Science Diplomacy Policy in Colombia, New Horizons for a New Country?

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Abstract

As Colombia moves towards a new phase of development, due to social, economic and political improvements, and the prospect of successful peace talks, the country has the opportunity to use science as an engine of development, and as a tool to gain a new place in the international arena through the implementation of a science diplomacy policy. The purpose of this thesis is to understand whether Colombia is prepared to develop a foreign policy that incorporates a science diplomacy dimension, as the country faces a post-conflict scenario of development that will greatly benefit from international scientific cooperation. The analysis was done through a qualitative exploration of Colombia's science diplomacy from a foreign relations perspective, interviews with members of the Foreign Service and scientific communities, and an analysis of Colombia's science and technology system. A comparison with the United States was used to illustrate where Colombia stands in terms of science diplomacy policy development. The results suggests that the development of a science diplomacy policy in Colombia faces serious challenges, including the government's disregard for science, foreign policies dedicated to bilateral relations and presidential political agendas, lack of public and private funding for science, and a lack of connection between actors. Such scenario leaves the work of international scientific cooperation in the hands of scientists themselves, a few universities' international relations departments, and the exceptional individual actions of foreign officers with a personal interest in supporting science. A set of recommendations is given for policy development.

Table of Contents

List of figures

Introduction

For more than fifty years, Colombia has been immersed in an armed conflict with guerrillas, paramilitary groups and organized crime, which has kept the country from reaching its potential for development outside the boundaries of war. In the last decade, Colombia has gone through a period of important transitions and even more important ones are expected to come. With the prospect of successful peace talks that could result in the signing of peace with the Colombian Revolutionary Armed Forces (FARC) in the next year, a rapid economic development that has placed the country among the five largest economies in Latin America, and significant political and social improvements, Colombia is preparing for a post-conflict period that could allow the country to focus on solving development issues that have been postponed due to the conflict. Furthermore, the country is striving to find a new place in the international arena; after decades of being an international aid recipient, and enduring a reputation for violence and human rights violations, Colombia has moved from low to middle-income status, and it is currently in the process of accession to the Organisation for Economic Co-operation and Development (OECD, 2013).

Endowed with a vast range of natural resources and biodiversity, a current government promising to advance its science, technology and innovation systems, and experienced researchers working on issues of global importance, such as food security, clean energy, and infectious and degenerative diseases, Colombia has the potential to use science as an instrument for development, and for promoting its influence and

significance globally. Many of the issues that Colombia still faces today, e.g., poverty and social inequality, climate change, and rapid urbanization, are among the challenges whose solutions call for scientific collaboration among nations, and for the use of science diplomacy as part of its foreign relations strategy.

Governments are increasingly using science diplomacy as an instrument of soft power that complements their economic and military influence abroad, to increase and improve diplomatic relations with other countries, support their special interests and trade objectives, and to promote the global commercialization of high-tech products, such as renewable energy technology.

One of the leading nations in research and development investment in the world, the United States has used science as a key driver of development, and international scientific cooperation as an important component of its foreign relations agenda. Not surprisingly, the United States is home to the world's best universities and research facilities (six of the top ten universities in the world are in the U.S. (Quacquarelli Symonds, 2015), and attracts some of the most prominent scientists and researchers worldwide. Even though the United States still faces challenges regarding the implementation of a science diplomacy policy that can integrate the diverse interests of the country's agencies, departments and bureaus, science has been at the center of the State Department's agenda, particularly since the turn of the 21st Century.

The United States is also aware of the potential influence that non-state transnational actors like universities can have in international affairs, a trend that is successfully carried out by universities like Purdue, which has made Colombia the focus of its academic and scientific cooperation with Latin America (Purdue University, 2010)

through a strategic partnership agreement. As with other soft power instruments, assessing the diplomatic impact that a university can have in a host society may take years, but previous examples like the American University of Beirut, and the American University of Cairo show that when it comes to soft power and diplomacy, universities should not be underestimated.

My research is a qualitative exploration of Colombia's science diplomacy policies from a foreign relations perspective, in light of the transformation that the country has experienced in the last ten years, and a potential post-conflict scenario of development that will benefit from international collaboration in science, technology and innovation. As Scientific Cooperation Advisor to Universidad de Antioquia's international affairs office –the only position of its kind in Colombia- I was able to do a systematic observation of -and to participate on- the development of international scientific cooperation strategies, and science diplomacy activities in Colombia. That position also allowed for the establishment of key contacts within the government, the Foreign Service, researchers, universities and international organizations, as well as to gain privileged access to information. The study is complemented by an analysis of Colombia's Ministry of Foreign Relations' Memoires to Congress from 2005 to 2015, and interviews with Foreign Service Officers, the scientific community and government officials.

Compared to the United States, Colombia lags substantially behind in designing and implementing a science diplomacy policy, which can be attributed to an incipient science and technology system, a government that has not been able to translate innovation rhetoric into investment and sound policy, foreign policies mainly focused on

either conflict or post conflict issues, and a private sector still reluctant or unable to invest in research and development.

Nevertheless, there are examples like the unprecedented agreement between Germany's prestigious Max Planck Society and Colombia's two major public universities -for the creation of six tandem research groups on tropical diseases and biotechnology of natural products-, which illustrates the potential of having a diplomatic body concerned with science affairs.

As the literature upon which to draw conclusions is limited, a challenge to this study was the apparent lack of knowledge about the concept and practice of science diplomacy among most Colombian Foreign Service Officers, government officials and the scientific community. The prospect of contributing to the body of knowledge on the subject, and to the generation of recommendations for the articulation of a science diplomacy policy in Colombia guided my research. It will contribute to the current discussion about public policies for the internationalization of higher education and scientific research in a post-conflict Colombia, in which the need for a further study of science diplomacy as a means of supporting the internationalization of research in Colombia (Colombia. Ministerio de Educación Nacional, 2014) has become evident.

Chapter I:

Colombia's past and new horizons

1964 marked the official beginning of the armed conflict between subversive groups and the Colombian state, which had its roots in the clash between liberal and conservative political parties, political repression, and the peasant workers' struggles of the 19th and early 20th centuries. Between 1982 and 1996, the two major guerrilla groups, the Revolutionary Armed Forces of Colombia (FARC) and the National Liberation Army (ELN) had expanded, and right-wing paramilitary groups -mainly the United Self-Defense Forces of Colombia (AUC)- began to appear as a way for elites and wealthy landowners to deal with the problem of leftist guerrillas. During the same period, drug trafficking propagated throughout many aspects of Colombian life, permeating not only paramilitary groups and guerrillas who used it to finance their operations, but also the government in the form of rampant corruption (Colombia. Centro Nacional de Memoria Histórica, 2014).

From 1996 to 2005, the armed conflict reached its peak. Guerrillas and paramilitary groups continued growing, while many in the country pressed for a military solution to the conflict. Recognizing that the problem of illegal drug trafficking is an international matter that demands shared responsibility, the United States and Colombia partnered up in a bilateral cooperation strategy called Plan Colombia (1999 to 2005), to fight drug production, trafficking and organized crime, and to promote economic, social and political reactivation (Colombia. Departamento Nacional de Planeación, 2006).

Although highly controversial, Plan Colombia yielded positive results in all three areas, paramilitary groups demobilized, and the government gathered military strength to launch a counterinsurgency offensive, which by 2012 had considerably weakened guerrillas.

In 2012, and after past failed attempts for a peace agreement, Colombia remained the country with the oldest unnegotiated conflict in the world (Fisas, 2014). However, in September of that year, president Juan Manuel Santos and the FARC announced "the beginning of a serious, dignified, realistic, and effective peace process (…) and presented a road map composed of five main points" (Fisas, 2014, p. 64) the first four of which (land reform, rebels' political participation, illegal drugs trade and reparation of victims) have been discussed and agreed upon after more than two years of dialogues. Although FARC disarmament, one the most crucial subjects remains to be discussed, Colombia has never had a peace process as advanced as this one.

Economic, social and political improvements are also evident in Colombia. In the last decade, the economy has accelerated notably, becoming one of the top five economies in Latin America, and one of the countries with the highest economic growth in the world. In 2010, the World Bank categorized Colombia as an upper-middle income country (OECD, 2012), GDP has increased at an annual average rate of 4.2% (Asociación Nacional de Empresarios Industriales de Colombia -ANDI-, 2015), and unemployment and inflation have almost halved (Colombia. Banco de la República, 2014), whereas exports to the United States and foreign investment continue increasing. Opening to new markets through free trade agreements with countries like the United States have also contributed to the country's positive macroeconomic environment.

In 2012, Colombia had the lowest murder rate in a decade (De la hoz Bohórquez, 2013), and the lowest number of newly displaced victims since 1997. Even though it remains the second country in the world with the largest accumulated number of people displaced by political violence (Hochshild, 2013), the number of new people forced to leave their homes due to the conflict has also decreased steadily every year. Contrary to other countries in conflict, the Colombian government has not only recognized its responsibility in the humanitarian crisis, but has also put in place mechanisms to assist the victims, like the Unit for Attention and Reparation of Victims. Furthermore, one of the main topics in the current peace talks with the FARC is finding solutions for the displaced and the victims of conflict.

Several government programs to support access to the judicial system, conflict resolution, citizen coexistence, and special human rights units -launched since the implementation of Plan Colombia- have also contributed to the strengthening of institutions and civil society (Colombia. Departamento Nacional de Planeación, 2014).

Although many challenges remain, such as unfair agricultural land distribution, vast social inequality, drug trafficking and political corruption, Colombia has made significant strides towards transformation, and it is preparing to take a new position in the international stage. As successful industrialized nations like the United States and Germany have done in the past, Colombia could use science as the foundation of its development, and as a soft power tool to improve and expand its presence in the world.

The following analysis illustrates why foreign officers like Juan Mayr (personal communication, November 07, 2014), current Ambassador to Colombia in Germany, believe that the country has the potential to turn science into one of its most effective

instruments for development, and to use it for the creation of solid and prolific international relations.

Colombia's scientific potential

In spite of the many obstacles Colombian scientists face, and thanks in part to active international cooperation, some research groups have managed to achieve remarkable advances in areas of global concern, or as Dr. Joseph Nye defines, issues that lie across the bottom chessboard of transnational relations (Nye, 2011). One of them is tropical and infectious diseases, an area that represents an opportunity for Colombia to take a leading role in the international arena. The United States Patent and Trademark Office recently granted patents to Universidad de Antioquia's research group PECET (Program for the Study and Control of Tropical Diseases) for discovering a series of ammonium compounds with applications for the treatment of cutaneous leishmaniasis, an infectious disease transmitted by sand flies that affects people in 88 countries and four continents, particularly in the poorest and most forgotten areas. In collaboration with scientists from Universidad de Caldas (Colombia) and Illinois State University, this group of dedicated researchers is developing a more accessible and safer treatment for a deadly neglected disease, whose prior attempts for treatment have been either too costly, or highly toxic with serious side effects (Universidad de Antioquia. Programa de Estudio y Control de Enfermedades Tropicales -PECET-, 2015). The same research group is also collaborating with scientists from Australia, Brazil, Indonesia and Vietnam in a project called *Eliminate Dengue*, a biological way to stop the spread of dengue, in which, through breeding, the transmitting mosquitoes are infected with bacteria that inhibits their

capacity to pass the disease (Eliminate Dengue Program, 2016). With globalization and climate change threatening to bring these types of diseases to the northern hemisphere, such discoveries are no longer the sole concern of developing nations.

Other examples include Dr. Lucía Atehortúa's innovative work on biotechnology of products like microalgae, fungi, and cacao, to find solutions to issues related to climate change, food security and energy (Atehortúa, 2010).

Colombia's great biodiversity –one of the richest in the world- is in itself an asset that could give the country scientific competitive advantage, and researchers like world-renown malaria expert, Dr. Manuel Elkin Patarroyo, are making use of it; his laboratory is located in Leticia, an area of Colombia that is home to the Aotus monkey, the only primate in the world known to develop malaria, which has given Dr. Patarroyo an advantage over malaria research groups in other parts of the world.

There are also public and private research centers, some developed in collaboration with international partners, who have gained worldwide recognition, and whose work is based on Colombia's ecosystem diversity. Two such examples are the Alexander von Humboldt Biological Resources Research Institute, and the International Center for Tropical Agriculture (CIAT). The Humboldt Institute is a public non-profit organization formed by several national universities and institutions, and attached to the Ministry of Environment and Sustainable Development, dedicated to generate the knowledge necessary to evaluate the state of Colombia's biodiversity, and to make sustainable decisions about it through scientific research on biodiversity, and hydro-biological and genetic resources. The International Center for Tropical Agriculture (CIAT) is the biggest international scientific infrastructure in the country, where more

than 200 scientists from partner institutions in 63 countries do research collaboration to increase the eco-efficiency of tropical agriculture, with the aim to help reduce hunger and poverty globally. Besides research on agro-biodiversity, CIAT also works on soils, decision and policy analysis, and maintains a collection of genetic resources, which currently holds over 65,000 crop samples.

In the past, the Colombian government has made attempts to support the internationalization of scientific research, such as the Red Caldas (Caldas Network), which operated from 1991 to 2002, and was managed by Colciencias, Colombia's Administrative Department of Science, Technology and Innovation. Named after lawyer, naturalist, and geographer Francisco José de Caldas (1768-1816), the Caldas Network's general objective was to coordinate Colombia's scientists' diaspora, in order to increase the country's scientific capacity, promote scientific and technological international cooperation, and consolidate the national and international scientific community. It was also meant to mitigate the effects of the brain drain caused by the political, financial and social crisis of the time, by involving Colombian professionals overseas in the country's scientific advancement (Chaparro, Jaramillo, & Quintero, 2004).

However, the Caldas Network began to lose strength towards the end of the 1990's, and gradually disintegrated by 2002. The network collapsed due mainly to Colciencias' budget cuts, the country's slow assimilation of new technological advances compared to its potential partners abroad, a disproportionate focus on joint research programs, which Colombian scientists could not properly co-fund due to lack of financial backing, and the creation of very specialized subnetworks that left many disciplines without internationalization champions (Chaparro et al., 2004). Since then, there has not

been a clear science diplomacy policy in Colombia to guide concerted actions between universities, research centers, Colciencias and the Ministry of Foreign Relations, in order to promote the internationalization of science, or to use science as an instrument to achieve the country's international relations objectives.

Chapter II:

What is science diplomacy?

When last June, leaders of the G7 called for the global transformation of energy generation into clean sources by 2050, the world witnessed a display of science diplomacy at the highest levels. Likewise, the 2015 Paris Agreement for the reduction of carbon dioxide measures to mitigate global temperatures did not come as the spontaneous conclusion of world leaders, but as the result of years of scientific research, and advice from researchers around the globe, who for decades have been warning diplomats, politicians, and the public about the devastating effects of human-induced climate change. These announcements proved the crucial role that science currently plays in international relations.

In *Science Diplomacy. New Day or False Dawn?* Turekian (Davis & Patman, 2014) give the following definition of science diplomacy:

> Science diplomacy is the process by which states represent themselves and their interests in the international arena when it comes to areas of knowledge – their acquisition, utilization and communication – acquired by the scientific method. Itis a crucial, if under-utilized, specialty within the diplomatic constellation that can be used to address global issues, enhance co-operation between countries and leverage one country's influence over another. In this regard, science diplomacy is a significant generator of *soft power* – that potent form of attraction that harnesses national image, reputation, and brand (pp. 4-5).

But the concept of science diplomacy is not new. Some of the most significant examples date back to World War II and the Cold War era, when in spite of heavily

strained relations, scientists from different countries collaborated in areas like nuclear energy and warfare, space science, medicine and public health, among others.

In a historic move by the Kennedy administration, The U.S.-Japan Committee on Science Cooperation was created "as part of a broad effort to repair 'the broken dialog' between the intellectual communities of the two countries" (Turekian & Neureiter, 2012, p. 2). The Committee continues to benefit the scientific communities of both nations to this day.

Other examples from the second half of the twentieth century include the Shanghai Communiqué, which was signed by president Nixon in a historic visit to China, and included science as one of the concrete areas for cooperation. The science and technology program between China and the United States remains one of the largest and most productive agreements across several disciplines.

In 1974, during his first months as the Nixon administration's Secretary of State, Henry Kissinger addressed the United Nations in a speech about development, stressing the role of science in both causing and solving the world's most pressing challenges, and reiterating his determination to use American science as an "arm of diplomacy" (Wade, 1974, p. 780). Kissinger believed that the biggest contribution America could make, and what the world wanted, was its scientific and technological capabilities. In Kissinger's own words, "no human activity is less national in character than the field of science, and no development effort offers more hope than joint technical and scientific cooperation" (Wade, 1974, p. 781).

Kissinger's concrete vision has evolved into a field of diplomacy that takes as many forms as the countries that practice it, and for which there is no unique or specific

approach. However, experts like Tim Flink and Ulrich Schreiterer have characterized three different science diplomacy policy goals -access, promotion and influence- in an attempt to unify the myriad of perspectives present in today's international relations practices (Flink & Schreiterer, 2010).

The first goal of science diplomacy is access, and it applies to countries aiming to improve their competitiveness and innovation capabilities by connecting with new talent and research findings, better research infrastructure, natural resources and capital. Access-driven initiatives serve small and developing countries looking to improve their scientific capacity by way of working with more advanced systems. 'Big science' projects, like the European Organization for Nuclear Research (CERN), also fit under the umbrella of access-driven initiatives, which no country could manage alone and therefore require multilateral collaboration.

Countries also engage in science diplomacy as a way to promote their achievements in research and development in the global market, and to attract the best scientists, research institutions and funding. By promoting a nation's scientific capacities and improving their reputation, they lay the grounds for solid and mutually beneficial international partnerships.

Influence is another important objective of science diplomacy, as countries like the United States have come to realize that in order to improve their leverage and international reputation, economic and military force alone are not sufficient, and in many cases, can be counterproductive. Instead, author Joseph Nye proposes the use of soft power: "the ability to get what you want through attraction rather than coercion or payments" (Nye, 2004, p. 34). In Dr. Nye's view, a country's culture, political ideas and

good policies can attract others, seducing them into supporting your ideals and moving in your direction. Science, one of the most important sources of a country's high culture (Nye, 2004), is legitimized by universal values like rationality, equality and merit, and therefore carries the power to influence others and build trust between nations. Thanks to its advanced scientific system, the United States has managed to maintain solid and fruitful relations with scientists around the world, even in countries where American foreign policy is despised and rejected.

According to the American Association for the Advancement of Science (AAAS, 2016), the term science diplomacy involves three main types of activities: science in diplomacy, diplomacy for science and science for diplomacy.

Three approaches to science diplomacy

The G7's recent decision to aim for a switch to clean sources of energy generation is a clear example of science in diplomacy, where global sustainability challenges call for the efficient endorsement of high quality scientific advice by policy makers (National Research Council, 2002). Since environmental threats affect the entire world's basic subsistence –constrains in food, water, energy, health and infrastructure- without distinction of borders, race or nationality, and science is one of the crucial tools to address them, the global scientific community must keep policy makers and foreign policy diplomats informed about the workings of the planet's natural and socio-economic systems. One of the best examples of science informing policy makers is the Intergovernmental Panel on Climate Change (IPCC), which was established in 1988 by

the United Nations Environment Programme (UNEP), and the World Meteorological Organization (WMO). The IPCC was established to review and disseminate scientific input from researchers around the world about the state of climate change and its environmental and socio-economic consequences. In 2007, the IPCC (jointly with former U.S. Vice-President Al Gore) was awarded the Nobel Peace Prize for its contribution to knowledge about man-made climate change, and for preparing the ground for the solutions needed to counteract its effects. National academies of science are also an important source of scientific advice for foreign policy makers.

The second category of science diplomacy is diplomacy for science, which aims to facilitate international scientific cooperation, be it in support of strategic scientific priorities set by the government, or bottom-up collaboration between scientists through diplomatic efforts. Vast projects like the Large Hadron Collider (LHC), which require enormous investment and risks, could not function without the collective diplomatic action of several nations. "The need for cooperation between the diplomatic and scientific communities on such large multilateral programs is the principal driver behind diplomacy for science" (Davis & Patman, 2014, p. 13).

Conversely, researchers often need international interaction in order to advance their scientific endeavors, and require diplomatic assistance in developing relationships with their peers abroad, negotiating contracts, and dealing with visa regulations and intellectual property issues. One such example is the agreement between Colombian scientists from the country's main public universities -Universidad Nacional and Universidad de Antioquia- and Germany's Max Planck Society, which was established in 2014 to set up tandem research groups on tropical and infectious diseases, and

biotechnology of natural products. As climate change threatens to spread tropical diseases in the northern hemisphere, European scientists recognize the need to collaborate with experienced scientists in the field. Likewise, Colombian scientists can significantly advance their research objectives by collaborating with researchers from one of the world's most prestigious scientific societies. Such an unprecedented agreement was possible thanks to the work of Colombian Ambassador to Germany, Juan Mayr -and his team at the embassy in Berlin-, who see science not only as a crucial component of their agenda, but also as a way for Colombia to compete in international markets, and improve the quality of life of its citizens.

The third category, science for diplomacy, is the use of science as an instrument of soft power to help develop new international relations and improve them where there is strain or tension. Science for diplomacy takes advantage of science's "attractiveness and influence both as a national asset, and as a universal activity that transcends national or partisan interests" (Davis & Patman, 2014, p. 18). It is the type of science diplomacy to which small nations often resort in order to maintain their presence and importance globally. New Zealand is often cited as a small nation with advanced science and technology capabilities, which uses its research and discoveries as part of a global strategy to remain relevant in a world that could easily overlook it. Similarly, science for diplomacy aims to build bridges between nations with stressed relations, where military force and economic sanctions have proven useless in improving those interactions. With his Cairo Speech in 2009, president Barack Obama expressed the need for a new beginning (United States. The White House, 2009) in the relations between the United States and the Muslim world, citing both the latter's cultural and scientific contributions

throughout the history of mankind, and the possibilities to bridge some of the current gaps through collaboration in science and technology.

In spite of its power to unite, solve common global problems and serve as an instrument to achieve diplomatic goals, science is by no means a silver bullet solution for a country's international affairs, and it still faces challenges that several authors have pointed out in the literature.

Challenges to Science Diplomacy

In *Science Diplomacy, New Day or False Dawn?* several authors make the case for the integration of science and diplomacy through successful examples like the Square Kilometer Array (SKA) project between South Africa and Australia, global health research diplomacy, and the Pugwash Conferences. Nevertheless, other authors point to the issues and challenges associated with practicing science diplomacy, particularly those raised by high expectations about the role of science diplomacy in conflict and improving tense relations between nations, and the reality about science informing climate change international policy.

President Obama's Cairo Speech in 2009 created great expectations about the capacity of science to improve US relations with the Muslim world. However, time has proven that it is difficult to assess science diplomacy's impact on improving relations between nations, as trust is difficult to measure and a population's opinions about a rival country may vary easily depending on the political and social circumstances of the time. US-Russian scientific collaborations after the Cold War are often cited as examples of

science diplomacy's power to bridge gaps between nations, but what most authors fail to mention is that those relations did not happen over night and took decades to produce meaningful results.

Cathleen A. Campbell, CEO of CRDF Global, an independent nonprofit organization that promotes international scientific and technical collaboration, argues that US science and technology initiatives to expand engagement with the Muslim world are too broad considering the Muslim World is composed of fifty countries with different economic, political and social situations, as well as varying needs and scientific capabilities (Davis & Patman, 2014). In general, Muslim countries' GDP investment on research and development is below the 2.2% world average, and the low number of scientific researchers per total population and scientific articles published in indexed journals, hinder their science and technology absorptive capacity when collaborating with advanced countries like the United States. Political and social turmoil in some countries also hamper the implementation of science collaboration programs. Campbell also points that such initiatives require a commitment to financial resources that the United States has not delivered, due to its own economic crisis, and a re-focusing of foreign policy priorities due to the Arab Spring. Public funding must back initiatives of this magnitude, something the Obama administration has not been able to secure from the U.S. Congress

Muslim and American scientists will continue to collaborate in spite of many limitations, but whether this would help improve relations is hard to tell. President Obama's Cairo Speech raised hope about science diplomacy's potential for improving international relations, but challenges for mobilizing resources, complexities in implementing programs during political and economic unrest, and declining favorable

impressions of the US in the Muslim world in the last years, raise the question of whether science diplomacy can truly help to improve relations with the Middle East.

Science in diplomacy, the role of science in informing important global policy decisions, also presents serious challenges. Cognitive science researcher Manjana Milkoreit conducted a study with 55 participants (36 diplomats and 19 NGO leaders) to analyze how climate change diplomats "receive and make use of scientific knowledge" (Davis & Patman, 2014, p. 109). The results were far from encouraging. Milkoreit found that most negotiators use a limited set of scientific insights about climate change, which have hardly changed over time. The study also found that recently defined crucial scientific concepts, such as global-scale tipping points, are not part of most diplomats' set of beliefs, and most of them are unable to imagine the consequences of present decisions in long-term futures affected by climate change. The author does not discuss the implications of this science-politics disconnect in detail, but rather gives some recommendations about how to improve science communication for diplomats and country representatives, arguing that much like the common folk, they also need to receive scientific information in ways that are easier to understand, and translated into mental pictures that allow them to imagine possible future scenarios.

Except for the recent work of authors like Norwegian researcher Rasmus Bertelsen, which analyzes the soft power of universities through the study of institutions like the American University of Beirut and the American University in Cairo, the potential power of universities in international relations has received little attention. Even Joseph Nye's extensive works on the concept of soft power barely mentions Harvard

University as one of the United States sources of attraction, but it does not elaborate on its impact in diplomacy.

As science has become an undeniably crucial tool to solve some the world's most pressing issues, as well as an instrument to hold soft power and project a nation's influence globally, science diplomacy plays an important role in international relations. Countries big and small, developed and developing are including science into their foreign policies, proving that, although not without challenges, science diplomacy is an inescapable need in an increasingly science and technologically determined world.

Chapter III:

Why countries engage in science diplomacy

Even though there is not one strategy that fits all countries equally, nations around the world are realizing the importance of incorporating science into their foreign policy programs, and are implementing it according to their domestic policies and governance structures for research, development and innovation, and to their international relations goals and objectives.

After World War II, when the threat of nuclear warfare loomed over the world, science diplomacy was used as a way to "alleviate tensions, contain the risks of armed conflicts, bridge ideological gaps, build trust, and stir civil relations by way of scientific collaboration as a 'diplomacy of deeds'" (Flink & Schreiterer, 2010, p. 668). Today, non-proliferation of nuclear weapons is still a common concern, but countries use science diplomacy due to factors that range from diplomacy itself, to solving shared challenges, to market forces, trade and special interests. Some governments focus more on increasing economic growth, others on the advancement of science, technology and innovation capacities, others on increasing their global influence and connectivity, while other approaches are designed to improve and maintain a nation's image internationally (Dufour, 2012).

Across the board, nations are moved by the need to address the common challenges brought about by globalization, and by an understanding that science and technology can address issues that affect the entire world regardless of borders; these

include issues such as environmental and social sustainability, response to natural disasters, energy and climate change, global health issues like pandemics and non communicable diseases, and the protection of biodiversity. Countries also engage collectively in science diplomacy as an effective way to gather the necessary players for the development of large-scale projects that require massive infrastructure and investment, like the Large Hadron Collider (LHC).

Nations like Japan see science diplomacy as a way to improve their science and technology systems, as it allows them to tap into new scientific resources, research facilities, and human resources beyond its borders. Once a leading producer of science worldwide, Japan's relative strength in science now faces challenges due to public investment reductions in research and development, and the rise of countries like China and South Korea, whose scientific capabilities have grown remarkably over the last years. Moreover, Japanese scientists have been traditionally prone to look inward, so Japan's science has been slow to open up to the rest of the world, limiting the expansion of its international research collaborations. With the 2008 Council for Science and Technology Policy (CSTP) report, *Towards the Reinforcement of Science and Technology Diplomacy*, Japan realized the need to link science and technology with its foreign policy for their mutual development. In 2010, the government launched a Science and Technology Diplomacy initiative to strengthen international cooperation, which included measures to (1) increase joint research with developing countries in order to tackle global challenges, (2) cooperate with advanced nations in the field of cutting-edge technologies, and (3) collaboration based on equal partnership with members of the East Asia Science and Innovation Area (Dufour, 2012). Several government programs have been implemented

under this initiative, such as the Japan International Cooperation Agency and the Japan Science and Technology Agency's SATREPS, for the promotion of international joint research that targets global issues; the Strategic International Cooperative Program for the support of international joint research and exchanges; and the e-ASIA Joint Research Program (e-ASIA JRP), which aims to strengthen Japan's research and development system by integrating resources from East Asian countries through multilateral projects. Through these initiatives, Japan aims to expand the number of international research collaborations, and revitalize its innovation system by incorporating research and development resources from other countries.

Trade is a powerful motivation for small advanced nations like New Zealand, which use science diplomacy to not only project their scientific capabilities and maintain their presence internationally, but mainly to support their open-market position in world trade. New Zealand's economy has been based traditionally on food exports, first to Europe and more recently to Asia, resulting in heavy investment on agricultural and food science, biosecurity and food safety science (Gluckman, Goldson, & Beedle, 2012). In spite of an absolute commitment to free trade in agriculture, the country faces big challenges in biosecurity from imported products, which could threat their export products, unique landscape and biodiversity. Import restrictions to face these challenges have resulted in other nations accusing New Zealand of using biosecurity as a nontariff barrier. Countries may attempt to block imports from New Zealand by questioning the safety of their products, an argument that can have devastating effects in an economy that relies heavily on exports and free trade. Science and diplomacy play a key role in dealing with both trade and biosecurity disputes. For instance, under the *WTO Agreement on the*

Application of Sanitary and Phytosanitary Measures (SPS Agreement) -developed by New Zealand scientists through the Ministry of Agriculture and Forestry, and the Ministry of Foreign Affairs and Trade-, countries agree to base their SPS standards on scientific evidence, ensuring that restrictions are not arbitrarily used to disguise trade barriers. When normal diplomatic processes failed, New Zealand used the SPS instrument to win a dispute with Australia over their refusal to accept New Zealand's apples, known as the fire-blight problem. Through scientific evidence New Zealand proved the safety of its product and the WTO ruled in its favor removing Australia's imposed restrictions (Davis & Patman, 2014).

Additionally, New Zealand lacks the capital market necessary to shift from commodity to higher-value exports -one of the country's current goals-, which requires the quick development of its innovation system, as well as a specific skill set for marketing technology. Through science diplomacy, New Zealand can develop strategic relations with partners who can address its domestic deficiencies, while creating mutually beneficial relations. Particularly for New Zealand, science has, almost inevitably, an international dimension.

Developed nations with knowledge-based economies have long understood science and technology as key components of their economic development, and science diplomacy as an instrument to put forward their special interests. Countries like Germany believe that "newly industrializing states" (Flink & Schreiterer, 2010, p. 675) will soon be the global drivers of innovation and economic growth, and therefore are working through publicly funded organizations like the Max Planck Society to tap into those potential assets by way of joint research projects and collaboration.

According to its long-standing tradition of neutrality in international affairs, and to maintain its global leadership as Europe's innovation leader (The World Bank, 2011), Switzerland's approach to science diplomacy is not about influence, neither is addressing global challenges among its top priorities. Instead, Switzerland pursues a science diplomacy agenda driven by innovation, which focuses on access and opportunity within strategic geographic and subject areas with economic and scientific potential, namely BRIC countries, and traditional partners like the United States and Europe. Those areas were defined in the government's *Education, Research and Innovation policy guidelines and objectives 2013-2016,* based on specific political, economic, and scientific policy goals that serve their need "to stay connected and remain competitive with the best players and infrastructures worldwide" (Schlegel, 2014, p. 9), and to anticipate research and innovation hot spots that can be beneficial to Swiss universities and research and development enterprises.

Marketing of high-tech products and cutting edge technologies derived of their advanced science and technology systems is another common science diplomacy goal among developed nations. Clean energy technology is a case in point. According to the International Trade Administration's 2016 Top Markets Report for Renewable Energy:

> The renewable energy industry remains one of the most vibrant, fast-changing, and transformative sectors of the global economy. Technology improvements, cost declines, and the catalytic influence of new financing structures, have turned the sector into a driver of economic growth – both in the United States and around the world (United States. Department of Commerce, 2016, p. 3).

The 2015 Paris international climate agreement is expected to boost nations' interest in promoting policy to support clean energy development, which will raise global demand for renewable energy capacity and drive investment in most markets. To meet those demands, "the global import market in this sector is expected to reach $195 billion cumulatively in the 2016-2017 timeframe" (United States. Department of Commerce, 2016, p. 3). Countries like the United Kingdom are already showing political interest in aligning their science diplomacy with global concerns like climate change, which represent great opportunities for the marketing of British environmental technology and renewable energy devices (Flink & Schreiterer, 2010). In the case of Canada, there is great economic interest in globally promoting its abundant renewable energy supplies, which include solar, geothermal, and ocean energy, biomass, wind and moving water (Natural Resources Canada, 2016).

Nations also aim to influence international scientific and technological standards as a way to advance their national interests. If a country's scientists participate actively in international forums they are more likely to influence, or even set scientific standards, so that other nations have to adapt to them, therefore giving the country a competitive advantage that could lead to significant economic benefits. The first one to develop a technology or science-based product is likely to establish the standard, and therefore profit the most from it, which in the case of products like Microsoft Windows, can result in multi-billion dollar corporations (J. M. Müller, personal communication, June 03, 2016).

Lastly, science itself is also widely used as a diplomatic tool, revealing a change in the way international relations are carried out in the information era. The European Union for instance, sees science and technology as a pillar of integration and engages in science diplomacy not only to find solutions for common problems, but as a way to foster peaceful relations with other nations. Others understand that as our societies become increasingly globalized, new generations need governments to provide the appropriate environment for global partnerships and coalitions that allow mobility, sharing of information, and knowledge and technology transfer. Science diplomacy is also increasingly viewed as a public diplomacy instrument to raise and improve the global image of nations, and to demonstrate leadership in important global gatherings.

As the following chapter will discuss, the United States uses science diplomacy for different purposes. Aware of the intrinsic international nature of today's science -co-authored papers increased 409% between 1985-2007 (Flink & Schreiterer, 2010)- the U.S. sees science diplomacy as a way to advance the interests of its science and technology community, and to improve the global marketing of its technological products. Similarly to Germany, the U.S. also understands that both developing and developed nations are putting science and technology at the center of their economic, social and development plans, and therefore the country must seize the opportunities to join those markets. As the concept of connectivity and soft power significantly permeated the current administration's diplomatic views, science becomes a public diplomacy instrument that could help bridge relations with other nations, and to positively influence public opinion in favor of the United States' political objectives.

Chapter IV:

United States

Before delving into the practice of science diplomacy in the United States, it is important to understand where the country stands in terms of scientific development and government support for research. In spite of the highly criticized reductions in public investment on scientific research in recent years (Mazzucato, 2015), which have led to a decline in U.S. leadership in several key areas -infectious diseases, synthetic biology, and cyber security (Massachusetts Institute of Technology -MIT-, 2015), the country remains one of the world's top investors in research and development (R&D). In the OECD report *Research and Development Statistics (RDS)* for 2014 (OECD, 2016), the U.S. appears 7th on research and development expenditure as a percentage of GDP with 2,80%, after Israel (4,21), South Korea (4,15), Japan (3,48), Sweden (3,30), Denmark (3,05), and Germany (2,85). Nonetheless, the United States remains the world leader in total research and development spending in billions of dollars with $396 billion, followed by China, which in 2013 spent $294 billion. Furthermore, the country ranked among the world's top five in registered patents, and American higher education continues leading world rankings, with eleven of its universities among the top twenty (Quacquarelli Symonds, 2015). U.S. scientists publish more scientific papers in peer-reviewed journals and win more Nobel prizes than any of their counterparts around the world (Nye, 2011). Such figures have led American universities and research organizations to attract the world's

most talented scientists, and have turned the country into one of the most attractive destinations for international scientific cooperation.

The following pages explain how science diplomacy has evolved in the United States, and where the country stands today in terms of public policies to continue with its development.

Science Diplomacy in the United States

The role of science in American foreign policy began in full force in the early years of the Cold War, but the country's strong relationship with science dates back to its founding years, when the spirit of the Enlightenment, infused the American colonies of the British Empire. Benjamin Franklin and John Adams established institutions like the American Philosophical Society and the American Academy of Arts and Sciences, which were seen as a "haven of patriot philosophers" (Macleod, 1997, p. 371), and brought the cultures of the different colonies closer to one another, as well as to Britain and Europe. Established on principles of religious toleration, freedom and equality, and the pursuit of natural knowledge through science, their creation was one of the most important steps towards independence. These institutions aimed also to link science and government by offering *pro bono* advice to policy makers.

In 1848, members of the Association of American Geologists and Naturalists agreed to turn the organization into what is know today as the American Association for the Advancement of Science (AAAS). Among their objectives was to foster interaction between people who were cultivating science throughout the country, to establish a

"more systematic direction to scientific research" in the United States, and to provide scientists with more facilities and a wider scope of action (AAAS, 2016, par. 3).

With the rapidly changing industrial and geopolitical landscape of the early twentieth century, President Woodrow Wilson formed the National Research Council (NRC), to foster cooperation between industry, government and scientific organizations, and to increase the use of science in America's development, as well as in national security and welfare (Feuer & Maranto, 2010).

In the decades that followed, the United States was involved in international scientific cooperation, including covert joint programs during World War I. As the Cold War era approached, science took an increasingly important role in diplomacy, when the USSR and American governments used scientific research as a way to increase their contacts and improve tense relations. Between 1958 and 1959, the U.S. National Academy of Sciences (NAS) and the Academy of Sciences of the USSR (ASUSSR) signed agreements to establish scientists exchanges and scientific cooperation programs (National Research Council, 2004). President John F. Kennedy also saw in science an opportunity to bridge gaps with Japan, and created the U.S.-Japan Committee on Science Cooperation to promote cooperation between both countries' intellectual communities during times of heavily strained relations. The Nixon administration, under the advice of Secretary of State Henry Kissinger, made extensive use of the President's science advisor and the Office of Science and Technology to increase the use of science in the country's international relations agenda.

In the past, several U.S. agencies have made the link between science and their international relations needs, but as the next section discusses, the State Department's

formal implementation of science came fairly recently, as the turn of the century made evident that science and technology were at the center of the country's goals and objectives.

Science and technology at the State Department

For decades, the U.S. government has used personnel trained to address aspects of science and technology that intersect with foreign policy, like the Office of Science Adviser and Special Assistant to the Secretary of State, which was created in 1950 to work on the relation between international science and national security. The Office lost prominence over the years, until it became part of the Bureau of Oceans and International Environmental and Scientific Affairs (OES) in 1974 (Pincus, 2014).

But it was not until 1998, that the U.S. Department of State took renewed actions towards formally integrating science into U.S. international relations policy. Then Secretary of State Madeleine K. Albright requested that a committee from the National Research Council (NRC) conducted a study on the connection between science, technology and health (STH), and the development and implementation of foreign policy, and how the State Department could improve its performance in those areas. The report titled *The Pervasive Role of Science, Technology and Health in Foreign Policy* – henceforth the NRC Report- showed how expertise in STH was "essential in assessing many bilateral issues, global developments, and interactions between countries of importance to the United States" (National Research Council, 1999, p. 11). The study found that, at the time, at least 13 of the 16 objectives of the U.S. Strategic Plan for

International Affairs contained science and technology issues like health, environment, agriculture, security, trade, terrorism, travel and migration. Moreover, the study illustrated how the joint work of the State Department and the U.S. scientific community should provide Congress with continued and persuasive evidence of the role of international STH activities in the achievement of American political, economic and security interests, and warned of the dangers of failing to make full use of the scientific resources available to the department.

The committee issued a set of recommendations to help improve STH understanding within the State Department, based on three main principles: increased leadership by the Secretary of State, strengthening of the Department's organizational structure, and a well informed and driven workforce that could efficiently handle the numerous STH issues related to the Department's objectives.

In terms of staff, the NRC Report recommended that the Secretary of State should create the position of Undersecretary for Scientific Affairs, who would be responsible for ensuring that science and technology factors were considered in policy formulation, and for attending to regular meetings and consultations related to science diplomacy. Similarly, the Report suggested that a Senior Advisor to the Secretary and the Undersecretary be selected to "provide expert advice, drawing on the resources of the American STH communities, as necessary, on current and emerging issues" (National Research Council, 1999, p. 6). In short, the main functions of the adviser would be "to provide advice, address S&T-related policy, and serve as a liaison to the scientific community" (Pincus, 2014, p. 4).

Furthermore, 25 Science Counselors with strong scientific backgrounds were to be assigned to embassies in countries where the United States had interests related to science, technology and health matters of substantial foreign policy significance. The NRC also proposed the creation of an STH Advisory Committee to the Secretary, and that specialists from other departments acted as rotating staff to participate in international negotiations, and to serve as counselors in their areas of expertise.

The NRC Report emphasized the importance of increasing STH literacy and awareness among all Foreign Service Officials and other staff within the State Department, by implementing promotion and professional incentives for good performance in positions related to science and technology, and by expanding the Department's training capabilities in those areas. To that end, the State Department was also advised to assign more value to STH skills during Foreign Service Officials' entrance examination process.

In order to implement such staff and training recommendations, the Report stressed the need to increase the State Department's financial resources dedicated to STH matters. In 1999, when the NRC Report was issued, only one percent (one penny out of every dollar) of the U.S. Federal budget went to international affairs, meaning that an even more insignificant fraction of that was dedicated to science diplomacy.

In essence, the NRC Report covered two of the three main approaches to science diplomacy; science for diplomacy by emphasizing the crucial role that science and technology should play in the formulation and implementation of U.S. foreign policy, and diplomacy for science by acknowledging the State Department's responsibility in

enabling American scientists participation in international scientific cooperation programs and activities, both in the public and the private sectors.

In the words of Dr. Vaughan Turekian, current Science and Technology Adviser to the Secretary of State, the 1999 NRC Report "resulted in a massive change in the way in which the United States thought about science and foreign policy" (International Institute for Applied Systems Analysis -IIASA-, 2015, YouTube).

On February 21, 2000 Secretary Albright addressed the American Association for the Advancement of Science (United States. Department of State, 2016b) during its annual meeting in Washington D.C., and reiterated her promise to appoint a Science and Technology Adviser for the State Department, based on the Report's recommendations. Later that year, Congress authorized the creation of the Office of the Science and Technology Adviser to the Secretary of State (STAS) through Senate Act 886 (United States. Department of State, 2016b), which determined that the position would be nonpolitical, and that each Adviser would serve a fixed three-year term (Pincus, 2014).

Five Science and Technology Advisers have served at the State Department since 2000, the first three under the Under Secretary for Global Affairs, and the others under the Under Secretary for Economic Growth, Energy, and Environment. Although the Adviser is in direct contact with the Secretary of State, most of their policy work is done through contact with the Department's different bureau's officials. All five of the Department's Science and Technology Advisers have had strong scientific backgrounds, and some had diplomatic experience. (See Figure I for a list of the State Department's Science and Technology Advisers and their backgrounds).

Today, STAS staff is composed of seven members dedicated to the strategic mobility needs of the Department, who operate outside the daily policy responsibilities of the office. There is a Science and Technology Adviser, a Deputy Science and Technology Adviser, a Senior Science Policy Officer, a Senior Science, Technology, and Innovation Adviser, three Foreign Affairs Officers, and one Staff Assistant. STAS complements the work of the Bureau of Oceans and International Environmental and Scientific Affairs (often referred to as Oceans, Environment and Science, or OES) in foreign policy issues related to official bilateral S&T cooperation, climate change, infectious diseases, the Arctic, oceans and space.

Fig. 1. U.S. State Department's Science and Technology Advisers since 2000 (Pincus, 2014).

Name	Background	Years at the State Department
Norman Neureiter	PhD in organic chemistry. Deputy science attaché in Bonn and Warsaw as a foreign service officer, in the International Affairs Office of the National Science Foundation, and at Texas Instruments. Assistant for international affairs in President Richard Nixon's White House Office of Science and Technology.	2000 - 2003
George Atkinson	Professor of chemistry and optical sciences at Arizona University. First American Institute of Physics science fellow in the Department of State. Senior Alexander von Humboldt Award. Senior Fulbright Fellow Award.	2003–2007
Nina Fedoroff	Professor of molecular plant biology at Pennsylvania State University. Member of the U.S. National Academy of Sciences (NAS). 2006 National Medal of Science.	2007–2010
William Colglazier	PhD in theoretical physics. Executive officer of the NAS and NRC. Executive director of the Office of International Affairs of the NAS and NRC. AAAS congressional science fellow.	2011–2014
Vaughan Turekian	PhD in Philosophy. AAAS Chief International Officer. Director of AAAS's Center for Science Diplomacy. Editor-in-Chief of Science & Diplomacy. Special Assistant and Adviser to the Under Secretary for Global Affairs. Program Director for the Committee on Global Change Research at the NAS. AAAS fellow.	2015

STAS priorities

Aligned with current U.S. foreign policy goals -which include preserving the country's national security, promoting world peace and a secure global environment, maintaining a balance of power among nations, and working with allies to solve international problems- the Office of the Science and Technology Adviser to the Secretary of State has also defined a set of priorities to guide their work. The first one is to promote science, technology and innovation to foster U.S. and other nations' economic growth. As a knowledge-based economy, the United States values the important role of science in creating more developed, prosperous and stable societies, which in turn become responsible global players, and open new markets for the United States. Programs like NODES (Networks of Diasporas in Engineering and Science) (United States. Department of State, 2016a), a partnership between the U.S. Department of State, the American Association for the Advancement of Science (AAAS), the National Academy of Sciences (NAS) and the National Academy of Engineering (NAE), aim to empower S&T professionals from foreign countries so they can use their connections and expertise to address development issues in their home countries (United States. Department of State, 2016b). In turn, these new and improved economies can become welcoming markets for American exports.

Another important goal, and one that was stressed in the NRC Report, is to increase the State Department's science, technology and innovation capacity through training and fellowships that reinforce the scientific and technical capabilities of the Department's personnel, so that they are better equipped to address global environmental, economic, security and political issues. AAAS supports this goal by offering foreign

policy fellowships to scientists and engineers, which allows them to learn about policy development, program planning, implementation and evaluation, while they contribute to the policy making process through their knowledge and analytical skills. (See Figure II for a list of AAAS S&T Fellowship Programs in Diplomacy, Security and Development). Other fellowships include the Jefferson Science Fellowship program and the Professional Science & Engineering Society Fellowship Program. The former invites tenured science, medical and engineering professors to work as consultants for the Department for a year, and while the home university continues to pay for their salaries and benefits, the Department covers the cost of living in the Washington D.C. area during their stay. The State Department benefits from the Fellows' scientific skills and expertise, and the home university from the professors' acquired knowledge in diplomacy and foreign policy, as well as from their access to international networks, both of which are crucial for the internationalization of their academic and research activities. Fellows often continue advising their host office long after they have finished the program. Similarly, the Professional Science & Engineering Society Fellowship Program hosts scientists from the American Institute of Physics (AIP) and the Institute of Electrical and Electronics Engineers (IEEE), who are interested in foreign policy, to work directly at an office at the State Department for one year, during which their home societies continue paying for their salaries and benefits (United States. Department of State, 2016b). Each year, STAS brings 30 PhD level experts to the Department, and more than 100 fellows -past and current- serve in different bureaus.

STAS also has programs aimed to empower women in science, technology and innovation by increasing their access to high-skilled professions, and as a way to boost

economic growth in other nations. Through the U.S.-Pakistan S&T Cooperation Fund, STAS has funded over 80 scientific and capacity building projects benefiting more than 10,000 Pakistani women. Similarly, the NeXXt Scholars Program connects female undergraduate students from Muslim countries, who are pursuing studies in science, technology, engineering and mathematic (STEM) in the United States, with their American counterparts, to receive advice and support regarding professional development and career advancement.

STAS priorities also include monitoring global emerging trends in science and transformational technologies –such as smart cities, biotechnology and Big Data-, which allows the State Department to better predict their effects in American markets and foreign policy.

Lastly, STAS aims to develop effective public-private partnerships in order to leverage U.S. capabilities in science and technology and increase international cooperation, which requires working closely with the private sector, non-governmental organizations, professional societies and academia. One successful example is LAUNCH, a public-private partnership between the Department of State, NASA, The U.S. Agency for International Development (USAID), and Nike. LAUNCH is an open innovation platform created to identify and promote new ideas for sustainability, currently focusing on changing the materials and manufacturing systems, which greatly impact the world at the social, environmental and economic levels. Private investors have contributed more than 40 million dollars since the program started (Launch, 2016).

Fig. 2. AAAS S&T Fellowship Programs in Diplomacy, Security and Development (AAAS, 2015).

Foreign policy and international trade, treaty engagement, and multilateral cooperation.
Disaster preparedness and response.
Infrastructure, environmental, cyber and health security, terrorism and warfare prevention, and nonproliferation.
International aid, capacity building, and development assistance.

Notwithstanding the policies developed in the past, and the programs and activities currently in place, science diplomacy policy in the United States faces challenges determined by the nation's foreign policy objectives, the funds available for the development of related activities, and the country's domestic priorities and strategic political objectives (UNESCO, 2010).

United States Science Diplomacy Policy

Foreign policy during George W. Bush's administration focused largely on the Middle East, and on three main national security objectives: defeating terrorism, stopping nuclear proliferation and actively promoting democracy throughout the world. Bush's foreign policy overemphasized the use of military force while heavily reducing reliance on diplomacy (Pressman, 2009). Moreover, the Bush administration was under scrutiny for interfering with and manipulating scientific processes, and distorting and suppressing scientific findings and publications, often sacrificing the scientific integrity of federal agencies like the Food and Drug Administration (FDA), the Centers for Disease Control

and Prevention (CDC), and the Environmental Protection Agency (EPA), in order "to further a political and ideological agenda" (Waxman, 2003, p. i). It is thus not surprising that during that time, diplomatic negotiations involving science revolved around issues of security and nuclear non-proliferation, such as the U.S.-India Civil Nuclear Cooperation Initiative (Goel, 2014).

The Obama administration took a radically different stance towards science, as well as towards foreign relations from that of his predecessor, although that has not necessarily translated into furthering effective science diplomacy policy. As Science Advisor to the current administration, John P. Holdren, expressed in an editorial for Science in 2009 that President Barack Obama "deeply grasps the importance of S&T to our national goals and is putting scientists, engineers, and innovators back into the center of what the executive branch does" (Holdren, 2009, p. 567). Indeed, even during the 2008 elections, science was at the center of the democratic campaign, where Hillary Clinton and Barack Obama emphasized the importance of science for addressing a myriad of global issues, respecting the independence of scientists, and warned about letting the United States loose its technological edge (Pierson, 2009).

Once in office, President Barack Obama made clear his aim to use science and technology to foster diplomacy and development (Deghan & Colglazier, 2012), and was supported by his then Secretary of State, Hillary Clinton, who deemed international science and technology cooperation as one of the "most effective ways of influencing and assisting other nations and creating real bridges between the United States and counterparts" (Lijesevic, 2010, par. 1). Several programs were launched to foment academic and scientific exchanges, such as 100,000 Strong in the Americas (between the

United States and Latin America), and Partnerships for Enhanced Engagement in Research (PEER), a grants program managed by the National Academy of Sciences (NAS) and USAID, to support capacity-building and research collaborative projects with strong potential developmental impact in developing countries (The National Academies of Sciences Engineering and Medicine, 2016). At the beginning of his administration, President Obama also signed an executive order to repeal obstacles for responsible human stem cell research, which the Bush administration had imposed since 2001 (Cable News Network -CNN-, 2009). The historic 2009 Cairo speech, in which President Obama called for a redefinition of America's relations with the Muslim world through opportunities like scientific collaboration, also showed the President's great expectations on the extent of science diplomacy's power. The fact that, in reality, such goals have proven difficult to achieve was addressed in the first chapter. Nonetheless, The Cairo speech is considered an important milestone in President Obama's initiative to use international scientific cooperation –as well as capacity building projects and the application of technology to solve global issues- as key components of his foreign policy agenda (Bollyky & Bollyky, 2012).

In spite of all the good intentions, and even though different science diplomacy programs and initiatives have been implemented in the past ten years, the United States still lacks a coherent international science policy to achieve foreign relations goals with significant science and technology elements (Carnahan, 2012). Several departments and agencies work with international partners on science and technology issues, e.g., the Department of State and the U.S. Agency for International Development (USAID), the National Science Foundation (NSF), the Environmental Protection Agency (EPA), the

Departments of Defense, Agriculture, Commerce, Energy, and Health and Human Services, and the National Aeronautics and Space Administration (NASA). However, as they work separately to achieve their own goals, science diplomacy in the United States ends up being "highly fragmented" (Flink & Schreiterer, 2010, p. 674); some members of Congress are already calling for an instrument to determine federal priorities on international science, and to reach interagency coordination (Carnahan, 2012).

In the past, several bills have been introduced in an attempt to create a cohesive policy that increases funding for science diplomacy, and to integrate the different agencies, bureaus and departments' international science and technology goals. However, none have been signed into law. In 2010, representatives Howard L. Berman (D-CA) and Jeff Fortenberry (R-NE) introduced a bill titled the Global Science Program for Security, Competitiveness, and Diplomacy Act of 2010 (GovTrack, 2010), which aimed to: establish a grant program to fund collaborative research and online access to international science journals; authorize the Secretary of State to create the Embassy Science Fellows Program, and the Jefferson Science Fellows Program, which would pay for the costs of having federal scientists and tenured scientists and engineers serving at the Department of State for up to three years. Currently, the scientists' home universities and research organizations carry the burden of paying their salaries during these terms. The bill also directed the Department to create a Scientific Envoys Program, in which scientists would serve as representatives of the country's commitment to global scientific cooperation, and to facilitate partnerships with other countries. Furthermore, the bill encouraged stronger integration of the Office of the Science and Technology Advisor into the State Department's activities, and called for the improvement of visa processes for foreign

researchers, in order for the United States to remain an attractive destination for science programs and activities. Although some of those programs already existed at the time, Congressional approval was crucial to secure funding. The House of Representatives introduced the bill, but it did not pass the Senate vote.

Later in 2013, Representative Daniel Lipinski (D-IL) introduced the International Science and Technology Cooperation Act of 2014 (H.R. 5029 – 113th) (United States. Congress, 2014), which had a more general objective than its antecedent, requiring the Director of the Office of Science and Technology Policy (OSTP) to create a body – under the National Science and Technology Council, and co-chaired by the Sate Department and the OSTP- responsible for identifying and coordinating international scientific cooperation opportunities that would "strengthen U.S. science and technology enterprise, improve economic and national security, and support U.S. foreign policy goals" (United States. Congress, 2014, p. 1). One of the committee's main objectives would be to coordinate the international research activities, partnerships and priorities of the different agencies, and to align them with the country's foreign policy goals. Once again, the bill passed the House of Representatives but it died in Congress, and was re-introduced in February 2015 (H.R. 1156) (United States. Congress, 2015) by Representatives Russ Carnahan (D-M) and Ileana Ros-Lehtinen (R-FL). No activity has been reported on it since May 2015 (United States. Congress, 2015).

The United States might continue to be one of the world's leading nations in science and technology, albeit recent budget reductions, and it certainly has made strides towards formalizing the relationship between science and foreign policy, but when it comes to policy, the country still has a long way to go to overcome the financial

restrictions and political disagreements that have impeded the development of a coherent and integrating science diplomacy policy.

Chapter V:

Purdue University: the role of universities as non-state transnational actors

Joseph Nye divides power in the 21st Century into three main levels: the top level is military, the middle is economic, and at the bottom are transnational relations. The latter refers to issues that are outside government control, such as terrorism, financial flows, or pandemics, in which non-state actors like banks, non-governmental organizations, or universities have the capacity to influence outcomes in the international arena. These actors now hold what Joseph Nye has termed "power with others" (Nye, 2011, p. 17), rather than power over others, the result of a growing interdependence trend among nations caused by globalization that calls for the use of soft power through cooperation and attraction -both of which are inherent characteristics of universities- as ways to achieve intended outcomes, rather than using military force or economic sanctions. Universities are also characterized by global interactions, such as movement of people, information, money and technology across state borders. Furthermore, they convey a sense of legitimacy, the common belief hat an actor or action is right, and they appeal to their capacity to be moved by qualities of "benignity, competence, legitimacy, and trust" (Nye, 2011, p. 48), like the pursuit of knowledge rather than pure strategic or self-interest. Although few authors have studied the role of universities as non-state transnational actors, some like Dr. Rasmus Bertelsen suggest that institutions like the American University of Beirut, have contributed to the United States diplomacy objectives in the Middle East, by achieving "milieu goals of attraction to norms, skills,

and knowledge" (Bertelsen, 2012, p. 31). However, universities alone cannot solve major conflicts, and as with other soft power tools, their impact is difficult to measure, and mostly felt in the long term

That is the case of Purdue, a university whose current work in Colombia is a good example of a non-state transnational actor applying American soft power. In 2010, in a ceremony that included Colombia's President Juan Manuel Santos, as well as the Minister of Foreign Relations and Colciencias officials, Purdue signed a cooperation framework agreement with Colombia as a country, making it the focus of its collaboration with Latin America. Initially, the agreement was meant to foster student and researcher exchanges, but it has now expanded to include joint research, technology transfer, advice for scientific entrepreneurship, multi-disciplinary collaboration, language training and cultural exchanges, study abroad programs, and support for doctoral training for Colombian students, among others. Purdue is also the first foreign university to open a liaison office in Colombia, and it did so in Ruta N, a government corporation located in the city of Medellin, created to facilitate the city's economic evolution towards science, technology and innovation businesses. Purdue also signed separate specific agreements with public and private universities throughout the country.

Since its insertion in Colombia, Purdue has involved major diplomatic actors like Colombia's Ministry of Foreign Relations and the U.S. Embassy in Colombia, who have helped coordinate networking activities, such as a meeting of Colombia's most important university rectors -and representatives from the science and academic communities- with Purdue officials in West Lafayette, Indiana, in 2014. As a result of that meeting, and in order to support international mobility of Colombian graduate students, Purdue signed an

agreement with Colfuturo, a public institution that helps finance Colombians' graduate studies abroad.

The U.S. Embassy is also working with Purdue and other U.S. land grant universities to create an institutional framework for the development of collaborative agricultural initiatives with Colombian universities. Before the first exploratory mission to Colombia in May 2015, which included representatives from fifteen American universities, most of the delegates had neither traveled, nor considered visiting Colombia because of its bad reputation. Their positive reaction during and after the missions shows that Colombian universities can also be a powerful source of Bertelsen calls reversed soft power, as they have the potential to change negative perceptions about the country, and attract people who otherwise would have never considered it. Similarly, Colombian public university students, researchers and professors, who have been traditionally skeptic about the United States due to its foreign policies and capitalistic influence in the country, are increasingly interested in exploring opportunities for research internships, study abroad programs and joint research with American universities[1]. Even though the costs associated with Colombian scholars mobility to the United States are much higher compared to European countries like France or Germany, agreements such as those made between Purdue, Colfuturo and Colciencias could help increase Colombians' chances to study in the United States.

Most Colombians, including students and scientists, are not aware of American people's inclination for philanthropic and altruistic endeavors, a trait that some Purdue

[1] Joint research indicators are equally challenging for Purdue and Colombian universities to maintain because there are not effective mechanisms to track all of scientists' international activities. If there have not been co-authored papers, traveling, transfer or exchange of resources, or signed agreements, and if the researchers do not inform their institutions' international relations offices, the interaction can be virtually impossible to track. That is why so many researcher collaborations are often unaccounted.

professors are effectively helping to present to Colombia by helping some of the least privileged students. In 2013, a group of nanotechnology researchers from Purdue University began working with Ruta N in a project called Interchange, which seeks to lure high school seniors from the lowest socio-economic tiers of Colombian society into pursuing careers in science. Purdue professors, as well as members of the Colombia-Purdue Institute (CPI), volunteer weekly hours of their work to virtually teach these students about nanotechnology, with the help of Colombian professors and translators. When the pilot project started in Medellin, fourteen students from Santo Domingo Savio –a district ridden with gang wars, poverty and lack of opportunity- attended the sessions after their school hours, hoping to win a place in a science summer camp that Purdue organizes every year in Indiana, and that was offered via scholarship to the best two students in the group. At the end of the semester, Purdue and Ruta N organized an event to announce the two winners, where parents and students anxiously waited for the results. To everyone's surprise, and as a reward for all the participants' dedication and hard work, Purdue professors had managed to raise funds so that all fourteen students could attend the summer camp with all expenses covered (Ruta N, 2014). Purdue even gave them language and intercultural training prior to the trip, with the help of its liaison office in Medellin. It is worth mentioning that most of these students are first-generation high school graduates, the first ones in their families to aspire to a college education, and certainly the first ones to travel overseas or get on a plane. Ten of those fourteen students are now pursuing careers in engineering, health and exact sciences. By 2015, Interchange evolved into what is now known as *Horizontes*, and in association with Purdue and other American universities, it has reached 7300 students in more than 200 institutions. Not all

of them will make it to the summer camp in Indiana as the pilot group did, but Purdue is surely contributing to bring new perspective and opportunities to their lives, and by doing so, it is also contributing to Colombia's development.

Culture is also a powerful instrument of soft power that the United States has used as far back as the Roosevelt administration, when he used American films during the Cold War to portray a positive image of the United States to Europe and the Soviet Union countries (Nye, 2004). France was one of the first nations to use language, culture and universities to exercise soft power, and today, emerging powers like India have come to understand that its ability to attract others with food, music, films, science and technology is as important in international affairs as its trade, military and politics. Indian writer and politician Shashi Tharoor argues that in the information era "it's not the side of the bigger army that wins, it's the country that tells a better story" (Tharoor, 2009, Ted Talk).

Purdue is also using culture and arts as effective soft power tools, by bringing parts of American culture and blending them into important events throughout Colombia. In May 2014 The Purdue Jazz Combo toured the country to participate in several jazz festivals. Later that year, 250 members of Purdue's All-American Marching Band from West Lafayette joined *La Feria de las Flores* (Flower Fair) parade, one of the biggest cultural celebrations in the country, which takes place in the city of Medellin. The band also participated in a variety of cultural, performance and school events, and received recognition from the city's Mayor for their contribution to the city's intercultural agenda. To many of the amazed spectators, it was their first time seeing such an iconic feature of American culture in person, one that they had only seen in American films and television.

Neither military nor financial aid through United States diplomatic initiatives like Plan Colombia -highly controversial and the source of much debate between liberals and right-wing sympathizers, due to allegations of atrocities against peasants accused of supporting leftists armed groups- have been able to promote such a positive image of the United States among Colombians as Purdue University has done in the past six years. Whether the United States is purposely using Purdue as a soft power tool has not been discussed explicitly, although it would not be surprising because as the diplomatic cables released by Wikileaks in 2010 revealed, the "United States sees universities as an important element in the exercise of global power"[2] (Matthews, 2012, par. 4).

[2] The diplomatic cables leak revealed several ways in which governments have used universities for diplomatic purposes; how the Libyan regime tried unsuccessfully to influence Oxford's decision to accept Mu'ammer Gaddafi's son into a PhD program; how "rival states and groups are seeking to use the academy to challenge US dominance," and how Western universities can influence the perception of other countries by educating their future elites. The cables also showed that the U.S. sees American universities' foreign graduates as potential allies, that attracting foreign students is an important foreign policy objective for rich countries like Qatar, and that some regimes are trying to control who studies abroad and what, as a way to counter the powerful influence that universities in democratic states can have in the views of their students.

Chapter VI:

Colombia

Similarly to the United States, over the last two presidential periods Colombia went through significant foreign policy changes, from a policy guided by internal security and defense interests that focused on a bilateral relation with the United States -while nearly isolating the country from its Latin American neighbors- to a policy of openness and reconciliation, where relations with its regional counterparts are prioritized (Ramírez, 2011). Although these changes have not translated into actual science diplomacy policies, international scientific cooperation takes place thanks mainly to researchers' individual efforts, the work of international relations offices in universities, and to individual initiatives from actors in the Foreign Service.

During the administration of former president Alvaro Uribe, foreign affairs in Colombia focused on supporting his Democratic Security Policy (2002-2010), which aimed to return control of the territory to the state, protect the population, and tackle illegal drug trade, all backed by military action heavily sponsored by the Bush administration through Plan Colombia. Such closeness with the American government, added to divergent economic and political ideas from those of its Latin American counterparts, caused tensions that in some cases resulted in the rupture of ties with countries like Ecuador and Venezuela, and a deterioration of official relations with Brazil.

Comparably to the United States under the Bush administration, during former president Alvaro Uribe's presidency science did not play a significant role in Colombia's foreign affairs agenda. A review of the Ministry of Foreign Relations' Memoires to Congress from 2002 to 2010 shows that most international activity during Uribe's administration focused on areas such as security, anti-terrorism and the fight against drugs, commercial trade and foreign investment. Technical cooperation also appears but mainly for development projects, not as scientific endeavors. There were also several agreements signed for scientific cooperation, including one with the United States in 2010, but unlike policies, these agreements are not legally binding, they do not specify a course of action, do not require the parts to commit financial resources, and it is difficult to measure their impact. There was no mention of science diplomacy during this period, however it is important to mention that other types of diplomacy did emerge in 2010, namely energy diplomacy, and environmental diplomacy; the former to capitalize on Colombia's energy resources and experience in commercialization, interconnection, networks and transmission as foreign policy assets; and the latter, to continue strengthening Colombia's position as a key player in environmental international negotiations (Colombia. Ministerio de Relaciones Exteriores, 2011).

In contrast, current President Juan Manuel Santos' foreign policy is grounded on commercial liberalism, where peaceful relations with other nations are promoted on the basis of free trade and commercial interdependence. In line with the theory of capitalist peace, this administration has used trade to repair broken relations with its Latin American neighbors, even with those who do not necessarily share the same political and ideological values as Colombia (Vargas-Alzate, Sosa, & Rodríguez-Ríos, 2012). Santos

has also diversified and expanded the list of international commercial partners beyond the United States and Canada, to include new ones, such as China, the European Union, Chile, Turkey, South Korea, Israel and the United Arab Emirates, mostly by opening new embassies and signing free trade agreements.

Even though, compared to the previous administration, the Foreign Relations Ministry's Memoirs to Congress during this period (2010 to 2015) show considerably more activity related to science, there is no mention of a specific science diplomacy policy, or even a program. Mr. Dixon Moya, acting Director of the San Carlos Diplomacy Academy -the Ministry's unit responsible for the comprehensive training of Foreign Service officers- said in an interview[3] that even though the Ministry is very interested in supporting international scientific cooperation activities, there is no personnel dedicated exclusively to those activities (D. Moya, personal communication, January 15, 2016). To the question of whether the Ministry had an appointed science advisor, Mr. Moya said it would be hard to imagine having advisors dedicated only to scientific issues; for such matters, the Ministry seeks the support of Colciencias, universities, research centers, and other ministries or government agencies depending on the subject. For instance, for Colombia's recent accession to the International Renewable Energy Agency (IRENA), the Ministry of Foreign Relations sought the approval and comments of the Ministries of Mining and Energy, and Environment and Sustainable development. Every year, the Diplomacy Academy holds different training courses for Foreign Service officers and students, which are seldom related to science, but there is nothing similar to the U.S. State Department's Jefferson Science Fellowship program, or the Professional Science &

[3] Mr. Dixon Moya's comments reflect his personal opinion and do not involve the official views of the Foreign Relations Ministry.

Engineering Society Fellowship Program, which aim to increase the scientific and technical capabilities of the U.S. State Department's personnel.

In 2011, the President's Office, along with the Ministry of Foreign Relations, created Agency for Colombia's International Cooperation (APC), to promote and manage the country's positioning in the international arena through three priority areas that support the administration's post-conflict vision: sustainable rural development, peace building, and conservation and environmental sustainability. Although science is transversal to many of the aspects of those three objectives, international scientific cooperation is not among the APC's priorities, and therefore there is no science diplomacy strategy in place. In fact, none of the three APC staff members interviewed was truly familiar with the concept of science diplomacy. In the case of the APC, the practice of science diplomacy takes place indirectly, whenever other policy objectives call for the use of science and international collaboration.

Several unsuccessful attempts were made to obtain an interview with the Ministry of Foreign Relations' Director of International Cooperation -the official in charge of science and technology agreements- to find out why if there are sports, cultural, environmental and energy diplomacy programs, and giving Colombia's great scientific potential in areas of global concern, there is not even mention of the practice of science diplomacy in the Ministry's Memoirs. However, all efforts to contact them were futile. Similarly, Colciencias' newly appointed Director of International Relations –the second one in less than two years- and members of her staff declined to give an interview until plans for their new strategy were finished. Therefore, and since the purpose of this study is not to find out what would be done in the future but to analyze what has been done

until now, the conclusions here presented are based on the author's findings, on my observations and experience as international scientific cooperation advisor at one of Colombia's major public universities, and on interviews with other sources.

The following considerations help illustrate why Colombia has not adopted a science diplomacy policy.

A look at Colombia's science, technology and innovation system Towards the end of the 18th Century, the Royal Botanical Expedition –led by Spanish priest, botanists and mathematician- was sponsored by the Spanish crown to assess the wealth of natural resources in flora and fauna of the Viceroyalty of New Granada (what is today Colombia, Venezuela, Panama, Ecuador, northern Brazil, Peru and western Guyana); it is considered a myth of origin, and the institution that legitimized the beginning of Colombia's scientific activity.

Coincidentally, German naturalist and geographer, Alexander von Humboldt, arrived in Colombia a few years later, an unexpected turn of events for the explorer, whose work was determinant for the rest of the world's knowledge of the American continent, and who can also be considered one of the world's first science diplomats. At the beginning of the 19th Century, Humboldt and his companion Aimé Bonpland failed to join France's Baudin expedition in Cuba, and as they attempted to go to Panamá instead, a storm forced their ship to the Colombian shores. Once in Cartagena, Humboldt heard about José Celestino Mutis, his botanical expedition and great political influence, so he wrote Mutis a letter saying that he had wanted to meet him for years, and that he would like to personally appreciate the great work he was preparing for humanity's posterity. Mutis felt honored and offered to help Humboldt with his expedition through Colombia, a

promise that he took to a level that even Humboldt was not expecting. Mutis helped him acquire the necessary permits form the Spanish crown, provided horses, food, personnel, and an entire infrastructure for their exploration; Mutis also opened his herbarium, and lent them his notes, manuscripts and drawings. Humboldt's first big botanical work, *Geographie des Plantes Equinoxiales,* is dedicated to "Mr. José Celestino Mutis, Director in Chief of the Nueva Granada's Botanical Expedition, Santa Fe de Bogotá's Royal Astronomer, as a true token of admiration and recognition" (Díaz, 2000, par. 19). Humboldt believed in the free flow of information and in promoting communication across borders and disciplines; his work served not only to illustrate Colombia's immense biodiversity, but also to create a positive image of Colombia in Germany, the root of a historical connection between the two countries that, to this day, continues bearing fruit.

However, scientific development was not a necessity for the Colombian ruling class of the time, whose pre-modern system of production was based on servitude, and therefore did not need science and technology for its subsistence. Only a few members of the elite were trained as doctors, lawyers, or priests (Gallego-Badillo, Gallego-Torres, & Pérez-Miranda, 2010). During the 19th Century, science was not highly regarded in Colombia, and veered mostly towards historiography (Obregón, 1994).

The first public university, Universidad Nacional de los Estados Unidos de Colombia (today Universidad Nacional), was founded in 1868, but as the government put the church in charge of education in 1888, well into the 20th Century Colombia had still not institutionalized a secular and independent academic system. Only by the 1970's thesis works became systematic at Universidad Nacional, and a few researchers began publishing in scientific journals; almost 200 years after science magazines had become

the means for communicating knowledge among specialized groups (Gallego-Badillo et al., 2010). The first formal research-based PhD programs in Colombia were organized in the 1980's, and still today the country lags behind its Latin American counterparts in number of PhD graduates per year, with only 245 in 2011 -considerably below Brazil (12,217), Mexico (4,665), and Argentina (1,680) (Semana, 2014a).

In the 1990's Colombia began to focus on developing its science, technology and innovation system, with the Constitutional Reform of 1991, which declared that the State was responsible for creating incentives so that people and institutions can develop and further science and technology, among other cultural manifestations, and will offer special incentives to those who participate in these endeavors (OECD, 2012). Since then, several departments and institutions have been created to support research, development and innovation in the country. Research became the responsibility of the National Planning Department, and science and technology became part of a national innovation system, which was established under a highly complex institutional framework that includes Colciencias –the Science, Technology and Innovation Administrative Department-, the Regional Commissions of Science and Technology, the Councils of National Programs for Science and Technology, and the Colombian Observatory of Science and Technology.

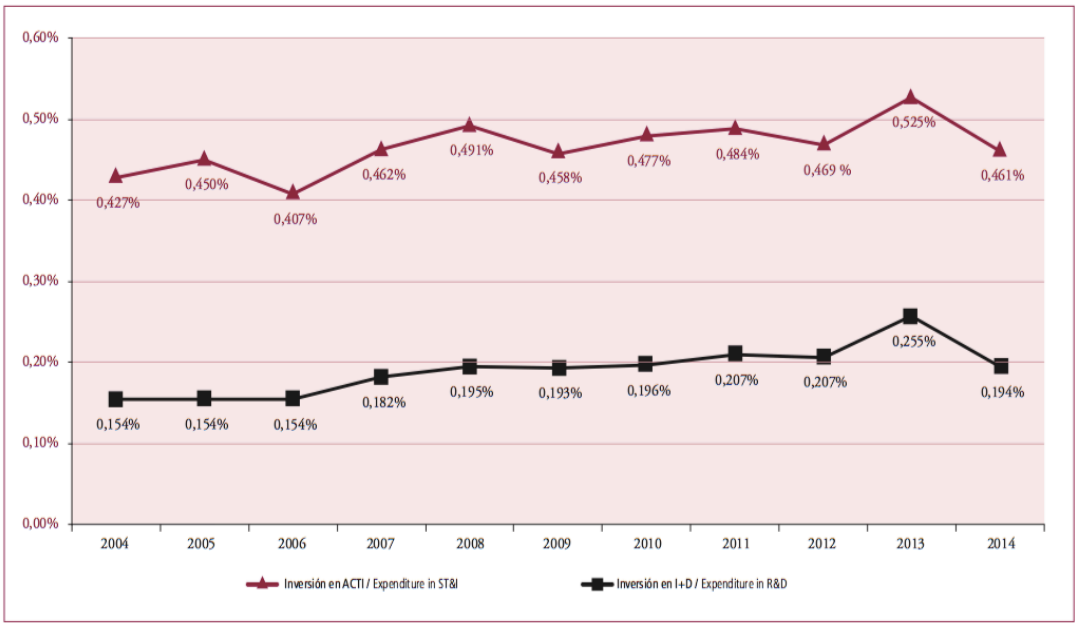
The National Council for Economic and Social Policy (CONPES) issued an official document in 2009 stating that in Colombia there was a very low level of innovation in private companies, the science, technology and innovation system needed institutional consolidation, there were insufficient human resources for research and innovation, and that technological and scientific developments had low social impact. It

also pointed out that there was lack of attention to strategic areas for the long term, and vast regional imbalances in science and technology capabilities. To address said issues, the CONPES document recommended a set of strategies, including the creation of a national fund for science and technology –what today is called the Francisco José de Caldas Fund-, the restructuring of Colciencias, fostering innovation and investment in the productive sector, and increasing public investment in strategic areas with high scientific and technological content (Colombia. Departamento Nacional de Planeación, 2009). The hope was to increase investment on science, technology and innovation (based on percentage of GDP), from 0.47% in 2009 to 2% by 2019, and to have an average of 500 PhD graduates per year. However, current figures show no indication that these goals could be achieved by 2019, as public investment in science, technology and innovation was 0.46% of GDP in 2014 and remained stagnant until 2015. Leaving innovation aside, the figures for investment in research and development (R&D) alone are even more alarming: a mere 0,19% of GDP in 2014 (Observatorio Colombiano de Ciencia y Tecnología, 2014), again behind Brazil, Mexico, Argentina, and Chile, its comparable counterparts. Only 329 PhD students graduated in 2013.

In 2012, the World Bank and the OECD released a report on the state of Colombia's higher education system -including research, development and innovation-, and the results were far from encouraging. It concluded that even though the number of graduate students in Colombia had increased considerably compared to the year 2000, it is still far from what the country and its higher education system need. The report also emphasizes the disconnect between the country's scientific research and its economic activities, where, for the most part, private companies neither invest nor employ

researchers, showing not only deep cultural issues regarding scientists, but more importantly, that since the country's economy is not knowledge-based, investment in science and technology is not considered a fundamental strategy for Colombia's industrial development. In spite of increasing government rhetoric about innovation being one of the five engines of development –the other four are infrastructure, mining, agriculture and construction- only 6% of all new entrepreneurial endeavors in Colombia can be considered innovative. The document even states that, for OECD standards, "research in Colombia is still in a state of underdevelopment" (OECD, 2012, p. 14), where not even Universidad Nacional –with over 44,000 students but only 400 pursuing a PhD- can be considered a true research university.

Fig. 3. Colombian expenditure in scientific, technological and innovation activities –ST&I as percentage of GDP, 2004-2014.



Colombian Observatory of Science and Technology

Fig. 4. Colombian graduates from higher education institutions (IES) by level of education, 2004-2013.

Nivel de formación Level	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Técnica profesional[1] / Technical	5.172	5.277	8.644	10.304	14.933	19.399	19.800	18.948	23.336	19.104	144.917
Tecnológica[1] / Technological	17.999	16.197	16.231	20.869	22.939	25.422	24.975	76.873	87.064	97.282	405.851
Pregrado universitario / Bachelor (B.A. - B.Sc.)	97.754	91.960	91.022	101.867	111.666	117.185	120.679	131.966	152.844	157.985	1.174.928
Especialización / Diploma	23.098	23.814	27.280	34.833	41.562	43.620	55.658	63.072	69.995	59.937	442.869
Maestría / Master's degree	2.281	2.464	3.286	3.488	4.141	4.803	5.935	7.664	10.198	10.453	54.713
Doctorado / PhD	50	48	91	94	139	173	211	276	338	329	1.749
Total graduados / Total graduates	146.354	139.760	146.554	171.455	195.380	210.602	227.258	298.799	343.775	345.090	2.225.027

Colombian Observatory of Science and Technology

The General Royalties System (Sistema General de Regalías) is a program developed to try to increase investment in science and technology, by allocating 10% of the income generated from the country's natural resources to science, technology and innovation projects. Critics argue that because regional governments manage the resources -instead of Colciencias, research institutions or field experts- many of the projects approved so far are not research-related, and therefore the program is not yielding the expected results. Some governors, for instance, have used royalties' funds for projects like improving the quality of elementary school teachers, or updating the Internet and telephone systems in their buildings, which clearly have no scientific content or purpose. Experts calculate that, so far, the total allocated to these ghost projects could be equivalent to Colciencias' current annual budget (Wasserman, 2014). Although the system has funded some legitimate research projects, there is growing concern among the scientific community about poor administration, improvisation, and political corruption threatening to impede the proper allocation of funds.

Another issue of concern is Colciencias -the Science, Technology and Innovation Administrative Department-, whose lack of financial resources, shortage of staff, and political instability has contributed to Colombia's poor scientific development. In 2014,

then director of Colciencias, Paula Arias, was fired for announcing publicly that the annual budget for 2015 -which at the time was only the equivalent to about 120 million dollars- would suffer a drastic 30% reduction compared to 2014. Such cuts would mean shutting down programs to finance doctoral studies for low-income students, one of the Department's main goals. A few hours after she expressed her concern to a scientific conference audience, and the media, the President's office "invited her to quit" (Semana, 2014, par. 1), and denied her statements arguing that she handled the situation poorly, because the document she referred to was not a final draft, and that the budget would actually increase by 0.2%. Regardless of what really happened, for a country committed to use innovation as a driver of development, such a meager increase to an already precarious institution is a worrying sign of the government's lack of regard for science. Paula Arias was Colciencias' fourth director in only four years.

The scientific community, which is mainly concentrated in universities, has complained repeatedly about Colciencias' highly bureaucratic procedures, and a disproportionate low number of staff personnel compared to the current number of Colombian scientists and research groups, which slow down even the most basic processes, like applying for funds or receiving resources (Fog, 2012).

Critics maintain that neither science, nor technology have truly taken off in Colombia, even though they are essential elements that cut across all of the present government's pillars of development (innovation, infrastructure, mining, agriculture and construction), and therefore are vital to the country's progress. Academics and members of the scientific community heavily criticized the preliminary draft of the latest CONPES document on Science, Technology and Innovation Policy, which would guide the sector

from 2015 to 2025. In a letter to Colciencias and the National Planning Department, the country's six major universities expressed their concern over a plan that "falls short of the country's real science and technology needs" (Dinero, 2016, par. 2), and reflects a vision that lacks depth, does not connect innovation and development with scientific research, and moves abruptly to a groundless discourse on competitiveness. In their view, the draft was made to satisfy the OECD science and technology policy recommendations, as one of the current government's main foreign relations goals is to enter the great powers' club. Paradoxically, the document only dedicates two paragraphs to the internationalization of science, stressing its importance without further explaining what strategies will be used for the purpose, and appointing Colciencias and the Ministry of Foreign Relations for their implementation (Colombia. Departamento Nacional de Planeación, 2015).

Under such discouraging circumstances, it is not surprising to find that, in Colombia, there is no science diplomacy policy in place. As former advisor to Universidad de Antioquia's International Relations Office, Diego Franco argues, the internationalization of Colombian science is currently attached to academic rather than government processes, and international cooperation actions are fragmented, dispersed and lack continuity. It is an approach where the lack of articulation between political actors leaves the practice of science diplomacy in the hands of either scientists who act individually, or universities' international relations offices, whose resources are not nearly enough for such challenge (D. Franco, personal communication, April 28, 2016). This is a worrying scenario because not all universities have a formal international relations department, those who have them do not grant them the status of a vice-

presidency, and their budgets are insufficient and negligible compared to other departments. At Universidad de Antioquia -second to Universidad Nacional in number of students, importance and research-, it is calculated that the International Affairs Office receives only 0.25% of the University's total annual budget. In 2014, the Office received $1,162 million pesos (COP) – about 400 thousand dollars calculated at current average exchange rates. Other relatively small departments, like Regionalization, received $23,000 million pesos (COP) –roughly seven million dollars -a vast difference, especially considering that other departments operate with much more. Moreover, only Universidad de Antioquia has recently formalized the position of scientific cooperation advisor, meaning that when it comes to international cooperation activities, Colombian scientists are practically on their own. Even within those that currently aim to become research universities, internationalization is often disregarded and left at the bottom of the list of priorities.

Red Caldas was a failed attempt to argue for the importance of science diplomacy at the government level, and it soon became an isolated internationalization activity that did not generate strategic steps towards political action. Still today, there is no proper system at the ministerial level concerned with science and technology, and no actors guiding the public interactions in international scientific cooperation, a combination of factors that make science diplomacy invisible to the government's eyes.

Science and technology are not among Colombia's foreign relations policy priorities, and that has also contributed to Colombia's isolation from the global processes of scientific integration. The foreign relations focus of the last two presidential periods have revolved around conflict and post-conflict, while maintaining strong links to

dominating agendas like the United States' global war on drugs and terrorism. These objectives have overshadowed other important aspects of development, such as science and technology, impeding the generation of paths towards Colombia's insertion in international dimensions. For instance, the European Union has formal separate science and technology cooperation agreements with Mexico, Chile, Brazil and Argentina, but none with Colombia. Compared to its Latin American counterparts, Colombia had the lowest participation in the European Commission's Seventh Framework Programme, known as FP7, which ran from 2007-2013. While its neighbors increase their international scientific integration, Colombia remains on the sidelines.

Fig. 5. CORDIS – LATAM research projects under FP7 (2007-2013).

Country	**Number of FP7 projects**
Brazil	167
Argentina	86
Mexico	83
Chile	58
Colombia	44

European Union Open Data Portal

Neither has a focus on bilateral relations contributed to the articulation of a foreign relations policy for science and technology. Since the country does not have a clear projection for science and technology, much less for their internationalization, it does not take them into consideration when developing bilateral relations strategies. Most developed nations create multilateral regional spaces for science collaboration, such as U.S.' *100 Thousand Strong in the Americas*, Germany's DAAD's programs, or EU-

CELAC, in which Colombia is still weak compared to its Latin American equivalents, so its participation is still limited.

Under Law 1286 of 2009, Colciencias' status was raised, moving from Institute for the Development of Science and Technology to become one of the President's Office administrative departments. However, the change did not put Colciencias at the ministerial level, so after more than forty years of existence, its political influence and resources remain limited. Research institutes like the Alexander von Humboldt Biological Resources Research Institute, the Institute of Hydrology, Meteorology and Environmental Studies of Colombia (IDEAM), the Colombian Geological Survey (previously INGEOMINAS), and the Agustín Codazzi Geographic Institute (IGAC), are affiliated to some ministries, but they also suffer from lack of funding, their influence is limited to an advisory role, and they are not articulated under an umbrella science and technology system.

Evidently, science is still not a priority for the Colombian government. This lack of connection with science could be partly explained by the fact that, in Colombia, most political leaders do not have graduate studies, and in many cases, not even a bachelor's degree. A 2013 study showed that within the legislative power, the departmental assemblies, and even the executive branch, less than 5% of representatives have doctoral studies; within the private sector, the percentage is only 10% (Caracol Radio, 2013). Most recently, both the former and current mayors of Bogota, the capital city, were under public scrutiny for having lied for years about their academic qualifications; several journalists' investigations discovered that they had claimed to have PhD's when in reality, they had not completed any formal graduate studies (Torres, 2016).

Colombian policymakers have not understood that science must be fully integrated into the political system as a mutually beneficial relation: science is key to solving many of the issues that a country, and therefore its politicians face, and researchers need the support of the government in order to properly develop science.

International scientific cooperation often requires matching funds that Colombian scientists are seldom able to finance on their own, and since Colombia is now categorized as a mid-income country, wealthier nations are no longer in a position to provide all of the resources needed for joint research projects. As one author stated, in science "even simply the perception of the absence of funding can impede international collaborative efforts" (Hollander, 2015, par. 13). With the scarce public resources allocated to science in Colombia, it is very difficult for Colombian researchers to match funds from developed nations, or even from regional neighbors like Mexico or Brazil.

Within the private sector, integrating research and development, innovation and competitiveness, is a luxury reserved mostly for big, multilatina enterprises, of which there are only 80 companies in Colombia (Dinero, 2015). The vast majority are small and medium enterprises -between 90% and 99%-, of which only 20% make it past the third year of creation, most are family and subsistence businesses disconnected from science, technology and innovation (Pérez-Uribe & Ramírez, 2015), and heavily fraught with government taxes that leave no room for investment in research and development. So much so that in 2015, the OECD released a report on Colombia's tax system urging the government to ease the burden on companies (Perret & Brys, 2012), as the "current tax policies are inefficient and regressive (…), discourage investment and job creation, and limit access to financial services" (Bristow, 2015, par. 2). In addition, there is a tradition

of mistrust of academia among Colombian SMEs owners that hinder the creation of strategic alliances, which could be the answer to their innovation needs.

Added together, the lack of articulation between actors, where universities' international relations offices, and scientists themselves, carry the responsibility of achieving international cooperation; a short term vision of science internationalization programs that are not properly evaluated and therefore do not generate lessons for the future; the government's lack of concern for science, and its inability to establish a governance system in science and technology; a foreign policy focused on presidential political agendas of either trade, conflict or post conflict; and the lack of funding both from the public and the private sector, make for a difficult scenario for the development of a science diplomacy policy in Colombia.

Nonetheless, there are examples that closely resemble science diplomacy activities, like the ones led by the Colombian Embassy in Berlin, which have been successful both in using diplomacy to promote science, and in using science as a tool for diplomacy.

Chapter VII:

The Max Planck Society in Colombia

Last year, an unprecedented science cooperation agreement was signed between Colombia's major public universities –Universidad Nacional (Bogota) and Universidad de Antioquia (Medellin)-, Colciencias, and Germany's Max Planck Society for the Advancement of Science. The agreement is unprecedented for a number of reasons. First, because no university or research organization in Colombia has had a formal collaborative agreement with an institution as prominent as Max Planck, one of the world's leading societies in basic research, home to 33 Nobel Prize winners and 83 research institutes throughout Germany. Second, because neither Colciencias, nor Universidad Nacional or Antioquia, had ever before made an investment of this sort for international cooperation. In total, the three institutions will spend $20,000 million pesos (COP) -about USD$6.5 million[4]- $10,000 (COP) from Colciencias and $5,000 (COP) each from Nacional and Antioquia, over an initial five-year period. This sum might seem insignificant compared to developed countries' standards, but for Colombia it is a very important investment. Third, and most importantly for the purpose of this thesis, is that it was the initiative of a Colombian ambassador and his team in Berlin that made such an agreement possible.

[4] The Colombian peso (COP) has devaluated significantly over the last two years and fluctuates from one week to the next. At the time of this research the exchange rate was US$1 = COP $3,150.

Developed to create six tandem research groups -three on tropical and infectious diseases, and three on biotechnology of natural products-, the agreement was signed after years of studying the German science, technology and innovation system, and intense lobbying efforts on the part of Colombian Ambassador to Germany Juan Mayr Maldonado, former Environment Minister and firm believer in the role that science plays in development. Along with his foreign officers, which contrary to most Colombian embassies include a Science and Technology Secretary, Ambassador Mayr saw the opportunity to take Colombia and Germany's historic connection to the next level.

For decades, even when incoming student mobility to Colombia was at its lowest due to the country's political situation, German students have been doing exchange semesters, research internships, and scientific collaboration with their Colombian counterparts. Today, Germany remains one of the top European countries to send people to Colombia for academic and scientific purposes. Climate change also played a role, as concerns over infectious and tropical diseases reaching southern Europe due to rising temperatures became a reality, and the Max Planck Society began looking to formalize partnerships with strategic players in the field. Both Universidad Nacional and Universidad de Antioquia showed an interest in pursuing a deal with the research giant, and Colciencias followed suit. Moreover, Colombia's improvements in the last decade and its positive macroeconomic environment made it an attractive partner for a country like Germany, whose science diplomacy approach emphasizes "fostering innovation, improving global competitiveness, and promoting German higher education and science abroad, especially in those countries and regions that show strong developmental dynamics and economic growth" (Flink & Schreiterer, 2010, p. 673).

After months of conversations and exchanges between scientists from the institutions involved, and with the unconditional support of Ambassador Mayr, former Max Planck President, Dr. Peter Gruss, was invited to do a presentation during Universidad de Antioquia's program *From Country to Country, Germany 2013,* an internationalization-at-home strategy that every year brings scholars and scientists from a guest country, to meet with their peers in Medellin. Dr. Gruss' talk titled *Why basic research is important for development* used compelling figures to illustrate the strong correlation between a country's investment in basic research and its economic and social development, and stressed the importance of supporting the humanities and the social sciences. But Dr. Gruss' lecture was only part of the agenda, for the visit served as the opportunity to meet with leading researchers, universities' top management, and representatives of the government and the private sector. He also took the time to carefully review the universities' scientific infrastructure, and to discuss possibilities for collaboration. It is worth mentioning that Dr. Gruss and his team were pleasantly surprised to witness Medellin's transformation, from a city that only fifteen years ago was burdened with such violence that few foreigners dared to visit, to a thriving example of South American development; in 2013, Medellin was awarded the Veronica Rudge Green Prize in Urban Design by the Harvard Graduate School of Design, for one of its urban development and integration projects (Harvard University, 2013). The success of his visit, given that Dr. Gruss is also a close advisor to German Chancellor Angela Merkel's government, is a good example of how science can contribute to diplomacy by helping improve a country's reputation abroad, providing positive visibility and long-term collaboration possibilities.

During the following year, Ambassador Mayr continued working with Max Planck, Colciencias, and the two universities to draft an agreement that was finally approved and signed in March 2015. Six tandem research groups are being created, three on tropical and infectious diseases at Universidad de Antioquia, and three on biotechnology of natural products at Universidad Nacional. The groups will be led by top researchers in each field, who were chosen late last year under rigorous criteria, and an even more demanding selection process following Max Planck's models. Members of the Colombian selection committee, like Universidad de Antioquia's Vice-Rector for research, Dr. Patricia Arbelaez, were impressed with the rigor of the process, which showed from the start that collaborating with Max Planck would very likely elevate the scientific standards of its partners. The response to the call for group leaders, which was posted in Science and Nature magazines, was a sign that Colombia's scientific diaspora is still eager to find the right opportunity to return to the country, as many prominent Colombian scientists, who were working in prestigious research organizations around the world, applied for the job. Not surprisingly, and for the relief of some skeptic Colombian researchers who dreaded the possibility of having only foreigners lead the groups, most of the selected leaders are Colombian, and in the case of Universidad de Antioquia, two of them are actually undergraduate alumni. The groups will be composed of researchers from Max Planck and both universities, and will be open to collaborate with experts from other universities and research centers in the country. The funds are currently in Colciencias' Francisco José de Caldas Fund -the national fund for the financing of science, technology and innovation-, and will be transferred to a logistics operator, who will manage the resources.

The agreement has had its detractors, mainly Colombian-based researchers who think that such an investment for international collaboration is outrageous, especially when funding for national projects is so limited, and Max Planck is not contributing with fresh resources. Others argue that Germany only wants to take advantage of Colombia's natural resources and experience in tropical diseases, based on misconceptions and distrust of developed nations that are deeply rooted in Colombia's culture due first to Spanish colonization, and more recently to U.S. intervention in South America. Moreover, some Colombian scientists with decades of experience in their fields were offended by some of Max Planck requirements, which included that group leaders had to be under 35 years old, and have vast international experience.

Nonetheless, those in favor believe that agreements of this sort are needed so that Colombia starts making serious investments in science, especially to support relations with partners that would significantly improve its scientific standards, and contribute to expand and improve specialized networks. As Ambassador Mayr expressed in an interview at his office in Berlin, "if Colombia wants to be truly competitive in international markets and elevate the quality of life of all its citizens, we must become a knowledge-based society. That is how Germany recovered from two World Wars, and that is how Colombia should approach its post-conflict scenario" (J. Mayr, personal communication, November 07, 2014). Time will tell whether partnering with Max Planck was a good decision in terms of scientific production and development for Colombia, but so far, achieving a partnership with such a prestigious institution demonstrates the importance of having diplomatic bodies dedicated to foster science and technology collaboration.

Ambassador Mayr has also been involved in the coordination of several meetings between Germany's highest science and technology authorities and institutions, including the Fraunhofer Society, the German Research Foundation (DFG), the Vice-Minister for Education and Research, and technical consultations in Berlin to explore possibilities for cooperation. The hope is that these initiatives will foster a solid and continuing relationship between Colombia and Germany. However, since they are derived from the will of an individual actor with the capacity to turn his vision into international relations transactions, a subjective interest and not a concerted effort between actors in a system, it is too soon to tell if this is the beginning of a new horizon for Colombia's science diplomacy, or whether the momentum that Ambassador Mayr has achieved will fade when his time in office ends.

Ambassador Mayr continues working to promote science advice and science diplomacy. He has been invited to speak at the European Union's International Network for Government Science Advice's second world conference on science and policy making, which will take place on September 2016. His talk will be tilted *What is required to build capacity for science advice in developing countries?*

Chapter VIII:

Recommendations

Countries like Colombia, with great scientific potential, vast natural resources and talented human capital, must understand that science is crucial for development, and that in the information era, international cooperation is crucial for scientific advancement. Colombia lags considerably behind the United States in terms of science diplomacy policy and practice, even though the latter still needs to implement more comprehensive and financially sound policies. Therefore, and as Colombia faces a potential post-conflict scenario, and the opportunity to enter into a new phase of development, foreign policy to support science diplomacy is more urgent than ever.

The following policy recommendations stem from the comparison with the United States science diplomacy policies and practice, and are grouped in the five areas which should be addressed in order to develop public policy in Colombia: (a) financial, (b) regulation, (c) institutions, (d) technical (in this case training and education), and (e) civil society and governance.

Financial

First and foremost, Colombia must increase public investment in science. This is not a new concept. Time and again, experts from different organizations around the world[5] have met with Colombian government officials to illustrate the direct correlation between investment in science, and a country's economic and social development, and to reiterate the importance of a solid science, technology and innovation system, if Colombia truly aspires to use innovation as an engine of development. In its 2014 Review of Innovation Policy for Colombia, the OECD was also clear in its recommendations; the total public budget for STI activities (both normal and royalties-derived) should be increased to match those of other emerging economies that have sought to reach OECD levels (OECD, 2014).

The government should also engage the private sector so that they invest in research and development. So far there are only tax incentives to invest in science, which most companies do not take advantage of. Innovation is a highly uncertain endeavor that requires capital risk investment, a concept that wealthy countries have understood for centuries, but that has proven difficult for Colombian private industries to assimilate.

Regarding royalties, Colombia should modify its current policy to allow qualified universities and research centers to manage those resources -instead of governor's offices- so that they can allocate them according to real scientific needs and standards.

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[5] During his visit in 2014, former Max Planck Society president Peter Gruss, spoke directly to Colombian President Juan Manuel Santos about the urgency to increase investment in both basic and applied sciences. In 2015, officials from the German Research Foundation (DFG) also met with the government and Colciencias to insist on the need for Colombia to invest more in science. Other examples include delegates from the New Zealand government, Purdue University, and the University of Groningen from Holland.

Additionally, a percentage of those royalties' funds should be dedicated specifically to international scientific cooperation efforts.

No diplomatic effort from the Ministry of Foreign Relations will produce meaningful results if Colombian scientists do not have the financial support needed to substantiate their collaboration with international partners, particularly those from developed countries.

Regulation

The Ministry of Foreign Relations should design and implement a policy to support the internationalization of Colombia's science, technology and innovation efforts, and give more importance to science as an instrument to increase and improve the country's participation in the international arena. Science cuts across many of the objectives of the current National Planning Department's Development Plan (2014-2018), such as education, peace building, infrastructure and strategic competitiveness, innovation, rural transformation and green growth, and therefore should be central to the work of the Ministries involved in those issues. Moreover, in today's globalization era, international cooperation is fundamental for the advancement of science, making the Ministry of Foreign Relations' involvement more crucial than ever. At the same time, Colombia's scientific potential can serve the Ministry's objectives of agenda diversification, and of positioning Colombia in global and multilateral scenarios, where transnational issues like tropical and infectious diseases -where Colombia is already leading player- are becoming increasingly important. Examples like the agreement with the Max Planck Society – as well as other opportunities with prominent German

institutions-, which have been spearheaded by the Colombian Embassy in Berlin, demonstrate that foreign officers working to promote science can achieve great results.

Such policy should include the appointment of a Science Advisor to guide the ministry's staff in the identification of potential agreements and international cooperation opportunities for Colombian scientists, ensuring their proper implementation, and to provide expert advice on science and technology matters, using the resources available among Colombia's scientific community when needed. The Science Advisor should ensure that the Ministry gives proper consideration to the scientific aspects of issues and policy formulation, and to seize opportunities to increase Colombia's active participation in the discussion of transnational matters related to science.

Science advisors should also be assigned to embassies in countries where Colombia would have the best opportunities to advance its scientific capacity through cooperation, as well as in those where Colombian scientists' expertise could contribute to solving global challenges.

Institutions

Colombian universities and research centers should intensify their international relations efforts beyond student mobility. For example, international affairs offices at universities should create the position of Scientific Cooperation Advisor to support all efforts related to connecting researchers with their peers abroad, look for opportunities for PhD research internships, and develop and maintain scientific cooperation agreements, among others. So far, only Universidad de Antioquia has appointed someone for the role. International affairs offices should be given the status of a vice-rectory, so

that they have more visibility and influence on the universities' decisions, and more resources to invest on international cooperation activities.

Universities should also work actively with embassies and foreign officers locally and abroad. Universidad de Antioquia for example has implemented a rapprochement strategy with embassies and consulates in Colombia, and abroad that has yielded positive results like the Max Planck Society agreement, which came about thanks to the concerted work of the university and the Colombian Embassy in Germany.

Universities should also offer more attractive opportunities to international researchers; just the same way that they expect wealthy countries to offer them to Colombian scientists. For instance, universities in Colombia do not offer foreigners full scholarships for PhD studies, which means they are missing great opportunities to develop solid and lasting relations with other institutions, and the opportunity to gain access into international networks.

The Ministry of Foreign Relations should work closely with Colombian universities and research centers, so that the Ministry can capitalize on their soft power potential. Since, compared to developed nations, the country has neither economic nor military power to achieve its desired outcomes globally, it should use soft power resources like universities more assertively.

Colciencias should be given the status of a science ministry. Learning from the experience of the United States, where lack of a science ministry causes disarticulation among the different agencies, Colombia should concentrate its scientific endeavors in one unit, and give it sufficient funds to propel the country's science, technology and

innovation system. In turn, said ministry should work more closely with the Ministry of Foreign Relations in the development of a science diplomacy policy.

Training and education

Colombian Foreign Service officers should acquire at least a minimum knowledge of science, technology and innovation issues relevant to Colombia's development goals and foreign policy. To that end, the Academia Diplomática de San Carlos (San Carlos Diplomacy Academy) should include science courses in its curriculum. The academy should also include short courses, seminars and conferences around these subjects, so that Foreign Service officers who have already finished their training can also acquire and improve their scientific literacy. The Ministry of Foreign Relations should also establish promotion and professional incentives to those who attend such courses.

Civil society and governance

Just as Colombian Foreign Service officers need to gain basic literacy in science and technology issues, Colombian scientists also need to engage in diplomacy to contribute both to their fields of work and to Colombia's promotion and visibility abroad. Most scientists do not think that their work can go hand in hand with that of diplomats or politicians, but the experience of the United States' Office of the Science and Technology Adviser to the Secretary of State (STAS) proves that nowadays, scientists are valuable

assets in international affairs[6]. To that end, the Diplomacy Academy should also offer training in diplomacy to Colombian researchers.

[6] Other examples include Dr. Ann Glover, the first Chief Scientific Adviser to the President of the European Commission, and her team.

Chapter IX:

Conclusion

Even in a country as technologically and scientifically advanced, as globalized and open as the United States, its science diplomacy policies still face challenges. Much has been accomplished since the turn of the century, when former Secretary of State Madeleine Albright and the National Research Council helped convinced the U.S. government that "in a world being transformed by science, good science is one of the tools most vital to good diplomacy" (Kirk, 2000, p. 10). The position of science and technology adviser to the U.S. Secretary of State, along with its supporting staff, the Office of the Science and Technology Adviser (STAS), were created, and several programs have been launched to improve the Department's response to the increasingly important role that science and technology play in the country's foreign policy objectives. However, further attempts to enact legislation that would increase U.S. efforts in science diplomacy, such as the International Science and Technology Cooperation Act, have failed to pass, limiting the political and financial capabilities needed to develop a more advanced and coherent science diplomacy policy; one that would integrate the needs of the different agencies whose activities involve science and technology, and enhance the State Department's role in global science policy.

Colombia is nowhere near what the United States has accomplished in terms of using diplomacy to support the internationalization of science, or in using science as an

instrument of diplomacy. With the cooperation agreement signed between the Max Planck Society, and Colombia's two major public universities, the Colombian Embassy in Germany has shown that when science becomes part of the Foreign Service's objectives, it can achieve much more than what scientists and universities alone could do when it comes to diplomacy and international scientific cooperation. Nonetheless, this was an individual action, a particular initiative derived of a diplomat's interests, but not part of a systematic, concerted political effort towards the development of a policy that would integrate science with the country's foreign relations agenda.

Until now, science diplomacy in Colombia has been characterized by discontinuous actions planned for the short term; fragmented initiatives, which have hardly left any lessons for the future. But how can a country rely on its science as an instrument of diplomacy, when international observers like the OECD still consider its science, technology and innovation system to be in a state of underdevelopment (OECD, 2012)? That is not to say that Colombian scientists are not capable or talented enough to collaborate with their peers in developed countries, in fact many of them already do -mostly through their own resources-, and are taking leading roles in transnational issues like research on degenerative, tropical and infectious diseases, to name just a few. What the OECD's statement reflects is that Colombia's science, technology and innovation system is incipient, lacks political relevance, government commitment, and proper financial backing both from the public and the private sectors. Against that background, foreign policy makers have overlooked the fact that science can be instrumental in achieving the country's foreign policy goals, even when they are narrowed by either the

dominant international agenda, or by the president's focus on trade, conflict or post-conflict objectives.

It is clear that "science diplomacy is not a panacea for all inter-state relations" (Hollander, 2015, par. 7) nor is it intended to be as it does not solve major violent conflicts, or fix heavily strained relations between rival nations. But countries around the world have found ways in which science diplomacy can serve their interests, be it as a public diplomacy tool of soft power, to improve their science and technology capacities, support their special interests and trade objectives, solve common global challenges, or as a way to gather the resources necessary for large scientific endeavors.

As Colombia faces a prospective post-conflict scenario of development, it would be wise for the government to follow the example of successful industrialized nations, which have and continue using science as a pillar of social development, economic growth and competitiveness, and to articulate and implement a concerted science diplomacy policy that could help the country overcome decades of international relegation, while contributing to develop its scientific potential through international cooperation.

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