher degree. Kenan Malik cites statistics on vaccine distribution as an indicator of inconsistent agreements and disparity between theory and practice; "Rich countries have administered more doses of Covid vaccine than the size of their populations – an average of

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[121] Nason Maani and Sandro Galea, "What Science Can and Cannot Do in a Time of Pandemic," *Scientific American*, (February 2, 2021), https://www.scientificamerican.com/article/what-science-can-and-cannot-do-in-a-time-of-pandemic/.
[122] Nason Maani and Sandro Galea, "What Science Can and Cannot Do in a Time of Pandemic," *Scientific American*, (February 2, 2021), https://www.scientificamerican.com/article/what-science-can-and-cannot-do-in-a-time-of-pandemic/.
[123] Sumbal Javed and Vijay Kumar Chattu, "Strengthening the COVID-19 Pandemic Response, Global Leadership, and International Cooperation through Global Health Diplomacy," *Health Promotion Perspectives* 10, no. 4 (November 7, 2020): 304, https://doi.org/10.34172/hpp.2020.48.
[124] E. William Colglazier, "Response to the COVID-19 Pandemic: Catastrophic Failures of the Science-Policy Interface," Science & Diplomacy, April 9, 2020, https://www.sciencediplomacy.org/editorial/2020/response-covid-19-pandemic-catastrophic-failures-science-policy-interface.

105 doses per 100 people. In low-income countries, that figure is just two per 100 people. It is a disparity that is likely to define the post-pandemic world."[125]

"Dr. Seth Berkley and Dr. Richard Hatchett, the CEOs of Gavi and CEPI, respectively, developed the idea for COVAX during the Forum."[126] De Bengy Puyvallée and Storeng explain that "Throughout 2021, COVAX, wealthy governments, and the International Federation of Pharmaceutical Manufacturers and Associations (IFPMA) all promoted vaccine donation as a key solution to what the WHO's Director General has dubbed a "vaccine apartheid". COVAX established itself as the go-to global hub for sharing doses "equitably, effectively and transparently," one that was to be implemented by experts, controlled by independent scientists, guided by ethical principles, and de- signed to be cost-effective."[127] From the beginning, securing funding was a crucial step in the swift and effective discovery, manufacture, and distribution of vaccines. "The designers of COVAX anticipated that most countries would not have sufficient funds to invest in developing COVID-19 vaccines,"[128] so wealthier countries funded the process, with COVAX promising to "[pool] funds to support vaccine research, development, procurement, and distribution and [coordinate] all participants and activities."[129] Although COVAX had a plan to provide vaccines equitably around the world, this did not happen. By January 2021, "more than 7 billion vaccine doses had been purchased globally and the lion's share — 4.2 billion doses — have gone to high-income countries. While high-income countries represent only 16% of the world's population, they currently hold 60% of the vaccines for COVID-19 that have been purchased so far."[130] The scramble to protect national health turned into a familiar situation where healthcare is more out of reach for those in poorer countries.

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[125] Kenan Malik, "The Rich Nations' Take on the World Post-Pandemic? 'I'm All Right, Jack,'" the Guardian (The Guardian, August 29, 2021), https://www.theguardian.com/commentisfree/2021/aug/29/the-rich-nations-take-on-the-world-post-pandemic-im-all-right-jack.
[126] Qi Shao, "Why Does the COVAX Facility Fail to Bridge the 'Immunization Gap'?," *Journal of Public Health Policy* 45, no. 1 (January 19, 2024): 127, https://doi.org/10.1057/s41271-023-00467-w.
[127] Antoine de Bengy Puyvallée and Katerini Tagmatarchi Storeng, "COVAX, Vaccine Donations and the Politics of Global Vaccine Inequity," *Globalization and Health* 18, no. 1 (March 5, 2022): 2, https://doi.org/10.1186/s12992-022-00801-z.
[128] Qi Shao, "Why Does the COVAX Facility Fail to Bridge the 'Immunization Gap'?," *Journal of Public Health Policy* 45, no. 1 (January 19, 2024): 127.
[129] Qi Shao, "Why Does the COVAX Facility Fail to Bridge the 'Immunization Gap'?," *Journal of Public Health Policy* 45, no. 1 (January 19, 2024): 129.
[130] Mary Brophy Marcus, "Ensuring Everyone in the World Gets a COVID Vaccine," Duke Global Health Institute, (January 20, 2021), https://globalhealth.duke.edu/news/ensuring-everyone-world-gets-covid-vaccine.

"COVAX lagged far behind these powerful countries in procuring vaccines due to a lack of funding."[131]

COVAX provided a telling look into the behavior of wealthy countries (and the data to quantify that behavior) while under the guise of providing much-needed funding for vaccine development to be distributed to all countries. Canada, at that point, had purchased vaccine doses to sufficiently cover five times their population. Meanwhile, Malik highlights the stark contrast between the richest and poorest nations and their vaccine distribution as of August 2021;"The 30 poorest countries in the world, with a combined population of almost a billion, have vaccinated on average barely 2% of their population. In the Democratic Republic of the Congo the figure is 0.1%, in Haiti 0.24%, in Chad 0.27%, in Tanzania 0.36%."[132] Once again, the Global South was left to experience the worst outcomes since those countries could not financially compete with the Global North. "Although dose-sharing helped to address COVAX's supply challenges and increased its deliveries, the impact of the mechanism was undermined by donors' and manufacturers' pursuit of national security, diplomatic and commercial interests through vaccine donations, which COVAX largely accommodated."[133] Covax employed a complicated structure that lacked the necessary accountability and transparency to prevent national interests winning out in the end.[134] The structure of COVAX allowed these loopholes to be exploited and it had "no mechanisms for enforcing its dose-sharing principles shows that the initiative's institutional design is poorly suited to the challenges it faces."[135] Aligning with de Bengy Puyvallée and Storeng's perspective, Qi Shao's goes on to explain that, "when vaccine-producing countries decided to suspend vaccine exports, COVAX lacked vaccines; when high-income countries delayed funding, it had no money to buy vaccines; when it set rules for vaccine allocation that did not satisfy high-income countries, it had to make changes."[136] The attempt of COVAX to

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[131] Qi Shao, "Why Does the COVAX Facility Fail to Bridge the 'Immunization Gap'?," *Journal of Public Health Policy* 45, no. 1 (January 19, 2024): 130.
[132] Kenan Malik, "The Rich Nations' Take on the World Post-Pandemic? 'I'm All Right, Jack,'" the Guardian (The Guardian, August 29, 2021), https://www.theguardian.com/commentisfree/2021/aug/29/the-rich-nations-take-on-the-world-post-pandemic-im-all-right-jack.
[133] Antoine de Bengy Puyvallée and Katerini Tagmatarchi Storeng, "COVAX, Vaccine Donations and the Politics of Global Vaccine Inequity," *Globalization and Health* 18, no. 1 (March 5, 2022): 11, https://doi.org/10.1186/s12992-022-00801-z.
[134] Antoine de Bengy Puyvallée and Katerini Tagmatarchi Storeng, "COVAX, Vaccine Donations and the Politics of Global Vaccine Inequity," *Globalization and Health* 18, no. 1 (March 5, 2022): 11.
[135] Antoine de Bengy Puyvallée and Katerini Tagmatarchi Storeng, "COVAX, Vaccine Donations and the Politics of Global Vaccine Inequity," *Globalization and Health* 18, no. 1 (March 5, 2022): 10.
[136] Qi Shao, "Why Does the COVAX Facility Fail to Bridge the 'Immunization Gap'?," *Journal of Public Health Policy* 45, no. 1 (January 19, 2024): 134, https://doi.org/10.1057/s41271-023-00467-w.

tackle inequities was done with the right intentions, and "COVAX has sought to depoliticize global vaccine allocation and to base it on science to protect the health of populations and of medical systems."[137] This is a goal to strive for generally speaking, but perhaps like the COP 15 in Copenhagen, nations were not ready to cooperate and national interests, along with fear, dictated much of the behavior seen in vaccine procurement and distribution. Ye et al. argue that a more fair system of vaccine distribution benefits all countries in the long run.[138] Suggesting several guidelines for how to prioritize distribution of vaccines during a pandemic, like COVID-19, they recommend prioritizing "larger population sizes…countries with a higher number of active cases…countries with a higher number of new deaths during the past two weeks as a share of the total population."[139] The overall failure of COVAX to meet its targets and provide equitable vaccine distribution serves as an informative case study for international health cooperation and science diplomacy in the future. Basrur and Kliem caution that "the Covid-19 crisis also points to what global action on other critical issues such as climate change, severe economic dislocation, or the apocalyptic consequences of nuclear war could look like in the future. They will in all probability not induce intense global cooperation to manage common challenges, but instead spur nationalism, zero-sum competition and the application of power to secure the objectives of individual nations."[140] Though a dismal projection of what the future may hold, the authors are right to warn against the possibility ahead of time in order to facilitate a more cooperative and inclusive approach to solving future global crises.

The aftermath of trial and error due to covid caused a tragic loss of life, but also global cooperation toward a vaccine that would be distributed around the world. There were flaws in the logistics of vaccine distribution, even with the willingness to cooperate, pool resources, and focus research on finding a way to mitigate the effects of the pandemic were at the forefront. Ultimately, the fast-tracked research and development of a vaccine for a type of coronavirus not seen in humans before saved millions of lives and greatly reduced the severity of disease for many others. Research and development that would have normally taken a decade was

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[137] Qi Shao, "Why Does the COVAX Facility Fail to Bridge the 'Immunization Gap'?," *Journal of Public Health Policy* 45, no. 1 (January 19, 2024): 132.
[138] Yang Ye et al., "Equitable Access to COVID-19 Vaccines Makes a Life-Saving Difference to All Countries," *Nature Human Behaviour* 6 (January 31, 2022): 207, https://doi.org/10.1038/s41562-022-01289-8.
[139] Yang Ye et al., "Equitable Access to COVID-19 Vaccines Makes a Life-Saving Difference to All Countries," *Nature Human Behaviour* 6 (January 31, 2022): 214.
[140] Rajesh Basrur and Frederick Kliem, "Covid-19 and International Cooperation: IR Paradigms at Odds," *SN Social Sciences* 1, no. 1 (November 9, 2020), https://doi.org/10.1007/s43545-020-00006-4.

condensed to about two years with the active cooperation of scientists, researchers, and politicians from around the world. Unfortunately, the countries with the least access to the vaccine were those located in the Global South, and they were disproportionately affected by the pandemic, economically and health-wise. In this chapter, I review the history of science diplomacy in China, India, and Latin America, and address how each region managed the COVID-19 crisis using science diplomacy. Then, I will provide an overview of the use of science diplomacy to address the climate crisis.

Science diplomacy in China:

In a 2023 paper, Xin Li examines the legacy of science diplomacy in China; "With the founding of the People's Republic of China in 1949, the ruling Communist Party of China was determined to develop S&T and cultivate domestic talent on a large scale to change the country's extremely lagging status."[141] The political landscape of 1950s China saw political tensions with the west clashing with a need for competitiveness. China wanted to catch up in technoscience fields, and needed to work with and learn from western countries to grow their national science capacity. Top Chinese scientists were sent to study in universities in the US and other western countries. "As China entered the 21st century, it began to build a multifaceted network of collaborations involving universities, research institutes, think tanks, non-governmental organizations, and corporations. This is especially true regarding China's S&T relations with the USA, Europe, and Japan. Often referred to as a 'people-to-people' diplomacy, the growth of these agreements has far outpaced what anyone could have imagined when the majority of bilateral umbrella agreements were first signed. It would appear that the umbrella agreements paved the way for the eventual expansion of cooperation."[142] The Chinese academy of sciences has promoted scientific cooperation with all countries (western and socialist) since 1956.[143] in the early 1960s "China started to provide technological aid to newly independent nations in Asia and Africa, as well as socialist nations such as the Democratic People's Republic of Korea, the Democratic Republic of Vietnam (North Vietnam) and Cuba."[144]

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[141] Xin Li, "Science Diplomacy in China: Past, Present and Future," *Cultures of Science* 6, no. 2 (June 1, 2023): 171-72, https://doi.org/10.1177/20966083231183473.
[142] Caroline S Wagner and Denis Fred Simon, "China's Use of Formal Science and Technology Agreements as a Tool of Diplomacy," *Science & Public Policy* 50, no. 4 (June 28, 2023): 811, https://doi.org/10.1093/scipol/scad022.
[143] Xin Li, "Science Diplomacy in China: Past, Present and Future," *Cultures of Science* 6, no. 2 (June 1, 2023): 172.
[144] Xin Li, "Science Diplomacy in China: Past, Present and Future," *Cultures of Science* 6, no. 2 (June 1, 2023): 172.

Wagner and Simon posit that "...the extensive nature of China's science and tech agreements (STAs) with the rest of the world is only one component of a larger network of S&T-related linkages that the PRC government has established since 1978. China has built up expanded channels of access to foreign scientific and technical knowledge through the following vehicles: student and scholarly exchanges, visits of foreign technical experts, foreign direct investment, foreign R&D centers, technology imports and licensing, hosting international and regional S&T conferences, membership in international and regional S&T bodies, defense cooperation agreements, and reverse engineering."[145] The casting of a wide net has made China a strong contender in matters of science diplomacy, and one that many other countries are eager to cooperate with, due to their resources, technical capabilities, and support from the government to pursue such agreements. Chinese policy towards technoscience since the 1950s has reflected a measured and broad approach to science and technology agreements and, by extension, science diplomacy. "As with other international actors, China uses STAs—or the promise of cooperation—as a tool of its own foreign policy."[146] China has an interest in being among the most influential parties in technoscience agreements; Elif Özkaragöz Doğan, Zafer Uygun, and İbrahim Semih Akçomak observe that "broadening and scaling-up South–South cooperation through additional resources, higher visibility on the international stage as a responsible member of the international community, gaining access to new markets were the main motivations behind China's science diplomacy attempts."[147]

As successful China's efforts in technoscience cooperation appear to be, Colglazier cautions that "Even with worldwide collaboration of scientists in many fields, roadblocks to international scientific collaboration have been growing in recent years. Scientific collaboration between the U.S. and China has been under siege."[148] This is a critical point since the U.S. and China are both hugely influential on a global stage, and they both contribute extensively to scientific papers individually and together. In the last decade, there have been increasing tensions between the U.S. and China in scientific cooperation, which potentially has a continued affect on

[145] Caroline S Wagner and Denis Fred Simon, "China's Use of Formal Science and Technology Agreements as a Tool of Diplomacy," *Science & Public Policy* 50, no. 4 (June 28, 2023): 811, https://doi.org/10.1093/scipol/scad022.
[146] Caroline S Wagner and Denis Fred Simon, "China's Use of Formal Science and Technology Agreements as a Tool of Diplomacy," *Science & Public Policy* 50, no. 4 (June 28, 2023): 815.
[147] Elif Özkaragöz Doğan, Zafer Uygun, and İbrahim Semih Akçomak, "Can Science Diplomacy Address the Global Climate Change Challenge?," *Environmental Policy and Governance* 31, no. 1 (September 22, 2020): 39, https://doi.org/10.1002/eet.1911.
[148] E. William Colglazier, "Response to the COVID-19 Pandemic: Catastrophic Failures of the Science-Policy Interface," Science & Diplomacy, (April 9, 2020), https://www.sciencediplomacy.org/editorial/2020/response-covid.

future engagements. Colglazier continues, "the Chinese government caused a backlash in the U.S. with clandestine programs employing some of their scientists to use research collaborations to steal technologies and research information in ways antithetical to the accepted norms of scientific collaboration. Scientific communities are clear that this behavior is a threat to scientific collaboration and must end."[149] There are also concerns from U.S. scientists about a political response to the situation resulting in a repression of scientists coming from abroad to study in American institutions and limiting their pool of potential collaborators.[150]

China COVID-19 Case Study:

COVID-19 emerged in late 2019 with the first publicly reported cases appearing in December of that year in Wuhan, China. The first few weeks and months were chaotic and full of misinformation and sometimes disingenuous reporting, whether from individual countries themselves, or media outlets around the world. Until stricter rules were set into place by the Chinese government in the spring of 2020, Chinese doctors and scientists were a key facilitator of sharing data regarding the virus, its symptoms, and treatment. The willingness of Chinese scientists to publish critical data in the early months of the pandemic and collaborate with scientists from other nations, ideally would have helped the world be more well-equipped to deal with the virus once it eventually reached every corner of the globe. "The Chinese medical and scientific community published in January the gene sequence of the virus, and issued in a leading medical journal, *The Lancet*, what they had learned dealing with COVID-19. It was a warning to take early action that went unheeded by governments almost everywhere."[151] Unfortunately this information was not taken seriously or with a high level of urgency in most countries, resulting in a catastrophic global pandemic.

Unlike the forthcoming Chinese medical and scientific workers who shared information as freely as possible, the Chinese government had a different strategy for dealing with the virus; in since-deleted documents published online in April 2020, "the Chinese government required that all COVID-19 articles be centrally reviewed, perhaps slowing the rate of collaboration

[149] E. William Colglazier, "Response to the COVID-19 Pandemic: Catastrophic Failures of the Science-Policy Interface," Science & Diplomacy, (April 9, 2020), https://www.sciencediplomacy.org/editorial/2020/response-covid.
[150] E. William Colglazier, "Response to the COVID-19 Pandemic: Catastrophic Failures of the Science-Policy Interface," Science & Diplomacy, (April 9, 2020).
[151] E. William Colglazier, "Response to the COVID-19 Pandemic: Catastrophic Failures of the Science-Policy Interface," Science & Diplomacy, (April 9, 2020).

between countries."[152] A senior research fellow of Chinese studies at Monash University, Kevin Carrico, spoke to The Guardian about China's alleged newly implemented restrictions for academic research and publication in China on Covid-19, saying he hadn't reviewed the specific documents in question, "but [that] the documents were generally consistent with efforts by China to control the narrative of the pandemic."[153] [The Chinese government is], "seeking to transform [the COVID-19 pandemic] from a massive disaster to one where the government did everything right and gave the rest of the world time to prepare," Carrico explains. A group of Chinese researchers, Zhang, Li, and Chen, analyze the efficacy of risk communication by the their government early in the pandemic, elucidating that, "the occurrence of the outbreak corresponded with China's political season, when officials gather for annual meetings of the People's Congresses—the Chinese Communist Party (CCP)-run legislatures for discussing policies and praising government. Bad news is inappropriate at this time."[154] Thus, a conscious decision was made by Chinese political actors to delay, conceal, or at the very least mitigate the seriousness of the risk of the newly detected virus. The political and social harmony of the country were prioritized over national and global health, swayed by political fears and protocol. Basrur and Kliem write in 2020 that, "Beijing aims to rewrite the Covid-19 narrative. [China] does not want to be seen as the point-of-origin of the Covid-19 virus and views the pandemic as an opportunity to come out ahead of the United States in a zero-sum competition for global primacy. Beijing wants to be recognized globally as a responsible provider of public health goods in the absence of US leadership, and thereby, progress towards its ultimate objective of comprehensive power accumulation relative to Washington."[155] China also partnered with Italy to provide supplies, an especially poignant move since Italy was one of the European countries most gravely affected by COVID; "Rome was happy to accept support from China, which, though itself badly affected, sent medical equipment and experts immediately. Far from being

[152] X. Cai, C. V. Fry, and C. S. Wagner, "International Collaboration during the COVID-19 Crisis: Autumn 2020 Developments," *Scientometrics* 126, no. 4 (February 14, 2021): 3692, https://doi.org/10.1007/s11192-021-03873-7.
[153] Stephanie Kirchgaessner, Emma Graham-Harrison, and Lily Kuo, "China Clamping down on Coronavirus Research, Deleted Pages Suggest," the Guardian (The Guardian, April 11, 2020), https://www.theguardian.com/world/2020/apr/11/china-clamping-down-on-coronavirus-research-deleted-pages-suggest.
[154] Liwei Zhang, Huijie Li, and Kelin Chen, "Effective Risk Communication for Public Health Emergency: Reflection on the COVID-19 (2019-NCoV) Outbreak in Wuhan, China," *Healthcare* 8, no. 1 (March 21, 2020): 64, https://doi.org/10.3390/healthcare8010064.
[155] Rajesh Basrur and Frederick Kliem, "Covid-19 and International Cooperation: IR Paradigms at Odds," *SN Social Sciences* 1, no. 1 (November 9, 2020), https://doi.org/10.1007/s43545-020-00006-4.

altruistic, however, Beijing aims to rewrite the Covid- 19 narrative."[156] The poor timing of the outbreak combined with China's political ambitions to create an image of strength and leadership especially when compared to the United States were impediments to effective management of the first few months of the pandemic, which then resulted in a more extreme global crisis due to the lack of information or perpetuation of dangerous rumors from the initial appearance of COVID-19.[157] Globally, "misinformation campaigns by some government leaders and actors on social media created public confusion and delayed action."[158]

Ultimately, Chinese scientists and doctors proved to be the most willing and effective collaborators and were trailblazers in sounding the alarm to the global community in this specific situation, working towards finding data that would be helpful for the world and sharing it as freely as they could, even as their own country's political actors worked against them and tried to restrict their publishing ability and the exchange of information with foreign countries. "Though Chinese officials initially covered up the outbreak and have since used it for propaganda purposes, Chinese scientists have in many ways led the world's coronavirus research. A Chinese laboratory made public the initial viral genome in January, a disclosure that formed the basis for coronavirus tests worldwide. And some of today's most promising clinical trials can trace their origins to early Chinese research on the disease."[159] Chinese scientists were working against an especially restrictive system and still managed to produce a large percentage of published research articles on the subject, notably during the first several months of the pandemic.[160] However, their publishing frequency waned along with the national case-load, at which time the United States and became the most prolific contributor to COVID-19 research papers, along with European countries, especially Italy, which had a very high caseload during the pandemic.[161]

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[156] Rajesh Basrur and Frederick Kliem, "Covid-19 and International Cooperation: IR Paradigms at Odds," *SN Social Sciences* 1, no. 1 (November 9, 2020).
[157] Liwei Zhang, Huijie Li, and Kelin Chen, "Effective Risk Communication for Public Health Emergency: Reflection on the COVID-19 (2019-NCoV) Outbreak in Wuhan, China," *Healthcare* 8, no. 1 (March 21, 2020): 64, https://doi.org/10.3390/healthcare8010064.
[158] E. William Colglazier, "Response to the COVID-19 Pandemic: Catastrophic Failures of the Science-Policy Interface," Science & Diplomacy, (April 9, 2020), https://www.sciencediplomacy.org/editorial/2020/response-covid-
[159] Matt Apuzzo and David D. Kirkpatrick, "Covid-19 Changed How the World Does Science, Together," *The New York Times*, (April 1, 2020), sec. World, https://www.nytimes.com/2020/04/01/world/europe/coronavirus-science-research-cooperation.html?campaign_id=2&emc=edit_th_200402&instance_id=17267&nl=todaysheadlines&regi_id=30381051&segment_id=23587&user_id=fa090cc506ce13db9a05faea5d295a62.
[160] Caroline V. Fry et al., "Consolidation in a Crisis: Patterns of International Collaboration in Early COVID-19 Research," ed. Lutz Bornmann, *PLOS ONE* 15, no. 7 (July 21, 2020): 1, https://doi.org/10.1371/journal.pone.0236307.
[161] X. Cai, C. V. Fry, and C. S. Wagner, "International Collaboration during the COVID-19 Crisis: Autumn 2020 Developments," *Scientometrics* 126, no. 4 (February 14, 2021): 3684, https://doi.org/10.1007/s11192-021-03873-7.

Writing on the subject of the United States' science policy and science diplomacy after COVID-19, E. William Colglazier opines that, "Even with the failures at the national and global level regarding the pandemic, the global scientific community did respond well, with unprecedented scientific collaboration and sharing of information."[162]

Science Diplomacy in India:

Occupying a unique position as a highly populated country in the Global South with longstanding government created science initiatives, India has a strong history of training scientists and doctors who go on to work locally and abroad. As there has been considerable investment in science and technology by the Indian government, India has been cooperating internationally on space and atomic research since the 1950s.[163] "The government of India launched the Indian Technical and Economic Cooperation Programme (ITEC) as a bilateral assistance programme in 1964. It is the flagship initiative of the Indian government's technical cooperation effort, through which partner nations get support in manpower development in a variety of sectors."[164] India has made itself a valuable and important partner for bilateral cooperation since its independence more than 75 years ago. Boasting a centuries old science and medicine tradition followed by a surge of scientists being trained in the British colonial period and onwards, "today, [India] occupies a prominent place in the promotion and application of science and technology-based solutions to issues of global concern."[165] As a cornerstone of the South Asian region, "it is valuable for India to achieve foreign policy objectives in cooperation with public diplomacy and S&T."[166]

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[162] E. William Colglazier, "America's Science Policy and Science Diplomacy after COVID-19," Science & Diplomacy (Science & Diplomacy, June 28, 2020), https://www.sciencediplomacy.org/editorial/2020/americas-science-policy-and-science-diplomacy-after-covid-19.
[163] Malti Goel, "India on a Road to Science Diplomacy," in *Springer EBooks* (Singapore: Springer Nature, 2021): 55, https://doi.org/10.1007/978-981-16-3025-5_5.
[164] Pooja Raghav et al., "View of India's Science Diplomacy in South Asia: Opportunities and Challenges," *The Online Journal of Qualitative Inquiry* 12, no. 6 (July 2021): 8442, https://www.tojqi.net/index.php/journal/article/view/3298/2237.
[165] Madhusudan Bandyopadhyay, "Development Paradigm of India as an Enabler for Practicing Science, Technology and Innovation Diplomacy," in *Science, Technology and Innovation Diplomacy in Developing Countries*, ed. Venugopalan Ittekkot and Jasmeet Kaur Baweja (Milan: Springer International Publishing, 2023): 115, https://doi.org/10.1007/978-981-19-6802-0_8.
[166] Jyoti Sharma and Sanjeev Kumar Varshney, "Science Diplomacy and Cooperation in Science and Technology in India," *Science Diplomacy Review* 1, no. 2 (March 2019): 20, https://www.ris.org.in/sites/default/files/2021-09/SDR%20March%202019-min%20%281%29.pdf.

Additionally, India stands out as a leader in its region especially since there is "a relative absence of functional science diplomacy forums in the region. Hardly any mention of science diplomacy can be found on the websites of national science academies, Science and Technology Ministries, or Foreign Ministries. Only India… has a forum for science diplomacy."[167] India has shown a consistent interest and dedication towards supporting scientific initiatives and research, and presently plays a major role in science and technology solutions for global issues.[168] "The contributing factors have been the implementation of well-framed S&T policies that remained in tune with the country's changing needs over time, and an efficiently linked foreign policy guided and supported by coordinated advice from the relevant science ministries especially in matters related to the country's participation in international cooperation in S&T and related global negotiations."[169] India has remained flexible in its governmental initiatives and open to evolving ideas about how to address major global issues, as a very diverse and highly populated nation, this adaptability has served India well in the grand scheme. "India is now an important global player due to its significant achievements in economy and capability in science, technology and innovation, and also because of its geo-political orientation. Many Indian scientists have been in the forefront in crucial international scientific deliberations to address global issues of concern and evolve multilateral initiatives."[170]

But, the path toward scientific advancement and participation in science diplomacy is not without impediments; another obstacle to the advancement of science and technology in South Asia, is that the "region is very complex geopolitically, with a history that gave rise to conservative social[171], political, and cultural mindsets."[172] In spite of the overall flexibility of the political minds in India regarding science and technology and their progress, not everyone is in

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[167] Monir Uddin Ahmen et al., "An Overview of Science Diplomacy in South Asia," Science & Diplomacy (February 17, 2021): 3, https://www.sciencediplomacy.org/article/2021/overview-science-diplomacy-in-south-asia.
[168] Madhusudan Bandyopadhyay, "Development Paradigm of India as an Enabler for Practicing Science, Technology and Innovation Diplomacy," in *Science, Technology and Innovation Diplomacy in Developing Countries*, ed. Venugopalan Ittekkot and Jasmeet Kaur Baweja (Milan: Springer International Publishing, 2023), 115, https://doi.org/10.1007/978-981-19-6802-0_8.
[169]Madhusudan Bandyopadhyay, "Development Paradigm of India as an Enabler for Practicing Science, Technology and Innovation Diplomacy," in *Science, Technology and Innovation Diplomacy in Developing Countries*, ed. Venugopalan Ittekkot and Jasmeet Kaur Baweja (Milan: Springer International Publishing, 2023), 115.
[170] Madhusudan Bandyopadhyay, "Development Paradigm of India as an Enabler for Practicing Science, Technology and Innovation Diplomacy," (2023): 116.
[171] Madhusudan Bandyopadhyay, "Development Paradigm of India as an Enabler for Practicing Science, Technology and Innovation Diplomacy," (2023): 115.
[172] Monir Uddin Ahmen et al., "An Overview of Science Diplomacy in South Asia," Science & Diplomacy (February 17, 2021): 5.

agreement over the direction the country, or region, should take. "Some [South Asian] scientists are progressive regarding peacebuilding and they would be honored to contribute to the betterment of overall South Asian communities. However, they are often judged as anti-nationalist by their more conservative colleagues and peers."[173] This is not the only stumbling block for India and its neighbors pursuit of science diplomacy in South Asia; regardless of potential desire by scientists in the Global South to take initiative and set the path for addressing global crises, the Global North typically sets the agenda based on what benefits their governmental goals and pressures developing countries to act in a way that may not be in their own best interests. Countries in the Global South are often expected to support and participate in initiatives that serve the interests of countries in the Global North, which often have the resources, tools, and funding to support science and technology initiatives and projects. The legacy of imperialism has left deep roots which are discernable in the imbalance of power and influence exerted by countries in the Global North over those in the Global South.

> "During the nineteenth century, the ascendance of major powers upon the world turned to imperialism. Colonization facilitated access to new territories attracting a scientific interest, and for some categories of scholars from dominant countries including naturalists and other scientists this enlarged the scope of what they could study: each colonial power encouraged the exploration of its colonies by "its" scholars. But, while the colonial power was supporting the work of scientists, the latter in turn sometimes supported the colonial policy."[174]

As Ruffini elucidates above, there is potential for science, technology, and science diplomacy to provide a seat at the table for countries that otherwise wouldn't have one, but there is also potential for a perpetuation of a dynamic and values that were put into place by imperialism, a key element and extension of colonialism. Ensuring the legacies of past centuries do not continue to prevent good scientific, political, and economic decisions will be a key consideration for science diplomacy and multilateral cooperation in the future. One way to help science diplomacy

[173] Monir Uddin Ahmen et al., "An Overview of Science Diplomacy in South Asia," Science & Diplomacy (February 17, 2021): 5, https://www.sciencediplomacy.org/article/2021/overview-science-diplomacy-in-south-asia.
[174] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017): 20, https://doi.org/10.1007/978-3-319-55104-3.

stay on the right track is for scientists, policymakers, and organizers to be inclusive in their planning and collaborations. Network with those researchers and students outside of their usual contacts and invite more people in to participate in the dialogue and discussion.

Monitoring and balancing the power dynamic of bilateral and multilateral diplomatic relationships is another element to consider when using science diplomacy. No diplomatic or political exchange will be perfectly even, but decolonizing the way nations interact, especially between the Global North and the Global South, will best serve people in all parts of the world; and science diplomacy gives smaller, less powerful nations a chance to participate in a way that other diplomacy may not. "Bilateral relationships can be crucial and foster sharing of need-based technologies with nations such as the USA and Germany, who want to attract top Indian talents to their research institutions."[175] Indian researchers propose that cooperation between scientific powerhouse countries like the United States or Germany could prove beneficial both to the Indian scientists and the countries who wish to employ them in the future.[176] The Indian scientists trained by countries with higher levels of funding and advanced equipment could bring back their knowledge to help India's scientific progress, and the institutions who train Indian scientists abroad would also benefit from being able to recruit from a pool of top Indian scientists.[177] "Recognizing the need to collaborate and the urge to compete helps to relativize both imperatives and to assess what is politically feasible and desirable."[178] This system provides a happy medium where both sides continually benefit and contribute to the progress of the cycle's continuation. India has especially relevant historical precedent for scientific diplomacy; "participation in mega science projects with different countries has been used by India to arrive at common positions in negotiations and join hands with other developing countries on matters related to the nation's priorities."[179] A key global player due to its economic and population size,

[175] Jyoti Sharma and Sanjeev Kumar Varshney, "Science Diplomacy and Cooperation in Science and Technology in India," *Science Diplomacy Review* 1, no. 2 (March 2019): 20, https://www.ris.org.in/sites/default/files/2021-09/SDR%20March%202019-min%20%281%29.pdf.
[176] Jyoti Sharma and Sanjeev Kumar Varshney, "Science Diplomacy and Cooperation in Science and Technology in India," *Science Diplomacy Review* 1, no. 2 (March 2019): 20.
[177]Jyoti Sharma and Sanjeev Kumar Varshney, "Science Diplomacy and Cooperation in Science and Technology in India," *Science Diplomacy Review* 1, no. 2 (March 2019): 20.
[178] Leo Eigner, "The Promise and Paradox of Science Diplomacy," *CSS Analyses in Security Policy* 326 (July 2023): 4, https://doi.org/10.3929/ethz-b-000619331.
[179] Jyoti Sharma and Sanjeev Kumar Varshney, "Science Diplomacy and Cooperation in Science and Technology in India," *Science Diplomacy Review* 1, no. 2 (March 2019): 20.

as well as its location in the Global South, India's ability to be cooperative with other nations has served its political agenda well and contributed to science and technology progress.

India has a reputation for cooperation in health diplomacy before COVID-19 as well, having played a large part in the fight against antibacterial/antimicrobial resistance studies; "Since 2009, a US and European joint task force, the Trans-Atlantic Task Force on Antibiotic Resistance, has been working on common recommendations. At a national level, some important initiatives have been implemented, in particular in European countries and in the USA. The Chennai declaration, in India, is also a good example of a multidisciplinary and national initiative that was highly political."[180] Bandyopadhyay suggests that "India's STI diplomacy efforts are aligned with the priorities of its foreign policy. For example, the promotion of South–South Cooperation is an increasingly important strategic priority for the country, not only in international politics, but also in science and technology."[181] Pooja Raghav et al. explain that the traits of scientists allow them to be flexible and dynamic in dealing with political matters; their reputation as truth seekers can be used to the advantage of science diplomacy.[182] "Science diplomacy can possibly assume an important part in improving international relations as scientists are natural consensus builders. They are mostly driven by evidence, respected, and trying to serve mankind across borders. South Asian scientific communities from each of the eight nations should take part in Science Diplomacy to build bridges among communities, social orders, and countries and lift the job of science in foreign policy to address national and regional challenges."[183] In spite of the potential for the use of science diplomacy in South Asia, Ahmen et al. assert that "politicians in the region have so far not ensured sufficient cooperation and collaboration among their home countries.[184] SD has yet to be implemented to a full capacity especially in a region with such disparate policy towards science and technology agreements.

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[180] J. Carlet, C. Pulcini, and L.J.V. Piddock, "Antibiotic Resistance: A Geopolitical Issue," *Clinical Microbiology and Infection* 20, no. 10 (February 2014): 949, https://doi.org/10.1111/1469-0691.12767.
[181] Madhusudan Bandyopadhyay, "Development Paradigm of India as an Enabler for Practicing Science, Technology and Innovation Diplomacy," in *Science, Technology and Innovation Diplomacy in Developing Countries*, ed. Venugopalan Ittekkot and Jasmeet Kaur Baweja (Milan: Springer International Publishing, 2023):138, https://doi.org/10.1007/978-981-19-6802-0_8.
[182] Pooja Raghav et al., "View of India's Science Diplomacy in South Asia: Opportunities and Challenges," *The Online Journal of Qualitative Inquiry* 12, no. 6 (July 2021): 8450, https://www.tojqi.net/index.php/journal/article/view/3298/2237.
[183] Pooja Raghav et al., "View of India's Science Diplomacy in South Asia: Opportunities and Challenges," *The Online Journal of Qualitative Inquiry* 12, no. 6 (July 2021): 8450.
[184] Monir Uddin Ahmen et al., "An Overview of Science Diplomacy in South Asia," Science & Diplomacy, (February 17, 2021): 6, https://www.sciencediplomacy.org/article/2021/overview-science-diplomacy-in-south-asia.

India COVID-19 Case Study:

Sharma et al provide their analysis of the global response to COVID-19 and write that "international scientific cooperation would provide mutual benefits to all partners in terms of complementary research, time, utilisation of the existing capabilities, and sharing of the best practices & resources."[185] COVID-19 provided a tragic but immensely informative view of the state of international science diplomacy in the midst of a sudden global pandemic. "The pandemic experience has shown that science policy framers have been successful in their prognosis but not in their lobbying – an area where science diplomacy can prove a crucial tool."[186] "Nations need to develop a sense of cooperation that serves as the basis for a mutual strategic trust for international development."[187] The cooperation required by globally managing a pandemic and distributing vaccines to achieve the best outcomes for all nations has more of a benefit than simple altruism. "There are reasons of self-interest, too, for trying to ensure global vaccination. Large unvaccinated populations create greater scope for new variants to emerge, variants that might render existing vaccines less effective, and so leave even inoculated populations more vulnerable. Selfishness is not just harmful to other people, it may not even be in one's own self-interest."[188] Kenan Malik explains in *the Guardian* that the sometimes exclusionary and selfish practices of wealthy, powerful countries like those in the G7 actually caused more problems for the those very countries because vaccines were hoarded and then unused, while they could have been sent to places with dire need for vaccines, and administered to people who would liked to have been vaccinated. As of August 2021, "that G7 stockpile would be more than sufficient to vaccinate the entire adult population of sub-Saharan Africa…The irony is that many poor countries show low levels of vaccine hesitancy, but have no supplies for communities eager for inoculation, whereas in many of the countries hoarding the stuff, more people are sceptical about the vaccine."[189] This is a problem for many reasons; In an

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[185] Jyoti Sharma et al., "Science Diplomacy and COVID‐19: Future Perspectives for South–South Cooperation," *Global Policy* 13, no. 2 (February 14, 2022): 297, https://doi.org/10.1111/1758-5899.13027.
[186] Jyoti Sharma et al., "Science Diplomacy and COVID‐19: Future Perspectives for South–South Cooperation," *Global Policy* 13, no. 2 (February 14, 2022): 297.
[187] Sumbal Javed and Vijay Kumar Chattu, (2020): 300.
[188] Kenan Malik, "The Rich Nations' Take on the World Post-Pandemic? 'I'm All Right, Jack,'" the Guardian (The Guardian, August 29, 2021), https://www.theguardian.com/commentisfree/2021/aug/29/the-rich-nations-take-on-the-world-post-pandemic-im-all-right-jack.
[189] Kenan Malik, "The Rich Nations' Take on the World Post-Pandemic? 'I'm All Right, Jack,'" the Guardian (The Guardian, August 29, 2021).

age of globalization, data collection, and instant communication, it is embarrassing that the distribution of vaccines was fumbled in such a way. Health care is a human right, and the countries with the power to control the supply and distribution should have taken a more balanced and reasonable approach to the doling out of vaccines; it would have been in everyone's best interest. Javed and Chattu, writing on the efficacy of the COVID-19 response with an emphasis on India write, "the implications for the lack of international cooperation will lead to increased global disparities and the inequities as the countries that cannot procure vaccines will find their population more vulnerable to the pandemic's repercussion."[190]

Latin America & Caribbean Science Diplomacy:

Bonilla et al. reviewed the state of female representation in science in Central America and found that science diplomacy could be a key to facilitating networks of female scientists and could increase their contributions to science in Latin America.[191] Science diplomacy creates a path for countries from the Global South to participate on a larger scale, as well as allowing women to access or realize their scientific research and participate in science diplomacy. The science of large institutions has historically been a male-dominated field, especially in Central American countries, where scientific fields are socially seen as an unsuitable choice for women.[192] Science diplomacy offers a way to simplify the sometimes perplexing nature of scientific data for policymakers, who can then make better, more informed decisions that are in the best interests of their citizens. Of course, policymakers cannot be expected to understand vast collections of scientific data on a deep level, so science diplomacy can help to support mutual understanding between researchers and policymakers. Another challenge facing Latin America and the Caribbean is that most of the literature on science diplomacy has been written in English, so there is a lack of resources on the subject available in Spanish, adding another barrier for access to science diplomacy for Policymakers in non English-speaking nations.[193]

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[190] Sumbal Javed and Vijay Kumar Chattu, "Strengthening the COVID-19 Pandemic Response, Global Leadership, and International Cooperation through Global Health Diplomacy," *Health Promotion Perspectives* 10, no. 4 (November 7, 2020): 300, https://doi.org/10.34172/hpp.2020.48.

[191] Kleinsy Bonilla et al., "Participation in Communities of Women Scientists in Central America: Implications from the Science Diplomacy Perspective," *Frontiers in Research Metrics and Analytics* 6 (July 12, 2021): 16, https://doi.org/10.3389/frma.2021.661508.

[192] Kleinsy Bonilla et al., "Participation in Communities of Women Scientists in Central America: Implications from the Science Diplomacy Perspective," *Frontiers in Research Metrics and Analytics* 6 (July 12, 2021): 2.

[193] Marga Gual Soler, "Science Diplomacy in Latin America and the Caribbean: Current Landscape, Challenges, and Future Perspectives," *Frontiers in Research Metrics and Analytics* 6 (June 17, 2021): 4, https://doi.org/10.3389/frma.2021.670001.

For citizens of the Global South "the opportunity to participate as equals in global scientific networks is particularly relevant for researchers in developing countries in order to guarantee that the particular needs and challenges will be taken into account."[194] The best people to identify a problem and build solutions for addressing those problems are the people who live in that country. Citizens, researchers, and policymakers who live in countries within the Global South are most suited to identify the issues facing their country and the nuances and challenges of addressing those issues. Colglazier wrote in mid-2020 that,"The hope is that the current political tensions arising from the pandemic will not cause further roadblocks in building better science advisory ecosystems and a stronger science-policy-society interface at the national and global levels. Scientific communities in countries with advanced STI capabilities have a responsibility to help their colleagues in emerging countries with capacity building. Science diplomacy is now needed more than ever."[195]

A historical, colonial-era way to 'fix' the world's problems was by defining the problem as seen by a foreign government, then offering outside solutions to the problem. Rather than solutions from policymakers in the Global North being thrust upon those in the Global South, science diplomacy can help to empower and give a voice to those who are intimately familiar with the challenges facing their country, and those who may not have a voice on an international stage; and those with a vested interest are more likely to come up with innovative and suitable solutions. "Several authors (Quadir, 2013; Beleboni, 2019) state that South-South cooperation, which is often knowledge-based, creates conditions for countries to strengthen local capacities and design context-adapted strategies. This model moves away from the conventional, top-down conditionality-driven aid approach and can become a more effective strategy to foster sustainable development."[196] The catalyst for Latin American countries to increase their use of and involvement in scientific research and science diplomacy should be institutes of higher education, according to Mencía-Ripley et al.; "[Universities] may lead the way by doing more than just providing critical perspectives to this approach, but by actively changing

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[194] Aída Mencía-Ripley et al., "Decolonizing Science Diplomacy: A Case Study of the Dominican Republic's COVID-19 Response," *Frontiers in Research Metrics and Analytics* 6 (March 11, 2021): 2, https://doi.org/10.3389/frma.2021.637187.

[195] E. William Colglazier, "America's Science Policy and Science Diplomacy after COVID-19," Science & Diplomacy (Science & Diplomacy, June 28, 2020), https://www.sciencediplomacy.org/editorial/2020/americas-science-policy-and-science-diplomacy-after-covid-19.

[196] Aída Mencía-Ripley et al., "Decolonizing Science Diplomacy: A Case Study of the Dominican Republic's COVID-19 Response," *Frontiers in Research Metrics and Analytics* 6 (March 11, 2021): 3.

internationalization policies, priorities, and indicators."[197] Ensuring enough students in the Global South are in STEM education is the other side of that coin, Gluckman et al. explain: "Central to the development of low- and middle-income countries (LMICs) is the enhancement of science literacy and capacity through the promotion of science, technology, engineering, and mathematics (STEM) education."[198]

The European Union has used science diplomacy to form stronger ties to Latin America, with mixed outcomes. In 1999, the first EU-Latin America summit was held, "cooperation in the area of science, higher education and innovation appeared consistently in every declaration and action plan as a core element of the EU-Latin America interregional partnership."[199] Latin America is seen to have similar values to the EU as well sharing a desire to operate independently from the U.S.[200] The interregional approach taken by the EU in Latin American regions has had inconsistent levels of success.[201] Selleslaghs reviewed the EU's policies and engagements with Latin America using science diplomacy and states, "Latin America is seen as the part of the world where the EU's interregional agenda should bear the most fruit, as it shares similar values like the EU (democracy, human rights, nuclear non-proliferation and multilateralism), and also has a strong will to counter its strong ties with the US."[202] The shared desire to conduct research partnerships or diplomacy outside the watchful scope of the United States is a compelling motivation for the two regions to cooperate. "Authority-type tools have to do with the government's ability to regulate and exercise legal power. In science diplo- macy terms, we can place here the EU's science and technology cooperation agreements, which have been signed with 20 countries. The association agreements to the framework projects discussed above are authority-type tools."[203] However, even if Latin America seems to share EU values, it

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[197] Aída Mencía-Ripley et al., "Decolonizing Science Diplomacy: A Case Study of the Dominican Republic's COVID-19 Response," *Frontiers in Research Metrics and Analytics* 6 (March 11, 2021): 3, https://doi.org/10.3389/frma.2021.637187.
[198] Peter Gluckman et al., "Science Diplomacy: A Pragmatic Perspective from the Inside," December 2017, https://www.sciencediplomacy.org/sites/default/files/pragmatic_perspective_science_advice_dec2017_1.pdf.
[199] Joren Selleslaghs, "EU-Latin America Science Diplomacy," *Latin American Studies Association (LASA) 2017*, May 1, 2017: 30, https://www.researchgate.net/publication/317278815_EU-Latin_America_Science_Diplomacy.
[200] Joren Selleslaghs, "EU-Latin America Science Diplomacy," *Latin American Studies Association (LASA) 2017*, May 1, 2017: 5.
[201] Joren Selleslaghs, "EU-Latin America Science Diplomacy," *Latin American Studies Association (LASA) 2017*, May 1, 2017: 5.
[202] Joren Selleslaghs, "EU-Latin America Science Diplomacy," *Latin American Studies Association (LASA) 2017*, May 1, 2017: 5.
[203] Simone Arnaldi, *Science Diplomacy. Foundations and Practice.* (Edizioni Università di Trieste, 2023): 46, https://www.researchgate.net/publication/372860870_Science_diplomacy_Foundations_and_practice.

is a complex region; "With few exceptions, Latin American nations have a relatively immature science, technology, and innovation ecosystem, compounded by low public and private investments in research, coexisting with profound socio-economic inequalities, and large vulnerable populations.Such challenging conditions have created barriers to a fluid relationship between science and diplomacy, fundamentally characterized by inefficient communication between scientists and policymakers, weak collaboration channels, and duplicated roles, which altogether perpetuate siloed mentalities and a lack of trust between the two communities."[204] The lack of trust and understanding impedes the building of effective relationships and continued channels of communication.

There are many obstacles in the way of Latin American researchers, far more than their European or North American counterparts would face. It is from this vantage point that collaborators like the EU need to approach multilateral cooperation like science diplomacy. A few conferences or occasional events will not be sufficient to create the network, support and sustained impact to ensure that Latin America is not under-represented in the future of science diplomacy.[205] López-Vergès et al. analyze the relationship between Latin American countries and science diplomacy, asserting that "for science diplomacy to have a lasting impact in the development of the region, in resolving societal, environmental and health issues, it needs to go beyond one-off workshops, seminars, and conferences. Capacity development goes far beyond training: it recognizes the complexity of processes which it aims to influence and the need for multiple knowledges (topical, political, societal, traditional, etc.), provides practical and immersion opportunities to help bridge the gap between theory and practice, and requires a large component of support and follow-up to foster the emergence of vibrant and self-sufficient networks."[206] The existence and flourishing of science diplomacy in Latin America will not happen without concerted effort and clear goals and partnerships. Echeverría et al. echo these ideas and emphasize the critical nature of infrastructure and networks to enhance science diplomacy; "Although diverse realities converge in Latin countries at the same time, there is a common axis: they all belong to the "Global South". Science Diplomacy requires an

[204] Sandra López-Vergès et al., "Closing the Gap between Emerging Initiatives and Integrated Strategies to Strengthen Science Diplomacy in Latin America," *Frontiers in Research Metrics and Analytics* 6 (April 12, 2021): 1, https://doi.org/10.3389/frma.2021.664880.
[205] Sandra López-Vergès et al. "Closing the Gap between Emerging Initiatives and Integrated Strategies to Strengthen Science Diplomacy in Latin America," *Frontiers in Research Metrics and Analytics* 6(April 12, 2021): 6.
[206] Sandra López-Vergès et al. "Closing the Gap between Emerging Initiatives and Integrated Strategies to Strengthen Science Diplomacy in Latin America," *Frontiers in Research Metrics and Analytics* 6(April 12, 2021): 6.

infrastructure of research-networks to develop and support projects related to it. Likewise, the creation of capacity building projects through the exchange of human resources specialized in research and science plays an important role."[207] López-Vergès et al. explain how the infrastructure of science diplomacy can be build up and maintained in Latin American countries; "This can be achieved with the creation of specialized structures within executive and legislative branches, as well as in diplomatic missions, including the deployment of science counselors and attaches to connect the local scientific community with ecosystems of innovation abroad- as well as the diaspora. Science policy fellowship programs, internships, and pairing schemes connecting scientists with legislators and civil servants. [Universities] start changing mindsets and cultures that the default career path for a scientist is academia."[208]

Latin American researchers are at the forefront of recommendations for how their countries can curate consistent cooperation with policymakers and use science diplomacy to the highest benefit for the region. Selleslaghs explains the shortcoming of the EU's efforts of pursuing science diplomacy in the Latin American region up to 2017; "The EU is not using all operational instruments it has at its disposal to further its science diplomacy agenda in Latin America: it has not developed a network of science counselors or officers in Latin America and cooperation and investment in shared research infrastructure has only [taken] place sporadically. In addition, whereas four Latin American states have also signed bilateral cooperation agreements with the EU, incentives for the EU to continue working through the more cumbersome large-scale 'continental' or interregional programmes seem to diminish day by day."[209] According to Selleslaghs, the EU is an active initiator of SD in Latin America; "by analyzing the EU's declaratory and operational foreign policy approaches in this particular policy area, it became clear that the EU is pushing for science diplomacy towards Latin America at various levels and in numerous projects and initiatives."[210] The interdisciplinary aspect of science diplomacy is a key feature to enhance its stability and growth especially in the Global South;

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[207] Luisa Echeverría, Karina Aquino, and Claudia Widmaier, "Science Diplomacy and Sustainable Development Goals: A Latin American Perspective ," *Science Diplomacy Review* 2, no. 1 (March 2020): 11, https://fisd.in/sites/default/files/Publication/SDR%20March%202020_0.pdf#page=9.
[208] Sandra López-Vergès et al., "Closing the Gap between Emerging Initiatives and Integrated Strategies to Strengthen Science Diplomacy in Latin America," *Frontiers in Research Metrics and Analytics* 6 (April 12, 2021): 6, https://doi.org/10.3389/frma.2021.664880.
[209] Joren Selleslaghs, "EU-Latin America Science Diplomacy," *Latin American Studies Association (LASA) 2017*, May 1, 2017: 30, https://www.researchgate.net/publication/317278815_EU-Latin_America_Science_Diplomacy.
[210] Joren Selleslaghs, "EU-Latin America Science Diplomacy," *Latin American Studies Association (LASA) 2017*, May 1, 2017: 30.

López-Vergès et al. insist that "...we need adequate institutional infrastructures, boundary-spanning professionals and academic incentives to bring science and diplomacy into closer orbits and promote trust-building between their communities, so that they can join forces toward achieving the Sustainable Development Goals for the well-being throughout Latin America and the world." The connection between development of the Global South and the achievement of the SDGs cannot be overstated; "In order to adequately face current and future health and economic challenges, developing countries need to increase investment in research and development and promote international research cooperation."[211]

Latin America & Caribbean COVID-19 Case Study:

Another interesting case study about COVID-19 cooperation and science diplomacy is that of the Dominican Republic. The small Caribbean nation found a way to cooperate with US and Italian universities in order to sequence the genome of the virus circulating in the Dominican Republic at a particular moment in the pandemic.[212] This was a forward thinking initiative where science diplomacy was allowed to guide international cooperation for the health and benefit of people in several nations.[213] This type of cooperation does have benefits for both sides, in spite of the disparities between the participating groups due to funding and access to resources; since the gap between the nations "is wide, the promotion activities may create win-win situations for both the developed and the developing partner (i.e., the developed can access new markets, while the developing can access new information and technology).[214] Analyzing the partnership between the Dominican Republic and Italy, Mencía-Ripley et al. explain that, "this kind of partnership differs from traditional cooperation initiatives since it encourages and expects local knowledge to inform the methodology, process, and policy recommendations resulting from the projects, increasing relevance and local ownership of the knowledge that is being produced."[215] Instead of

[211] Aída Mencía-Ripley et al., "Decolonizing Science Diplomacy: A Case Study of the Dominican Republic's COVID-19 Response," *Frontiers in Research Metrics and Analytics* 6 (March 11, 2021): 3, https://doi.org/10.3389/frma.2021.637187.
[212] Aída Mencía-Ripley et al., "Decolonizing Science Diplomacy: A Case Study of the Dominican Republic's COVID-19 Response," (2021): 2.
[213] Aída Mencía-Ripley et al., "Decolonizing Science Diplomacy: A Case Study of the Dominican Republic's COVID-19 Response," (2021): 2.
[214] Elif Özkaragöz Doğan, Zafer Uygun, and İbrahim Semih Akçomak, "Can Science Diplomacy Address the Global Climate Change Challenge?," *Environmental Policy and Governance* 31, no. 1 (September 22, 2020): 41, https://doi.org/10.1002/eet.1911.
[215] Aída Mencía-Ripley et al., "Decolonizing Science Diplomacy: A Case Study of the Dominican Republic's COVID-19 Response," *Frontiers in Research Metrics and Analytics* 6 (March 11, 2021): 2.

a country from the Global North creating an initiative and proposing to include a country from the Global South, which is often how research collaborations happen since more of the funding is provided by or to institutions in the Global North, this was a research initiative proposed by the Universidad Iberoamericana in Santo Domingo. This was an unusual venture by the government of the Dominican Republic and one of their first attempts to use science diplomacy, and it turned out to be a great success, as they secured partnerships with two universities in the Global North and helped to secure more equipment for their country's fight against COVID-19.[216] The situation in this region was especially precocious with the emergence of a pandemic; "in addition to the health crisis, Latin America and the Caribbean plunged into a deep socio-economic crisis that affected the region throughout 2021."[217]

Especially in regions of the Global South, like Latin America and the Caribbean, "Every year there are re-emerging or emerging pathogens, global warming adds to these challenges, and as such, systems are constantly under pressure, and health infrastructures exhausted."[218] Mencía-Ripley et al. highlight the intersectionality of the international issues that affect the Global South even more harshly. Fuentes et al. highlight that "it is imperative to recognize the uneven distribution of climate change impacts, with diverse communities and socio-economic strata shouldering disparate burdens. This underscores the essentiality of a concerted global endeavor that spans individuals, communities, and nations, addressing both mitigation and adaptation strategies."[219] A global pandemic is made worse by unpredictable climate conditions, storms, and natural disasters. A country in the Global South then directs more funds to deal with unforeseen humanitarian crises than to technological devices to better equip scientists to perform their research. There is a snowball effect that keeps countries in the Global South in a more compromised position. Additionally, Gluckman recalls the interconnectedness of global aid and science; "A great deal of aid has a technological dimension, whether to address water and other environmental and resource issues, public health, food and energy security, or to grow and

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[216] Aída Mencía-Ripley et al., "Decolonizing Science Diplomacy: A Case Study of the Dominican Republic's COVID-19 Response," *Frontiers in Research Metrics and Analytics* 6 (March 11, 2021): 2, https://doi.org/10.3389/frma.2021.637187.
[217] Beata Wojna, "European Union Initiatives Supporting Latin American and Caribbean Countries in Combating the COVID-19 Pandemic," in *The EU towards the Global South during the COVID-19 Pandemic*, ed. Katarzyna Kołodziejczyk (Berlin: Peter Lang, 2022), 134, https://doi.org/10.3726/b20199.
[218] Aída Mencía-Ripley et al., "Decolonizing Science Diplomacy: A Case Study of the Dominican Republic's COVID-19 Response," *Frontiers in Research Metrics and Analytics* 6 (March 11, 2021): 3.
[219] Miguel Fuentes et al., "Global Digital Analysis for Science Diplomacy on Climate Change and Sustainable Development," *Sustainability* 15, no. 22 (November 8, 2023): 17, https://doi.org/10.3390/su152215747.

diversify the economy. However, well-intended efforts can be counterproductive if they are not evidence based. Scientific input, therefore, needs to be incorporated into the evaluation and design of proposed programs."[220]

Latin America and the Caribbean face unique challenges socio-culturally that affect the way their countries interact with scientific knowledge and manage a health crisis like COVID-19, for example. "Latin American policymakers report receiving too much information and not knowing how to identify which information fits their needs."[221] One way to improve the relationship between policymakers and communication of scientific data is to increase the participation of researchers based in Latin America with science diplomacy networks internationally. Mencía-Ripley et al. emphasize that when dealing with a global health crisis, "Creating and increasing participation in research networks and development initiatives based on the principles of mutual learning, collaborative problem solving and co-creation of innovative technologies and expertise, as discussed by Abdenur and Estevao Marques da Fonseca (2013) are some of the mechanisms that researchers and policymakers must promote in order to challenge the current health, economic and social crisis and foster sustainable development."[222] Ensuring stable infrastructures for health and networks between researchers and policymakers is critical for populations of the Global South, not only for day-to-day health needs, but also for global health crises like the COVID-19 pandemic. Networks of scientists and diplomats with open channels of communication also play an important role in science diplomacy as a whole. Sir Peter Gluckman also argues in favor of international cooperation via science diplomacy to facilitate diplomatic relations; "In seeking to build their science, technology, and innovation (STI) infrastructure, many countries use diplomacy, whether to open doors to expertise in other countries, to foster relationships through partnership agreements at the national, university, or company level, or to reach out to scientists in their national diaspora."[223] This strategy offers

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[220] Peter Gluckman et al., "Science Diplomacy: A Pragmatic Perspective from the Inside," December 2017, https://www.sciencediplomacy.org/sites/default/files/pragmatic_perspective_science_advice_dec2017_1.pdf.
[221] Marta Pulido-Salgado and Fátima Antonethe Castaneda Mena, "Bringing Policymakers to Science through Communication: A Perspective from Latin America," *Frontiers in Research Metrics and Analytics* 6 (April 26, 2021): 7, https://doi.org/10.3389/frma.2021.654191.
[222] Aída Mencía-Ripley et al., "Decolonizing Science Diplomacy: A Case Study of the Dominican Republic's COVID-19 Response," *Frontiers in Research Metrics and Analytics* 6 (March 11, 2021): 3, https://doi.org/10.3389/frma.2021.637187.
[223] Peter D. Gluckman, "Science Advice to Governments," Science & Diplomacy, June 9, 2016, https://www.sciencediplomacy.org/article/2016/science-advice-governments.

benefits to the diaspora of scientists and creates a network with more links between countries with a strong STI infrastructures as well as those trying to build them.

The Climate Crisis:

Turekian et al. state that "the most profound challenges to human survival — climate change, diminishing biodiversity, public health, food insecurity and resource scarcity, to name but a few — are rooted in science and driven by technology."[224] The global climate crisis is another phenomenon where science diplomacy can be of use. Ruffini writes that "climate change is a particularly insightful case for studying the complex interactions between science and diplomacy because it is a science-intensive issue."[225] He adds that there is a shared sensibility of responsibility for climate stability which " is a global public good and defending it requires reaching cooperative solutions at the global scale."[226] There is precedent for international collaboration on climate guidelines. "Scientific knowledge informed the 1992 United Nations Framework Convention on Climate Change and the 1997 Kyoto Protocol, both of which stipulated binding obligations for states to reduce carbon emissions."[227] In order to prevent catastrophe, emissions targets were set for countries to follow. Davis and Patman point to the inconsistencies in the adherence to these targets; "The 1997 Kyoto Protocol set emissions targets for developed countries that were supposedly binding under international law although, notably, the USA (the world's second-largest emitter) did not ratify the protocol;" and in the years following, CO_2 levels rose consistently.[228] Fuentes et al. emphasize that "Nations must collaborate to reduce greenhouse gas emissions, lead in the development of sustainable technologies, and implement adaptive strategies. Such collective endeavors can foster diplomatic relationships and facilitate the exchange of knowledge and resources, ultimately reinforcing global stability and peace."[229] The climate crisis goes beyond erratic weather patterns and

[224] Vaughn C Turekian et al., "Science Diplomacy," in *WORLD SCIENTIFIC EBooks*, ed. Lloyd S Davis and Robert G Patman (World Scientific, 2015): 12, https://doi.org/10.1142/8658.
[225] Pierre-Bruno Ruffini, "The Intergovernmental Panel on Climate Change and the Science-Diplomacy Nexus," *Global Policy* 9 (August 23, 2018): 73, https://doi.org/10.1111/1758-5899.12588.
[226] Pierre-Bruno Ruffini, *Science and Diplomacy*, (2017), 114, https://doi.org/10.1007/978-3-319-55104-3.
[227] Vaughn C Turekian et al., "Science Diplomacy," in *WORLD SCIENTIFIC EBooks*, ed. Lloyd S Davis and Robert G Patman (World Scientific, 2015): 16.
[228] Lloyd Davis and Robert G Patman, "New Day or False Dawn?," in *Science Diplomacy: New Day or False Dawn?*, ed. Lloyd Davis and Robert G Patman (World Scientific, 2014), 263.
[229] Miguel Fuentes et al., "Global Digital Analysis for Science Diplomacy on Climate Change and Sustainable Development," *Sustainability* 15, no. 22 (November 8, 2023): 2, https://doi.org/10.3390/su152215747.

threatens to influence populations in long-term ways related to agriculture, migration, economic interests, and has the potential to strain global tensions.[230] According to Fuentes et al. "addressing climate change extends beyond being merely an environmental concern; it is intricately interwoven with multifaceted societal objectives, encompassing the assurance of human well-being and the cultivation of international collaborations."[231]

Colglazier recalls that long before the COVID-19 pandemic, there was an excellent example of "positive development"[232] in the Intergovernmental Panel on Climate Change (IPCC). "It has been a partnership of the worldwide scientific community, national governments, and the U.N. for understanding the implications of anthropogenic climate change and policies that could help mitigate the damages. This partnership helped lead to the Paris Climate Agreement."[233] When making policy decisions about climate, diplomats must have a level of awareness of the scientific facts associated with climate change, and the International Panel on Climate Change (IPCC) is a crucial resource for collecting and disseminating relevant information.[234] Another benefit of institutions like the IPCC, potentially "offer new centres of power through which political actors operating beyond the reach of the nation state can be held to account."[235] These decisions have big consequences for future generations, yet the success or failure depends on quality of scientific advice and, perhaps more importantly, on political will to reach an agreement.[236] Colglazier emphasizes that "providing objective, high-quality advice with integrity, free of politics and special interests, is an important civic responsibility for the worldwide scientific community."[237] This statement is especially true regarding climate change, where actionable steps are urgent and must be based on the most accurate, up to date research.

[230] Miguel Fuentes et al., "Global Digital Analysis for Science Diplomacy on Climate Change and Sustainable Development," *Sustainability* 15, no. 22 (November 8, 2023): 2, https://doi.org/10.3390/su152215747.
[231] Miguel Fuentes et al., "Global Digital Analysis for Science Diplomacy on Climate Change and Sustainable Development," *Sustainability* 15, no. 22 (November 8, 2023): 17.
[232] E. William Colglazier, "Response to the COVID-19 Pandemic: Catastrophic Failures of the Science-Policy Interface," Science & Diplomacy, April 9, 2020, https://www.sciencediplomacy.org/editorial/2020/response-covid.
[233] E. William Colglazier, "Response to the COVID-19 Pandemic: Catastrophic Failures of the Science-Policy Interface," Science & Diplomacy, April 9, 2020.
[234] Pierre-Bruno Ruffini, "The Intergovernmental Panel on Climate Change and the Science-Diplomacy Nexus," (2018) 73, https://doi.org/10.1111/1758-5899.12588.
[235] Mike Hulme, "Problems with Making and Governing Global Kinds of Knowledge," *Global Environmental Change* 20, no. 4 (October 2010): 562, https://doi.org/10.1016/j.gloenvcha.2010.07.005.
[236] Pierre-Bruno Ruffini, "Does Science Diplomacy Keep Its Promise?," Presentation (Science Diplomacy week ExPoSTEAM, October 22, 2024), https://www.youtube.com/live/8HV8zeiW-Pg?si=rpWQzNUmNlJqh-Mt.
[237] E. William Colglazier, "America's Science Policy and Science Diplomacy after COVID-19," Science & Diplomacy (Science & Diplomacy, June 28, 2020), https://www.sciencediplomacy.org/editorial/2020/americas-science-policy-and-science-diplomacy-after-covid-19.

He goes on to add that, "the practitioners must not only present accurately the state of scientific knowledge with its uncertainties, but also clearly state where the advice incorporates value judgments that go beyond science."[238] Eigner explains that "in the 1990s, efforts to reduce transboundary air pollution in East Asia failed because Chinese scientists refused to accept Japanese and South Korean studies that described China as the main polluter in the region."[239] China has since changed its tune and is now putting a concerted effort to combat climate change; "South–South cooperation is becoming an increasingly important dimension of international cooperation that addresses climate change. China is leading this development with its growing support to other developing countries over the last few years through Climate Change South–South Cooperation (CCSSC)."[240]

The lack of a desire to cooperate politically can hinder diplomatic negotiations. The COP 15 in Copenhagen in 2009 was considered a failure as consensus was not reached, it was merely noted, not adopted, since only 139 parties eventually agreed to it.[241] Ruffini, speaking about science diplomacy in the COP 15 and Paris COP 21, reminds us that, "Barriers to achieving climate goals are more political than technical."[242] Though the IPCC presented excellent information about the state of the global climate conditions, the political actors were not immediately moved to adopt policies in line with the recommendations of scientists. This gap between scientific data and policymakers is a common theme in the literature about science diplomacy, as SD hopes to provide structure for the interactions between the two groups. Whether or not science diplomacy is successful in its endeavors is a question that depends heavily on the context of a particular situation.[243] In spite of the COP 15 not being successful on paper, "the Copenhagen Accord laid the foundation for a new style of climate agreement based

[238] E. William Colglazier, "America's Science Policy and Science Diplomacy after COVID-19," Science & Diplomacy (Science & Diplomacy, June 28, 2020).
[239] Leo Eigner, "The Promise and Paradox of Science Diplomacy," *CSS Analyses in Security Policy* 326 (July 2023): 4, https://doi.org/10.3929/ethz-b-000619331.
[240] Elif Özkaragöz Doğan, Zafer Uygun, and İbrahim Semih Akçomak, "Can Science Diplomacy Address the Global Climate Change Challenge?," *Environmental Policy and Governance* 31, no. 1 (September 22, 2020): 38, https://doi.org/10.1002/eet.1911.
[241] Mark A Maslin, John Lang, and Fiona Harvey, "A Short History of the Successes and Failures of the International Climate Change Negotiations," *UCL Open. Environment* 5, no. 8 (July 19, 2023): e059, https://doi.org/10.14324/111.444/ucloe.000059.
[242] Pierre-Bruno Ruffini, "Does Science Diplomacy Keep Its Promise?," Presentation (Science Diplomacy week ExPoSTEAM, October 22, 2024), https://www.youtube.com/live/8HV8zeiW-Pg?si=rpWQzNUmNlJqh-Mt.
[243] Pierre-Bruno Ruffini, "Does Science Diplomacy Keep Its Promise?," Presentation (Science Diplomacy week ExPoSTEAM, October 22, 2024).

on country based pledged commitments to an overall global emission reduction target."[244] "The climate negotiations in Paris 2015 were a huge success in part because of the huge amount [of] preparation work at the previous COPs and at the United Nations Educational, Scientific and Cultural Organisation (UNESCO) 'Our Common Future Under Climate Change' international scientific conference held in Paris in July 2015."[245]

According to Gluckman, there are difficulties associated with gathering scientific data for international policy decisions on climate; "as we have seen in the complex processes associated with the Intergovernmental Panel on Climate Change (IPCC), sometimes very elaborate processes are needed for globally driven science to influence domestic policies and to diminish the role of national interests in shaping the science."[246] Hulme warns that "Global kinds of knowledge yield global kinds of meaning-making and policy-making. They erase cultural differentiation and heterogeneity. They fail to do justice to the plurality of human living and may have considerably less purchase in problem-solving and policy-making than a multiplicity of local and diverse tools and indicators."[247] In analyzing why the majority of scientific knowledge about climate change is not taken into account when policy formulation occurs, Ruffini argues that there are two main reasons; firstly, diplomats are not very familiar with this data as they work with it very little in practice; secondly, in spite of climate data being widely agreed upon and accepted by scientists and diplomats alike, national interests usually take precedence at the end of the policy making progress, as diplomats and politicians have to achieve short term goals to maintain their positions.[248] "In these arenas, national interests confront each other, and science does not have the last word: the large consensus that exists among scientists about the origins and long-term risks of climate change does not translate into a consensus among diplomats."[249]

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[244] Mark A Maslin, John Lang, and Fiona Harvey, "A Short History of the Successes and Failures of the International Climate Change Negotiations," *UCL Open. Environment* 5, no. 8 (July 19, 2023): e059, https://doi.org/10.14324/111.444/ucloe.000059.
[245] Mark A Maslin, John Lang, and Fiona Harvey, "A Short History of the Successes and Failures of the International Climate Change Negotiations," *UCL Open. Environment* 5, no. 8 (July 19, 2023): e059.
[246] Peter D. Gluckman, "Science Advice to Governments," Science & Diplomacy, June 9, 2016, https://www.sciencediplomacy.org/article/2016/science-advice-governments.
[247] Mike Hulme, "Problems with Making and Governing Global Kinds of Knowledge," *Global Environmental Change* 20, no. 4 (October 2010): 563, https://doi.org/10.1016/j.gloenvcha.2010.07.005.
[248] Pierre-Bruno Ruffini, "The Intergovernmental Panel on Climate Change and the Science-Diplomacy Nexus," *Global Policy* 9 (August 23, 2018): 76, https://doi.org/10.1111/1758-5899.12588.
[249] Pierre-Bruno Ruffini, "The Intergovernmental Panel on Climate Change and the Science-Diplomacy Nexus," *Global Policy* 9 (August 23, 2018): 76.

Science diplomacy must be careful not to fall into the patterns of global knowledge which become so theoretical in nature that it is detached from its practical application. The hesitation of some countries to adopt the COP 15 agreement is an example of scientific data not achieving the goal of influencing policy decisions. The process is not completely broken, but for matters where timeliness of decisions is critical (like climate change or global health crises) speeding the trust and understanding between scientists and policymakers is absolutely urgent. Gluckman adds that "Inclusiveness builds trust, so it was important for the IPCC to broaden the scope of expertise and clearly demonstrate that the scientific consensus was international."[250] However, consensus alone may not be the best way to judge the validity or accuracy of scientific data. Hulme suggests that one way to improve the IPCC is to employ spectral knowledge; "spectral in that it more explicitly captures and communicates the full range of expert beliefs about how the world is and may become, rather than valorising consensus. This may be cumbersome and clumsy, but it better captures the ambiguities in the human search for warranted truth."[251] Using such a technique would encourage a more realistic view of the knowledge of various scientists, and paint a clearer picture. Aukes et al. add that "A smart approach to science diplomacy—to global resilience through knowledge-based cooperation—does not prescribe the content, but rather focuses on the process of science-based international exchange."[252] In terms of methods of climate cooperation internationally, Fuentes et al. studied the statistics of climate research by region and country over the last few decades, and noted that "the USA, UK, Australia, Japan, and China, not only have extensive collaborations but also exhibit a tendency to sustain these relationships over decades. This consistent partnering reflects the importance of building and maintaining strong alliances, both personal and institutional, in climate change research."[253] As more North-South and South-South cooperation can be established, we will likely be closer to achieving climate goals and have increased levels of cooperation.

Economic decisions and habits can also slow or hinder the implementation of changes required by policymakers to reduce factors contributing to climate change. Research from the

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[250] Peter D. Gluckman, "Science Advice to Governments," Science & Diplomacy, June 9, 2016, https://www.sciencediplomacy.org/article/2016/science-advice-governments.
[251] Mike Hulme, "Problems with Making and Governing Global Kinds of Knowledge," *Global Environmental Change* 20, no. 4 (October 2010): 562, https://doi.org/10.1016/j.gloenvcha.2010.07.005.
[252] Ewert Aukes et al., "Global Resilience through Knowledge-Based Cooperation: A New Protocol for Science Diplomacy," *F1000Research* 10 (August 18, 2021): 827, https://doi.org/10.12688/f1000research.55199.1.
[253] Miguel Fuentes et al., "Global Digital Analysis for Science Diplomacy on Climate Change and Sustainable Development," *Sustainability* 15, no. 22 (November 8, 2023): 11, https://doi.org/10.3390/su152215747.

International Institute for Sustainable Development published in September 2024 shows that, "G20 governments are spending three times as much on fossil fuels as renewables;" this is in line with data over the last few years, in 2023 the support for renewable energy was at least 168 billion USD, while fossil fuel subsidies amounted to approximately 535 billion USD.[254] With the cost of renewables having radically reduced over the last decade, the hesitation to fully commit to using renewable energy, especially by the countries with the financial capacity to do so can be puzzling. Another key concern is the effect that transitioning to clean energy will have on employment. Feffer writes that the concern spans more than just fossil fuel workers, "along with automation, the energy transition also threatens to reduce the ranks of those in sectors dependent on fossil fuel, like plastics, steel, and petrochemicals. And unions are particularly concerned that unionized jobs in these sectors will be replaced with lower-paid non-union positions if they aren't outsourced to lower-wage countries altogether."[255] Lim, Aklin, and Frank emphasize that even in a wealthy country like the U.S., "For example, this transition could displace 1.7 million fossil fuel workers in the United States and many more globally." Unions are fighting to have assistance provided in finding these workers clean energy jobs, but geographical and logistical issues complicate the process or inhibit some from seeking alternate careers. For example, many fossil fuel related jobs are not in close proximity to the clean energy jobs being created, and being required to relocate to a different part of the country would inhibit some workers from making the change.[256] Recurrent themes of a North/South divide are expressed, especially by researchers in the Global South. "The energy transition also threatens to widen the gap between North and South, with the latter serving as a vast "sacrifice zone" that provides the inputs—extracted in environmentally damaging ways—that the former needs for its "clean energy" products. "Our countries cannot be forced simply to provide the resources of the North," argues Ibis Fernández of the Confederación Intersectorial de Trabajadores Estatales del Perú. "This is all a new colonialism, right?""[257] The climate crisis and employment related to clean

[254] International Institute for Sustainable Development, "G20 Governments Are Spending Three Times as Much on Fossil Fuels as Renewables," International Institute for Sustainable Development, September 30, 2024, https://www.iisd.org/articles/press-release/g20-spending-three-times-fossil-fuels-renewables.
[255] John Feffer, "Labor and Green Colonialism in the Global South - FPIF," Foreign Policy in Focus, (January 10, 2024), https://fpif.org/labor-and-green-colonialism-in-the-global-south/.
[256] Junghyun Lim, Michaël Aklin, and Morgan R. Frank, "Location Is a Major Barrier for Transferring US Fossil Fuel Employment to Green Jobs," *Nature Communications* 14, no. 1 (September 26, 2023): 5711, https://doi.org/10.1038/s41467-023-41133-9.
[257] John Feffer, "Labor and Green Colonialism in the Global South - FPIF," Foreign Policy in Focus, (January 10, 2024).

energy transition also highlights existing tensions between entire regions. Feffer cites Felipe Diaz, from the Colombian research institute Centro de Innovación e Investigación para el Desarrollo Justo del Sector Minero Energético, who explains, "Especially in Latin America, every government that emphasizes its own sovereignty is sabotaged either internally or externally," he points out. "The cases have been very, very clear in Uruguay and Brazil. They tried to not depend on other countries, specifically the expansionist model of the United States, but they were literally squashed."[258] If science diplomacy could provide a more stable path to true autonomy, it would surely motivate policymakers, diplomats, and governments in Latin America to invest in scientific infrastructure to help counter immense power imbalance. Ruffini explains the pervasiveness of the climate crisis and cites the work of Dahan and Aykut (2012); "Countries must agree: this is the diplomatic dimension. Climate change has been among the priorities of the inter- national political agenda for the last 30 years and tends to combine all development- related discussions. It is at the heart of multilateral diplomacy."[259] Multilateral agreements are, indeed, the only way to sufficiently manage climate change, as every country contributes in one way or another (some more than others). "Science diplomacy can also be applied as a collective action mechanism to resolve transboundary issues affecting common goods. The assumption is that, given air pollution or groundwater depletion affect regional actors equally, the incentive to collaborate is high."[260] These climate relevant issues are intrinsically linked to fluctuations in climate and have potentially disastrous effects if ignored in the short-term. Agricultural problems, fresh water scarcity, drought; these have the potential to set larger shifts of migration, economy, and agricultural practices into motion and lives could be disrupted even more extensively. Özkaragöz Doğan et al. suggest that "while sustainable development pathways are both technologically and economically feasible (e.g., Kainuma, Miwa, Ehara, Akashi, & Asayama, 2013) they are at the same time hard to achieve due to inertia and resistance to change (Burch, 2010) and difficulty in governing a complex network of actors that work for this change to occur (Burch, Shaw, Dale, & Robinson, 2014)."[261] The network of

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[258] John Feffer, "Labor and Green Colonialism in the Global South - FPIF," Foreign Policy in Focus, (January 10, 2024), https://fpif.org/labor-and-green-colonialism-in-the-global-south/.
[259]Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017), 114.
[260] Leo Eigner, "The Promise and Paradox of Science Diplomacy," *CSS Analyses in Security Policy* 326 (July 2023): 3, https://doi.org/10.3929/ethz-b-000619331.
[261] Elif Özkaragöz Doğan, Zafer Uygun, and İbrahim Semih Akçomak, "Can Science Diplomacy Address the Global Climate Change Challenge?," *Environmental Policy and Governance* 31, no. 1 (September 22, 2020): 42, https://doi.org/10.1002/eet.1911.

diverse actors and experts required to cooperate on matters of climate change increases the odds of a failure at some point of the cooperation. Özkaragöz Doğan et al. emphasize that science diplomacy has the potential to "provide a more structured way of policy-learning and peer-to-peer learning."[262] The long-term requirements of policy to mitigate climate change would benefit from the flexibility and usefulness of science diplomacy.[263]

Ch 4: conclusion; Critiques, Decolonizing Science Diplomacy, South-South Cooperation:

Critiques of Science Diplomacy:

In spite of its application across a range of fields and situations, science diplomacy is not without critique. Rungius and Flink, in a critical review of science diplomacy, argue that it is vague, circular, and not as widely applicable as its proponents claim it to be.[264] They take a stance against the broad application of science diplomacy, arguing it is too vaguely defined, and disagree with the use of historical examples by supporters of the phenomenon; claiming the latter is a "discursive strategy," asserting that science diplomacy has only existed since the 2010s and onward.[265] While there is some merit to the claims of definitions being vague, this appears to be a tool commonly seen in diplomacy, so science diplomacy is not unusual for not having a rigid definition. It fills the shape of the container it is poured into, by nature it needs to be flexible, changeable to be a more effective tool. Özkaragöz Doğan et al. explain that, "science diplomacy instruments are various. Some are more direct in terms of expected results like development aids, joint research, and joint ventures while some are more indirect such as scientific personnel exchanges and training." [266] Though there are epistemological downsides to science diplomacy

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[262] Elif Özkaragöz Doğan, Zafer Uygun, and İbrahim Semih Akçomak, "Can Science Diplomacy Address the Global Climate Change Challenge?," *Environmental Policy and Governance* 31, no. 1 (September 22, 2020): 41, https://doi.org/10.1002/eet.1911.
[263] Elif Özkaragöz Doğan, Zafer Uygun, and İbrahim Semih Akçomak, "Can Science Diplomacy Address the Global Climate Change Challenge?," (2020): 41.
[264] Charlotte Rungius and Tim Flink, "Romancing Science for Global Solutions: On Narratives and Interpretative Schemas of Science Diplomacy," *Humanities and Social Sciences Communications* 7, no. 1 (September 23, 2020): 8, https://doi.org/10.1057/s41599-020-00585-w.
[265] Charlotte Rungius and Tim Flink, "Romancing Science for Global Solutions: On Narratives and Interpretative Schemas of Science Diplomacy," *Humanities and Social Sciences Communications* 7, no. 1 (2020): 8.
[266] Elif Özkaragöz Doğan, Zafer Uygun, and İbrahim Semih Akçomak, "Can Science Diplomacy Address the Global Climate Change Challenge?," (2020): 41.

being vaguely defined, that very vagueness allows it to fit into a wider variety of situations, especially in an increasingly complex set of global challenges. Büyüktanir Karacan and Ruffini assert that "SD is an attractive concept: the name is flexible enough for everyone to make it their own (at the cost of ambiguity, for the catch-all nature of the wording 'science diplomacy' has often been denounced). However, to be attractive, the concept must also be useful and help make the world more intelligible by naming and promoting explicit diplomatic actions regarding issues that combine scientific knowledge, states' foreign policies, and global governance."[267] Empirically, science diplomacy as a field would likely benefit from a more structured set of characteristics and guidelines. In a lecture given at the University of Padova in 2024, Pierre-Bruno Ruffini spoke on science diplomacy and explained that there is not much empirical evidence of science diplomacy helping to ease international tensions.[268] For the field to be more easily assessed and measured, narrowing the definition of science diplomacy would be a helpful first step.

The argument that science diplomacy is not as applicable as some literature suggests is an understandable one, but science diplomacy is very context dependent, so it is still possible that SD is still widely applicable in the right situations. The context and the groups involved determine whether or not science diplomacy is a fitting tool, which needs to account for the wide array of possibilities diplomatically and politically speaking. Ruffini mentions to keep in mind that science diplomacy has stronger effects in the political realm than it does in the scientific realm.[269] The name science diplomacy may convey an image that is scientific and empirical above all else, but diplomacy defines science in this context.[270] The critical geopolitical issues facing the world today such as "global health, biodiversity conservation, ocean governance, water resource management, nuclear non-proliferation, energy security or climate change," are issues that must be addressed by scientists and policymakers in conjunction with one another.[271] There is no way for policymakers alone to solve the issues that face the international community

[267] Derya Büyüktanir Karacan and Pierre-Bruno Ruffini, "Science Diplomacy in the Global South—an Introduction," *Science and Public Policy/Science & Public Policy* 50, no. 4 (June 13, 2023): 742–43, https://doi.org/10.1093/scipol/scad028.
[268] Pierre-Bruno Ruffini, "Does Science Diplomacy Keep Its Promise?," Presentation (Science Diplomacy week ExPoSTEAM, October 22, 2024), https://www.youtube.com/live/8HV8zeiW-Pg?si=rpWQzNUmNlJqh-Mt.
[269] ibid.
[270] ibid.
[271] Marga Gual Soler, "Science Diplomacy in Latin America and the Caribbean: Current Landscape, Challenges, and Future Perspectives," *Frontiers in Research Metrics and Analytics* 6 (June 17, 2021): 2, https://doi.org/10.3389/frma.2021.670001.

today. Scientists have always played a key part in solving humanity's crises, and as earth's population continues to increase, especially in the Global South, any constructive path forward must include scientists. To focus on the Global South further, Latin American policymakers claim to receive too much scientific data to know which information is relevant to their needs, which complicates their ability to make informed decisions and guide their work.[272] The process of scientific communication does need some clarity and consistency across nations, which would improve the understanding of data by policymakers as well as the general public, but this will come with time as science diplomacy is terminology-wise a young term. The application of science diplomacy to historical events is not automatically discursive. In historical studies of all kinds, we reflect on the events of the past with a new lens and apply modern concepts retroactively to analyze in a new way. This is a part of studying history, and it may not always lead to valuable information, but reflection and analysis are critical ways for us to use history to inform the present and future. Science diplomacy should not be applied to any historical event without discrimination, but there are certainly examples starting from World War II that are widely agreed to be the early phases of science diplomacy. Rungius and Flink do not explicitly emphasize the need for South-South cooperation, but they do mention that the EU seems to be employing science diplomacy in order to exert control in a global context under the guise of being friendly.[273] The potential for abuse or imbalance of power is always present in an international diplomatic context; highlighting the colonial roots of this imbalance is a way to begin deconstructing and reassessing the protocol of diplomatic relations. Science diplomacy does not claim to take care of all the concerns of diplomats and governments, it merely provides another in a large set of tools which can be employed at the right time, in the right context. In spite of its shortcomings, Colglazier offers an optimistic suggestion resulting from the pandemic; "Even with the failures at the science-policy interface on COVID-19, there is hope going forward. The global scientific community has engaged in unprecedented scientific collaboration and sharing of information that accelerated from the very beginning."[274]

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[272] Marta Pulido-Salgado and Fátima Antonethe Castaneda Mena, "Bringing Policymakers to Science through Communication: A Perspective from Latin America," *Frontiers in Research Metrics and Analytics* 6 (April 26, 2021): 7, https://doi.org/10.3389/frma.2021.654191.
[273] Charlotte Rungius and Tim Flink, "Romancing Science for Global Solutions: On Narratives and Interpretative Schemas of Science Diplomacy," *Humanities and Social Sciences Communications* 7, no. 1 (September 23, 2020): 7, https://doi.org/10.1057/s41599-020-00585-w.
[274] E. William Colglazier, "Response to the COVID-19 Pandemic: Catastrophic Failures of the Science-Policy Interface," Science & Diplomacy, April 9, 2020.

Decolonizing Science Diplomacy:

> "Here is the most robust dividing line between SD as perceived from the South and SD as inherited from the North. The Royal Society-AAAS seminal report did not address the topic of the development of the South. The literature from the North has only touched on this issue in passing."[275]

Above, Büyüktanir Karacan and Ruffini highlight a critical point about science diplomacy; it is a point that will likely be the focus of much analysis related to SD in the coming decades.Science diplomacy was first employed under the legacy and shadow of imperialism established during colonialism. The Global South only exists in contrast to the Global North, they continuously confirm the place of each other, in a geopolitical context. Dados and Connell aim to illuminate the North/South relationship in a global framework; they posit that, "North-South terminology, then, like core-periphery, arose from an allegorical application of categories to name patterns of wealth, privilege, and development across broad regions."[276] The fact that the terms Global North and Global South emerged around the same time as science diplomacy did (in practice) further cemented the connection between the concepts. Dados and Connell elaborate further on the North/South terminology, "with the Cold War winding down, the terms "Global North" and "Global South" spread in academic fields like international relations, political science, and development studies. The North-South language provided an alternative to the concept of "globalization," contesting the belief in a growing homogenization of cultures and societies."[277] Where globalization sees the world as harmonious through rose colored glasses, Global North/South terminology offers perhaps a more reasonable assessment of the realities faced in different parts of the world, though the situation each individual country faces may be more of a spectrum realistically. In a display of increasing tension and dispute of the status quo, "the OECD's Development Assistance Committee (DAC), which has worked to

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[275] Derya Büyüktanir Karacan and Pierre-Bruno Ruffini, "Science Diplomacy in the Global South—an Introduction," *Science and Public Policy/Science & Public Policy* 50, no. 4 (June 13, 2023): 745, https://doi.org/10.1093/scipol/scad028.
[276] Nour Dados and Raewyn Connell, "The Global South," *Contexts* 11, no. 1 (February 2012): 12, https://doi.org/10.1177/1536504212436479.
[277] ibid.

encode a set of norms, values and practices as part of the organization's guidelines, is being increasingly (and openly) contested by South–South providers who do not always endorse the same principles."[278]

Mencía-Ripley et al. caution that "Science diplomacy, when directed by developed nations alone, can replicate colonial structures that continue to ignore the needs of developing nations and silences voices from countries historically ignored by the scientific community."[279] This is where the Global North can extend cooperative efforts to countries in the Global South to foster scientific study and practice and develop skills and knowledge in the Global South. Büyüktanir Karacan and Ruffini argue that "The underinvestment in resources for science and research in the South affects performance. In world scientific publications, China occupies a unique position (24.5 percent of the world total in 2019), and India (6.1 percent) has produced more publications than Latin America and the Caribbean combined (5.3 percent)."[280] Enabling better research capacities in the Global South would benefit researchers in the Global North and South.

According to Echeverría et al. "The Global South is related to a history of colonialism, periphery and rebellion."[281] The roots of decolonialism in international politics on a grand stage stretch back to the Cold War era, as with science diplomacy and the classification of the Global North and South. The struggle existed within the Global North and eventually showed up in colonized nations; "Nonwhite minorities inside the metropoles fought battles for the rights of citizenship, battles that paralleled the concurrent struggles of nonwhite majorities outside the metropoles for the rights of self-rule."[282]Parker explains that as new nations emerged in Asia, Africa and the Caribbean, "nationalist leaders sensed that the long era of formal empire in human history was coming to a close. They invoked the Wilsonian watchword of "self-determination"

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[278] Adriana Erthal Abdenur and João Moura Estevão Marques Da Fonseca, "The North's Growing Role in South–South Cooperation: Keeping the Foothold," *Third World Quarterly* 34, no. 8 (September 2013): 1475, https://doi.org/10.1080/01436597.2013.831579.
[279] Aída Mencía-Ripley et al., "Decolonizing Science Diplomacy: A Case Study of the Dominican Republic's COVID-19 Response," *Frontiers in Research Metrics and Analytics* 6 (March 11, 2021): 2.
[280] Derya Büyüktanir Karacan and Pierre-Bruno Ruffini, "Science Diplomacy in the Global South—an Introduction," *Science and Public Policy/Science & Public Policy* 50, no. 4 (June 13, 2023): 743.
[281] Luisa Fernanda Echeverria, Karina Elizabeth Aquino Valle, and Claudia Natalie Widmaier Muller, "Science Diplomacy and South-South Cooperation for Emergency Response: The Case of COVID-19 Pandemic in Latin America," *Jurnal Sosial Politik* 6, no. 2 (October 10, 2020): 168.
[282] Jason Parker, "Cold War II: The Eisenhower Administration, the Bandung Conference, and the Reperiodization of the Postwar Era," *Diplomatic History* 30, no. 5 (November 2006): 867–68, https://doi.org/10.1111/j.1467-7709.2006.00582.x.

and did what they could to quicken progress toward that end."[283] Even in the early days of the Cold War, there was resistance on the part of the Global South towards the existing dynamics relative to the Global North; the "Bandung conference [of 1955…was] a political movement which aims to challenge the political and economic landscape dominated by countries from the North."[284] Researcher Ahmad Rizky Mardhatillah Umar explains, "the conference was held in Bandung, Indonesia, from 18–24 April 2019 and was attended by 29 countries from Asia and Africa. It was organized by five countries—Indonesia, India, Pakistan, Ceylon/Sri Lanka, and Burma, as a result of a series of prior meetings in Colombo and Bogor."[285] The meeting was a trailblazing example of South-South cooperation and the beginning of a more formalized solidarity in colonial resistance. It was one of many steps towards the solidarity of the Global South; organizing an official meeting to address their countries' futures independently of the Global North, whose global superpowers usually had a say over the terms or context of such events in the colonial era. Jason Parker highlights the uniqueness of the meeting, especially in its era; "The meeting marked the first time that the decolonizing world had come together to attempt to find a shared voice, one capable of transcending race, region, and the Cold War dichotomy."[286]

Parker explains that Adam Clayton Powell, an African-American congressman in Harlem in the 1950s and 60s and former baptist minister, offered advice to the Eisenhower administration ahead of the Bandung conference; Powell wanted to be sent to partake in the conference on behalf of the U.S. government, thinking his presence as a black American would help dissuade sentiments against his country's government and history of racial oppression.[287] The administration passed on his suggestion, fearing he may ruffle some feathers or be too bold and outspoken, as Powell was known for being a larger-than-life personality, and the administration wanted to take a more low-key approach to the meeting, according to Parker. In

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[283] Jason Parker, "Cold War II: The Eisenhower Administration, the Bandung Conference, and the Reperiodization of the Postwar Era," *Diplomatic History* 30, no. 5 (November 2006): 867.
[284] Luisa Fernanda Echeverria, Karina Elizabeth Aquino Valle, and Claudia Natalie Widmaier Muller, "Science Diplomacy and South-South Cooperation for Emergency Response: The Case of COVID-19 Pandemic in Latin America," *Jurnal Sosial Politik* 6, no. 2 (October 10, 2020): 168.
[285] Ahmad Rizky Mardhatillah Umar, "Rethinking the Legacies of Bandung Conference: Global Decolonization and the Making of Modern International Order," *Asian Politics & Policy* 11, no. 3 (July 2019): 462, https://doi.org/10.1111/aspp.12473.
[286] Jason Parker, "Cold War II: The Eisenhower Administration, the Bandung Conference, and the Reperiodization of the Postwar Era," *Diplomatic History* 30, no. 5 (November 2006): 870.
[287] Jason Parker, "Cold War II: The Eisenhower Administration, the Bandung Conference, and the Reperiodization of the Postwar Era," 879.

the end, Powell did attend the meeting sponsored by two prominent African American magazines, and was a welcomed presence who may have done some good for the U.S. government by attending.[288] After careful consideration, "Eisenhower's team chose to play it safe with respect to Bandung, and smiled at their success. Afterward, though, officials recognized that the conference stood at the confluence of three streams— neutralism, nationalism, and racially tinged anticolonialism— rushing ever faster and wider across the postwar landscape."[289] Ahmad Rizky Mardhatillah Umar adds that "the Bandung Conference affected the international order by highlighting the importance of decolonization in world politics and [bringing] it into global politics."[290] Powell was acutely aware of the changing tides and informed the Eisenhower administration hoping they would take immediate action. Months after the conference took place, "Powell told Dulles and Eisenhower at the end of 1955, "Colonialism and racialism must be eradicated as quickly as possible in our foreign policy. . . . The timetable for freedom was no longer within our control—Bandung had stepped it up, and we [had] to move fast.""[291] Powell was also a civil rights activist who was known and respected in many circles, he saw ahead to the future and warned early on that events like the Bandung conference signaled the beginning of a deconstruction of the old ways. Umar adds that in spite of the "early precursor of Bandung, the *League against Imperialism,* was invented by the Communist network, the idea went beyond ideological divide, which paved the way for the establishment of anti-colonial internationalism after [the Second World War]."[292] The Bandung conference did stir up concern about potential for the spread of communism, as well as an indication of growing anti-imperialist sentiment among developing nations. Parker asserts that the conference represented an "announcement of an embryonic Third World neutralist bloc presented a potential paradigm shift in international affairs; the attendance of China heralded a possible opening for Communist expansion."[293]

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[288] Jason Parker, "Cold War II: The Eisenhower Administration, the Bandung Conference, and the Reperiodization of the Postwar Era," 879.
[289] Jason Parker, "Cold War II: The Eisenhower Administration, the Bandung Conference, and the Reperiodization of the Postwar Era," 871.
[290] Ahmad Rizky Mardhatillah Umar, "Rethinking the Legacies of Bandung Conference: Global Decolonization and the Making of Modern International Order," *Asian Politics & Policy* 11, no. 3 (July 2019): 475, https://doi.org/10.1111/aspp.12473.
[291] Jason Parker, "Cold War II: The Eisenhower Administration, the Bandung Conference, and the Reperiodization of the Postwar Era," 885.
[292] Ahmad Rizky Mardhatillah Umar, "Rethinking the Legacies of Bandung Conference: Global Decolonization and the Making of Modern International Order," *Asian Politics & Policy* 11, no. 3 (July 2019): 476.
[293] Jason Parker, "Cold War II: The Eisenhower Administration, the Bandung Conference, and the Reperiodization of the Postwar Era," 871.

According to Parker, "the Bandung Conference represented the crossroads of several key Cold War trends: the old specter of communism and the newer one of neutralism; the vectors of anticolonialism and Third World nationalism; and a stirring consciousness of changes in inter- and intranational race relations. As such it offers an opportunity to probe the Eisenhower administration's handling of these challenges at a crucial stage."[294]

In spite of a lack of consensus over the legacy of the Bandung conference, or little scholarly analysis of the meeting's importance, Umar argues that, "...the Bandung Conference was successful in bringing about the transition from the international colonial order—which was in decline but did not totally disappear at the end of Second World War—to a modern international order based on equal sovereignty among nations."[295] Umar goes on to emphasize the transitional quality fostered by the event; "...the Bandung Conference constituted an important site of "transition" from the international colonial order—which was in crisis after the Second World War but had not yet demised in the global level—to a Westphalian interstate system."[296] Jason Parker brings to light the emerging perspective of an existing link between the Cold War and decolonization.

> "Yet nuanced, compelling explanations of the link between that conflict and the great wave of Third World decolonization—one more sophisticated than mere chronological coincidence—have only just begun to emerge. There thus remains a great challenge facing any effort to write an international history of the Cold War, or indeed of the twentieth century: discerning the precise, subtle, and intricate connections between the Cold War, the global postwar "race revolution," and the course of Third World decolonization."[297]

Though historical meetings occurring in such a different time period seem like a relic of the past, they may mirror modern political tensions more than we realize. Those insights gained in the last century can help illuminate some of the logic behind modern politics and practices. I believe

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[294] Jason Parker, "Cold War II: The Eisenhower Administration, the Bandung Conference, and the Reperiodization of the Postwar Era," (2006): 888.
[295] Ahmad Rizky Mardhatillah Umar, "Rethinking the Legacies of Bandung Conference: Global Decolonization and the Making of Modern International Order," (2019): 463.
[296] Ahmad Rizky Mardhatillah Umar, "Rethinking the Legacies of Bandung Conference: Global Decolonization and the Making of Modern International Order," *Asian Politics & Policy* 11, no. 3 (July 2019): 475.
[297] Jason Parker, "Cold War II: The Eisenhower Administration, the Bandung Conference, and the Reperiodization of the Postwar Era," *Diplomatic History* 30, no. 5 (November 2006): 868.

more analysis and attention should be given to events like the Bandung conference in order to have a more balanced perspective of modern international relations and science diplomacy, especially when it comes to issues related to the balance of power between the Global North and the Global South. These dynamics seem even more critical to international relations when we acknowledge that the Global North/South terminology, according to Dados and Connell, "references an entire history of colonialism, neo-imperialism, and differential economic and social change through which large inequalities in living standards, life expectancy, and access to resources are maintained."[298]

Studying historical events of South South cooperation can help us understand and build bridges to help various regions and countries of the Global South connect with and use science diplomacy today. To look at a more modern example of science diplomacy engagement between Global North and South, Joren Selleslaghs explains that, "If other Latin American countries would thus like to either continue, or improve cooperation with the EU in the domain of science, higher education and innovation, it appears the CELAC framework would work best in placing Latin America in a better position to interact with the EU as one region. Only then, the Latin American states could (continue) engaging more fully with the EU as an equal, autonomous and independent partner as manifested in the shared Vision 2030."[299]

Adriana Erthal Abdenur and João Moura Estevão Marques Da Fonseca examine the increasing involvement of the Global North in South-South cooperation, explaining that "[the Global North seeks] to keep a 'foothold' in the Global South. In essence, Northern donors are struggling to redefine their roles and expand their power, both within and beyond the field of development cooperation."[300] Now beyond the days of overt colonialism, the Global North has to find more creative ways to assert power and be involved in the realm of South-South cooperation. The dynamic of the Global North trying to insert itself into the dealings of South-South cooperation is an example of the lingering imperialist sentiments that are at play in the modern era, though less overtly than they were in the 19th and 20th centuries. According to

[298] Nour Dados and Raewyn Connell, "The Global South," *Contexts* 11, no. 1 (February 2012): 12–13.
[299] Joren Selleslaghs, "EU-Latin America Science Diplomacy," *Latin American Studies Association (LASA) 2017*, May 1, 2017: 30.
[300] Adriana Erthal Abdenur and João Moura Estevão Marques Da Fonseca, "The North's Growing Role in South–South Cooperation: Keeping the Foothold," *Third World Quarterly* 34, no. 8 (September 2013): 1487, https://doi.org/10.1080/01436597.2013.831579.

Büyüktanir Karacan and Ruffini, "SD is a conceptualization of Northern origin. Considering it from a Global South perspective means questioning it in two ways: (1) testing the robustness of the concept and its transferability to the context of Global South countries and (2) on a practical level, testing its ability to meet the challenges these countries are facing."[301] Following this logic in a practical sense, science diplomacy may be more useful for countries in the Global South than for those in the Global North. The Global South faces more severe consequences of events like global health crises, climate change, and supernatural disasters. With less robust infrastructure in cities, less efficient healthcare systems, and underfunded scientific programs, recovering from such events is more of an economic and social burden. These concerns are not new, of course. In 1990 Nye claimed that "the solutions to many current issues of transnational interdependence will require collective action and international cooperation. These include ecological changes (acid rain and global warming), health epidemics such as AIDS, illicit trade in drugs, and terrorism."[302] These themes are familiar almost 25 years later, with only slight differences in the specificities. Sir Peter Gluckman writes in a paper on scientific advice to governments that, "Many such challenges stem from the large scope of relevant issues, a situation made particularly complex by the range and variable state of development of advisory mechanisms across countries with different cultures, modes of government, and levels of economic development."[303] Gluckman rightfully identifies the compounding factors of difficulty facing countries in the Global South when faced with national or global crises. Mitchell Young explains that there is strength in employing bilateral and multilateral agreements in the field of science diplomacy to address said issues; "The bilateral and multilateral interactions, both explicit and implicit, that bring knowledge into the policymaking arena and policy alignment across nations at sub-national, national, sub-global, and global levels are critical. These can happen between scientists, science managers, science policymakers, diplomats, officials in foreign, health, science and other ministries, and international organizations."[304]

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[301] Derya Büyüktanir Karacan and Pierre-Bruno Ruffini, "Science Diplomacy in the Global South—an Introduction," *Science and Public Policy/Science & Public Policy* 50, no. 4 (June 13, 2023): 746, https://doi.org/10.1093/scipol/scad028.
[302] Joseph S. Nye, "Soft Power," *Foreign Policy*, no. 80 (1990): 163, https://doi.org/10.2307/1148580.
[303] Peter D. Gluckman, "Science Advice to Governments," Science & Diplomacy, June 9, 2016.
[304] Mitchell Young, "Building Better Science Diplomacy for Global Challenges: Insights from the COVID-19 Crisis," *S4d4c.eu*, June 2020, https://www.s4d4c.eu/wp-content/uploads/2020/06/S4D4C_PolicyBrief_June2020_BuildingBetterScienceDiplomacy_COVID-19.pdf.

SOUTH-SOUTH COOPERATION:

The history of South-South cooperation did not begin in recent times. Echeverria et al. explain that "The cooperation between countries located in the Global South is not new; this form of cooperation began to become dynamic in the mid-20th century after the emancipation of countries that were colonies of countries of the North."[305] There is a solidarity between countries that were formerly colonies which can be used to a diplomatic advantage in establishing common ground and understanding between states. But changes in recent decades have affected the overall landscape of how the Global North and South interact with and among themselves. Abdenur and Da Fonseca explain that "over the past decade the field of development cooperation has undergone deep changes. On the one hand, South–South cooperation has grown substantially as countries like China, Brazil and India, boosted by economic growth and stability, expand their partnerships abroad in pursuit of new opportunities and influence."[306] China is an especially big player in scientific publications, with nearly 25% of the world total in 2019.[307] As such, China has one of the most comprehensive strategies towards science and technology (including science diplomacy) of the Global South today. Sharma et al. analyze science diplomacy and the COVID-19 epidemic, concluding that "[South-South Cooperation] may serve as a mode of cooperation to foster the transfer of need-based technologies among developing and least developing countries and open many fronts for mutual sharing in terms of geopolitical, available resources, and expertise."[308] This point is reinforced by Mencía-Ripley et al. who cite authors Quadir (2013) and Beleboni (2019) in their assessment that "South-South cooperation, which is often knowledge-based, creates conditions for countries to strengthen local capacities and design context-adapted strategies. This model moves away from the conventional, top-down conditionality-driven aid approach and can become a more effective strategy to foster sustainable development."[309] Ahmen et al explain the need for more awareness on the benefits of

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[305] Luisa Fernanda Echeverria, Karina Elizabeth Aquino Valle, and Claudia Natalie Widmaier Muller, "Science Diplomacy and South-South Cooperation for Emergency Response: The Case of COVID-19 Pandemic in Latin America," *Jurnal Sosial Politik* 6, no. 2 (October 10, 2020): 168.
[306] Adriana Erthal Abdenur and João Moura Estevão Marques Da Fonseca, "The North's Growing Role in South–South Cooperation: Keeping the Foothold," *Third World Quarterly* 34, no. 8 (September 2013): 1475.
[307] Derya Büyüktanir Karacan and Pierre-Bruno Ruffini, "Science Diplomacy in the Global South—an Introduction," *Science and Public Policy/Science & Public Policy* 50, no. 4 (June 13, 2023): 743.
[308] Jyoti Sharma et al., "Science Diplomacy and COVID‐19: Future Perspectives for South–South Cooperation," *Global Policy* 13, no. 2 (February 14, 2022): 294.
[309]Aída Mencía-Ripley et al., "Decolonizing Science Diplomacy: A Case Study of the Dominican Republic's COVID-19 Response," *Frontiers in Research Metrics and Analytics* 6 (March 11, 2021): 3.

South-South cooperation and its facilitation and encouragement; "it is important to promote awareness that countries facing similar challenges can solve them much more quickly by working with neighbors rather than extra-regional partners, given the higher costs and longer time required for long-distance exchange."[310] India has played a key role in the management of climate induced natural disasters in South Asia; Raghav et al. explain "India, being the major power of the region, has been responding first and offered necessary technical and relief assistance to mitigate the menace of climate change and disaster management. With the increasing materialistic, technical and military capacity, India always stood in each and every disaster affected state and sent man and machinery across the border in disaster management. As per the report published by Global Public Policy Institute, more than two-third of India's USD 1.32 billion humanitarian assistance goes to its South Asian neighbours."[311]

One strategy that can be successfully employed in science diplomacy is North-South cooperation, this may be an easier first step both for countries in the Global North and South. Those in the North are used to being leaders in scientific initiatives and already have the research capacity and technical facilities needed, while countries in the Global South may look for a partnership that translates to more knowledge for their researchers and allows entry into a field where access is limited by funding and resources. There were several instances of North-South cooperation used in addressing the pandemic; researchers based in the Dominican Republic used a North-South strategy during the COVID-19 pandemic in order to gain knowledge and access higher quality equipment in sequencing the most prevalent variant of the virus spreading in their region at the time. Dados and Connell (2012), Echeverría et al. (2020), Mencía-Ripley et al. (2021), Sharma et al. (2022) assert that on the subject of science diplomacy, South-South cooperation is an ideal for many countries of the Global South, but in the process of creating those networks, scientists in the region are focused on the need for more extensive training and familiarity with the uses and practices of science diplomacy, including North-South cooperation; these partnerships with established institutions in the Global North encourages a more stable presence of SD in the Global South and allows young researchers to consider and explore the path of science diplomacy. The fostering of growth of the field of science diplomacy in the

[310] Monir Uddin Ahmen et al., "An Overview of Science Diplomacy in South Asia," Science & Diplomacy, February 17, 2021: 5, https://www.sciencediplomacy.org/article/2021/overview-science-diplomacy-in-south-asia.
[311] Pooja Raghav et al., "View of India's Science Diplomacy in South Asia: Opportunities and Challenges," *The Online Journal of Qualitative Inquiry* 12, no. 6 (July 2021): 8440, https://www.tojqi.net/index.php/journal/article/view/3298/2237.

Global South will be a key part of ensuring it is established and utilized to the highest capacity. López-Vergès et al. emphasize the integration of science diplomacy into academia in order to increase exposure to the concept and encourage young researchers to pursue this path.[312] Researchers coming from the Global South initiating science diplomacy initiatives will help to ensure the decolonizing of science diplomacy- a key part of empowering and ensuring a more balanced future for those in the Global South. Özkaragöz Doğan et al. caution that there are more obstacles than just networking which prevent the facilitation of North-South cooperation; "In terms of challenges, the pre-conditions for cooperation between developed and developing countries (or even among developing countries) may hinder international S&T cooperation. The capability gap between parties, how strict the rules and regulations are enforced, national priorities, fear of brain drain, the skill gap between researchers and workers are just a few factors that may create obstacles for benefitting from science diplomacy. Coupled with the differing motivations of governments and various government agencies involved in the process, science diplomacy process can become a cumbersome way of international S&T cooperation."[313]

For countries in the Global North, the concept of South-South cooperation could be perceived as threatening their position, but authors Abdenur and Da Fonseca assure that from their research, South-South cooperation "far from existing separately and in antagonism to Northern assistance, intersects in important ways with Northern aid, and that analyzing these intersections (and how different stakeholders relate to these intersections) is key to understanding the changing dynamics of development cooperation, including its shifting politics."[314] Sharma et al. assure that "the cooperation under SSC does not substitute but complements North-South development cooperation to achieve the Sustainable Development Goals (SDGs)."[315] One of the key ways global progress is measured is through the SDGs, adopted by all UN members in 2015, aiming to be achieved by 2030. Gluckman et al. highlight the role of science cooperation in achieving these goals; "All require complex scientific input and many require new science and technologies in order to meet a given goal. Others call for considerable data collection and

[312] Sandra López-Vergès et al., "Closing the Gap between Emerging Initiatives and Integrated Strategies to Strengthen Science Diplomacy in Latin America," *Frontiers in Research Metrics and Analytics* 6(April 12, 2021): 6.
[313] Elif Özkaragöz Doğan, Zafer Uygun, and İbrahim Semih Akçomak, "Can Science Diplomacy Address the Global Climate Change Challenge?," *Environmental Policy and Governance* 31, no. 1 (September 22, 2020): 41.
[314] Adriana Erthal Abdenur and João Moura Estevão Marques Da Fonseca, "The North's Growing Role in South–South Cooperation: Keeping the Foothold," *Third World Quarterly* 34, no. 8 (September 2013): 1487.
[315] Jyoti Sharma et al., "Science Diplomacy and COVID‐19: Future Perspectives for South–South Cooperation," *Global Policy* 13, no. 2 (February 14, 2022): 294.

analysis, as well as careful scientific analysis of the policy options."[316] The authors elaborate on the specific challenges of achieving the SDGs due to the way the UN functions in using votes by member states to reach consensus on issues. Ministries of foreign affairs are usually in charge of casting the votes; while "the scientific input to UN bodies, however, generally comes from UN agency staff or advisory committees and is largely disconnected from the advice possessed by a national representative. For progress to be made on many of the issues discussed here, a strong linkage must be established between domestic science-advisory systems and international agencies on one hand, and domestic science-advisory systems and foreign affairs ministries on the other."[317] This discrepancy between familiarity with crucial scientific data and the people who submit the vote is one of the biggest issues facing science diplomacy today, as well as potentially affecting the outcome of the achievement of the SDGs. "There is a need for intensified [South-South cooperation] on STI for SDGs," according to Sharma et al.[318]

Colglazier assesses America's science diplomacy and science policy after COVID-19 and adds that the seventeen SDGs "are also value judgments, and our success in achieving them at the national and global level also depends very much on how we make the value tradeoffs informed by what is known from science."[319] The fact that value judgements are used as global targets doesn't account for the fact that not all nations will agree on one set of values, nor will they prioritize the same goals. According to Sharma et al., the pandemic showed us the realities of how governments prioritize needs is dire situations; "As the countries in the Global North turn increasingly protectionist and inward-looking, both due to the restrictions imposed by the COVID-19 crisis as well as power politics, the developing and least developed countries of the Global South are left to fend for themselves."[320] The authors suggest that science diplomacy is one of the tools that should be used to help counter difficult diplomatic realities in situations like a global pandemic. According to Echeverria et al., South-South cooperation is essential in the management of crises in the future, and allows us to see science diplomacy in action and better understand its mechanisms of action; "Today, the integration of South - South cooperation in

[316] Peter Gluckman et al., "Science Diplomacy: A Pragmatic Perspective from the Inside," December 2017.
[317] Peter Gluckman et al., "Science Diplomacy: A Pragmatic Perspective from the Inside," December 2017.
[318] Jyoti Sharma et al., "Science Diplomacy and COVID‐19: Future Perspectives for South–South Cooperation," *Global Policy* 13, no. 2 (February 14, 2022): 297.
[319] E. William Colglazier, "America's Science Policy and Science Diplomacy after COVID-19," Science & Diplomacy (Science & Diplomacy, June 28, 2020).
[320] Jyoti Sharma et al., "Science Diplomacy and COVID‐19: Future Perspectives for South–South Cooperation," *Global Policy* 13, no. 2 (February 14, 2022): 294-95.

emergency situations is fundamental to create capacity building and use strategies such as science diplomacy for Science for decision making, advice and resources exchange."[321] The key to addressing global health crises and disparities in global health systems is the strategic use of science diplomacy, especially in the Global South; Sharma et al. after studying SD in the COVID-19 pandemic, insist that "international scientific cooperation would need to work in tandem with science diplomacy to ensure that the benefits of advancements in science are reaped in an equitable manner."[322]

They go on to propose science diplomacy as a part of the answer to address the issues facing the international community; "The use of science diplomacy would be an effective tool to bring all the stakeholders of the Global South to a common platform to combat future global challenges."[323] However, the efficacy of science diplomacy does depend on the quality and clear dissemination of scientific data and advice to policymakers and diplomats; Colglazier explains that "decision-makers need good science advice, and society needs good decision-makers who can listen to the science advice, weigh the tradeoffs, and make wise decisions that garner trust from the public. It is, of course, not so easy in practice."[324] While we can look to science diplomacy as a strategic army knife that can be useful in many situations, the practice is more difficult than the theory. "The great powers of today are less able to use their traditional power resources to achieve their purposes than in the past. On many issues, private actors and small states have become more powerful. At least five trends have contributed to this diffusion of power: economic interdependence, transnational actors, nationalism in weak states, the spread of technology, and changing political issues."[325]

"As the processes of science are performed, scientists are confronted with the reality of national rivalries: the entry into the atomic age and the Manhattan Project provided the strongest illustrations. Because science does not exist in a weightlessness state above society, but it is intended to become one with society in order to promote its progress through its applications,

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[321] Luisa Fernanda Echeverria, Karina Elizabeth Aquino Valle, and Claudia Natalie Widmaier Muller, "Science Diplomacy and South-South Cooperation for Emergency Response: The Case of COVID-19 Pandemic in Latin America," *Jurnal Sosial Politik* 6, no. 2 (October 10, 2020): 168.
[322] Jyoti Sharma et al., "Science Diplomacy and COVID‐19: Future Perspectives for South–South Cooperation," *Global Policy* 13, no. 2 (February 14, 2022): 297, https://doi.org/10.1111/1758-5899.13027.
[323] Jyoti Sharma et al., "Science Diplomacy and COVID‐19: Future Perspectives for South–South Cooperation," *Global Policy* 13, no. 2 (February 14, 2022): 297, https://doi.org/10.1111/1758-5899.13027.
[324] E. William Colglazier, "America's Science Policy and Science Diplomacy after COVID-19," Science & Diplomacy (Science & Diplomacy, June 28, 2020).
[325] Joseph S. Nye, "Soft Power," *Foreign Policy*, no. 80 (1990): 160.

science enters the field of power relationships, which are orchestrated on the international scene by foreign policies of states."[326] These national rivalries and interests compete with desires to maintain and grow diplomatic relations, but the national interests often win. South-South cooperation aims to reduce the imbalance of power and reframe the legacy of development through a grassroots approach, rather than a prescriptive one. South-South Cooperation "is used to improve development, share good practices, and promote partnerships in the region."[327] "SSC is a way forward after the pandemic to strengthen the collective self-reliance to achieve a greater degree of participation in international scientific and technological cooperation promoting new innovative and affordable solutions."[328] Mencía-Ripley et al. explain that universities should lead the way in the quest for encouraging South-South cooperation. "In the developing world, universities need to play a major role in strengthening international cooperation, including South-South collaboration, as they have historically looked northward for academic mobility, dual degree programs, and research collaborations."[329] Eigner cautions that the role of science diplomacy should always be questioned and reassessed. "In a context of rising geopolitical tensions, it will be important for advocates and practitioners of science diplomacy to engage with the limits of science diplomacy by addressing the consequences of politicizing science and pushback from scientists."[330] Hulme offers insight to the function of science diplomacy in a modern political landscape; "We need kinds of knowledge which are 'liquid' – i.e. mobile and responsive – rather than 'brittle' – i.e. thin and flat."[331] Without a malleability to the scientific knowledge used to inform policy decisions and diplomacy, it does not stand up well when put under pressure. Insuring knowledge is mobile or dynamic allows it to apply to a greater number of situations and to provide supportive structure instead of adding confinement.

Though science diplomacy is considered a blurry and emerging field of research, science diplomacy does have relevance in an international political sphere. The clearest guidelines for

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[326] Pierre-Bruno Ruffini, *Science and Diplomacy*, 1st ed. (2017; repr., Springer Cham, 2017), 31, https://doi.org/10.1007/978-3-319-55104-3.
[327] Luisa Fernanda Echeverria, Karina Elizabeth Aquino Valle, and Claudia Natalie Widmaier Muller, "Science Diplomacy and South-South Cooperation for Emergency Response: The Case of COVID-19 Pandemic in Latin America," *Jurnal Sosial Politik* 6, no. 2 (October 10, 2020): 172, https://doi.org/10.22219/sospol.v6i2.11647.
[328] Jyoti Sharma et al., "Science Diplomacy and COVID‐19: Future Perspectives for South–South Cooperation," *Global Policy* 13, no. 2 (February 14, 2022): 298.
[329] Aída Mencía-Ripley et al., "Decolonizing Science Diplomacy: A Case Study of the Dominican Republic's COVID-19 Response," *Frontiers in Research Metrics and Analytics* 6 (March 11, 2021): 3.
[330] Leo Eigner, "The Promise and Paradox of Science Diplomacy," *CSS Analyses in Security Policy* 326 (2023): 4.
[331] Mike Hulme, "Problems with Making and Governing Global Kinds of Knowledge," *Global Environmental Change* 20, no. 4 (October 2010): 563.

science diplomacy, set forth by authors like Özkaragöz Doğan et al., Büyüktanir Karacan and Ruffini emphasize the versatility of science diplomacy and potential for its use by nations in the Global South to shift power dynamics, as well as caution against it as a cure-all for global issues. Özkaragöz Doğan et al. explain that "science diplomacy may provide a more structured way of policy-learning and peer-to-peer learning. Because climate change mitigation requires accumulative connected decisions over a long period to achieve a particular objective, coordinated government initiatives such as science diplomacy may provide fast and effective results."[332] This statement also highlights previously cited work by Fuentes et al. showing that the most effective science and technology cooperation is seen in longstanding and well-maintained diplomatic relations, like S&T agreements between the US, UK, Australia, Japan and China.[333]

Science diplomacy is a useful tool for international diplomacy, and can be used across an array of situations. However, as Ruffini states, the context is critical and determines the extent to which science diplomacy can be utilized. In the context of COVID-19, science diplomacy showed some positive advancements in global research cooperation and international vaccine initiatives, but ultimately it did not stop national interests of wealthy countries from securing more doses of the vaccine and enjoying better outcomes than countries in the Global South. In addressing climate change there is a long history of employing science diplomacy through the IPCC. There have been some failures in this context, such as the non-adoption of the agreement of the COP 15 in Copenhagen due to a lack of consensus, and the G20 countries' failure to reach targets for a reduction in global carbon emissions, while "G20 governments are spending three times as much on fossil fuels as renewables."[334] There have also been successes in management of climate change, albeit slowly. The COP 21 in Paris was widely seen as a success and a strong response to the failures five years earlier in Copenhagen, and the IPCC continues to produce excellent data and increase knowledge about the importance of managing the climate crisis. Science diplomacy is also a useful tool to address the climate crisis, but as with COVID-19, science diplomacy alone cannot solve the issue and must be used alongside other diplomatic

[332] Elif Özkaragöz Doğan, Zafer Uygun, and İbrahim Semih Akçomak, "Can Science Diplomacy Address the Global Climate Change Challenge?," *Environmental Policy and Governance* 31, no. 1 (September 22, 2020): 42.
[333] Miguel Fuentes et al., "Global Digital Analysis for Science Diplomacy on Climate Change and Sustainable Development," *Sustainability* 15, no. 22 (November 8, 2023): 11.
[334] International Institute for Sustainable Development, "G20 Governments Are Spending Three Times as Much on Fossil Fuels as Renewables," International Institute for Sustainable Development, September 30, 2024.

tools and strategies to ensure the best possible outcomes. I predict that the future of science diplomacy will show a close relationship between decolonization, South-South, and North-South cooperation. Science diplomacy is an especially useful instrument for challenging existing infrastructures of knowledge, research, and power.

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