Nature and Culture in Nineteenth-Century Mexico:

The *Sociedad Mexicana de Historia Natural* (1868–1914)

By

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Submitted to the graduate degree program in History and the Graduate Faculty of the University of Kansas in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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Date Defended: October 20, 2014

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Date approved: October 20, 2014

Abstract

This dissertation centers on the place natural history occupied in Mexican science and the ideas of the members of the Sociedad Mexicana de Historia Natural (SMHN). I propose that between 1865 and 1914, Mexican intellectuals who joined the Sociedad Mexicana de Historia Natural or participated on its margins, maintained a traditional, teleological understanding about the close links between the natural and social world. However, in this period they also embraced the use of scientific inquiry to enhance their understanding of the natural world in order to guide the country toward order and progress, similar to that enjoyed by other Western societies, especially France and the US. Influenced by Humboldt, Comte, Lamarck, and Spencer, Mexican scientists encouraged the study of natural history, believing that there was a strong and reciprocal relationship between the natural and social world. Mexican scientists had clear goals for this research: First, to learn how nature worked in order to maintain an equilibrium in the use of natural resources. Second, natural history could provide knowledge of how to use natural resources (flora, fauna, minerals), as well as improve the environment (climate, soil, air, water, geography) and the Mexican people (race, public health), which scientists believed would help to construct a modern and progressive country. Indeed, according to SMHN scientists, nature played a key role in the economic and social development of the country. For them, knowledge of the natural world would allow them to construct a progressive, civilized, and modern country similar to other powerful Western nations. In this vein, this dissertation examines what SMHN scientists thought about natural history and the management of resources to improve the country's economy and public good during the period from 1865 to 1914. This period is relevant because it constituted a turning point in the study of natural history in Mexico, linked to a long period of

stable, authoritarian government known as the Porfiriato, the most important formative period of industrial expansionism in Mexico, increasing international investment in mining and railroads, a rise in agricultural exports, and other endeavors with a massive impact on the natural world.

Acknowledgements

Many people and institutions significantly aided in the completion of this dissertation—far more than I can address in these brief pages. I feel a profound gratitude toward all of my mentors at the University of Kansas, but especially toward the five who honored me by guiding me through this process: Gregory T. Cushman, Santa Arias, Sara Gregg, Luis Corteguera, and Robert Schwaller. Each of you shared your experiences, comprehension, and encouragement, which ultimately allowed me to finish this project. My heartfelt thanks for helping me to understand Latin America from a different perspective. I would also like to thank other faculty members for their comments, especially Marisol Cortez and Andrew Townsend Peterson.

Significant to my success were also a number of fellowships and grants. My graduate courses were supported by the *Programa de Mejoramiento al Profesorado* (PROMEP) from the Universidad Autónoma de San Luis Potosí, Mexico. In 2012, I received the Robert and Andrea Oppenheimer Award from Department of History of The University of Kansas—it facilitated summer research at the Nettie Lee Benson Library of the University of Texas at Austin. The Stansifer Fellowship Fund for 2013–2014 supported my archival research in several Mexican cities.

Thank you Olivia Islas, and Liliana and José de Jesús Izaguirre for your valuable time contributing to archival research and designing the graphics in my dissertation. I also must give thanks to Cielo Orozco and the staff of the *Enrique Beltrán Collection* of the *Biblioteca Pública "Juan José Arreola" del Estado de Jalisco*, Mexico, and Carmen Serna for the warm hospitality I received while conducting archival research in Zapopan, Jalisco. I must also extend my gratitude to Miguel Aguilar Robledo; thank you for trusting me and guiding me in my professional career.

During my four years in Lawrence, Kansas, I came to know excellent human beings, whose solidarity and camaraderie eased any anxiety I may have felt as a visitor from another country: Irene Olivares, Ximena Sevilla, Miwa Itto, Mu Ciao, Claire Marie Wolnisty, Jacki Smith, Allison Schmidt, Mónica Torrices, George Klaeren, Ricardo de la Torre, Sergio Baños, and the entire Environmental History team. I hope that I may someday reciprocate the hospitality of Gregory Cushman and Santa Arias who opened their home to me and, more importantly, included me in their family activities—thank you for adding a personal touch to my time in Lawrence. In this vein, I particularly wish to mention Marta Vicente and Luis Corteguera whose hospitality and goodness got me through some stressful moments—without your friendship, these four years in Lawrence would have been difficult.

Back home in Mexico my friends Socorro Carrizales, Anuschka von't Hooft, and Julio Serrano were and are my spiritual crutch; thank you for all the times you called, emailed, and texted me—doing so narrowed the distance between us.

I owe much to my family for their unending supply of emotional support, which was essential in helping me to achieve my goals. Thank you to my sisters Isabel and Angelica, my brother Arturo, my nephew Humberto, my sister-in-law María Luisa, and my brothers-in-law Javier and Juan Antonio for your continuous encouragement and care.

Lastly, I dedicate this dissertation to my parents. It is a tribute to my mother who taught me that a woman can achieve her dreams, even while living in a patriarchal society, and to my father who taught me to seek my own answers to questions in History.

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Introduction

> *Studies on animals' habits are very important because they show us the wonderful resources that nature displays in order to hold organized beings in equilibrium [that is] essential to their existence ….[Those studies] teach us not to oppose nature's laws [and] not to overlap individual interests to nature´s laws, [because individual interests could] lead us to remove everything that does not seem directly useful and radically modify the order and proportions of beings.*[1]

In 1870, Manuel M. Villada, Antonio Peñafiel, and Jesús Sánchez wrote the article "Aves del Valle de México" ("Birds from the Valley of Mexico"), which focused on how humans used birds over time. The authors described how, from antiquity, Mexicans have consumed bird meat and their eggs and decorated luxurious coats, *penachos* (head bands), and crafts with their feathers; they also highlighted that birds offered "pleasure and gave happiness."[2] (Fig.1). Another scholar, Alfonso Herrera, recognized that even birds of prey were relevant to humans because they devour rodents and poisonous reptiles. In fact, Herrera stated that birds of prey, such as buzzards, did much to aid humans—during the last Mexican and French war, birds of prey had heralded the presence of humans, thus influencing the war effort. At one point during the war, the author explained, a general had tied a white ribbon around a buzzard's neck. Soldiers realized that the bird followed troops during their battles and were, thus, warned of the presence of their enemy.[3]

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[1] Manuel Villada, "Apuntes para la mamología mexicana" [Notes on Mexican Mammalian Studies], *La Naturaleza* I, 1a. Serie (1870): 290.

[2] Manuel Villada, Antonio Peñafiel, and Jesús Sánchez, "Aves del Valle de México" [Birds of Valley of Mexico], *La Naturaleza* I, 1a. Serie (1870): 97.

[3] Alfonso Herrera, "Fauna indígena" [Indigenous Fauna], *La Naturaleza* I, 1a. Serie (1870): 51.

Figure 1. Map of the Mexican Republic and the Valley of Mexico.
(Map by María Gabriela Torres and Jesús Izaguirre)

Meanwhile another scientist, Antonio del Castillo, stated that studies of nature were important because they increased national and international scientific knowledge and bolstered the country's prosperity. For him, studies on mineralogy were particularly valuable because mining was the elementary "force and power of Mexico," and it had to be protected from foreign intervention.[4] Although these scientists underscored the usefulness of nature, they also stated the necessity of understanding the laws of the natural world in order to maintain its state of

[4] Ibid., 4.

equilibrium and they suggested that the balanced use of resources could turn Mexico in a progressive country.[5]

Looking more broadly at modern history, studies of natural history have allowed science and society to understand "the system-builders, and their imaginative connections between species and across disciplines [and] to understand the importance of each plant, tree, animal, mountain, and river in the broader scheme of things."[6] However, knowledge of the natural world has been linked to economic, political, and cultural realms in Western history. Since the sixteenth century, the American continent has dealt with the ecological and social ramifications of colonial rule and exploitation. During the early nineteenth century, after gaining independence from Spain, a number of new Latin American countries entered into the world of free trade and fed off the economic expansionism of Western Europe and the United States. As a result, scientists, politicians, businessmen, travelers, and religious organizations increased their visits to these new nation-states.[7] Many Latin American countries, such as Mexico, had the additional challenge of reconstructing their country after more than sixty years of civil wars and international interventions. Several times these visitors advertised Mexico as a place of untapped resources and rife with opportunities regarding Western countries' expansionist plans.[8] Nevertheless, Latin American governments, scientists, and economic elites "were much more

[5] Manuel Villada, "Apuntes para la mamología mexicana" [Notes on Mexican Mammalian Studies], 291.

[6] Richard W. Judd, "A 'Wonderfull Order and Balance': Natural History and the Beginnings of Forest Conservation in America, 1730–1830," *Environmental History* no. 11 (2006).

[7] Tulio Halperín Donghi, *Historia contemporánea de América Latina* [*Contemporary History of Latin America*], 3. ed., El Libro de bolsillo 192: Sección Humanidades (Madrid: Alianza Editorial, 1975); A. Charles Hale, "Political and Social Ideas, 1830–1930," in *Bibliographical Essays*, ed. Leslie Bethell (Cambridge: Cambridge University Press, 1995).

[8] Matthew Frye Jacobson, *Barbarian Virtues: the United States Encounters Foreign Peoples at Home* (New York: Hill and Wang, 2000).

than simple marionettes set to dance [for] overseas commands and demands."[9] From Mexico's perspective, they viewed the United States and France as nations that could contribute to Mexico's development of science and infrastructure through investment, loans, institutional agreements, immigration, and models of democratic governance.

During the nineteenth century, intellectuals turned to scientific knowledge, especially to natural history, in search of patterns and to establish laws in order to guide their country toward order and progress—emulating their European and North American counterparts, especially France and the United States. One example of these intellectuals was a group of more than sixty-six men who comprised the *Sociedad Mexicana de Historia Natural* (SMHN) from 1868 to 1914. As physicians, engineers, chemists, and botanists, they recognized the wealth of the natural world and believed that a better understanding of the relationship between nature, geography, and society was the key to Mexican development. Although they individually wrote about their explorations and findings, they decided that the association should publish the natural history findings of its members in a periodical or wide dissemination in order to inform the public on scientific advances. Thus, between 1869 and 1914, the SMHN published the journal *La Naturaleza* (*Nature*).

This dissertation is a close study of the SMHN as a group of men linked by their interest in scientific knowledge, who worried about lack of understanding of natural forces and their relationship with society during the formative industrial period in Mexico. In the process, it explores nature's role in the social and economic development of Mexico, while considering the space that natural history occupied in Mexican science and intellectual life in the second half of

[9] Steven Topik, Carlos Marichal, and Zephyr Frank, *From Silver to Cocaine: Latin American Commodity Chains and the Building of the World Economy, 1500–2000* (Durham: Duke University Press, 2006), 3.

the nineteenth century, and it analyzes the geographical and social thought of the members of the SMHN. This study is a rediscovery of the motivations of these scientists, and their contributions to the development of the state. It also looks for answer to these questions by examining *La Naturaleza*, the journal published by the SMHN from 1869 to 1914. I propose that between 1865 and 1914, Mexican intellectuals who joined the Sociedad Mexicana de Historia Natural or participated on its margins, maintained a traditional, teleological understanding about the close links between the natural and social world. However, in this period they also embraced the use of scientific inquiry to enhance their understanding of the natural world in order to guide the country toward order and progress, similar to that enjoyed by other Western societies, especially France and the US Influenced by *Naturphilosophie* of Humboldt, the positivism of Comte, the evolutionary ideas of Lamarck and Spencer, and Darwin's theory Mexican scientists encouraged the study of natural history, believing that there was a strong and reciprocal relationship between the natural and social world.

Nature and Society in Mexican Thought

The relationship between nature and humans has occupied a central place in intellectual, economic, and social life in Latin America countries, specifically in Mexico, since the pre-Columbian period. Early European chroniclers and historians were surprised at how indigenous people related to the natural world, and amazed at their rich knowledge about plants, animals, and other resources—particularly, their classification and use of medicinal plants. During the early colonial period, priests—because of their ties to medieval scientific knowledge and close relationship with native people—played a key role in introducing and developing scientific study in the Americas. For example, a number of friars, such as Jesuit José de Acosta, examined the geography, nature, and native cultures in Spain's American colonies. Years later, royal

authorities added to priests' interest in natural history, and they wrote a number of detailed chronicles about flora, fauna, minerals, and indigenous people.[10]

Concomitantly, the Spanish crown held an interest in cataloging natural resources from its colonies throughout the centuries because doing so had important ramifications for a range of economic and political issues. Consequently, Spanish authorities supported natural research in fields such as botany. Philip II designated physician Francisco Hernández to study the plants and animals of New Spain. For seven years, he carried out a comprehensive survey: "the first wide work, encyclopedic, rigorous, and methodical […] according to contemporary European rules."[11] In addition, colonial officials funded botanical expeditions to learn more about Mexican and Peruvian flora, and they eventually established a botanical garden in Mexico City.[12] Geographical expeditions and surveys were frequently conducted during the Spanish colonial period, peaking during the late sixteenth and late eighteenth centuries.

In Western Europe during the late seventeenth and eighteenth centuries, the study of living beings became more closely linked to concerns about nature being a divine creation and increasing one's "passion for science," which encouraged the cultivation of knowledge of the natural world and its relationship with humans.[13] For instance, natural historians and

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[10] José de Acosta, *Historia Natural y Moral de las Indias: en que se tratan las cosas notables del cielo, y elementos, metales, plantas, y animales dellas: y los ritos, y ceremonias, leyes, y gobierno, y guerras de los Indios* [*Natural and Moral History from the Indies: about notable things from sky and metal, vegetal, and animal elements, and rituals, and ceremonies, laws, and government, and wars of indigenous people*] (México: Fondo de Cultura Económica, 2006); Bernardino de Sahagún, *Historia General de las Cosas de la Nueva España* [*General History of the Things of New Spain*] (Porrúa, 2005).

[11] Elías Trabulse, *Historia de la ciencia en México: estudios y textos. Siglo XVIII* [*History of science in Mexico: studies and texts. The Eighteenth Century*], 1a ed., 5 vols., vol. 3 (México, D.F.: Conacyt: Fondo de Cultura Económica, 1983), 46.

[12] Lucas Alamán, *Historia de Méjico desde los primeros movimientos que prepararon su independencia en el año de 1808, hasta la época presente* [*History of Mexico from First Movements Toward it Independence in 1808 to Present Epoch*] 5 vols., vol. 1 (Méjico: Impr. de J. M. Lara, 1849), 81.

[13] Clarence J. Glacken, "Changing Ideas of the Habitable World," in *Man's Role in Changing the Face on the Earth*, ed. William L. Thomas (Chicago: University of Chicago, 1956).

philosophers such as George-Louis Leclerc, the Comte de Buffon; Corneluis De Pauw; James Robertson; and Guillaume Thomas Raynal stated that the differences in soil, humidity, and climate between the Old and New World had determined the physical and moral characteristics of their inhabitants. They emphasized that the inhabitants as well as the flora, fauna, and soil of the New World were inferior to those of Europe because people were weaker and smaller than those of the Old. Likewise, they argued that natives societies were primitive and savage and that their "population [was] insufficient to develop the arts."[14] European opinions about the inferiority of the native inhabitants of the Americas inspired a number of men born in the Americas (Creoles) to reject those arguments and to prove themselves equal to Europeans. Jesuit priests such as Francisco Javier Clavijero, Giuseppe Jolis, Juan Ignacio de Molina, and Juan de Velasco devoted many pages to refuting European criticisms. They argued that New World inhabitants and geography were different but had no inherent disadvantages. On the contrary, they used natural history to reaffirm the equality between Europe and the Americas, contending that nature, everywhere, was a manifestation of God's creation.[15]

In the early nineteenth century, one new point of departure was the voluminous work of Prussian naturalist Alexander von Humboldt, who highlighted a new concept of the relationship between people and the natural world based on scientific and empirical interpretations and "his disdain for Spanish colonialism." Particularly, he cited Spaniards' destruction of nature and their

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[14] Clarence J. Glacken, *Traces on the Rhodian Shore; Nature and Culture in Western Thought from Ancient Times to the End of the Eighteenth Century* (California: University of California Press, 1967), 680.

[15] Antonello Gerbi, *The Dispute of the New World: The History of a Polemic, 1750–1900* (Pittsburg: The University of Pittsburg Press, 1973); Francisco Javier Clavijero, *Historia antigua de México* [*Antique History of Mexico*] (México: Porrúa, 2009); John D. Browning, *Cornelius de Pauw and Exiled Jesuits: The Development of Nationalism in Spanish America*, vol. 11, Eighteenth-Century Studies (1978); Anthony McFarlane, "Identity, Enlightenment and Political Dissent in Late Colonial Spanish America," *Transactions of the Royal Historical Society* 8 (1998).

violence toward native people.[16] He traveled throughout New Spain and northern South America and was impressed by the diversity and quantity of natural resources and climates. He examined the Americas' climate, soil, geography, flora and fauna, culture and history and published several works, such as *The Political Essay on the Kingdom of New Spain.* According to scholars, Humboldt's influence went far beyond the scientific realm: Epistemological, social, and political factors informed his work, and Latin American scientists took into account "his viewpoints on the human causes of climate change."[17] According to Humboldt's works, geography, climate, and nature closely related to the independence movements of the Spanish colonies in the Americas. Nature became a recurring topic in Simón Bolívar's, Tomas Heredia's, Hipólito Unanue's, José de Caldas', and other independence leaders' texts, which attributed the abundant and diverse flora and fauna in Latin America to its benign climate but condemned the abuses and mismanagement of the Spanish colonists.

During the first half of the nineteenth century, after the War of Independence, Mexico endured almost continual struggles between political groups, who sought to organize the new nation but disagreed about how to do so, and destructive US and French interventions. Likewise, interest in learning about new territories among outsiders improved the knowledge of natural history. In 1865 Maximilian I, the French-imposed Austrian monarch of the ephemeral Second Mexican Empire (1864–1867), mandated the creation of the *Museo Público de Historia Natural, Arqueología e Historia* (the Public Museum of Natural History, Archaeology, and History). The

[16] Richard Grove, "Origins of Western Environmentalism," *Scientific American*, no. July (1992); Gregory Cushman, "Humboldtian Science, Creole Meteorology, and the Discovery of Human-Caused Climate Change in South America," *Osiris* 26, no. 1 (2011): 22; Aaron Sachs, "The Ultimate "Other": Post-colonialism and Alexander von Humboldt Ecological Relationship with Nature," *History and Theory* December, no. 42 (2003):118.

[17] Gregory Cushman, "Humboldtian Science," 23; Mary Louise Pratt, *Imperial Eyes:Travel Writing and Transculturation* (New York: London; New York Routledge, 2008).

monarch announced that the museum's goals were "to protect scientific objects that were in our country, which we unfortunately do not sufficiently know, and […to] elevate our patria to the level that she should have."[18] Even though the museum had three divisions, natural history was its top priority. Maximilian I had long demonstrated affection for science, especially botany, strengthened by his European education as a member of the Austrian royal family.[19] The monarch selected one Mexican and three European scientists to organize the museum: Mexican engineer, lawyer, and historian Manuel Orozco y Berra became the museum's director, Austrian naturalist Domingo Billimeck was responsible for natural history, Austrian archeologist Leo Simon Reinisch organized the archeological collections, and German priest Agustin Fisher coordinated the library. The museum began its activities in July of 1866, but in June of 1867, six months after the empire crumbled and following years of civil war, the new liberal government executed the Austrian emperor.[20] Nevertheless, the interest in studying nature was institutionalized by the empire and continued for the next forty-seven years under the auspices of associations such as the SMHN—established in 1868 and dissolved in 1914 during the wars of the Mexican Revolution.[21]

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[18] "[…] proteger los objetos científicos que había en nuestro país, que por desgracia no son bastante conocidos,[para que] eleve a nuestra Patria a la altura que le es debida." Luz Fernanda Azuela, Rodrigo Vega y Ortega Baez, and Raúl Nieto García, "Un edificio científico para el Imperio de Maximiliano: el Museo Público de Historia Natural, Arqueología e Historia" [Scientific Building to the Maximilian's Empire: the Public Museum of History of Nature, Archeology and History], in *Geonaturalia. Geografía e Historia Natural: hacia una historia comparada. Estudio a través de Argentina, México, Costa Rica y Paraguay*, ed. Celina Lértora Mendoza (Buenos Aires, Argentina: Ediciones F.E.P.A.L., 2009), 110.

[19] Although traditional imperialistic interest in natural history sought knowledge of nature to gain control of resources and cultures from other lands, some scholars posit that late Renaissance literature and science provided Europeans empires with a stimulus to value "tropical environments" held by the colonial state; Richard Grove, *Green Imperialism: Colonial Expansion, Tropical Island Edens, and the Origins of Environmentalism, 1600–1860*, Studies in environment and history (Cambridge: Cambridge University Press, 1995),475.

[20] Luz Fernanda Azuela, Rodrigo Vega y Ortega Baez, and Raúl Nieto García, "Un edificio científico ," 121.

[21] In 1936, biologist Enrique Beltrán and thirty-nine men joined the SMHN's second period. They were interested in continuing the works of the association's predecessor. Beltrán warned that Mexico lacked scientific associations specifically devoted to natural sciences studies and stated that he and his colleagues would fill this gap. He was the perpetual president of the association. In 1994, after Beltrán's death, the SMHN reduced its activities. In

Scientific interest in natural history outlived the Second Mexican Empire and another period of civil wars, as Mexican political life renewed its search for an independent and progressive nation during the historical periods known as La Reforma and the Porfiriato. In this sense, Mexican scientists stressed the utility of nature as a means of constructing a prosperous nation through the balanced use of resources. Because nature and humans held a close and reciprocal relationship, scientists posited that they had to learn how nature worked in order to maintain equilibrium in the use of natural resources—ultimately improving Mexico's circumstances. Government officials coincided with those scientists and looked in nature for the elements that would bolster the country's economy and its progress. For this reason, natural history became an important subject for the liberal governments of the late nineteenth and early twentieth centuries. With limited government support, Antonio del Castillo, Antonio Peñafiel, Manuel Villada, Leopoldo Río de la Loza, and sixty-six other scientists from diverse disciplines founded the SMHN to study resources in order to improve the country's development.

Early historiography related to natural science underlined that Mexican liberals' interest in understanding nature and society derived from their desire to extract a profit from resources.[22] Because it went contrary to these trends in the relationship between science and Mexican society, the results of my analysis were somewhat unexpected: Mexican intellectuals, belonging to the natural history tradition that placed great emphasis on balance, claimed that ignorance of the

2013, biologist Frank Raúl Gio, president of SMHN, stated via a telephone conversation that the association had few contributors, that the association's works were scarce, and they only met on special occasions, such as Christmas.

[22] Luz Fernanda Azuela, *Tres sociedad científicas en el Porfiriato. Las disciplinas, las instituciones y las relaciones entre la ciencia y el poder* (México: Sociedad Méxicana de Historia de la Ciencia y la Tecnología, A.C., Universidad Tecnológica de Nezahualcóyotl, Instituto de Geografía-UNAM, 1994); Lane Simonian, *La defensa de la tierra del jaguar. Una historia de la conservación en México* [*Defending the Land of the Jaguar: a History of Conservation in Mexico*] (México: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO), Instituto Nacional de Ecología-SEMARNAP, Instituto Nacional de Recursos Naturales Renovables A.C., 1999).

laws of the natural world was resulting in environmental problems such as deforestation and extinction of birds. This group wanted to recognize geographical, meteorological, geological, and biological characteristics, as well as multiple resources (described by Humboldt's works from the early nineteenth century) that were still unknown to many Mexican scientists. Unsurprisingly, they argued that studies on mineralogy were particularly valuable because they could directly increase public wealth (Fig.2).[23] Although scientists promoted the use of natural resources, they warned that people had to learn how nature works in order to prevent a dangerous disequilibrium in the natural order. Between 1867 and 1910 the national policy on education therefore, adopted and encouraged natural history studies. In other words, they insisted on promoting natural scientific knowledge to benefit from nature without disturbing organic processes. Those scientists from the early second half of the nineteenth century held a combination of organic and utilitarian viewpoints on nature, which (they thought) could help improve their country's circumstances. Although men who joined the SMHN reflected the influence of Humboldt's works and believed in the close and reciprocal relationship between nature and society, they brought different intellectual approaches to the analysis of these links. Some of them believed their work reflected a divine design, while others followed the *Naturphilosophie* of Humboldt, the positivism of Comte, the evolutionary ideas of Lamarck and Spencer, and (to a lesser extent) Darwin's theory.

[23] Antonio del Castillo, "Discurso pronunciado por el Señor Ingeniero de Minas Don Antonio del Castillo, Presidente de la Sociedad, en la Sesión Inaugural verificada el día 6 de septiembre de 1868," *La Naturaleza* I, 1a. Serie (1870).

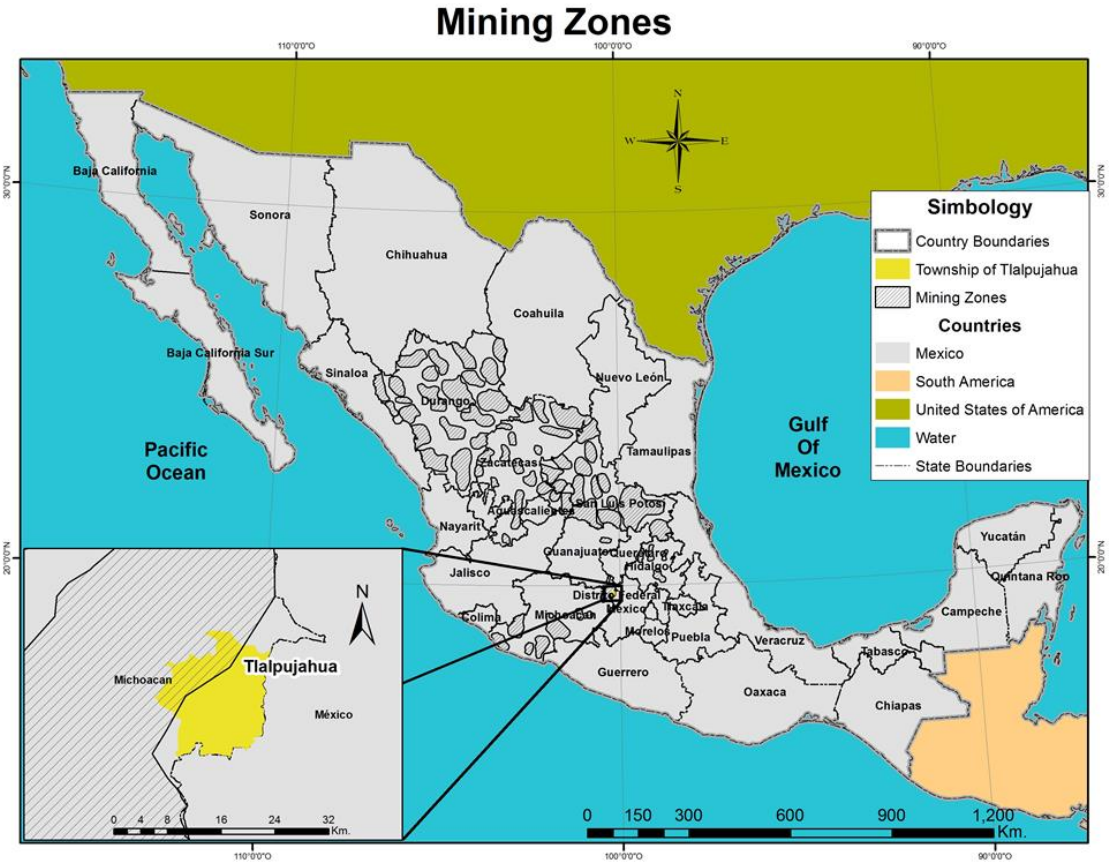

Figure 2. Mining zones Central Mexico analyzed by SMHN in the nineteenth century. *Source:* SMHN, *La Naturaleza*. (Map by Gabriela Torres and Jesús Izaguirre)

Mexican scientists also turned up new evidence of the strong influence of nature and environment on humans and their well-being. Positivist and social Darwinist ideas presented ways in which the government could improve people's and Mexico's circumstances. In other words, research produced by the SMHN suggested that the environment could turn Mexico into a progressive and civilized country in two ways. First, the environment could be improved through natural science studies, the implementation of public policies in health, and international investment. Second, some scientists and government officials proposed "racial improvement," by mixing white and indigenous races in order to "civilize" the population. Indeed, from a survey of ideas expressed in *La Naturaleza*, utility and equilibrium were two concepts that deeply

concerned Mexican scientists in the second half of the nineteenth century. Even though utilitarianism was behind these scientists' attitudes towards nature, they insisted that the use of resources must be balanced according to nature's laws. In addition, some SMHN contributors proposed laws and projects to preserve forest and to protect birds.[24]

The SMHN was a heterogeneous group of distinguished physicians, engineers, botanists, chemists, and painters who were professors of medicine, engineering, and agriculture at the main educational institutions in Mexico. They became directors of national schools and institutes of research and maintained relationships with international scientific organizations, such as the Smithsonian Institution in the United States. They also had a strong influence on the Mexican educational system from 1868 to 1910—by which time most of them had passed away. The SMHN's contributors came from diverse geographical origins and differed in age, family status, and training; they also cultivated relationships with political and ideological powers.[25] Although some of them directly served the Mexican government under Maximilian (1864–1867), Benito Juárez (1867–1872), and Porfirio Díaz (1876–1880; 1884–1911), others were deputies and congressmen. Most intellectuals who joined the SMHN, however, were far from the inner circle of the presidency. This is relevant because historiography, at large, identifies scientists as being responsible for policies and strategies of industrial development and the use of resources. Although these scientists (along with politicians) held the notion that resources were a fountain of wealth and the path to reach international recognition as a civilized country, SMHN members

[24] Alfonso Herrera, "La protección de las aves útiles de México" [Protection of useful birds from Mexico], *La Naturaleza* III, 2a. Serie (1903).

[25] Mauricio Tenorio-Trillo, *Artilugio de la nación moderna: México en las exposiciones universales, 1880–1930* [*Mexico at the world's fairs: Crafting a Modern Nation*], 1. ed. (México: Fondo de Cultura Económica, 1998); Mauricio Tenorio-Trillo and Aurora Gómez Galvarriato, *El Porfiriato* 1. ed., Herramientas para la historia (México, D.F.: Centro de Investigación y Docencia Económicas: Fondo de Cultura Económica, 2006); Hale, "Political and Social Ideas, 1830–1930."

remained on the sidelines of the political group called *los Científicos* (scientists), who designed and applied many of the key policies and strategies of industrial development in Mexico during the Porfiriato.

In 1869, the SMHN founded the journal *La Naturaleza*—the same year that Norman Lockyer edited the first issue of *Nature* in London. From 1869 to 1914, *La Naturaleza* published 740 articles on diverse topics related to natural history and history as well as biographies of Mexican, US, and French scientists.[26] These articles revealed the changes, contradictions, and continuities that Mexican scientists disseminated in their ideas about nature, which changed in the early twentieth century. A new generation of Mexicans sought a new political, economic, and social order through violent revolution, disrupting the developments in the field of scientific research. Eventually, the specialization of the natural sciences displaced natural history studies. In addition to these changes, SMHN contributors dwindled and their output diminished, and in 1914, the association dissolved. For forty-five years, ideas on nature retained a sort of dynamism—where contradictions often emerged—however, the idea that nature could help improve Mexico's circumstances and strengthen Mexican nationalism continued over time.

In this context, some questions emerge: What was nature's role in the social and economic development of Mexico between 1868 and 1914? What place did natural history occupy in Mexican science and intellectual life? What was nature's role in the geographical and social thought of the members of the SMHN? And to what extent did Mexican scientists favor unlimited exploitation of resources, or conversely, promote conservationist policies?

[26] SMHN, Revista *La Naturaleza*, 11 vols. México: Imprenta de Ignacio Escalante, 1870-1914. Trabulse, *Historia de la ciencia en México: estudios y textos. Siglo XVIII* [*History of science in Mexico: studies and texts. The Eighteenth Century*], 3: V.5.53.

Between 1865 and 1914, Mexican intellectuals who joined the SMHN and those who participated on its margins mostly maintained a traditional and teleological understanding of the close links between the natural and social world. However, I argue that in this period they also embraced to an unprecedented extent the use of scientific inquiry to enhance their understanding of the natural world as a means to guide the country toward order and progress—similar to that pursued by other Western societies, especially France and the United States. Influenced by Humboldt, Comte, Lamarck, and Spencer, Mexican scientists encouraged the study of natural history, believing that there was a strong and reciprocal relationship between the natural and social world. Mexican scientists had clear goals for this research: first, to learn how nature worked in order to maintain equilibrium in the use of natural resources. Second, natural history could provide knowledge on how to use resources (e.g., flora, fauna, minerals, etc.) and to improve the environment (e.g., climate, soil, air, water, and geography) and the Mexican people (i.e., race, public health). Scientists believed such knowledge would help construct a progressive, civilized, and modern country similar to other powerful Western nations.

Indeed, in scientists' minds, nature would play a key role in the economic and social development of Mexico. In this vein, this dissertation examines how SMHN scientists thought about natural history and the management of resources to improve the country's circumstances during the period from 1868 to 1914. This period is relevant because it constituted a turning point in the study of natural history in Mexico. By promoting the study of natural history, the conservative government helped natural history studies to reach their peak starting in 1868—continuing throughout the late nineteenth century—until its end in 1914, when the SMHN dissolved and a new government came to power in the midst of the upheaval of the Mexican Revolution.

Historiographical Review

There exists an established scholarship examining how Western societies viewed the relationship between nature and humanity over time. For instance, Clarence Glacken, Antonello Gerbi, Lucian Boia, Luis Urteaga, and Mauricio Nieto Olarte have analyzed ideas about the environment in Europe and its consideration of the Americas at different points in history.[27] Meanwhile, Donald Worster and Shen Hou have examined US ideas about nature and environmentalism in the Americas in the nineteenth and twentieth centuries.[28] Regarding analyses of Mexican thoughts on conservation and resource management in the nineteenth and twentieth centuries, Lane Simonian and Emily Walkid have published important works.[29] Early studies affirm that few Mexicans were intent on protecting nature, and those that were tended to be proponents of European romanticism. For instance, Simonian identifies the artist José María Velasco, one of the most important nationalist landscape painters in Latin America, as an isolated follower of romantic and transcendentalist ideas—expressed in famous paintings such as the *Valle de México* (Fig.3).

[27] Clarence Glacken, *Trace on the Rhodian*; Lucian Boia, *The Weather in the Imagination* (London: Reaktion Books, 2005); Gerbi, *The Dispute of the New World: The History of a Polemic, 1750–1900*; Luis Urteaga, "Higienismo y ambientalismo en la medicina decimonónica" [Hygienism and Environmentalism in Medicine in the Ninetheenth Century], *Dynamics: Acta Hispanica ad Medicinae Scientiarumque Historiam Illustrandam* 5–6 (1985), http://divulgameteo.es/uploads/Higienismo-ambientalismo.pdf; Mauricio Nieto Olarte, *Remedios para el imperio: historia natural y la apropiación del Nuevo Mundo* [*Remedies for Empire: History of Nature and ownership of New World*] (Bogotá, Colombia: Instituto Colombiano de Antropología e Historia, 2000).

[28] Donald Worster, *Nature's Economy: a History of Ecological Ideas*, 2nd ed., Studies in environment and history (Cambridge: Cambridge University Press, 1994); Shen Hou, "Garden and Forest: A Forgotten Magazine and the Urban Roots of American Environmentalism," *Environmental History* 17, no. October (2012).

[29] Lane Simonian, *La defensa de la tierra del jaguar. Una historia de la conservación en México* [*Defending the Land of the Jaguar: a History of Conservation in Mexico*] (México: Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO), Instituto Nacional de Ecología-SEMARNAP, Instituto Nacional de Recursos Naturales Renovables A.C., 1999); Emily Wakild, *Revolutionary Parks: Conservation, Social Justice, and Mexico's National Parks, 1910–1940*, Latin American landscapes (Tucson: University of Arizona Press, 2011).

Figure 3. Valley of Mexico 1873 by José María Velasco.
Source: María Elena Altamirano Piollé, José María Velasco, 173.

Interestingly, Velasco was an active member of the SMHN and wrote several articles that posited increasing public knowledge of nature through paintings. He illustrated several of the issues of *La Naturaleza* and worked within Porfirio Díaz's government. Simonian overlooks the labor of scientific associations aimed at the study of the relationship between nature and society, and he misses altogether the activities of ornithologist Porfirio Rovisora, who promoted laws for the protection of birds. Wakild underscores the continuity of sciences in the latter part of the nineteenth century with those of the revolutionary era, focusing on the forestry issue that inspired revolutionary conservation policies relating to national resources after 1914. However, in making

generalizations about the role of scientists in Porfirio Díaz's government (1876–1911) she presents the scientists as a homogenous and oligarchical group. She perpetuates the widely held idea that the *Científicos,* scientifically oriented advisors to key Porfirian projects such as the draining of the Valley of Mexico, meant to take control of "wild nature." As Chapter two will show, most scientists who joined the association actually had little relationship with, much less influence over key members of the *Científicos* who controlled economic and political matters during the latter part of the nineteenth century.

Scholars interested in the Mexican history of science, scientific organizations, and scientific publications of the nineteenth century have examined the SMHN and *La Naturaleza* as part of Porfirian intellectual and political life.[30] For instance, Elías Trabulse compiled an overview of the history of science in Mexico using, among others, texts from *La Naturaleza*, whereas Fernanda Azuela has analyzed the role that scientific societies played in improving scientific knowledge in the fields of botany, biology, geography, and mineralogy—thereby laying the foundations for the subsequent institutionalization of the natural sciences.[31] Mauricio Tenorio Trillo has examined the close relationship between Mexican scientists and political power.[32] He argues that self-identified scientists and the ideology of scientific governance played an important part in constructing an elitist image of Mexico as a progressive country at the end of the nineteenth century. In their works, Rodrigo Antonio Vega y Ortega and Claudia Agostoni

[30] *Porfirian* and *Porfiriato* are terms that referred to period from 1876 to 1911 when President Porfirio Díaz and his group governed Mexico.

[31] Elías Trabulse, *Historia de la ciencia en México: estudios y textos* [*History of Science in Mexico: Studies and Texts*], 1a ed., 5 vols. (México, D.F.: Conacyt: Fondo de Cultura Económica, 1983); Luz Fernanda Azuela, "La influencia de Humboldt en los viajes americanos del siglo XIX," *Revista de Historia de América*, no. 134 (2004); Luz Fernanda Azuela y Rafael Guevara Fefer, "La ciencia en México en el siglo XIX: una aproximación historiográfica," *Asclepio. Revista de Historia de la Medicina y de la Ciencia* 50, no. 2 (1998), http://asclepio.revistas.csic.es/index.php/asclepio/article/view/337/335.

[32] Mauricio Tenorio-Trillo, *Artilugio de la nación moderna*.

argue that the scientific publications of the nineteenth century corresponded with an effort to educate the population regarding hygiene and public health.[33] Vega y Ortega, Patricia Carpy Navarro, and Rafael Guevara Fefer also examined the works of the SMHN; they contended that the SMHN contributed to an increase in studies on biology and natural sciences, but that its work was tied to political interests.[34] Other scholars have examined members of the SMHN on a more individual, biographical level, or as part of scientific communities.[35] What is still missing, therefore, is an examination of these scientists' interest in natural history and broad goals for this endeavor, particularly their interest in promoting a balanced management of natural resources—with respect to competing in international economic markets—and their interest in contributing to Mexico's development.

Analysis of the geographical ties and the social thought of SMHN members is important for three reasons. First, the historiography on Mexican environmental issues has tended to neglect scientific interest in the knowledge and management of resources beyond their ties to narrow economic interests. A series of recent studies related to geography and cartography have

[33] Rodrigo Vega y Ortega, "Los establecimientos científicos de la ciudad de México vistos por viajeros 1821–1855," Araucaria12, no.24 (2010); Claudia Agostoni, "Discurso médico, cultura higiénica y la mujer en la ciudad de México al cambio de siglo (XIX–XX)," *Mexican Studies/Estudios Mexicanos* 18, no. 1 (2002).

[34] Rodrigo Vega y Ortega, "Los naturalistas Tuxtepecadores de la sociedad mexicana de historia natural: desarrollo y profesionalización de la historia natural entre 1868 y 1914" [Naturalists Tuxtepecadores of the Mexican Society of Natural History: Development and Professionalization of Natural History between 1868 and 1914] (History, Universidad Nacional Autónoma de Mexico, 2007); Patricia Carpy Navarro, "La Sociedad de Historia Natural" [Society of Natural History] (History, Universidad Nacional Autónoma de México, 1986); Rafael Guevara Fefer, *Los últimos años de la historia natural y los primeros de la biología en México. La práctica científica de Alfonso Herrera, Manuel María Villada y Mariano Bárcena* [*The Last Years of Natural History and the Early Years of Biology in Mexico. Scientific Practice of Alfonso Herrera, Manuel María Villada y Mariano Bárcena*], Cuadernos 35 (México: Instituto de Biología, UNAM, 2002).

[35] Lucero Morelos Rodríguez, *La geología mexicana en el siglo XIX. Una revisión histórica de la obra de Antonio del Castillo, Santiago Ramírez y Mariano Bárcena* (México: Secretaria de Cultura de Michoacán, Plaza y Valdés, 2012); Luz Fernanda Azuela, *De las minas al laboratorio: la demarcación de la geología en la Escuela Nacional de Ingenieros (1797–1895)* (México: Universidad Autónoma de México, 2005); Luz Fernanda Azuela and Rodrigo Vega y Ortega Baez, *La geografía y las ciencias naturales en el siglo XIX mexicano*, Textos Universitarios Núm. 9 (México: Instituto de Geografía, UNAM, 2011).

begun to address these concerns, in which some scholars argue that Mexican liberals' interest in understanding nature and society in the nineteenth century stemmed from their desire to extract a profit from these resources because they "adopted material 'progress' as a severe god."[36] Other historians, such as Wade Graham, have even gone so far as to argue that there was a general lack of interest in the management of natural resources in Mexico before the second half of the twentieth century. My study shows this was certainly not the case, at least within intellectual circles, and the range of Mexican ideas regarding nature was far richer than has usually been presumed.[37] Second, the majority of studies on Mexican environmental history and thought have focused on pre-Hispanic times, the colonial period (especially the eighteenth century), or the twentieth century after the Mexican Revolution of the 1910s.[38] There is, thus, a major gap in our knowledge of the nineteenth century and its international context, yet from the point of view of Mexican society's relationship with the environment, this was the most important formative period of industrial expansion and development of modern institutions of governance in Mexico, and it led to large increases in international investment in mining and railroads, agricultural exports, and other endeavors that impacted the natural world. Accordingly, this dissertation

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[36] Lane Simonian, *La defensa, 67*; Magali Marie Carrera, *Traveling from New Spain to Mexico: Mapping Practices of Nineteenth-Century Mexico* (Durham: Duke University Press, 2011); Raymond B. Craib, *Cartographic Mexico: a History of State Fixations and Fugitive Landscapes*, Latin America otherwise (Durham: Duke University Press, 2004).

[37] Wade Graham, "MexEco?: Mexican Attitudes toward the Environment," *Environmental History Review* 15, no. 4 (1991).

[38] Enrique Delgado López, "Los aires, aguas y lugares en las antigüedades de la Nueva España" [Winds,Waters and places in New Spain antiquities], *Fronteras de la Historia* 13, no. 2 (2008); Enrique Delgado López and Nicolás Caretta, "Historiar la naturaleza: reflexiones sobre la traducción a la historia natural de Plinio por Francisco Hernández." [To Chronicle Nature: Reflections on Plinios' Natural History Translation by Francisco Hernandez], *Delaware Review of Latin American Studies* 11, no. 1 (2010); Church Henry Ward, "Corneille De Paw, and the Controversy over His Recherches Philosophiques Sur Les Américains," *PMLA* 51, no. 1 (1936); Arij Ouweneel, *Shadows over Anáhuac: an Ecological Interpretation of Crisis and Development in Central Mexico, 1730–1800*, 1st ed. (Albuquerque: University of New Mexico Press, 1996); Christopher R. Boyer and Emily Wakild, "Social Landscaping in the Forests of Mexico: An Environmental Interpretation of Cardenismo, 1934–1940," *Hispanic American Historical Review* 92, no. 1 (2012); Wakild, *Revolutionary Parks: Conservation, Social Justice, and Mexico's National Parks, 1910–1940*.

contributes to environmental history and the history of Mexico by considering the place that scientific investigation of Mexico's flora, fauna, and minerals; the discipline of natural history; and the idea of nature occupied during this period of rapid industrial development and state institutionalization.

This dissertation consists of four chapters. In the first, I develop a contextual framework for Mexico's natural history tradition from an international perspective. I explore seminal works of natural history that influenced Latin American authors—works from Alexander von Humboldt, Jean-Baptiste Lamarck, and Herbert Spencer—and I contextualize their influence within Mexican scientific traditions from the sixteenth to the nineteenth century—seeking to identify interconnections, controversies, omissions, and critiques that existed between European proposals and Mexican scientists' works. Chapter two examines how the background and experience of Society contributors potentially shaped their interests in natural history, how their relationships with other intellectual, economic and political groups influenced the use of natural resources, and the broader cultural context in which the SMHN worked between 1868 and 1914. Chapter three provides a background for understanding the thought and activities of natural historians in Mexico during the second half of the nineteenth century. The first part focuses on an overview of Mexican environmental thought during the colonial era. The second part explains European influence on the frameworks and practices of Mexican natural history in the nineteenth century and seeks to identify interconnections, controversies, omissions, and critiques that existed between European proposals and the research of Mexican intellectuals—with a focus on their expression in the journal *La Naturaleza*. In chapter four, focusing on the texts produced by members of the SMNH, I examine the *variety* of ways in which Mexican natural historians perceived the relationships between nature and society, with an emphasis on how natural

historians understood the links between natural elements (e.g., climate, soil, air, etc.) and social factors (e.g., race, economy, public health, etc.) and how they dealt with the intellectual legacy of environmental determinism—a remnant from the colonial era.

Methodologically, this study combines an interest in the history of environmental ideas with a social history of intellectual life in Mexico before the Revolution. Because scientific ideas relate to social, cultural, and political conditions, I analyze the biographies, commonalities, and differences among Society members and their relationship to and influences on government and other groups (e.g., other scientific societies). In other words, I employ a prosopographical approach in my analysis of SMNH members that seeks to contextualize their ideas and work, emphasizing the places in which they worked and the roles they played in their society. This analysis allowed me to then evaluate the connections of key contributors to Porfirian governance and their influence over the oligarchy of advisors known as the *Científicos*.[39] The collective study of scientists' lives and their common background characteristics as a group—such as birth and death, marriage and family, social origins and inherited economic position, as well as place of residence, education, and experience with scientific research—are some of the variables analyzed in this prosopography of the natural historians.[40] This information revealed internal and external correlations with political and economic realms that, in some cases, disclosed the deeper interests of scientists such as their participation in business, relating to international investments in railroads, as well as their political affiliations. In other words, this prosopographical approach helps to make sense of their political activities, to explain instances of ideological or cultural

[39] "In historical studies, prosopography is an investigation of the common characteristics of a historical group, whose individual biographies may be largely untraceable, by means of a collective study of their lives, in multiple career-line analysis." See Katharine Keats-Rohan, *Prosopography Approaches and Applications. A Handbook*, vol. 13, Prosopographica et Genealogica (England: The University of Oxford and Contributors, 2007).

[40] Lawrence Stone, "Prosopography," *Daedalus* 100, no. 1 (1971): 46.

change, to identify their linkage with social realities, and to describe and analyze, with precision, the structure of the society and its internal politics.[41]

To determine what Mexican scientists thought about nature, I considered developments specific to the study of natural history, paying particular attention to scientists' views on the balanced use of resources and their interconnections with industrial advances. This dissertation concentrates on two types of sources. The first consists of 740 articles on a range of subjects published in *La Naturaleza* from 1869 to 1914. These texts provided fundamental information on this community of scientists' viewpoints on natural history and their concerns about nature's relationship to society. In other words, these texts reveal how an important group of contributors to late-nineteenth-century Mexican thought prioritized nature in their writings for a key scientific organization. The second source consisted of documents and bibliographies related to SMHN contributors located in Mexico and the United States. These include the *Archivo Histórico de la Universidad Iberoamericana*, focused on its *Porfirio Díaz Collection* (AUI-PD); the *Biblioteca Nacional de la Universidad Autónoma de México* (BN-UNAM); the *Archivo Histórico del Museo Nacional de Antropología e Historia* (MNA-INAH), the *Enrique Beltrán Collection* in the *Biblioteca Pública "Juan José Arreola" del Estado de Jalisco* (BPEJ); *Biblioteca "Armando Olivares"* of the *Universidad de Guanajuato (B-UGTO)*; and the *Centro de Documentación Histórica de la Universidad Autónoma de San Luis Potosí (CDHI-UASLP).* In the United States, the documents' sources stemmed from the *Nettie Lee Benson Latin American Collection* at the University of Texas at Austin; and the libraries of the University of Kansas.

[41] Ibid., 47.

Chapter 1 Natural History in an International Context

In 1777, Scottish historian William Robertson stated in his *History of America* that the first characteristic of the American continent was its vastness—greater than that of Europe, Africa, and Asia.[1] However, geographical disadvantages such as cold climate and the small size of its population dominated in this part of earth. "Even the tropics are lukewarm, because of cooling fogs and breezes.… The 'rude and indolent' inhabitants have done nothing to improve the land, which has thus become inhospitable and in fact almost everywhere unhealthy for the European, and strangely feeble in all that it produces."[2] Robertson was one of several European intellectuals who shared adverse opinions about the Americas. Despite such negative opinions toward the American continent, since the sixteenth century, European empires had considered knowledge of geography, mineralogy, botany, zoology, and native history from their American colonies as key elements to their own economic prosperity, as well as political and cultural control of these territories. In the seventeenth and eighteenth centuries, well after the supposed end of the Renaissance, European naturalists resurrected several ancient Greek ideas, many associated with the followers of Hippocrates, which regarded the natural elements (i.e., water, air, fire, earth), temperature, humidity, and place as the basic causes for the variety of human cultures—and in many cases used these principles to strengthen preexisting ideas on the New World inhabitants' inferiority. At the same time, a new round of voyages of exploration to distant territories—this time with a focus on the interior of South America and the Pacific Ocean—set out to discover, collect, and classify flora, fauna, and mineral samples that would

[1] Before the nineteenth century, commentators tended to conceive of the whole Western Hemisphere as a single geographical entity distinct from the three continents of the Old World.

[2] Antonello Gerbi, *The Dispute of the New World*, 160.

bolster scientific knowledge of these "new lands" and contribute to increasing expansionist and commercial interests overseas.

During the nineteenth century, the "new science" of authors such as Alexander von Humboldt, Charles Darwin, and Herbert Spencer in some instances went further to reinforce ancient beliefs about geography's influence on the historical development of countries. For instance, Humboldt stated that

> The physiognomy of a country, the shape how the mountains is grouped, the expanse of the plains, the elevation that determining their temperature, … everything that constitutes the structure of the globe, has the most essential relationships with the progress of population and their welfare.[3]

Additionally, Spencer highlighted extrinsic factors such as climate, surface, flora, and fauna that affected social evolution.

> We have climate; hot, cold, or temperate, moist or dry, constant or variable. We have surface; much or little of which is available, and the available part of which is fertile in greater or less degree; and we have configuration of surface, as uniform or multiform. Next we have the vegetal productions; here abundant in quantities and kinds, and there deficient in one or both. And besides the Flora of the region we have its Fauna, which is influential in many ways; not only by the numbers of its species and individuals, but by the proportion between those that are useful and those that are injurious. On these sets of conditions, inorganic and organic, characterizing the environment, primarily depends the possibility of social evolution.[4]

For all of these authors, sensibility to natural history was critical to their understanding of societal development.

After the wars for independence ended in the 1820s, Latin America again became an attractive territory for European expansion, as well as the growing interests of North American industrial capitalism, both of which sought raw materials and new mass markets for their

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[3] La fisonomía de un país, el modo como estás agrupadas las montañas, la extensión de las llanuras, la elevación que determina su temperatura, en fin todo lo que constituye la estructura del globo, tiene las relaciones más esenciales con los progresos de la población y el bienestar de los habitantes. Alejandro de Humboldt, *Ensayo político sobre el reino de la Nueva España [Political Essay of the Kingdom of the New Spain]* (México: Editorial Porrúa, 2011), 21.

[4] Herbert Spencer, *The Principles of Sociology*, III vols., vol. I (New York,: D. Appleton and Company, 1897). 11.

products. Travelers—many of them scientists, businessmen, and religious leaders who were interested in the climate, soil, geography, natural diversity, and the culture of Latin America—considered former Spanish colonies, such as Mexico, as lands filled with untapped resources and occupied by savage people, which Europeans and North Americans could exploit while guiding them toward "civilization."[5] They presented detailed descriptions of landscapes, flora, fauna, and mineralogy, as well as the history from independent territories. As Mary Louise Pratt has argued, these American trends were pivotal to the emergence of the "new imperialism" of the nineteenth century, inaccurately portrayed as focusing on new colonies in Asia, Africa, and the Pacific.[6]

Meanwhile in the colonies and new, postcolonial states of Latin America, natural history played a relevant scientific, economic, and cultural role for a diversity of groups touting the advantages of the New World and intent on disproving arguments for its inhabitants' inferiority. There was a long tradition of natural historical studies rooted in the Americas fixated on these issues, much of it produced by priests. One of the most influential examples was the 1590 publication of Spanish Jesuit José de Acosta's *Natural and Moral History of the Indies*, in which he described winds, lakes, rivers, minerals, flora, fauna, and indigenous customs from New Spain (now Mexico), New Granada (now Colombia), and Peru.[7] In the eighteenth century, the Creole priest Francisco Javier Clavijero was especially vocal in refuting European ideas on the supposed disadvantages of the Americas.[8] In the nineteenth century, Creole groups considered

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[5] Michael James Box, *Capt. James Box's Adventures and Explorations in New and Old Mexico. Being the Record of Ten Years of Travel and Research* (New York: James Miller, Publisher, 1869); A. A. Graham, *Mexico, with Comparisons and Conclusions*, 1st ed. (Topeka, Kan.,1907), Includes index; Gilbert Haven, *Our Next-Door Neighbor: a Winter in Mexico* (New York,: Harper & Brothers, 1875).

[6] Mary Louise Pratt, *Imperial Eyes: Travel Writing and Transculturation* (London and New York: Routledge, 1992).

[7] José de Acosta, *Historia Natural y Moral*.

[8] Analysis of Clavijero's arguments against European ideas on the Americas' inferiority may be found in Chapter 2.

the natural world as an essential constituent of their identity and the construction of their new nations. A range of Latin American thinkers used natural history studies as the bases for plans for agricultural, commercial, and scientific development intended to improve the circumstances of their new states and to help "nationalize nature."[9] As a part of these projects, European and North American natural historians conducted extensive intellectual exchanges with their counterparts in the Americas.

Even though European natural historians emphasized differences between inhabitants of the Old and New Worlds—reinforcing European imperial pretensions—Latin American natural historians focused on the unique richness and advantages of nature in their territories. It is clear that studies on the relationships between nature and society have occupied a significant place in intellectual discourse in both Europe and the Americas for some time. In this sense, three questions emerge. What was the proper role of natural history from this international perspective? What natural elements did European natural historians highlight on the American continent? And what concerns did Latin American natural historians adopt from European natural history?

This chapter provides a survey of seminal international natural history studies that influenced Latin American scientists and, particularly, Mexicans intellectuals in the nineteenth century. I argue that European ideas on natural history were viewed as key elements for Mexican prosperity, as was the perception of an abundance of resources in Latin America. Environmental influence on cultural progress fed Latin American scientific thought in two ways. On the one hand, those ideas bolstered understanding of the natural world and the development of new

[9] Stuart McCook, *States of Nature: Science, Agriculture, and Environment in the Spanish Caribbean, 1760-1940*, 1st ed. (Austin: University of Texas Press, 2002), 11.

scientific theories and methodologies (most notably, Darwin's ideas on biological evolution). On the other hand, natural history provided the basis for economic policies, which were vital to the construction of new nations, following their independence movements.

The Early Modern Natural History Tradition

According to Mauricio Nieto, Marcos Cueto, Jorge Cañizares-Esguerra, Janet Browne, Mary-Louise Pratt, and Stuart McCook, studies of natural history reflected the political, military, commercial, scientific, and public interests of European empires.[10] Indigenous people who inhabited the Americas had developed elaborate studies of flora, fauna, air, land, water, and minerals long before the Spanish and Portuguese conquest. However, according to the European scientific viewpoint that emerged in the course of the Scientific Revolution, most pre-Columbian cultures associated nature and the elements with religion and empirical practices, which Western science did not recognize as scientific knowledge.[11] It is important to recognize that information from indigenous populations provided an important basis for natural history studies well into the nineteenth centuries. Nature in the Americas proved extraordinary to European and American scientific endeavors as well as to their economic interests.

From the sixteenth to eighteenth centuries, the Spanish empire had the largest overseas colony in the world in America, which was crucial for Spain's economic prosperity and its cultural expansion. The Spanish monarchy tried to control their overseas colonies by learning, in detail, their geography and natural resources. Beginning in 1569, King Phillip II asked repeatedly

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[10] Mauricio Nieto Olarte, *Remedios para el imperio*; Jorge Cañizares-Esguerra, *Nature, Empire, and Nation: Explorations of the History of Science in the Iberian World* (Stanford, Calif.: Stanford University Press, 2006); Janet Browne, "Biogeography and Empire " in *Cultures of Natural History*, ed. Nicholas Jardine, James A. Secord, and Emma Spary (Cambridge: Cambridge University Press, 1996); Mary Louise Pratt, *Imperial Eyes*.

[11] Marcos Cueto, *Excelencia Científica*: 31; Elías Trabulse, *Historia de la Ciencia en México (Versión abreviada) [History of Science in Mexico. Abbreviated Version]*, Selección Obras de Ciencia y Tecnología (México: Consejo Nacional de Ciencia y Tecnología/ Fondo de Cultura Económica 1997).

for data on geographic, mineralogical, botanical, zoological, historical, linguistic, cultural, demographic, and economic information from his colonies on the American continent. Eight years later, imperial authorities sent a 50-question survey in order to obtain more information. From 1578 to 1586, the monarchy requested, via questionnaires, what are called *Relaciones Geográficas* (Geographical Accounts), providing data about population demographics, political jurisdictions, languages, geography, diseases, and native vegetation. At the same time, Phillip II ordered scientific expeditions and medical studies of the Americas, naming his personal physician Francisco Hernández responsible for the voyage. In close collaboration with native people, Hernández collected a great diversity of local plants and animals previously unknown in Europe. In 1600, King Felipe III sent out another questionnaire, this time with 255 items organized into four categories—the first related to natural issues; the second, moral and political affairs; the third, military topics; and the fourth, ecclesiastic issues.[12] Like rival empires, the Spanish monarchy believed that economic prosperity necessitated the efficient exploitation of natural wealth and the subordination of societies to the monarchy's religious, economic, and political laws.

In addition, Spanish rulers found that arguments based on appeals to the natural order of things strengthened their justifications for colonialism, expansionism, and racial discrimination.[13] The coincidence between these explorations and the Renaissance encouraged the recovery of older theories pertaining to air, water, places, and climate in order to explain the

[12] Gerardo Bustos Trejo, *Libro de las descripciones [Descriptions Book]* (Mexico: Universidad Nacional Autónoma de México, 1988); Manuel Carrera Stampa, "Relaciones geográficas de Nueva España. Siglos XVI y XVII [Geographical Accounts of New Spain. Sixteenth and Seventeenth Century]," *Estudios de historia novohispana.* II(1968); René Acuña, *Relaciones geográficas del siglo XVI [Geographical Accounts of the Sixteenth Century]*, ed. René Acuña, 10 vols. (Mexico: Universidad Nacional Autónoma de México, 1982-1988).

[13] Mauricio Nieto Olarte, *Remedios para el Imperio*; Jorge Cañizares-Esguerra, *Nature, Empire, and Nation*.

physical and cultural differences between people on the earth, and began to be used to legitimate conquest and overseas exploration. Since antiquity, philosophers such as Herodotus, Aristotle, Plato, Hippocrates, Galen, Pliny, Botero, Bodin, and others had considered climate an important issue that affected human beings.[14] For the ancient Greeks, climate and soil directly influenced humans, in which warm climates produced passionate natures, cold climates resulted in bodily strength and endurance, and temperate climates spawned intellectual superiority. Likewise, fertile soil produced soft people—contrary to barren soil, which made them brave.[15] Plato's and Aristotle's political theories maintained that certain geographical characteristics might be favorable to the existence of high civilizations, such as their own, because the influence of climate fanned the development of governments and was responsible for encouraging the progress of societies.[16] Hippocrates and Galen found in the physical relationship between natural elements (e.g., water, air, fire, and earth) and substances of the human body the causes for diseases and the variety of human cultures. Hippocrates advised, "One should study meteorology before studying medicine."[17] Ideas about the relationship between climate and race were also rooted in the texts of other ancient writers. Pliny (23–79 AD), a highly influential author in the Middle Ages best known for his massive *Natural History*, proposed that climate and race shared a close relationship. He argued, "the Negro people who lived in the hottest climates received the strongest and most direct solar heat, that the Mediterranean peoples were in an intermediate position, and that the northerners were in the

[14] Clarence J. Glacken, *Traces on the Rhodian Shore*, 432.

[15] Ibid., 81.

[16] Richard Peet, "The Social Origins of Environmental Determinism," *Annals of the Association of American Geographers* 75, no. 3 (1985): 1.

[17]Those ideas were the basis of medical meteorology, which was very important in Mexican public health strategies during second half of the nineteenth century. Frederick Sargent, *Hippocratic Heritage: a History of Ideas About Weather and Human Health* (New York: Pergamon Press, 1982), 37.

other extreme."[18] This idea of the superior influences of temperate climates eventually came to support an idealization of the White race: "[In] the universe, as in everything, the ideal lies between the two extremes."[19] This ancient climatic hierarchy placed the white race in a privileged position.

Some centuries later, during Europe's Renaissance and Age of Exploration, philosophers readdressed some of these old ideas of climate's influence on human culture. Jean Bodin (1530–1596), a key French thinker of the Renaissance, examined the relationship between human life, the environment, and astrology. He proposed that climate was a significant element of the environment that influenced people. Inspired by new geographical discoveries, Bodin examined the environmental differences between the northern, the southern, and the temperate zones, and their connection to cultural differences. He affirmed that the hottest places on earth were located in the two tropical zones and the coldest places at the poles. For instance, in the Northern Hemisphere, the extremes of hot and cold were found at the Tropic of Cancer and at the North Pole, respectively.[20] He posited that inhabitants from northern areas received less heat from the sun but that they generated compensatory heat within their own bodies; for this reason, they were superior. Furthermore, Bodin explained that great empires which spread their power to the south typically established themselves in areas where animals were more active and robust.[21]

Another important element in Bodin's works was the "humoral theory," based on Hippocrates and Galen, which presupposed a relationship between body and mind influenced by air, water, climate, and geography. According to Bodin, humoral theory "could explain not only

[18] Clarence J. Glacken, *Trace on the Rhodian*, 258.
[19] Ibid., 369.
[20] Ibid., 437-38.
[21] Ibid., 438.

physical and mental health but [also] physical and cultural characteristics of people as a whole."[22] Humoral theory states that different hot, cold, and temperate environments elicit different combinations of humors, different physical and mental characteristics dependent on an individual's place of birth and upbringing. Interestingly, Bodin found that "the people of the south are a contemplative sort, adept in the secret science, [with] the black bile or melancholy dominant among them, causing prolonged meditation; they have the ablest philosophers, mathematicians, and prophets."[23] Such conclusions and the manner of thinking on which they were based permeated scientific ideas regarding natural history for several centuries.

Giovanni Botero (1544–1617), an Italian intellectual, also related climate with human behavior. During the Counter-Reformation, Botero, trained in the Jesuit tradition, wrote three works that analyzed the relationship between religion and climate, focusing on the new schisms promoted by the Reformation and non-Christian beliefs. In these works, he correlated heat with cunning and cold with boldness, and his theories reflected the climatic influence on population growth, migration, laws, politics, and the social behavior of countries.[24] A range of intellectuals began to seek explanations for physical and cultural differences between Europeans and the inhabitants of the Americas, drawing from these ideas on climatic influence on humans as a part of their natural history.

European expansion to the Americas promoted great debate over relationships between the natural and social worlds. Intellectuals inquired constantly about the New World and what place it might occupy in relation to the Old World, and these questions persisted in Europe and Spanish America for some time. A range of commentators sought to understand the climate of

[22] Ibid., 81.
[23] Ibid., 440.
[24] Ibid., 370.

the Americas as well as its geography, landscapes, flora, fauna, and people in relation to Europeans. This age-old interest in climatic influences increased as European expansion discovered more and different environments, particularly in equatorial regions where people and their culture differed from other societies at similar latitudes.

The relationship between nature and humans has occupied a central place in Mexico's intellectual, social, and economic life since the pre-Columbian period. Early European chroniclers and historians were surprised at how Mexico's indigenous people related to their natural world, and were amazed by their knowledge of plants, animals, and other resources, such as the classification of medicinal plants. During the early colonial period, priests—due to their intimate knowledge of ancient and medieval traditions and their close relationship with native people—played a central role in the development of a natural history tradition in the Americas. The most important example was the Spanish Jesuit José de Acosta, who sought to analyze the region's natural resources and indigenous cultures in hemispheric terms. His *Historia natural y moral de las Indias* (The Natural and Moral History of the Indies) described winds, lakes, rivers, minerals, flora, fauna, and indigenous customs in New Spain, New Granada, and Peru, and was one of the first texts to engage European ideas on climatic influence. According to Acosta, the climate was very charming because people there could not differentiate between winter or summer. The priest also argued that if Europeans abandoned their greedy, useless, and wealthy aspirations, they could live happily in the Americas.[25] Juan González de Mendoza was another author based in Mexico who dispelled old ideas about places in torrid zones (or tropics) being uninhabitable. He examined the climate of the Spanish colonies and its nature, and wrote that its

[25] José de Acosta, *Historia Natural y Moral*.

"good climate" was particularly propitious for raising cattle. Other immigrant Spaniards, including physician Francisco Hernández and writer Francisco Cervantes de Salazar also examined the climate of the Americas and its influence on plants and animals.[26]

In the seventeenth century, the Spanish priest Francisco Ximénez and physician Diego de Cisneros published voluminous works on the relationship between the climate and medicinal plants, animals, water, and air currents in Mexico, giving particular attention to their influence on morality and human behavior. For instance, Ximénez highlighted that the use of medicinal plants called *atatapácatl*, cultivated in lagoons and backwater, which "help to keep chastity, and opposed all vices caused by hot and dry climates."[27] Cisneros applied Galenic doctrine to examine the relationship between diseases and the meteorological characteristics of Mexico City. He affirmed that there were three climates on earth: hot, temperate, and cold but contended that although the second was the best climate, because it produced the most fertile land, it generated lazy people. Cisneros argued that a temperate climate generates "good waters, abundant cattle, beautiful men and women, but as there is no perfect human thing, they lack encouragement, boldness, and desire for work."[28] Flemish engineer Enrico Martínez (d. 1632) also gave consideration to these problems as part of his official duty to construct a great canal that would drain the Valley of Mexico. Once again, these Mexican-based authors related climate to

[26] Elías Trabulse, *Historia de la ciencia en México*, 38-45.

[27] Francisco Ximénez, "Cuatro libros de la naturaleza y virtudes medicinales de las plantas y animales de la Nueva España, extracto de las obras de Fr. Francisco Hernández, anotados, traducidos y publicados en México en 1615," in *Historia de la ciencia en México: estudios y textos [History of Science in Mexico: Studies and Texts]*, ed. Elias Trabulse (México: Fondo de Cultura Económica - Conacyt, 1983), 294.

[28] Cisneros Diego de, "Sitio, naturaleza y propiedad de la ciudad de México, agua y vientos a que está sujeta y tiempos del año," in *Historia de la ciencia en México: estudios y textos [History of Science in Mexico: Studies and Texts]*ed. Elias Trabulse (Mexico: Fondo de Cultura Económica- Conacyt, 1983), 445.

disadvantages in human behavior, but were not hesitant in their attempts to revise European thought.

During the sixteenth and seventeenth centuries, the belief that climate was a determining factor in human development helped provide justification for the manner in which Europeans treated and controlled native people. In the eighteenth century, the discussion about environmental influences in New World populations only increased. European naturalists, philosophers, and historians such as Cornelius De Pauw, William Robertson, and George-Louis Leclerc Comte de Buffon, affirmed that inhabitants of the New World were inferior to those of Europe.[29] These intellectuals assumed that the differences of soil, humidity, and climate in Europe and North America had determined the physical and moral characteristics of their inhabitants. They emphasized that the inhabitants, flora, fauna, and soil of the New World were inferior to those of Europe because people were weaker and smaller than their counterparts in the Old World. Likewise, they argued that native societies were primitive and savage, and their "population [was] insufficient to develop the arts."[30] According to these authors, climate contributed to those differences because it was not "benign." Europeans thus, to an extent, legitimized their colonial domination, supported by the idea that "nature" bred superior and inferior races and that white Europeans occupied the top of this racial hierarchy.[31] Thus, European scientific knowledge far more obviously became a tool used to defend this perspective.

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[29] Ibid., 680; Church Henry Ward, "Corneille De Paw"; Gerbi, *The Dispute of the New World*.

[30] Analysis of Creole authors who participated in this discussion may be found in Chapter 3. Clarence J. Glacken, *Trace on the Rhodian Shore*: 680.

[31] Santiago Castro Gómez, "(Post) Coloniality for Dummies: Latin American Perspectives on Modernity, Coloniality, and the Geopolitics of Knowledge," in *Coloniality at Large: Latin American and the Postcolonial Debate*, ed. Mabel Moraña, Enrique Dussel, and Carlos A. Jáuregui (Durham, NC: Duke University Press, 2008).

Climatic determinism and medical climatology, two key eighteenth-century trends in Western science, explained the influence of climate on behavior, morality, culture, and the health of human beings, as well as the economic development of societies. Climate determinism argued that climate controlled and influenced the physical, intellectual, cultural, and spiritual characteristics of people; meanwhile, medical climatology proposed that climate strongly influenced the causes, prevention, and treatment of diseases. These trends fostered ideas on the inferiority of the inhabitants of the Americas in Enlightenment thinkers such as Jean-Baptiste Dubos (1670–1742); Charles-Louis de Secondat, Baron de La Brède et de Montesquieu (1689 – 1755); and David Hume (1711–1776). Dubos, a member of the French Academy, argued that artistic abilities were one characteristic of a superior race. He analyzed the causes of talents for the arts by examining artists and their works. Dubos concluded that the emergence of genius was not due to moral causes, such as education; on the contrary, he believed that physical causes, such as wind, land, soil, and mostly climate, played a much greater influence on these abilities. The natural history of climate also had a role to play in social history for Dubos: "Artists' genius flourished only in countries with suitable climates (always between twenty-five and fifty-two degrees north); that changes in climate must have occurred to account for the rise and decline of the creative spirit in particular nations."[32]

Meanwhile, the Scottish philosopher Hume followed Dubos's ideas on climate and affirmed that a moderate climate had led to "the gradual advance of cultivation in Europe."[33] Likewise, Montesquieu, a much better-known French author of the Enlightenment influenced by Dubos, argued that climate shaped the character of both individuals and nations; however,

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[32] James Rodger Fleming, *Historical Perspectives on Climate Change* (New York: Oxford University Press, 1998). 12-13.

[33] Ibid., 17.

Montesquieu believed that human efforts such as education, medicine, agriculture, and so forth "could overcome the negative influence of climate."[34] Montesquieu's explanation was relevant because he introduced the element of human agency into climatic determinism: people could improve their circumstances if they altered and controlled their environment. In parallel with these concerns placing climate at the heart of natural history, during the late seventeenth and early eighteenth centuries, the study of living beings began to include concerns about nature as divine creation, which combined with people's increasing "passion for science," greatly promoted the pursuit for knowledge of the natural world and its relationship with humans.[35] These links between the history of the natural world (e.g., soil, geography, climate, etc.) and the social world (e.g., race, morality, etc.) had at their core a discussion about differences between the Old and New Worlds. In other words, studies on the relationships between nature and society have occupied a significant place in intellectual discourse in Europe.

Such discussions about the climate's influence on history and culture were not only of interest to *philosophes* based in Europe. A key expeditionary in the employ of the Spanish colonial state, Spanish explorer Antonio de Ulloa (1716-1795) closely examined the natural world and emphasized the advantages of the climate and nature of the Americas, particularly those that favored agriculture and mineral production.[36] Even though he examined the benefits of climate diversity, he found it was difficult to explain these varieties and their effects. Ulloa, who unlike many of these commentators had long experience as a scientific traveler in the Americas, acknowledged that the New World had characteristics and inhabitants that looked odd to people from other places; however, "among those [odd characteristics] there are some

[34] Ibid., 16-17.
[35] Clarence J. Glacken, "Changing Ideas."
[36] Elías Trabulse, *Historia de la ciencia en México*, 50.

more secretive than others because we cannot [definitively] explain their causes."[37] Like so many eighteenth-century thinkers, Ulloa's works incorporated ancient ideas on nature and divine creation mingled with contemporary vocabulary—words such as *liberal*. He explained, "Nature is liberal in each one of its arrangements, because it distributes its generosity according to climate, territory and air" in order to maintain natural diversity.[38]

European debates over the inferiority of Spanish-American inhabitants, fostered by European authors and energized by scientific activities within the New World, produced several new controversies related to the progeny of Spaniards born in the Spanish colonies (Creoles) who were themselves intent on constructing their own cultural identity combining with elements from the Old and New World. Inspired by these discourses, Spanish-American Creoles used natural history, climate, and geography as key elements in their construction of an identity, particularly when Creole intellectuals sought to defend themselves from European ideological attacks.[39] As will be discussed in later chapters, such concerns continued to influence natural historians when they turned their attention to climate, viewing it either as the cause of diseases or as a way to promote health.[40]

Mexican Jesuit priest Francisco Javier Clavijero wrote one of the most influential Creole texts on these subjects, in which he denied the idea of the "malign nature" of the New World that De Paw and Buffon had presented. Clavijero's work analyzed each of these authors' arguments, using the principle of divine creation to counter their ideas. He argued that if the American

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[37] Ibid., 59

[38] Antonio de Ulloa, "De algunas plantas, frutos y árboles de América," in *Historia de la Ciencia en México*, 61.

[39] Analyzes of these discussions may be found in Chapter 2. Jorge Cañizares-Esguerra, *Nature, Empire, and Nation*.

[40] Clarence J. Glacken, *Traces on the Rhodian Shore*; Antonello Gerbi, *The Dispute of the New World*; Lucian Boia, *The Weather*.

population was inferior to Europeans, it was not due to the climate: the cause was God because he had created the world—an idea that could be embraced only if one accepted the corollary idea that God's creation had been flawed. Indeed, Clavijero compared flora, fauna, and people from New Spain, Europe, and sometimes Africa and examined their characteristics, similarities, and differences in order to show that in all of these countries, inhabitants were diverse. In addition, he used an ancient idea regarding climatic influence to repudiate these criticisms, noting that most Mexican regions were in a temperate climate, which positively influenced nature and people. "Temperate soils produce temperate things, sweet herbs, quiet animals and humans, who belong to the happy climate. Thus, land produces plants, land and plants produce animals, and land, plants, and animals produce man."[41] European opinions about Americans' inferiority inspired a number of other Creoles to reject those arguments and to show themselves as equal to Europeans. Giuseppe Jolis, Juan Ignacio de Molina, and Juan de Velasco devoted many pages to refuting European criticisms. They argued that New World inhabitants and geography were different but had no inherent disadvantages.[42] On the contrary, they used natural history to reaffirm the equality between Europe and the Americas, contending that nature across the entire world was a manifestation of God's creation.

Science in the service of political reform also influenced these discussions and provided an unprecedented stimulus for investigations in natural history. As part of the so-called Bourbon reforms during the mid eighteenth century, the Spanish king Charles III followed the French model of using science as a political strategy to increase Spain's political and economic power. He and his ministers believed that natural history represented a medium to produce "greater

[41] Francisco Javier Clavijero, *Historia antigua de México*, 653.

[42] Anthony McFarlane, "Enlightenment and Political Dissent in Late Colonial Spanish America," *Transactions of Royal Historical Society*, Vol. 8 (1998): 310.

efficiency of natural wealth in his colonies," and the Spanish state therefore provided enormous support for explorations in America, with a special focus on botanical studies.[43] Botanists and physicians led these explorations and looked for medicinal and commercial characteristics of tropical flora because the uses of medicinal plants in pharmaceuticals were fundamental imperial commercial strategies. For example, colonial officials funded botanic expeditions to learn more about Mexican and Peruvian flora and eventually established botanical gardens in Mexico City and Havana. Similarly, the French and British empires promoted voyages of naturalists, such as Joseph Banks, to study the relationship between plants, medicine, and a host of other phenomena considered part of natural history.[44]

Expeditions and surveys with an interest in the natural history of the Americas have become a topic of major recent interest among historians. The best known expedition, the *Misión Geodésica Franco-Española* (French-Spanish Geodesic Mission), supported by the French and Spanish crowns, joined Charles de La Condamine, Antonio de Ulloa, and several other scientists to measure the length of the meridian of earth, starting from Ecuador. It eventually explored much of northern South America in order to study flora and fauna, to take geodesic measurements, and to collect social, military, and political information. During the eighteenth century, twelve scientific expeditions arrived in the Viceroyalty of Peru. Studies on Mexican natural resources, indigenous groups, and populations were also prominent during this era. Most of them entailed expeditions supported by the Spanish Crown and others. The most elaborate of these was the botanic expedition from 1787 to 1803 led by Martín de Sessé y Lacasta (1751–1808), José Mariano Mociño (1757–1820), Vicente Cervantes (1758–1829), and Pablo de la

[43] Elías Trabulse, *Historia de la ciencia en México*, 1239.
[44] Idem

Llave (1773–1833). These scientists traveled throughout New Spain, collecting and classifying around four thousand species. This expedition resulted in two catalogs titled *Plantea Nova Hispaniae* (*The Novohispanic Plants*) and *Flora Mexicana* (*Mexican Flora*)—all of which significantly influenced members of the SMHN.[45]

José Antonio Alzate (1737-–1799) and Antonio León y Gama (1735—1802) were two enlightened Creole who were integral to a second botanic expedition that, according to Elías Trabulse, revealed a different viewpoint from its predecessors, and on which Spanish and Creole naturalists had worked together and did not fight against traditional European knowledge. They underscored the relevance of the experimental method and observation and diligently took care of the precise data that they published. For them, observation was the only way to know the body's characteristics.[46] José Antonio Alzate (1737–1799) took an interest in studies on natural history and Mexican history; he published several works on astronomy, geography, cartography, botany, chemistry, anthropology, and the arts such as the *Historia natural y artes útiles* (*Natural History and Useful Arts*). He also balanced "his religious beliefs and his scientific thought … his attitude was similar to observant and critical scientists, who looked into Holy Scripture [for something other] than moral judgment and good advice."[47] Antonio León y Gama was another enlightened intellectual trained in astronomy, physics, archeology, and medicine. He wrote several texts, including a description of a solar eclipse in 1778 and *Instrucción sobre el remedio de las lagartijas nuevamente descubierto para la curación del cancro y otras enfermedades*

[45] Elías Trabulse, *Historia de la ciencia en México*, 24.
[46] Ibid., 26.
[47] Ibid., 19; Jesús Sánchez, "Apéndice. Colección de Documentos para la Historia Natural," *La Naturaleza* I, 2ª. Serie (1891).

(*Instruction in Use of Lizards Newly Discovered to Heal Cancer and Other Illnesses*).[48] In 1790, Antonio León undertook repair works in the main plaza of Mexico City where he accidentally discovered two relevant sculptures from the Aztec empire: the Stone of the Sun and *Coatlicue* (The Mother of the Gods).[49] These Creole intellectuals help to build Mexican natural history in the second half of the nineteenth century.

Natural history in Humboldt's thought

No scientific traveler had a greater impact on these trends than Prussian geographer and naturalist Alexander von Humboldt (1769-1859). At the turn of the nineteenth century, natural diversity was an attraction for European travelers and naturalists who, despite the Spanish Crown's frequent restrictions, sometimes found the opportunity to travel to the American continent. From 1799 to 1804, Humboldt traveled to Latin America and was continually impressed by the diversity and quantity of natural resources, climates, and peoples he encountered. Humboldt and his travel companion, French botanist Aimé Bonpland, arrived at the Captaincy General of Venezuela, South America in July of 1799 and subsequently traveled to Cuba (1800–1801), New Granada (Colombia; 1801–1803), New Spain (Mexico; 1803–1804), back to Cuba, and lastly the United States (1804). Humboldt wrote extensively on Latin America's natural diversity, climate, geography, and its relationship with societies; and his work strongly influenced Latin American scientists, politicians, and intellectuals.[50] They touted his findings as providing the basis of modern geographical, geological, and biological analysis in

[48] Elías Trabulse, *Historia de la ciencia en México: estudios y textos. Siglo XVIII* [*History of science in Mexico: studies and texts. The Eighteenth Century*], 3.

[49] Enrique Florescano, "The creation of the Museo Nacional de Antropologia of Mexico and its Scientific, Educational, and Politic Purposes," in *Nationalism. Critical concepts in Political Science*, ed. Hutchinson John and Smith Anthony D (USA: Routledge, 2000), 1241.

[50] Luz Fernanda Azuela and Rafael Guevara Fefer, "La ciencia en México en el siglo XIX: una aproximación historiográfica"; Luz Fernanda Azuela, "La influencia de Humboldt.

Latin American science and often as the justification to promote independence movements. Humboldt's career and ideas thus deserve close attention.

Humboldt began his career as a mining official in German territories, but even before his journey to the Americas, he and other intellectuals involved in what became known as *Naturphilosophie* had subscribed to cultural Romanticism and focused on the "re-enactment of the creation and a reintegration of spirit and nature."[51] Hence, Humboldt formed a close relationship with philosopher Friedrich Shelling and writer Johann Wolfgang von Goethe. Spirit, nature, and wealth were themes in Humboldt's work, which was bolstered by the diversity and quantity of natural resources and climates of the American continent. Humboldt led the search to understand the relationship between geography, natural history, and the culture of diverse societies. He explained that the elements of a country's physiognomy (e.g., mountains, plain extension, and altitude, which determined temperature and other parameters of what he called *Geophysik*) shared close links with the wealth of nature in a locale. In turn, those elements influenced agriculture—the base of wealth—interior trade, communications, roads, and military defense, and ultimately the progress and welfare of its population.[52] Moreover, Humboldt believed in free trade and individual freedom, but the Spanish monarchy controlled commercial activities in most of the Americas, impeding progress. On the other hand, the United States was, for him, was an example of progress.

In the course of his travels, Humboldt examined the climate of the Americas, their soil, geography, flora and fauna, culture and history and published several works after he returned to Europe, the most important of which Mexico was concerned being *The Political Essay on the*

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[51] Michael Dettelbach, "Humboldtian Science," in *Cultures of Natural History*, ed. Nicholas Jardine, James A. Secord, and E. C. Spary (Cambridge: Cambridge University Press, 1996), 288; Nicholas Jardine, "*Naturphilosophie*."

[52] Alexander von Humboldt, *Ensayo político*, 21.

Kingdom of New Spain. This specific work revealed characteristics of *Naturphilosophie* such as the vitalism of the forces involved in the development and activities of living beings—for example, ideas on elements of natural growth, development, maturation, and decay, which Humboldt found in stones, flora, fauna, and people. For Humboldt, specimens from the visible world were products "representing a particular and temporary balance of forces."[53] In this interplay of forces, nature and history had a dynamic role—for instance, in *The Political Essay*, Humboldt highlighted nature's intervention in determining the geographical order of plants, animals, winds, mountains, and people.

> We can say that nature has given to the country the best military defense against the Europeans than attacks from Asian enemy […]. The *aliso* winds, and permanent rotation current between tropics, do almost zero any political influence […] that China, Japan or Russia would want into New Continent.[54]

Humboldt was crucially important in making the *history* of these relations—including human's own interventions in nature—an object of scientific study.[55]

Another characteristic of *Naturphilosophen*, "opposed to chemistry based on analytical experiment in the manner of Lavoisier, [and] botany based on standardized descriptions in the manner of Linneaus," was a form of auto-experimentation involving intense natural historical observation of the diversity of natural beings.[56] Humboldt followed this auto-experimentation and natural historical observation during his multiple journeys. From March 1803 to March 1804, Humboldt stayed in New Spain (Mexico) where he found abundant and diverse forms of nature and landscapes. He constantly compared these with European cities; for instance, when he described the Valley of Mexico: "The city appears to the spectator bathed by the waters of Lake

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[53] Nicholas Jardine, "*Naturphilosophie*," 233.
[54] Alexander von Humboldt, *Ensayo político*, 22.
[55] Gregory Cushman, "Humboldtian Science."
[56] Nicholas Jardine, "*Naturphilosophie*," 233.

Texcoco, that surrounded by towns and small localities, remind him of the most beautiful mountain lakes of Switzerland."[57]

Humboldt stated that in New Spain (in contrast to Peru) nature had advantageously placed silver mines at medium altitudes; consequently they were surrounded by farms, small and large towns, and forests. However, Mexico's scarcity of water and the lack of navigable rivers were great disadvantages "amid the many favors provided by nature."[58] In this sense, the author identified with Adam Smith and other Enlightenment political economists who regarded agriculture as the most important source of wealth.

> The main wellspring of wealth in Mexico is not in mines if not in its agriculture […] the state of neglect of the most fertile land and lack of manufacturing industry are attributed to the wealth and abundance of metallic gold and silver in the same way that all the evils of Spain come from the discovery of America, of the transhumance of merinos, or religious intolerance of the clergy. [Nevertheless,] mines [had] beneficial influence on agriculture.[59]

Humboldt underscored that only agricultural pursuits attached men to land and generated love for one's country.

Humboldt claimed responsibility for cities in New Spain that formed around mines, such as Guanajuato, Zacatecas, San Luis Potosi, and Durango. Humboldt also claimed that New Spain could produce all the goods that international commerce demanded (e.g., metals, mercury, etc.) and that such production would equally benefit Mexico—producing iron, copper, and wood for

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[57] "La ciudad se presenta al espectador bañada por las aguas el lago de Texcoco, que rodeado de pueblos y lugarcillos, le recuerdan los más hermosos lagos de las montañas de Suiza." Alexander von Humboldt, *Alejandro de Humboldt. Breviario del Nuevo Mundo* La Expresión Americana (Venezuela, 1993), 35.

[58] Alexander von Humboldt, *Ensayo político*: 27.

[59] "Los principales manantiales de la riqueza del reino de México no están en las minas, sino en su agricultura, que se ha mejorado muy visiblemente desde fines del último siglo. La despoblación de la América española, es estado de abandono en que se hallan sus tierras más fértiles, la falta de industria de manufacturas, se atribuyen a las riquezas metálicas y a la abundancia de oro y de plata del mismo modo que según esta lógica, todos los males de España vienen del descubrimiento de la América, de la trashumación de los ganados merinos, o de la intolerancia religiosa del clero benéfica influencia de las minas sobre la agricultura. Sin los establecimientos formados para el beneficio de las minas ¡cuántos sitios habrían permanecido desiertos! ¡Cuántos terrenos sin desmontar en las intendencias de Guanajuato, Zacatecas, San Luis Potosí y Durango, entre los paralelos de 21 y 25º, en donde se hallan reunidas las riquezas metálicas más considerables de Nueva España!" Ibid., 237-38.

shipbuilding that would help to develop Mexican navigation.[60] In addition, Humboldt underscored race as an additional element in the natural history of societies. Akin to many European commentators, he considered indigenous people an unsuitable race for this kind of development due to two reasons. Indigenous people—representing the majority of the Mexican population—were emotionally volatile, and they also lacked creativity and imagination.

> The Mexican indigene is serious, melancholic, noiseless, when he is not run mad by liquors […]. The Mexican likes turn his most indifferent actions to a mystery; they do not show in their physiognomy even the most violent passions; I cannot even describe how frightening it is when they suddenly go from an absolute rest to an agitated frenzy.
> I do not know any human race appears to have less imagination […]. [Mexicans] do not maintain that vivacity of imagination, that colorful passion, that art to create and produce that characterizes of the people of the noontime of Europe and diverse black Africans tribes.[61]

He argued that contemporary indigenous people were indolent and lazy because their abundance of resources promoted sloth—contrary to poverty, which encourages work. He believed than indigenous groups in the past had been more intelligent and civilized than their modern-day counterparts, but had degenerated as a consequence of the environment of exploitation created by Spanish colonialism.

Nevertheless, rejecting the argument of European commentators like Buffon, the Prussian author underscored that the origin of Mexican problems stemmed from the social realm—people and government—not from the lack of natural resources or the influences of climate. For instance, in addition to indigenous people, Humboldt identified other groups within the Mexican population, such as Creoles and whites, who had been influenced by the region's natural and

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[60] Ibid., 30.

[61] "El indígena mexicano es grave, melancólico, silencioso mientras los licores no le sacan de sí….el mexicano gusta de hacer un misterio de sus acciones más indiferentes; no se pintan en su fisonomía aún las pasiones más violentas; presenta un no sé qué de espantoso cuando pasa de repente del reposo absoluto a una agitación desenfrenada. No conozco ninguna raza de hombres que al parecer tengan menos imaginación…[los mexicanos] no mantienen esta vivacidad de imaginación, este colorido de pasión, este arte de crear y producir que caracteriza a los pueblos del mediodía de la Europa y a diversas tribus de negros africanos." Alexander von Humboldt, *Breviario*: 146.

civil history. He believed that both Creoles' and whites' development related to their own behaviors and failures of institutions more than to environment influences. For instance, for Humboldt, Creoles (decedents of Spaniards) were uncultured, but had been relatively unaffected by climate; on the contrary, they remained in ignorance due to isolation and lack of social institutions, which the Spanish crown maintained in its colonies.[62]

> This new sky, this climatic contrast, this physical conformation of the country works on society's organization in the colonies a much better effect than their absolute distance from the metropolis […]. This influence of physical causes on nascent societies' organization is manifested mainly in parts of population of the same race which have been separated.[63]

In addition, Humboldt suggested that the mix of races in New Spain had been a mistake, because "Mestizos" (i.e., people of mixed European and Native ancestry) had come out so similar to indigenous people. They were lazy and prone to vice because they were the "*heces del pueblo*" (country's feces). The Prussian naturalist affirmed, "everywhere, Europeans mixed with blacks produce a human race more active and constant in work than the mix of white with Mexican indigenous people."[64] In other words, Humboldt's analysis highlighted the race of native people as key to developing societies, more so than geography, such as in the cases of Spain and Mexico.

Nevertheless, for the Prussian, only whites fully demonstrated the progress that could come from "learning" and therefore benefit from the wealth of Mexico's environment. Humboldt supposed that the climate and the geography of Mexico had improved the social organization of the Spanish people because whites were more intelligent. For the Prussian naturalist, only whites

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[62] Alexander von Humboldt, *Ensayo político*: 69,70-72,76,83,87,170,76,88,201-45.

[63] "Este nuevo cielo, este contraste de los climas, esta conformación física del país, obran sobre el estado de la sociedad en las colonias mucho mejor que el alejamiento absoluto de la metrópoli […] esta influencia de las causas físicas sobre el estado de las sociedades nacientes se manifiesta sobre todo cuando se trata de pueblos de una misma raza que se han separado." Alexander von Humboldt, *Breviario:43*.

[64] "La mezcla de europeo y negro produce en todas partes una raza de hombre más activa y constante en el trabajo, que la del blanco con el indio mexicano." Ibid.

exhibited the characteristics needed to properly exploit the abundant resources of Mexico, resources unexplored by the native inhabitants. This affirmation provides one of the clearest windows we have into Humboldt's concept of race. For him, Europeans exhibited favorable characteristics, which they had accumulated over time, and which they could apply to development anywhere; in addition, the Mexican climate and soil were favorable to them. In contrast, indigenous people and mixed races displayed unfavorable characteristics for work and were therefore not capable of developing their country and needed white people to exploit the potential of Mexican wealth. In summary, *The Political Essay* revealed that the most basic obstacles to progress in Mexico were the Spanish monarchy, indigenous people, and the mixed races, who together would not permit agricultural development, had resulted in the stagnation of public welfare, and served as impediments to free commerce. The unfortunate racial composition of New Spain was a result of both natural and civil history, and conspired to prevent this country from realizing the possibilities that its natural wealth might provide.[65] These ideas drew connections between the environment, race, and society.

Nevertheless, Humboldt identified some environmental problems in the Americas. New Spain, he warned, could lose its natural resources, including the water of the lakes of the Valley of Mexico that had greatly decreased year by year according his records, when compared to Spanish chronicles from the conquest period. Another problem he highlighted was the loss of forest due to human activity. For him, lack of forest led to the decrease in water availability—a key conservation doctrine of the nineteenth century. He also identified problems relating to

[65] Alexander von Humboldt, *Ensayo Político*.

social health caused by lead seeping into drinking water, the danger of floods and swamps, and thus, he ultimately favored draining the Valley of Mexico.

Humboldt's studies of the American continent and its population transcended what had come before them and influenced several generations of Latin American thought on natural history and its relation to human history. Diverse reasons enhanced this influence. One of them was that he was able to produce a unified analysis of several factors and their links to the country including physical geography, meteorology, geology, biology, economy, history, and population and compiled statistical data unknown to local people in the early nineteenth century. Another reason was that the Spanish king and royal authorities in New Spain supported Humboldt's journey to several regions because his presence represented a scientific authority, and it was expected he would produce information of great practical value for colonial governance and development. Another aspect of Humboldt's influence was his ability to bring together political and scientific elites from the Spanish colonies who provided Humboldt with information.[66] The most important factor for Humboldt's impact in the Spanish colonies rested on his promotion of the idea that they needed a new government as well as a new economic and political system based on free trade and democracy in order to become similar to the United States. In this way, Humboldt echoed and helped to strengthen the preexisting political and economic aspirations of many Spanish-Americans. Perhaps the most important legacy he left for each subsequent period of political and economic upheaval of the nineteenth century, was the idea that change in government should center on American natural wealth.

[66] Juan Antonio Ortega y Medina, "Estudio preliminar," in *Ensayo político sobre el reino de la Nueva España* [*The Political Essay of the Kingdom of New Spain*], ed. Juan Antonio Ortega y Medina (México: Editorial Porrúa, 2011).

In 1864, just after Humboldt's death, the seminal book *Man and Nature* by the American geographer and diplomat George P. Marsh examined man's effects on natural history and described how human actions had modified the earth. It closely examined a half-century of research in the Humboldtian mold that had been produced in the wake of his American travels. Even though Marsh gave little attention to Latin America and did not have a major direct influence on Mexican natural history, his work brings to the fore an important principle that Humboldt, Marsh, and the members of the SMNH shared in common: a concern for the balance of nature and its disruption.

Marsh affirmed that many of the Old World's physical conditions had changed since ancient times—vast forests had disappeared and meadows that had been irrigated had become unproductive wastelands. He attributed the causes of this decay to geology, but above all to "man's ignorant disregard of the laws of nature, or an incidental consequence of war, and of civil and ecclesiastical tyranny and misrule."[67] In addition, he defended a version of the natural design argument, which affirms that a superior force (i.e., God or a Creator) had made nature for human use. Although in the eighteenth century the French naturalist the Comte de Buffon had proposed similar ideas and believed that man was in control of nature—hence fulfilling creation—Marsh did not believe in the role of man as a natural complement of nature. On the contrary, he recognized that the earth "in its natural conditions" was designed simply for "the sustenance of wild animals and wild vegetation."[68] Consequently, people were required to adapt it for their own use; however, Marsh pointed out that human actions had often changed the "physical conditions of the globe we inhabit" in an imprudent manner.

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[67] George P. Marsh, *Man and Nature; or, Physical Geography as Modified by Human Action* (New York: C. Scribner, 1864), 5.

[68] Clarence J. Glacken, *Trace on the Rhodian Shore*: 38, 65.

> Man has too long forgotten that the earth was given to him for usufruct alone, not for consumption, still less for profligate waste. Nature has provided against the absolute destruction of any elementary matter, the raw material of her works; […] But she had been proportioning and balancing, to prepare the earth for this habitation, when, in the fullness of time, his Creator should call him [man] forth to enter into its possession.[69]

Marsh claimed that human activity tended to subvert the original balance of species because "agriculture and pastoral industry" had affected the earth's surface. For this reason, he indicated those changes "[pointed] out the dangers of imprudence and the necessity of caution in all operations which, on a large scale, [interfered] with the spontaneous arrangements of the organic or inorganic world."[70] Marsh underscored the importance of a restoration of "disturbed harmonies and the material improvement of waste and exhausted regions" because humans depended on nature for survival. In this vein, Marsh defended an organic viewpoint of nature premised on the doctrine of natural equilibrium and the sustainable use of resources during the formative period of industrial expansion.

Throughout his work, Marsh explained the organic function of nature and the negative consequences of disturbing its harmony. For Marsh "[nature] knows no trifles, and her laws are as inflexible in dealing with an atom as with a continent or a planet."[71] Furthermore, he warned about the future consequences of disregarding small details of nature's work, or changes occurring in the earth, because they could generate severe problems. Although these ideas about the organic work of nature, nature as a divine creation, and the balanced use of resources were key concerns for Mexican scientists in the nineteenth century they neglected to listen to George

[69] George P. Marsh, *Man and Nature*: iii, 35.
[70] Ibid., iii.
[71] Ibid., 548.

P. Marsh, in part because Mexican intellectual life had such a strong orientation toward France, where Humboldt had made his home for many years after returning to Europe.

The Latin American Tradition into the Nineteenth Century

During the early 1800s, Spanish-American colonies demanded their political and economic independence and established new nation-states, such as Peru and Mexico. However, the recently formed countries dealt with new problems. Economic crises, clashes between liberal and conservative groups, and political instability were themselves difficult, and periodically inspired interventions from powerful nations such as the United States and France. During this period of conflict and change both scientists and some politicians—with a shared interest in stimulating the economy and maintaining political control—tried to expand the place of natural science in society.[72] At the end of the colonial period, Creole scientists claimed to recognize geographical, meteorological, geological, and biological characteristics and multiple resources important to the future of their countries, which Humboldt had begun to describe in his works, but which were still largely unknown. Others accepted the idea that climate determined the biology of people and, consequently, the economic development of specific countries.

For instance, in 1790, Peruvian intellectuals organized their country's first scientific society called the Sociedad Académica de Amantes del País (Academic Society of Lovers of the Country). Between 1791 and 1795, the society published the *Mercurio Peruano* (Peruvian Mercury), an intellectual journal that analyzed nature from a nationalistic viewpoint and sought to refute the inferiority arguments made by Buffon and other European authors. Peruvians analyzed a range of topics related to chemistry, physics, natural history, and medicine. Physician

[72] Lane Simonian, *Defending the Land of the Jaguar: a History of Conservation in Mexico*, 1st ed. (Austin: University of Texas Press, 1995).

Hipólito Unanue, Peru's most notable scientific intellectual at the end of the eighteenth century, was a key figure in this association.[73] In 1806, he wrote *Observaciones sobre el clima de Lima* (Observations on Lima's Climate), in which he revived ancient Hippocratic ideas on the close relationship between climate and diseases. However, during the middle decades of the nineteenth century, the combined impact of wars for independence, economic instability, and social upheaval greatly impeded scientific research. Peru's professionally trained elite as well as educational, cultural, and scientific activities also struggled to gain a footing.

Since the sixteenth century, Spanish and Portuguese colonies in the Americas had dealt with the ecological and social ramifications of imperial rule and exploitation. Contrary to the expectations of Humboldt and many Latin American intellectuals, this problem did not go away with decolonization. After gaining independence, most of the new countries of Latin America embraced the world of free trade, feeding the economic expansionism of Western Europe and the United States.[74] As we have already seen with reference to natural scientists, the number of politicians, businessmen, religious organizations, and other foreign travelers to the region greatly increased, as did the promotion of the Americas as a land of untapped resources and abundant opportunities to exploit natural wealth.[75]

According to the dependency tradition of Latin American historiography, the end of the Spanish colonial system brought a new pact with "burgeoning industrial powers."[76] As an important part of this "pact," Latin American intellectuals in the nineteenth century turned to scientific knowledge, especially to natural history, as a means to unlock this untapped potential.

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[73] Marcos Cueto, *Excelencia Científica*, 39.

[74] Tulio Halperín Donghi, *Historia contemporánea de América Latina*; A. Charles Hale, "Political and Social Ideas".

[75] Matthew Frye Jacobson, *Barbarian Virtues*.

[76] Tulio Halperín Donghi, *Historia contemporánea de América Latina*: xiv.

International naturalists "mined Latin America for information about plants and animals the same way that foreign businessmen mined for petroleum, copper, gold, and guano. Foreign naturalist tended, in fact, to visit those areas where their home countries had political or economic interest."[77] As Stuart McCook explains, for most of the nineteenth century, international naturalists dominated botanical research in the Caribbean Basin, "extract[ing] botanically interesting plants in much the same way that foreign corporations such as Grace and Company extracted guano from Peru and the United Fruit Company extracted bananas from Central America."[78] Visiting naturalists typically published their findings in international journals and donated their collected specimens to their respective institutions. McCook found that international naturalists contributed little to the development of local intellectual communities in Venezuela and Costa Rica. However, as I will detail in Chapter 3, the case of Mexico demonstrates that international contacts did much to promote interest in natural history and the development of science in Mexico throughout the nineteenth century.

During this period, several political, military, and scientific commissions also promoted the study of Mexico's flora, fauna, and minerals—commissions such as the German-American Mining Society of Düsseldorf, created by Napoleon III; the Horticulture Society of London; the United States and Mexican Boundary Commission, and the Scientific Commission of Mexico. From 1571 to 1887, more than fifty international botanists collected species in Mexico, and between 1803 and 1903, thirty-three foreign malacologists came to Mexico just to study its Mollusca.[79] These commissions promoted contact between intellectuals in Europe and the

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[77] Stuart McCook, *States of Nature*: 19.

[78] Ibid., 26.

[79] Marcos Cueto, *Excelencia científica en la periferia: actividades científicas e investigación biomédica en el Perú, 1890-1950,* 1.ed. (Lima: Grupo de Análisis para el Desarrollo).37; J. Díaz de León, "Catálogo de los moluscos terrestres pluviales que se encuentran en el territorio de la República Mexicana, arreglado por el Dr. J. Díaz de León,

Americas that persisted over time. Indeed, it eventually became routine for international explorers to work on the American continent for three to five years, joined by local scientists and aids on their expeditions, and then travel back to their respective countries. A number travelled back to the Americas repeatedly, and some settled there permanently.

For example, in the field of the earth sciences, Mexican intellectuals referred often to the works of Joseph Burkart (1798–1874), a Prussian miner hired by the British mining company, Tlalpujahua Co., to undertake the direction of excavation of *minerales de oro* (gold deposits) in Tlalpujahua, in southwest Mexico in 1824, just after the end of the independence wars. He was secretary to the Royal Prussian Mining office, and, before his travel to Mexico, had published papers on geology in scientific journals in Prussia.[80] After three years, he became the director of mining operations for the British Bolaños Mining Company. Burkart frequently traveled to Mexico City and several mining zones in the states of Hidalgo, Zacatecas, and Guanajuato in order to collect information about geology, mineralogy, climate, volcanoes, meteorites, thermal waters, and pre-Columbian buildings. In July of 1834, Burkart returned to Prussia and one year later published *Residence and Travels in Mexico between the Years 1825 and 1834*. In two volumes, Burkart provided in the Humboldtian mold assorted information on geology, mineralogy, sociology, ethnography, geography, history, and social health in the areas of Zacatecas, Guanajuato, and Michoacán.[81] Burkart contacted local scientists and miners who

segundo naturalista en la Comisión Geográfico Exploradora," *La Naturaleza* I, 3ª. Serie (1910); W.B. Hemsley, "Bosquejo de la historia de la exploración botánica de México," *La Naturaleza* I, 2ª. Serie (1891); Díaz de León, "Catálogo de moluscos"; Hemsley, "Bosquejo."

[80] W/A, "Aufenthalt und Reisen in Mexico, in den Jahren 1825 bis 1834 [Residence and Travels in Mexico] By Joseph Burkart.," *The Foreign Quarterly Review* XIX, no. XXXVII (1837): 267; Santiago Ramírez, "Discurso en elogio fúnebre del doctor H. José Burkart," *Boletín de la Sociedad Mexicana de Geografía y Estadística de la República Mexicana* II Tercera época, no. 1874-1875 (1875): 201-02.

[81] Luz Fernanda Azuela, *De las minas*, 74-76; W/A, "Residence," 267.

provided information, which he included in his publications. For example, José Maria Bustamante had studied at the *Colegio de Minería* (Mining College) established during the late colonial period, became a mining judge in Guanajuato and Zacatecas, and published his *Descripción de la Serranía de Zacatecas* (*Description of the Zacatecas Highland*) in the same year that Burkart published his *Residence and Travels in Mexico*.[82] After Burkart returned to Prussia, he maintained contact with Mexican intellectuals, such as Antonio del Castillo and Mariano Bárcena, both members of the Society. Burkart published around forty-one works on mineralogy, paleontology, geology, meteorology, and geography of the places in Mexico where he worked and traveled that provided a starting point for later work by Mexican natural historians.[83]

Like so many scientific travelers and technicians who journeyed to Latin America during the post-independence period, one of Burkart's goals was to continue Humboldt's work.[84] He focused on regions that Humboldt did not visit, followed Humboldt's framework of including all landscape elements of the natural and social worlds, and provided vivid, detailed descriptions of physical characteristics of men and their activities, costumes, behavior, social inequality, and political life relating to geographic characteristics of the regions.

> This defile (*cañada*) extended seven leagues beyond the Indian village of that name. Lemons and many beautiful kinds of cactus grow here. The inhabitants weave a great quantity of the coarse cottons which Indians use for clothing. The pastor of the place, of the same dark colour as his parishioners, received several of us very hospitably in his parsonage-house, the majority, however, were obligated to seek accommodation in the casa real. […] This *cañada* affords the geologist an admirable opportunity of observing elevations and depressions. Limestone in strata of from 6" to 5" thick, alternating with a few not very thick strata of flint slate.[85]

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[82] Ibid.,72

[83] José Alfredo Uribe Salas, "Andrés del Río, Antonio del Castillo y José G. Aguilera en el desarrollo de la ciencia mexicana en el siglo XIX," *Revista de Indias* LXVI, no. 237 (2006): 508.

[84] See Mary Louise Pratt, *Imperial Eyes*, ch. 8.

[85] W/A, "Residence," 270.

Elsewhere, Agustín Codazzi in Venezuela and Ramón de la Sagra in Cuba carried out comprehensive "chorographic" surveys, which included information related to fauna, climate, agriculture, commerce, and population. Mariano Eduardo de Rivero y Ustáriz from Peru studied chemistry and mineralogy in Europe, and thanks to Humboldt's suggestion, took charge of a technical mission to revive the scientific institutions of Gran Colombia, then in 1826, was named the Peruvian director of mining, agriculture, public instruction, and museums by Simón Bolívar.[86]

Meanwhile, as domestic intellectuals turned to natural history in search of patterns to establish laws in order to guide their respective countries toward development, the relationship between the natural history tradition and economic and political power strengthened. For many new countries, the period following the wars of independence was dominated by reconstruction, slow economic recovery, and stagnation. For this reason, many Creole elites looked to European models of national development and founded organizations that joined planters, politicians, physicians, engineers, and "enlightened citizen [who] promoted economic development by diagnosing the country's main problems and proposing concrete solutions to them."[87] Those associations called *sociedades económicas* (economic societies) organized botanical gardens, natural history museums, expeditions, and cartographic surveys in order to "use science to nationalize nature, to extend state power over the natural world," and to use natural resources in order to improve their countries' circumstances. Many associations "leftover from the colonial period" sponsored research on natural history, at first mainly to promote agricultural modernization.[88]

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[86] Marcos Cueto, *Excelencia Científica*: 44.
[87] Stuart McCook, *States of Nature*, 16.
[88] Ibid.

The Challenge of Neocolonialism

After the Spanish colonies' wars of independence the region was in flux; it needed to refashion itself on an international geopolitical plane. Conflict erupted among several political and economic groups, and most inhabitants were caught in the middle. These circumstances occasioned not only US and French military interventions in Mexico but also left lingering economic and ideological marks. One of these ideological legacies of colonialism was the notion that there was an abundance of natural resources in Mexico—an idea that strengthened during the nineteenth century and attracted the interests of new and powerful nations interested in establishing what are often referred to as "neocolonial" relationships with Latin America. The French Scientific Commission of Mexico contributed to the image of Mexico as a country plentiful with minerals. According to the Commission's reports, Mexico had a larger area of mining zones than people believed.[89] French scientists proposed that metal-bearing territories accounted for four-fifths of Mexico's territory and that mines in the plateau were more accessible due to a climate that promoted agricultural resources and communication facilities. The Commission also highlighted that the benign climate played a key role in mining activities because extraction and production of precious metals required agricultural activities and the existence of pack animals. For instance, miners needed horses, donkeys, as well as grains to feed workers and their beasts of burden. For this reason, he argued, plateau areas had been climatically favored for development.[90]

Even though Commission scientists underscored the abundance of minerals in Mexico, at the same time they lamented that all the forces, intelligence, and the capital devoted to the

[89] La Commision Scientifique du Mexique, *Rapport sub Divers Memories de Geologie*, ed. Archives de La Commision Scientifique du Mexique, vol. III (Paris: Imprimerie Imperiale, 1867), 296.

[90] Ibid., 297, 314.

mining industry had seemed to be detrimental to social progress and had made Mexican agriculture subservient to mining.[91] Contradicting earlier commentaries from the "dispute of the New World," they did not blame climate for this situation. Commission scientists also observed that people who lived on the central plateau had experienced no adverse effects from the climate because they were well "acclimated," had a nervous system predisposed to be "sanguine" (optimistic), but had relatively limited physical and intellectual strengths. "In contrast to what people think, they [plateau inhabitants] did not suffer degeneration, and they continue representing the climate of the region."[92] According to the French Commission, cultural factors were more important. Infant mortality and lack of hygiene, which prompted diseases like yellow fever in lowland areas, negatively affected the rate of population increase in Mexico. The Commission also blamed cultural factors for causing the supposed degeneration of indigenous races, noting that indigenous children demonstrated intelligence, but this changed as they became adults due to the development of instinctual habits, for instance, women expressed more moral qualities than men.[93] These scientists tended to follow Humboldt's ideas regarding the oppressive nature of the Spanish colonial system, which had eliminated initiative and energy from the Mexican people, and believed that the colonial and postcolonial education systems had not trained Mexicans to manage their independence. In other words, the French Commission argued that the Spanish Crown was responsible for problems the Mexican people were still suffering decades after independence. Scientists of the French Commission suggested that European participation could quickly improve Mexican circumstances: "during recent years we have been very preoccupied with Mexican political issues and its future. We have seen that

[91] Ibid., 316.
[92] Ibid., 466.
[93] Ibid., 468.

[Mexico] is a big country and its natural resources could lead European migration to increase population with good results."[94] However, they were not too keen on the idea that European migration would lead to a "mix of races" because of acclimatization problems. French scientists argued that Spanish people acclimatize easily but that people from north and central Europe could not readily achieve it.

During the nineteenth century, the United States began to expand rapidly in two directions: the economy and the new ideology commonly termed Manifest Destiny. Scholars such as Richard Peet, Matthew Jacobson, and Ian Tyrrel underscore that both increases—in markets and new ideologies—influenced US economic and cultural expansion abroad, promoting the extension of transnational networks and construction of an American Empire. Richard Peet explains that US expansion for most of the nineteenth century was confined to the claimed national territory of North America. "The last third of the century saw this claim realized at the remarkable rate, Americans settled more land during 30 years after 1870 than they had during the entire 300 years before."[95] During the second half of the century, the US government increased its interest in overseas territories in the Pacific Basin, the Caribbean, and Central America. Their focus was on land, agricultural capitalism, markets, and raw materials that were important to industry and urban consumers. Jacobson explains that from at least 1861 Secretary of State William H. Seward had stressed the importance of developing international commerce and policies of global reach toward Alaska, Hawaii, and others areas such as China, the Caribbean, and Latin America, in order to conquer foreign markets.[96] However, several economic depressions occurred in the United States in the years 1873–79, 1882–85, 1893–97, and 1907–

[94] Ibid., 469.
[95] Richard Peet, "The Social Origins," 319.
[96] Matthew Jacobson, *Barbarian Virtues*, 21.

08. These financial difficulties prompted many to think about ways in which the United States could avoid these problems in the future. As Jacobsen argues, "one … mainstay of economic discussions throughout these years was the fevered talk of 'overproduction' and the need to secure foreign markets."[97] Transportation routes and communication lines increasingly extended beyond regional economies, as US goods became integrated to a worldwide economic system. Jacobson notes that "[by] the late nineteenth century, Americans seemed to have created precisely such an empire; […] American producers felt themselves more and more dependent upon the spending habits of little-known consumers in distant lands."[98] However, both China and Latin America presented two different possibilities for US exports and were a "significant proving-ground for those expeditionary forces associated with empire."[99] In this sense, Latin America and the Caribbean were not only consumers of US goods, they provided an ideal setting for an export economy that required canals, harbors, naval bases, natural resources, and cheap labor.[100] While from Mexico's perspective US could contribute to its economic development.

One of the results of US economic expansion was the hardening of racial and cultural stereotypes. Peet argues that behind the economic interests motivating this expansion were also "more sophisticated kinds of theoretical justification." The ideology of Manifest Destiny was a key factor. The idea of Manifest Destiny consisted of "metaphysical dogmas of a providential mission and quasi-scientific laws of national development, conception of national right and, ideals of social duty."[101] Moreover, some intellectuals influenced the thought of US policymakers in order to create a new empire. These intellectuals drew connections between the

[97] Ibid., 18.
[98] Ibid., 17.
[99] Ibid., 25.
[100] Ibid., 26–40.
[101] Richard Peet, "The Social Origins," 320.

environment, race, and society, "explaining thereby the natural basis of national superiority in expansion."[102]The United States framed its imperial attitude toward Latin America with claims that its inhabitants were savages and that "destiny had provided lands south of the border as a mere extension of the North American frontier."[103] For this reason, US nationalists and businessmen promoted the idea that, by natural law, Latin American trade was theirs.

Hence, Gardiner affirms that between 1810 and 1910, as a part of the spirit of Manifest Destiny in the United States, North American businessmen, travelers, and scientists became interested in many remote areas of Mexico. Steam ships and railroads helped Americans visit their unknown, incomprehensible, and "savage" neighbor. After the United States recognized Mexico's independence in 1821, Americans published hundreds of writings about Mexico including diaries, letter collections, and travelers' accounts.[104] Writings from the first half of the nineteenth century tended to belong to businessmen, military personnel, and diplomats, whereas during the second half, we see the proliferation of writings by geographers, geologists, meteorologists, and naturalists who came to Mexico to study the landscapes, economy, and culture of the country. In 1869, Michael James Box published *Capt. James Box's Adventures in New and Old Mexico*, in which he narrated his trips to Mexico's northern states of Sonora, Chihuahua, Sinaloa, and Durango, describing geography, roads, people, rivers, and valleys linked to mining. He remarked on the abundance of silver, gold, copper, land, and wood that had not been explored because Mexico was a wild, uncontrolled country and an awkward place, and its inhabitants were "half-civilized, half-barbarous" natives who were too occupied with

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[102] Ibid.

[103] Matthew Jacobson, *Barbarian Virtues*, 38.

[104] Walther Bernecker, "Literatura de viajeros como fuente histórica para el México decimonónico: Humboldt, inversiones e intervenciones," *Tzintzun. Revista de estudios históricos* Julio-Diciembre, no. 38 (2003) http://www.redalyc.org/articulo.oa?id=89803803 (accessed March, 12 2012).

"wrangling over miserable shreds of past wealth."[105] Some American scientists, such as those from the Smithsonian Institute, added to the interest in the diversity and abundance of Mexico's flora and fauna throughout the nineteenth century. Environmental determinism and ideas about the abundance of resources in Mexico influenced economic and scientific models over time.

French natural history and the challenge of evolutionary biology

French thought in general and the methodology of French natural historians powerfully influenced Latin American intellectuals. Mexican scientists who joined the Sociedad Mexicana de Historia Natural frequently cited in their journal, *La Naturaleza*, works by George Cuvier (1769–1832), Étienne Geoffroy Saint-Hilaire (1772–1844), and Horace-Bénédict de Saussure (1740–99). Most of the French scientists they cited worked in the Museum National d'Histoirie Naturelle in Paris, which itself provided a model for the institutionalization of natural history in Mexico. This influence reached its peak with the efforts of *la* Commission Scientifique du Mexique (1864–1867), whose work was often translated by Mexican journals, along with other French publications such as the Faculty of Medicine of Paris, the Zoological Society of Paris, and the Annales de Chimie et de Physique (Annals of Chemistry and Physique).[106]

According to Dorinda Outram, the Museum National d'Histoire Naturelle was the best and most prestigious institution in the field of natural history during the first half of the nineteenth century. At this institution, naturalists such as George Cuvier, Jean-Baptiste Lamarck, and Étienne and Isidore Geoffroy Saint-Hilaire developed their scientific work, and it became a

[105] James Box, *Capt. James Box's Adventures*, 16.

[106] Discussions on the origins and career trajectories of the community of individuals belonging to the in the SMHN, especially their personal and professional background, and their institutional networks to understanding those links with French thought may be found in Chapter 2.

kind of home for scientists and their families.[107] Cuvier looked for relationships between living beings "by comparing their internal structures rather than their external characteristics." He achieved this by carrying out comparative anatomical studies. As a result of Cuvier's works and those of other naturalists, anatomical exploration of internal structures emphasized work in detail: "to discover the particular ways in which systems related, and to use those relationships as the basis for grouping living beings together. This way of classifying tended to privilege function over form." In addition, Cuvier's influence on comparative anatomy promoted many other paleontological explorations bringing the history of life on earth to light.[108]

French investigations in natural history not only took place in the museum, but also in the field. Horace-Bénédict de Saussure, a naturalist of the late eighteenth century, focused on the study of minerals, rocks, and their relation to landforms. He underscored fieldwork as "an essential part of scientific practice," not just for collecting specimens, "but for seeing with one's own eyes how the various minerals and rock masses were spatially related to one another and to the physical topography of the areas in which they were found."[109] Mineralogy was one of the three kingdoms of nature, but had a special claim to practicality. Managers and owners of mines expanded their collections, which they frequently exchanged or compared with others. However, naturalists, such as Saussure, looked beyond collecting, sorting, naming, and classifying specimens. They added a category called formation: "a concept of immense practical value [it] was an assemblage of broadly similar rocks, separated more or less sharply from the adjacent

[107] Dorinda Outram, "New Spaces in Natural History," in *Cultures of Natural History*, ed. Nicholas Jardine, James A. Secord, and E. C. Spary (Cambridge: Cambridge University Press, 1996), 250.

[108] Ibid., 251.

[109] Martin Rudwick, "Minerals, Strata and Fossils," in *Cultures of Natural History*, ed. Nicholas Jardine, James A. Secord, and E. C. Spary (Cambridge: Cambridge University Press, 1996), 271.

formations."[110] Using this concept, Saussure and others sought to define and to describe formations that would be recognizable beyond a single region and, ideally, even on a global scale. Formations were identified with their equivalents in other regions or even on the other continents—regardless of whether or not scientists discovered exactly matching copies. By around 1840, most geologists conceded, in practice, that the course of earth's history could not be predicted in advance by any grand theory; it could only be reconstructed by detailed analyses of the organic and inorganic "archives of nature."

The analysis of environmental factors and their relationship with demography gradually turned to a different focus in the nineteenth century thanks to an emerging understanding of biological change. On these matters, the works of Frenchmen Jean-Baptiste Lamarck (1744–1829) and Auguste Comte (1798–1857) and Englishman Herbert Spencer (1820–1903) influenced more Mexican scientists far more than the works of Charles Darwin (1809–1882). Their ideas on changes in nature over time, adaptation, environmental influence, inheritance, progress, and evolution presented new explanations on the workings of natural history and the processes of change within societies. In the process, they reinforced some ancient beliefs about the influence of nature on societies and further strengthened the idea that the environment was a determining factor in regional historical development, but they also took into account humans' ability to modify their circumstances.

According to Lamarck, another figure closely tied to the Museum National d'Histoire Naturelle, the environment directly influenced the habits that caused changes in an organism's shape and its internal organization. The reproduction between organisms sharing the same

[110] Ibid., 274.

environment preserved such characteristics and resulted in the accumulation of physiological traits.[111] This explained how the giraffe had stretched its neck reaching for the uppermost leaves of trees in semi-arid regions. For Lamarck, these processes of organismic change inherently tended toward complexity.[112]

> Nature, in producing successively all the species of animals, beginning with the most imperfect or most simple in order to end her work with the most perfect…. Each species received from influence of the circumstances in which it is found the habits now recognized in it and the modifications of its parts that observations show to us.[113]

Lamarck explained that the inheritance of acquired characteristics—and the environmental forces that adapted them to local environments through use or disuse—caused differences among organisms. Although few embraced Lamarck's ideas on evolution during his lifetime, they attained great popularity and influence after the publication of Darwin's *The Origin of Species* in 1859—more so than Darwin's own work.

Auguste Comte's positivist approach was an intellectual milestone for the second half of the nineteenth century in Latin America. Surprisingly, this French sociologist was seldom cited directly by members of the SMNH. His ideas on the relevance of theoretical and applied knowledge to obtain advances in societies exercised a powerful influence, however, as the basis of national educational plans in Mexico, and through these educational institutions several generations of Mexican scientists were trained according to Comte's paradigm. His philosophical argument (positivism) proposed that the scientific method is the only way of gaining true knowledge. (Its methods are observation, experimentation, and the search for the laws of phenomena or the relationships between them.) His approach had even more important

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[111] Richard Peet, "The Social Origins of Enviromental Determinism," 312.
[112] Ibid., 1.
[113] Ibid., 312.

ramifications for the organization of society. "As a set of social ideas, positivism argued that society was a developing organism, not a collection of individuals. … The key to the scientific management of the society was to develop an elite that could provide the leadership for social regeneration."[114] In this sense, Latin American scientists believed that countries lead by trained technocratic elites, with appropriate strategies in education and public health, were best suited to direct the world. In other words, scientists and politicians found in Comtean positivist theory the foundation to search for patterns and laws derived from the unique conditions of each nation capable of guiding the country toward "order" and "progress" as in European societies, especially France.[115]

Herbert Spencer's positivist proposals offered another biological explanation for social life that greatly influenced Latin American thought, mainly among Mexican intellectuals. This British sociologist and philosopher was the most prominent of the so-called Social Darwinists who applied biological principles to social science by way of analogies between natural and social processes. Environment was a critical part of his philosophy. Spencer explained that all objects "could be understood in terms of a purely physical interaction between internal and external forces." For instance, "species or society changes under the combined influences of [their] intrinsic nature and the environment's actions, inorganic and organic."[116] According to Spencer, the factors of evolution were (a) original and extrinsic such as climate, surface qualities and intrinsic such as physical and intellectual character; and (b) either secondary or derived: "a set of factors brought into play by social evolution itself, like modifications of environment, size

[114] Claudia Agostoni, *Monuments of Progress: Modernization and Public Health in Mexico City 1876-1910* (Canada: University of Calgary Press, University of Colorado, UNAM, 2003), 25.
[115] Luz Fernanda Azuela, "La ciencia en México."
[116] Ibid., 313.

and density of the social aggregate, and inter-societal reactions." In other words, Spencer identified interactions between extrinsic and intrinsic factors as the key to shaping species and societies. Earlier geographical works drew from the theory of interactions the effects of the environment on human society and affirmed that "the source of those forces by which life […] is carried on […] is the source of the forces displayed in human life, and consequently in social life."[117] For Spencer, climate was an extrinsic factor of evolution because of its interaction with intrinsic factors—similar to how the physical and intellectual characteristics were key in shaping species and societies.[118] Furthermore, he believed that humans were capable of changes to the environment—thereby improving their health. In this sense, he echoed ancient Greek thought on the relationship between the climate and health. It explained that although weather and climate could cause diseases, certain types of conditions brought beneficial illnesses that improved human health and fitness of the human species, an idea that late nineteenth-century medical climatology widely embraced.

In contrast to the enthusiastic and rapid adoption of Lamarckian and Social Darwinist ideas, Darwin's theory of natural selection, as explained in *The Origin of Species*, was incorporated only gradually, though controversially, in Latin American intellectual circles. Darwin, throughout his voyages around the world from December 1831 to October 1836, investigated a wide range of biological and geological phenomena, which helped him to develop his theory, and in many ways represents the culmination of the natural history tradition, particularly the version advocated by Humboldt. Darwin's theory of evolution focused on what he called "natural selection," the mechanisms by which random variations proved beneficial in

[117] Ibid.
[118] Ibid.

the struggle for survival. The results of these struggles could be diverse, including the extinction of species, and those species most adept at reproduction ensured their survival.[119] In summary, he explained that

> In considering the Origin of Species, it is quite conceivable that a naturalist, reflecting on mutual affinities of organic beings, on their embryological relations, their geographical distribution, geological succession, and other such facts, might come to the conclusion that each species had not been independently created, but had descended, like varieties, from other species. Nevertheless, such a conclusion, even if well founded, would be unsatisfactory, until it could be shown how the innumerable species inhabiting this world have been modified so as to acquire that perfection of structure and co-adaptation which most justly excites our admiration. Naturalists continually refer to external conditions, such as climate, food, & c., as the only possible cause of variation. In one very limited sense, as we shall hereafter see, this may be true; but it is preposterous to attribute to mere external conditions, the structure, for instance, of the woodpecker, with its feet, tail, beak, and tongue, so admirably adapted to catch insects under the bark of trees.[120]

In the initial controversy following its publication, Cuban and Mexican intellectuals loudly favored or dismissed Darwin's work. Nevertheless, some authors, such as Cuban José Martí, stated that science alone would not resolve the country's problems, nor grant people their freedom: "What good is having Darwin on the table if we have the foreman in our habits?"[121] In Mexico, the Catholic Church, conservative groups, and several followers of Comte's philosophy strongly opposed Darwin's theory.[122] Some Mexican intellectuals did embrace Darwin's theory in order to explain social evolution, however; and politicians found in natural selection and evolution concepts that justified their economic and social policies.[123]

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[119] Richard Peet, "The Social Origins of Environmental Determinism," 312.

[120] Charles Darwin, "On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life," *Resonance*, no. February (2009): 206.

[121] Thomas F Glick, "La polémica del darwinismo en Cuba" [The Darwinism Controversy in Cuba], in *II Congreso de la Sociedad Española de Historia de las Ciencias*, ed. Sociedad Española de Historia de las Ciencias y de las Técnicas (Jaca: SEHCYT, 1984).

[122] Roberto Moreno, *La polémica del darwinismo en México, siglo XIX: testimonios [Darwinism polemic in Mexico, the nineteenth century: testimonies]*, Segunda Edición ed. (México: Universidad Nacional Autónoma de México, 1989). 17-22.

[123] Analyzes of those ideas in the Mexican government may be found in Chapter 4.

In many Latin American states, the 1870s represents an important point of departure for natural history research, when the widespread triumph of liberalism, quickening pace of national development, free-trade policies, and long export boom provided a boost to scientific research and its institutionalization. Relationships between liberal governments, science, technology, and medicine became even more important in the construction and sustention of Latin American states during this era. By this time, developments in science and technology were noticeably helping to bolster the economy because they helped to increase crops and goods produced for export, contributed to railroad construction, and helped to eradicate diseases. In other words, the institutionalization of science and technology during the late nineteenth century favored Latin American attempts to attract international investment and to increase their participation in world markets, however, often at great environmental cost, including the destruction of forests and spread of diseases and pest, which in turn led planters and governments to turn to scientists for help.[124]

At the end of the nineteenth century, the positivist paradigm was widespread in intellectual circles throughout Latin America. Scientists and politicians continued to regard scientific strategies as means to improve their respective country's circumstances and frequently organized scientific conferences and meetings with governmental support. For instance, in 1898, the Scientific Society of Argentina organized the First Latin American Scientific Conference in Buenos Aires, with subsequent meetings in 1901 (presenting 121 papers), in Montevideo in 1905 (presenting 202 papers), in Rio de Janeiro in 1908 (presenting 120 papers)—culminating in the

[124] Stuart McCook, *States of Nature*: 22; Cueto, *Excelencia Científica*: 57.

First Pan American Scientific Conference and Fourth Latin American Conference in Santiago de Chile in 1908-09 (presenting 420 papers).[125]

In 1868, Mexico's liberal government, led by Benito Juárez, designed a new academic (for children or university students?) curriculum where natural history and scientific method had an important place, in keeping with Comte's methods. However, as part of the institutionalization of science during this period, new generations of Mexican scientists gradually lost interest in natural history studies and focused instead on new specializations within the natural sciences. As early as 1871, law students asked that the study of natural history be omitted from their curriculum because they did not consider it useful in their professional training.[126] In 1883, natural history's priority in the educational plan decreased even further. As one _____ bemoaned:

> Incredible is that, while civilized countries on the world natural sciences study is mandatory, in the capital of the Mexican Republic people tried to hold the uselessness of natural history studies to engineers and agriculture.… I remember with surprise that in the visit of an influential person at Agriculture School in 1856, he qualified of uselessness and burdensome to government this school, because he argued that in our country, whose fertile soil is noticeable, was have enough practice ´to cultivate land and to know the herbs.' The wealth of our country did not limit some mineral exploitation; the organic kingdom is as abundant, useful, and productive as inorganic."[127]

In 1898, the SMHN tried to turn this situation to its advantage by stating that the lack of interest in natural history studies had resulted in the loss of resources because the sort of attitudes toward their rational development promoted by the natural sciences did not carry weight among Mexican educational authorities. Ricardo Ramírez, a lawyer, explained that during the colonial period, educational law required natural history courses only for medical and pharmacy schools.

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[125] Marcos Cueto, *Excelencia Científica*, 59.

[126] Sexta Legislatura del Congreso de la Unión, "Diario de debates de la Cámara de Diputados," ed. Congreso de la Unión, Diario de debates. Primer periodo de sesiones ordinarias (México: Imprenta de F. Díaz de León y Santiago White, 1871).

[127] Leopoldo Río de la Loza, "Discurso pronunciado por el Sr. Dr. Leopoldo Río de la Loza, presidente de la Sociedad Mexicana de Historia Natural," *La Naturaleza* I, 1ª. Serie (1870): 410-11.

Courses “were elemental botany classes and [disorganized]” because students thought that natural history was not useful.[128]

As a result, physician Fernando Altamirano and lawyer Ricardo Ramírez began to insist on including natural history studies in national education because “the lack of studies from early periods in Mexico was generating problems such as deforestation and the loss of knowledge regarding the laws of life.”[129] Altamirano suggested including natural history topics in primary and secondary schools because he blamed extensive deforestation on the apathy of several generations, which threatened the country. “The explanation is in the mistake of [paying little] attention to natural science studies.”[130] Altamirano paraphrased seventeenth-century French minister Jean-Baptiste Colbert “French Minister said France will perish because of [the lack of] forest, in this moment we have to exclaim that Mexico will perish because of [the] destruction of its forest,” and he consequently believed that knowledge of nature would train students to live in harmony with it. For Ramírez, the most important lesson for people was to know laws and the general conditions of the lives of other organized beings.[131] Ramírez explained within a Darwinian framework that humans were organized in the same manner as plants and animals because the natural laws subjugated them equally. For this reason, he thought it imperative that people know these laws, which explained origins and the circumstances of institutions, uses, customs of societies, as well as the known solutions to their problems.[132]

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[128] Ricardo Ramírez, "La Enseñanza de la Historia Natural en la República Mexicana [Natural History training in Mexican Republic]," *La Naturaleza* III, 2ª. (1898).

[129] Fernando Altamirano, "Necesidad de la repoblación de los bosques" [Necessity of restock forests], *La Naturaleza* II 2ª. Serie (1897); Ramírez, "Enseñanza."

[130] Fernando Altamirano, "Necesidad de la repoblación de los bosques" 11.

[131] Ibid.

[132] Ricardo Ramírez, "Enseñanza."

Those theories in natural sciences, which were based on an understanding of reciprocal relationships between nature and society, took into account human intervention in modifying their circumstances and enhanced Mexican thought regarding the idea that knowledge about nature would help to develop the country. However, studies on natural history and society's participation in its understanding gradually decreased, whereas interest in the analyses of other sciences (e.g., biology) and the number of scientific societies and institutions increased.[133]

Conclusions

Western studies on flora, fauna, mineralogy, climate, soil, winds, and water and their linkage to social development had their roots in the ancient Greek tradition and were maintained and elaborated upon in European and American thought throughout the centuries. Since the end of the fifteenth century, this growth in natural history knowledge had accompanied the expansion of European political and economic interests during their colonization of territories overseas. However, when Spanish immigrants arrived to the American continent, they faced natural conditions and human societies vastly different from those of Europe, and struggled to make sense of them. The early modern European natural history tradition highlighted the Americas' extensive territory, natural diversity, and abundance of resources. Under these circumstances, many European thinkers came to believe that natural elements affected the population of the New World in a negative manner, and Europeans tended to justify their colonization policies by stating that "nature" had created superior and inferior races. Ideas on the inferiority of the Americas' inhabitants fluctuated according to changes in scientific and geopolitical interests.

[133] Rafael Guevara Fefer, *Los últimos años*.

The nineteenth century was a time in which political, economic, and ideological changes greatly affected the development of technology, science, and environment. The industrial revolution brought about the use of steam engines and changes in production processes, increased demand for natural resources to help fuel production, and emerging mass markets around the world. After the wars of independence, Spain's former colonies became increasingly attractive to northern travelers and investors, many of whom began promoting the new countries as lands filled with untapped resources, which Europeans and North Americans could exploit. Natural history studies attained new relevance to these international markets and governments, as did interest in the laws of nature focused on maximizing the utility and benefits to society. Where the new nations of Latin America was concerned, Alexander von Humboldt's works dominated the discourse and underscored the relationship between the wealth of nature, geography and the culture of societies. George P. Marsh insisted that man, as an agent, had greatly modified the earth, and even though Latin American authors did not read him directly, they later adopted and expanded similar ideas on their own. Lamarck, Spencer, and Darwin's theories related to biological principles of evolution strengthened interest in the influence of environment in social development, and reworked earlier ideas of national inferiority for countries, such as Mexico, saying they had not evolved because their inhabitants lacked the skills to exploit their resources to the same extent as Europeans and North Americans. However, the same logic declared, Mexicans were not doomed by their inheritance; circumstances could be better if the environment were modified.

Even though Latin American natural history seemed to follow European natural history paradigms, a deeper analysis of natural history studies reveals several additional nuances. First, during the early colonial period, priests involved in retrieving natural knowledge from

indigenous cultures often argued that European ideas on the unfavorable climate of the Americas were wrong. During the eighteenth-century, natural history knowledge became a means to construct an identity for Spanish descendants born in the Americas, as it did for later independence leaders, for whom Humboldt's works strengthened notions of independence. One other nuance in the formation of the Latin American natural history tradition was the particular politicization of nature's diversity and abundance in each country. After the wars for independence, political, economic, and social crises led politicians and scientists to claim they had found strategies to improve the circumstances of their new nation-states by using natural history studies to better allocate resources in order to obtain the most benefits from them. Ideas on the local population's inferiority also provided a useful argument against indigenous people that favored Creole Spanish-American descendants. In other words, the European natural history tradition helped to develop Latin American scientific endeavors in an array of fields and strengthened the understanding of the relationships between nature and society. Overall, natural history contributed tangibly to economic policies during the construction of new nation-states, focusing on use of nature toward the development and progress of countries.

Chapter 2 The Societal Roots of Natural History in Nineteenth-Century Mexico

In 1868, two engineers, six physicians, and two pharmacologists—all between the ages of twenty-five and forty-eight—and more than sixty other Mexican and foreign intellectuals from diverse disciplines came together to do something about the fact that Mexico had a natural patrimony still unknown to many Mexicans. They proposed to track the geographical, meteorological, geological, and biological characteristics of their homeland in order to discover resources that would improve their country's circumstances. Those same intellectuals founded the Sociedad Mexicana de Historia Natural (SMHN) with the further objectives of: 1) introducing the natural history of Mexico and promoting its study to the public, 2) joining together as a community of practitioners and publishing works by national and international authors related to indigenous species and, 3) integrating the collection, classification, and systematic study of objects from the three kingdoms of nature.[1] Many of these intellectuals had worked earlier on national scientific commissions, arguing that studies on mineralogy were particularly valuable because mining was the elementary "force and power of Mexico" and could directly increase public wealth.[2] Although scientists promoted the use of natural resources, they also warned that the Mexican people would have to learn how nature works in order to prevent generating dangerous disequilibrium in the natural order. In other words, they insisted on promoting the production of scientific knowledge to maximize human benefit from nature without disturbing organic processes.

Probably the most important task of this new society was the dissemination of this new knowledge. From 1869 to 1914, the SMHN edited a journal titled *La Naturaleza* that published

[1] Antonio del Castillo, "Discurso" .
[2] Ibid.

the researchers' results, translated articles of other international institutions, and distributed the texts of early naturalists operating in Mexican territory—the subject of chapter 3. As was often the case with national institutions of this sort, a number of contributors worked in the Natural History section of the National Museum, which provided the location for the SMHN's meetings, archive, and library. In 1879, Mexican president Porfirio Díaz officially recognized SMHN contributors for their participation in the Philadelphia Centennial Exhibition of 1876 and underscored their growing contribution to the development of the natural sciences. During the remainder of the century, the federal government increased its consultations with the association in an effort to increase the exploitation of natural resources relevant to international trade, as well as to resolve some growing problems related to the environment such as the drying up of the Valley of Mexico and reforestation of Mexico City.

Over the course of forty-five years, the Society made a number of contributions to biology, zoology, chemistry, and anthropology. Its main contributors served as authorities in national academic circles, founders of scientific institutions, directors of schools, participants in international scientific conferences and associations. A few of them emerged as important politicians and businessmen linked with the centers of political and economic power in Mexico during this formative period of industrial expansion and cultural development. This outline of the Society's emergence and disappearance gives rise to some deeper questions. How did the Society operate? What factors influenced its ascent and decline? Who were the SMHN's main contributors? How did they reflect the development of cultural and political life during the Porfirian era? To what extent was Porfirian Mexico governed and transformed by *científicos* who were actual scientists?

Earlier historiography on the Society has proposed that the association was a homogenous group of positivist, patriotic Mexican intellectuals with a utilitarian emphasis that actively participated in designing strategies to modernize the country during the *Porfiriato*—Porfirio Díaz's ruling era from 1876 to 1911. Some authors have highlighted the political aspect of the SMHN and discussed how contributors' generational profiles influenced the ascent and decline of the association.[3] I argue that SMHN was in fact a heterogeneous group of Mexican and international intellectuals whose activities and cohesion was influenced by personal dynamics (family, geographical origin, training), as well as political and academic links and individual economic interests. Even though several associates played a relevant role in important academic institutions, international scientific networks, governmental projects, and even occupied seats in Congress, the SMHN and its members did not belong to the inner circle of political power that decided resource management during this critical period of state institutionalization and industrial expansion. Thus, this chapter examines how the background and experience of Society contributors potentially shaped their interests in natural history, how their relationships with other intellectual, economic and political groups influenced natural resource policy, and the broader cultural context in which the SMHN worked between 1868 and 1914. Based on the presumption that the social, cultural, political, and economic conditions of these individuals would have permeated their ideas about the relationship between nature and society (the subject of subsequent chapters), this chapter analyzes the biographical information of sixty-five main SMHN contributors. The aim of this chapter is to identify social, cultural,

[3] Luz Fernanda Azuela, *Tres sociedad científicas*; Enrique Beltrán, "El primer centenario de la Sociedad Mexicana de Historia Natural [One Hundred Years of Mexican Society of Natural History]," *Revista de la Sociedad Mexicana de Historia Natural* XXXIX (1968); Patricia Carpy Navarro, "La Sociedad de Historia Natural y su influencia"; Rafael Guevara Fefer, *Los últimos años*; Rodrigo Vega y Ortega, "Los naturalistas."

political, and economic factors that influenced the Society's activities, as well as their degree of participation in the industrial development of Mexico and its impacts on the natural world. This collective study of their lives (a prosopography) will reveal commonalities and differences among SMHN members and their degree of influence on decision-making regarding the management of natural resources.

Contributor profiles

Generally, societies have established inclusion and exclusion criteria based on their internal rules. The SMHN instated strict rules to admit and reject members. According to SMHN statutes from 1869, in order to accept a new affiliate, three associates had to nominate him as a candidate. After nomination, the collective group of associates decided by ballot whether or not to integrate the candidate. Candidates had to be men with an interest in science, within a scientific profession, or who had published important works related to the natural sciences. SMHN membership was divided into five categories: (a) founding associate, (b) numbered associate, (c) corresponding associate, (d) honorary associate, and (e) collaborating associate. Because founding associate was an honorific title tied to role in establishing the organization there were ten founding associates: José Joaquín Arriaga (1831–96), Leopoldo Río de la Loza (1807–1876), Antonio del Castillo (1820–95), Francisco Cordero y Hoyos (1826–79), Alfonso Herrera (1838–1901), Gumesindo Mendoza (1829–1886), Antonio Peñafiel (1830–1922), Jesús Sánchez (1844–1911), Manuel Urbina y Altamirano (1843–1906), Manuel Villada (1841–1929). Two of these founding associates were engineers, six physicians, and two pharmacologists, and they were relatively young at the time of the society's establishment—all between the ages of

twenty-five and forty-eight.[4] The second category, numbered associates, had to live in Mexico City, attend all ordinary and extraordinary sessions, present reports related to science issues (when requested by the board), and present (at a minimum) one scientific research paper per year. The number of associates in this category was restricted to no more than fifty—making this an elite organization, by definition. Corresponding associates lived outside of Mexico City in other states of the Mexican Republic. They had to fulfill the same tasks as numbered associates, except for attending the association's meetings. Honorary associates had only one obligation, "to seek by all ways the promotion and progress" of the SMNH. Enrolled in this category were politicians, writers, and military officials. Meanwhile, collaborating associates were people who provide the SMHN with "natural objects that [needed] analyzing." In other words, they were officially recognized fact gatherers and informants (Fig. 4).[5]

[4] W/A, "Registro de los señores socios de la Sociedad Mexicana de Historia Natural" [Roll of Associates of The Mexican Society of Natural History], *La Naturaleza* I, 1ª Serie (1870): 405-409.

[5] SMHN, *Estatutos de la Sociedad Mexicana de Historia Natural* [*Mexican Society of Natural History Statutes*], 2.

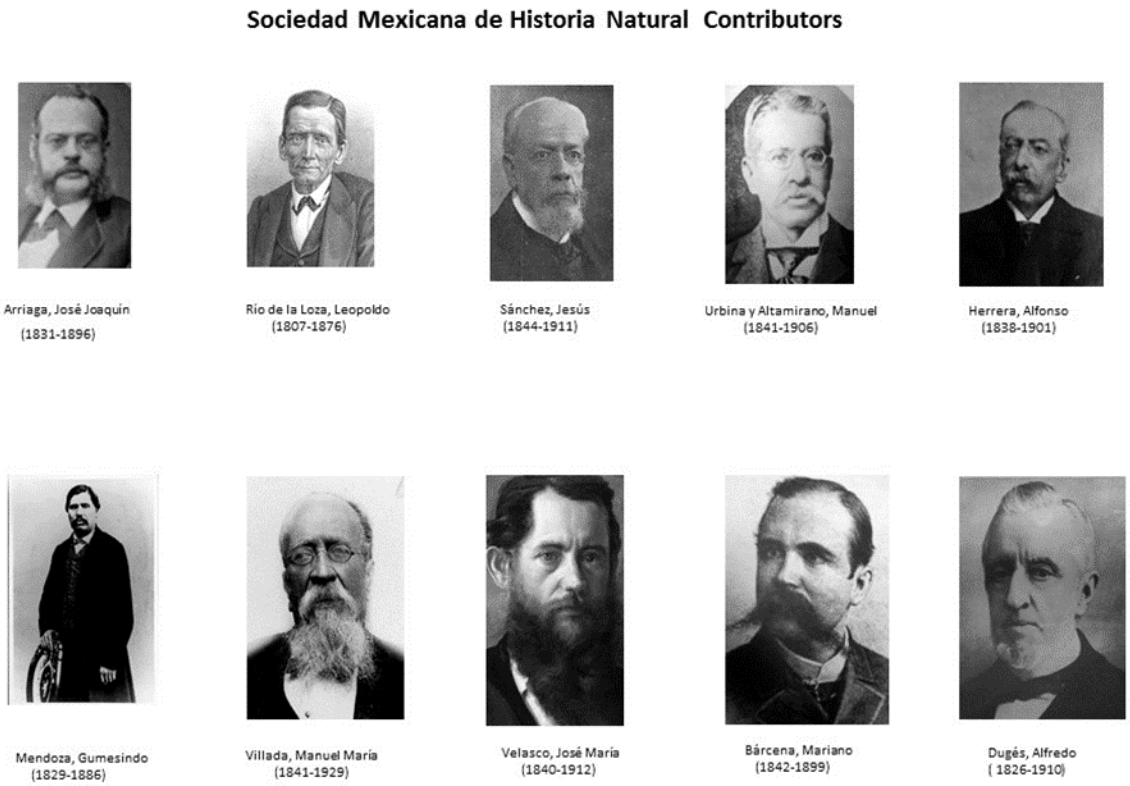

Figure 4 Some founders and honorary members of the Sociedad Mexicana de Historia Natural.

Sources: Academia Nacional de Medicina de México, *Particular Files*; Enrique Cárdenas et.al. *Mil personajes en el México del siglo XIX, 1840-1870* Banco Mexicano Somex, 1979 – México 4 vols; María Elena Piollé Altamirano, *José María Velasco*; Enrique Beltrán, et al. *Alfredo Dugés*.

Since the 1930s, scholars interested in the history of science and the past of the SMHN have generally agreed that the SMHN was a homogeneous and relatively changeless group of Mexican intellectuals with a like interest in the natural sciences, similar education, and a theoretical approach to scientific understanding. Alfonso L. Herrera, José Joaquín Izquierdo, Enrique Beltrán, Patricia Carpy, Luz Fernanda Azuela, Rafael Guevara, and Rodrigo Vega y Ortega have all highlighted the similarities of SMHN members and overlooked their differences.

They identify a strong, solid, and uniform group of naturalists that contributed to institutionalization of diverse areas of science in Mexico such as biology, geography, meteorology, and mineralogy.[6] Herrera, Izquierdo, and Beltrán all emphasized the founders' expertise, professional careers, publications, and contributions to natural sciences. Azuela goes further to state that these "masters and their disciples" from Mexico's National Museum and professional schools "integrated two generations linked by common interest in natural history that opened institutional places and educational strategies."[7] According to Azuela, from 1869 to 1886 the SMHN's efforts to improve scientific knowledge and national wealth were particularly successful, but its accomplishments decreased thereafter due to lack of political support. Azuela also emphasizes the professionalism of the Society's founders, but categorized them as amateur scientific practitioners because "none of them was devoted exclusively to researching."[8] Guevara, in contrast, emphasizes their positivist approach to explanation, and believes the group had some of the more novel scientific ideas of their epoch.[9] Those authors all highlight the similitudes of association and difficulties of academic work while revealing their capacity to make significant contributions to Mexican natural science during the beginning of its turn toward specialization. However, these authors overlook important elements of their collective biography that reveal differences of geographical origin, professional training, social and economic status,

[6] Alfonso L. Herrera, "La fundación de la Sociedad Mexicana de Historia Natural," *Revista de la Sociedad Mexicana de Historia Natural* I, no. Noviembre (1939); José Joaquín Izquierdo, "Contactos y paralelos de la nueva Sociedad Mexicana de Historia Natural, con su precursora, y divergencias que convienen para su futuro" *Revista de la Sociedad Mexicana de Historia Natural* XI, no. 1-4 (1950); Beltrán, "El primer centenario"; Carpy Navarro, "La Sociedad."; Azuela, *Tres sociedades*; Guevara Fefer, *Los últimos días*;Vega y Ortega, "Los naturalistas."

[7] Luz Fernanda Azuela, *Tres sociedades*, 67.

[8] Ibid.

[9] Rafael Guevara Fefer, *Los últimos días*, 40.

scientific approach, political and economic linkages, networks with other intellectual groups, and degree of influence in other societal realms.

Who joined the SMHN during its forty-six years of operation? Beltrán warned of the difficulty of tracing the path of members of SMHN because a full list of members was only published one time in 1879, when 141 members belonged to the association.[10] Most authors have simply focused on the ten main founders of the association and four other figures whose works were most relevant to the development of Mexican science and culture: José María Velasco (Art History), Mariano Bárcena (Metallurgy and Meteorology), Alfonso L. Herrera (Biology), and Fernando Altamirano (Medicine). Vega y Ortega, however, has published a list of 107 members based on an 1871 issue of *La Naturaleza*, including many famous Mexican scientists from the late nineteenth century. However, he omits collaborators, international members, and several correspondents from Mexican states who had ties to the Society and does not explain his criteria for inclusion on this list of supposed core members.[11]

Sixty-six members of the Society comprise the universe of this analysis. Selection is based on their degree of commitment represented by their work in the organization (serving as members of the board, the number of articles and drawings published in *La Naturaleza*, positions of authority in the association, attendance of sessions, and participation in research projects), rather than their political links or individual contribution to some scientific discipline (Tables 1 and 2).

[10] Enrique Beltrán, "El primer centenario."
[11] Rodrigo Vega y Ortega, "Los naturalistas," 28-30.

Table.1 Major Contributor to the Sociedad Mexicana de Historia Natural

Profession	Name
Founders of SMHN	
Engineer	Arriaga, José Joaquín (1831-96)
	Castillo, Antonio del (1820-95)
Physician	Cordero y de Hoyos, Francisco (1826-79)
	Peñafiel, Antonio (1830-1922)
	Río de la Loza Leopoldo (1807-1876)
	Sánchez, Jesús (1844-1911)
	Urbina y Altamirano, Manuel (1841-1906)
	Villada, Manuel María (1841-1929)
Physician-Pharmacologist	Herrera, Alfonso (1838-1901)
Pharmacologist	Mendoza, Gumesindo (1829-1886)
Members of Number	
Engineer	Almazán, Pascual
	Cornejo, Ignacio
	López Monroy, Pedro
	Iglesias, Miguel
	Manzano, Jesús
Physician	Barreda, Gabino
	Barragán, José
	Jiménez, Lauro María
	Martínez, Felipe
Chemist	Río de la Loza, Leopoldo
Painter	Velasco, José María
Honorary Members (taking an active participatory role)	
Engineer	Bárcena, Mariano
Physician	Dugés, Alfredo
	Dugés, Eugenio
	Velasco, Idelfonso

Sources: SMHN, *La Naturaleza*; Antonio Vega y Ortega; *Los naturalistas*; Patricia Carpy; *La Sociedad Mexicana*; Luz Fernanda Azuela, *Tres sociedades científicas*.

Table 2. Other Outstanding Members of the Sociedad Mexicana de Historia Natural.

Profession	Name
Other Outstanding Members	
Physician	Alemán, Jesús
	Altamirano Carbajal, Fernando
	Armendariz, Eduardo
	Díaz de León, Jesús
	Fernández, Ramón
	Heinemann, Carlos
	Oliva, Leonardo
	Ramírez, José
	Ramos, José
Botanist	Alcocer, Gabriel
	Blázquez, Ignacio
	Schaffner, Guillermo
Engineer	Burkart, José
	Cabrera, Florencio
	Díaz Covarrubias, Francisco
	Escontría, Blas
	Fernández, Carlos
	Galindo y Villa, Jesús
	García Cubas, Antonio
	Navia, Severo
	Ordoñez, Ezequiel
	Orozco y Berra, Manuel
	Puga, Guillermo
	Mallet, J.W.
	Quevedo, Miguel
	Ramírez Palacios, Santiago
	Rovirosa, José Narciso
	Segura, José Carmen
Chemist	Dónde, Ibarra Joaquín
	Fernández, Vicente
Ichthyologist	Goode, Br.
Biologist	Herrera, Alfonso Luis
Zoologist	Macías Valadez, Samuel
Ornithologist	Montes de Oca, Rafael
Entomologist	Nieto, Apolinario
Lawyer	Pujol, José Fidel
	Ramírez, José Fernando
	Ramírez, Ricardo
Writer-Historian	Sosa Escalante, Francisco
Zoologist	Sumichrast, Francisco
Lawyer-Poet	Alcaraz, Ramón Isacc

Sources: SMHN, *La Naturaleza*; Antonio Vega y Ortega, *Los naturalistas*.

Although one can identify a cluster of twenty core contributors noteworthy for their constant and intense contribution, between 1868 and 1914 the quantity and interest-level of contributors of SMHN changed for several reasons, such as age, links with academic, political, and economic groups, and economic status. Even though in 1870 the president of SMHN reported that the association had a robust 181 members (including prominent politicians, military officers, and governments), Society associates often remarked on the lack of participation in sessions and activities.[12] For example, in 1880, Pedro López Monroy proposed activities to remedy this perceived lack of enthusiasm and improve participation. In 1882, José María Velasco remarked on the lack of interest in studies on nature when he stepped down as vice-president, and in 1897, Alfonso L. Herrera remarked "there are many people registered, but few of them work."[13] In other words, the initial roll from 1871 may have shown the Society as far more robust than it actually was in practice, and the number of participants whose works actively contributed to association goals was always much less than the quantity of members registered at the beginning of the SMHN.

This issue was typical of nineteenth-century associations of this type in Latin America, and has long preoccupied historians of science in Latin America concerned with the regions' scientific underdevelopment.[14] But it does not mean that Mexican intellectual life lacked continuity. According to Juan José Saldaña, from the sixteenth century to the nineteenth century there were a succession of scientific communities in Mexico that transmitted data, experiences,

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[12] Antonio Peñafiel, "Informe rendido por el secretario 1869 y 1870."

[13] José María Velasco, "Discurso pronunciado por el Sr. José María Velasco al dejar la vicepresidencia de la sociedad," *La Naturaleza* V, 1ª. Serie (1882): 149-151; Alfonso L. Herrera, "Informe acerca de los trabajos de la Sociedad Mexicana de Historia Natural durante los a;os de 1890 y 1891," *La Naturaleza* II, 2ª. Serie (1892): 131.

[14] Thomas F. Glick, "Science and Society in Twentieth-Century Latin America," in *The Cambridge History of Latin America*, edited by Leslie Bethell (Cambridge and New York: Cambridge University Press, 1994), 463-535.

theories and organizational forms that the recipient community integrated into its practice.[15] In this sense, the initial lack of scientific Mexican institutions devoted to research in the nineteenth century promoted the creation of intellectual communities like the SMNH that integrated a range of participants. Because men of different ages integrated those groups, however, this characteristic changed over time. The association's founders were scientists who had worked for several years in diverse fields of the natural sciences, and some were from other fields altogether. Later, a few young students or relatives of associates, such as Alfonso L. Herrera, son of Alfonso Herrera, joined the association. However, young people showed little interest in joining the association over time and by the late nineteenth century the SMHN was "an association of old men surrounded by death."[16] It is important to note that age was not a decisive factor in the initial constitution of the Society, with most contributors between the ages 25 to 48 years old (Chart 1). The Society became more homogeneous over time, and by the early twentieth century most of the conspicuous contributors had passed away. New members who joined after 1870 were few. The absence of new members was the most important factor that contributed to the dissolution of SMHN because of a shift in professional scholarly activities and gradual specialization of the natural sciences.

Historian Vega y Ortega believes the generational circumstances of intellectuals to have been a key factor influencing the membership of SMHN, and he categorized SMHN contributors by five generations. The first, he called the "Pléyade de la Reforma" comprised by sixteen intellectuals who were born from 1806 to 1825; the second "Tuxtepecadora" generation, integrated by members born between 1826 and 1842 had accomplished the Tuxtepec rebellion of

[15] Juan José Saldaña, "La formación de la comunidad científica en México," in *Historia de la Ciencia y la tecnología: el avance de una disciplina* (Cartago, Costa Rica: Editorial Tecnológica de Costa Rica, 1989).
[16] Fernanda Azuela, *Tres sociedades*, 73.

1876. Vega named the third generation the "Científicos" for their role as architects of the Porfiriato, comprised of members who were born between 1843 and 1857. The fourth category was the "Blue Generation," made up by scientists who were born between 1858 and 1872, and the fifth was the "Revolutionary Generation," incorporating members born between 1873 to 1887 who came of age in the years leading up to the Mexican Revolution (1910-20).[17] He argues, following Ortega y Gasset, that historical circumstances and shared living conditions tended to give naturalists of the same age the same attitudes and concerns toward problems of his epoch. Vega assumes that SMHN members of the same generation were a homogeneous group (at least within generations), with similar interests in and contributions to the sciences, and more specifically to the development of biology in Mexico.[18] Even though the ages of associates were a relevant factor in their participation in SMHN activities, Vega y Ortega overlooks other social factors that differentiated SMHN contributors. His classification explains little about their position on political and social issues of their day and offers no insight into why intellectuals of different generations came together to form the Society in the first place.

The geographical origin of SMHN contributors is an especially relevant element to consider, particularly with regard to their interest in studying diverse areas of the country. Only thirty-eight percent of SMHN members were born, lived, and worked their whole lives in the Valley of Mexico (including Mexico City), while sixty-two percent were born outside the Valley. Twenty-eight percent of the total were from more distant regions, such as Veracruz, Chihuahua, and Tabasco, which strengthened the Society's ability to contribute to knowledge of Mexican diversity in these areas. A few contributors were born in other countries, including

[17] Rodrigo Vega y Ortega, "Los naturalistas."
[18] Ibid.

Alfredo and Eugenio Dugés who were born and lived their youth in Montpellier, France, Joseph Burkart from Germany, and Francisco Sumichrast from Switzerland (Fig. 5). Despite growing up and training under different circumstances, these foreign contributors shared an avid interest in Mexican natural history, were consistent contributors to SMHN, and introduced ideas, methodologies, and personal links from other nations.

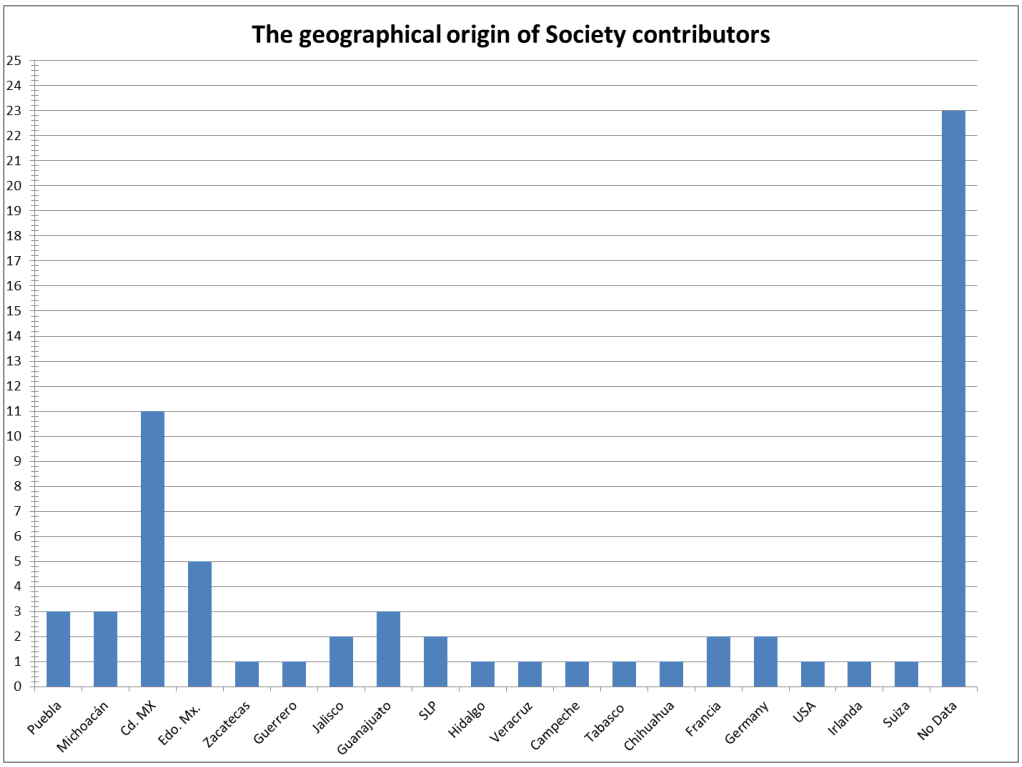

Figure 5. The Geographical Origin of Society Contributors.

Sources: SMHN *La Naturaleza*; Lucero Morelos Rodríguez, *La geología mexicana*; Rafael Guevara Ferfer, *La danza de las disciplinas*; Santiago Ramírez, *Estudio Biográfico del Sr. Ing. Don José Joaquín* Arriaga; Fernanda Azuela, *Tres sociedades*; Huerta Jaramillo, *El gabinete de historia natural de Puebla*; Aurora Jauregui de Cervantes, *Vicente Fernández Rodríguez*, María Elena Altamirano Piollé, *José María Velasco*; Enrique Beltrán, et.al., *Alfredo Dugés*

The social status provided by family more clearly influenced the scientists' trajectories. Although only 26 records for the 66 contributors related to their fathers' occupation were found, they support the conclusion that most of the SMHN contributors inherited their professional

occupation and political activities from their fathers. The fathers of 44% of these 26 contributors were professionals (lawyers, chemists, physicians, etc.), while many others were businessmen, had military experience, or were otherwise well connected within Mexico's economic and political spheres. This upbringing likely influenced associates' concerns regarding national and international circumstances. For instance, the fathers of Manuel Orozco y Berra, José Fernando Ramírez, and Antonio del Castillo were military officers and politicians who had fought in the country's various wars during the early nineteenth century.[19] The father of Orozco y Berra had been a captain in the Mexican War of Independence. Ramírez's father had been an *independentista* colonel, was a mine owner, and his uncle was a congressman. Del Castillo's father was a general who became governor of the state of San Luis Potosí during the 1846-48 war against the United States, and had served as president of the Mining Council. His mother Marcelina Patiño was a daughter of one of the richest families in Michoacán.[20] Meanwhile, José and Ricardo Ramírez were both sons of Ignacio Ramírez, "El Nigromante"—the famous liberal politician, educator, poet, and Minister of Education who participated in *la Reforma* of Benito Juárez and the first year of Díaz's government.[21] On the other hand, the fathers of José Joaquín Arriaga, Alfonso Herrera, Leopoldo Rio de la Loza, Manuel Urbina, Fernando Altamirano y Carbajal, Ignacio Blázquez, Vicente Fernández, Alfonso L. Herrera, Robert Mallet, as well as Alfredo and Eugenio Dugés all had ties to the scientific profession. For instance, the Dugés' father was French physician Louis Antoine Delsescautz-Dugés, a professor of the Medical

[19] Francisco Sosa, *Biografías de Mexicanos distinguidos* (México: Oficina Tipográfica de la Secteraía de Fomento, 1884). 747; Luis González y Obregón, *Vida y obras de Don José Fernando Ramírez* (México: Imprenta del Gobierno Federal en el ex-Arzobispado, 1901). 2; Morelos Rodríguez, *La geología mexicana*, 55.

[20] Lucero Morelos Rodríguez, *La geología mexicana*, 51.

[21] Ricardo Ramírez, "Legislación acerca de los bosques" 28; Salvador Moreno, "El Porfiriato. Primera Etapa," in *Historia de la Educación Pública en México*, ed. Fernando Solana, Raúl Cardiel Reyes, and Raúl Bolaños Martínez (México: Secretaría de Educación Pública / Fondo de Cultura Económica, 1982), 48.

School in Montpellier and member of the Academy of Science in Paris, Berlin, and Madrid, and their grandmother was Madame Lachapelle, a nurse (or midwife) responsible for obstetrics in the Hotel Dieu of Paris. Mallet's father was Robert Mallet (1810-81) an engineer and seismologist who cataloged world earthquakes.[22] However, a few SMHN members were born far away from scientific activities. Mariano Bárcena's father was a leatherworker; the father of José María Velasco and Ildefonso Velasco was a petty merchant; and Gumesindo Mendoza was a rarity in these circles; his indigenous father was a *peon de hacienda* (farm laborer).[23]

The often-countervailing influence of Catholicism and French culture were other elements that influenced the social and intellectual formation of SMHN contributors born in Mexico. Until early 1843, the Compañía Lancasteriana [Lancasteriana Company] and Catholic Church had total control of the Mexican education system. Most Mexicans born between 1810 and 1840 who attended elementary and secondary school did so in Catholic *colegios*, or took private lessons with priests. Several SMHN contributors, such as the Velasco brothers and José Joaquín Arriaga attended Lancasterian primary schools. These institutions based their education on a mutual teaching system in which more advanced students taught less advanced ones. Authorities implemented this method, in large part, because it was the most cost effective way to educate large numbers of students. The education system was based on reward and punishment,

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[22] Santiago Ramírez, *Estudio Biográfico del Sr. Ing. Don José Joaquín Arriaga* (México: Oficina Tipográfica de la Oficina de Fomento, 1900); Azuela, *Tres sociedades*; Ana María Huerta Jaramillo, "El gabinete de historia natural de Puebla," *Elementos: ciencia y cultura* 9, no. 048 (2002-2003); Aurora Jauregui de Cervantes, *Vicente Fernández Rodríguez, un científico del Porfiriato Guanajuatense* (Ediciones La Rana, 1999); University of Texas Libraries, "John William Mallet," The University of Texas at Austin, http://www.lib.utexas.edu/chem/history/malletbio.html (accessed January 24, 2013); María Elena Altamirano Piollé, *José María Velasco Paisajes de Luz Horizontes de Modernidad* (México: DGE Equilibrista, 2006); Enrique Beltrán, Aurora Jáuregui de Cervantes, and Rafael Cruz Arvea, *Alfredo Dugés* (México: Ediciones La Rana, 1990).

[23] Lucero Morelos Rodríguez, *La geología mexicana*; Rafael Guevara Ferfer, "La danza de las disciplinas. El Museo Nacional a través de los trabajos y los días de Gumesindo Mendoza," in *Alarifes, amanuenses y evangelistas. Tradiciones, personajes, comunidades y narrativas de la ciencia en México*, ed. Mechthild Rutsch and Mettle Marie Wacher (México: Instituto Nacional de Antropología e Historia/ Universidad Iberoamericana, 2004).

strict discipline, and the inculcation of Catholic doctrine.[24] However, some private schools, often of more liberal politics, included courses related to French culture. For instance, El Colegio Francés required their students to take several courses of French language and culture. These two elements were common aspects of the intellectual development of SMHN contributors born before 1850.

In 1843, the Mexican Government underwent a liberalizing trend and began to take control of public education. Many Mexican scientists born after 1850 attended non-religious elementary and high schools before pursuing professional careers. In 1867, as one of the core accomplishments of La Reforma, Liberal president Benito Juárez organized a specialized team to modify the National Education System. Three important members of the SMHN, Gabino Barreda (who had studied in France with positivist philosopher August Comte), Leopoldo Río de la Loza, and Alfonso Herrera proposed the establishment of the *Escuela Nacional Preparatoria* (ENP, National Preparatory High School) employing a Positivist approach. Although this school trained several generations of lawyers, physicians, and engineers and was important for the popularization of positivist philosophy in Mexico, most SMHN contributors had already completed high school by this date, and we should not make the generalization, as several authors have, that SMHN members had received extensive training in accord with positivist ideas because they attended high school at the ENP.[25]

In 1878 after long pressure from conservative and Catholic sectors to modify the positivist paradigm of ENP, Mexican president Porfirio Díaz sent Barreda on a diplomatic

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[24] Dorothy Estrada, "Las escuelas Lancasterianas en la ciudad de México: 1822-1842," in *La Educación en la historia de México*, ed. Zoraida Vázquez (México: El Colegio de México, 1996), 49.

[25] Lourdes Alvarado, "Saber y poder en la Escuela Nacional Preparatoria 1878-1885," in *Saber y poder en México, siglos XVI al XX* ed. Margarita coord. Menegus (México: Centro de Estudios sobre la Universidad, UNAM, 1997),

mission to Berlin. This allowed professor of natural history Alfonso Herrera to take over the direction of the ENP. Even though, Herrera had been involved in elaborating a National Education Plan that established ENP, he was far more "distant from the dogmatic positivism prevailing at the institution" and his ideas were more in accord with "Diaz's goals of peace and progress."[26] After 1874, Alfonso Herrera became director of ENP and promoted natural history studies, including the establishment of a botanic garden, zoological cabinet, observatory, greenhouse, as well as Sunday trips through the Valley of Mexico with students to collect specimens. This had an obvious impact on the natural history education of Porfirian youth, but by itself does not indicate that SMHN members were strong followers of the positivist paradigm of Comte emphasized by Barreda.

Herrera's directorship itself ended abruptly in 1884 when a national fiscal crisis sparked intense political conflict within the ENP. Two factions of students and school authorities, led by professors Alfonso Herrera and Justo Sierra, fought for several weeks, leading to President Díaz's intervention and Herrera's exile to the United States. Only four SMHN members (from the cases analyzed) actually studied at ENP, and only two of them, Mariano Bárcena and Gabriel Alcocer, did so under the direction of Gabino Barreda. Ezequiel Ordoñez attended in 1881 during Herrera's directorship, while Alfonso Luis Herrera (Alfonso Herrera's son) attended in 1885, but then dropped out when his father resigned due to political differences with Díaz.[27]

Other Mexican SMHN members attended institutions including the Academia de San Carlos devoted to artistic studies and the Instituto Científico y Literario del Estado de México, while many did their secondary coursework at similar institutions in other Mexican states.

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[26] Lourdes Alvarado, "Saber y poder," 247.
[27] Ibid., 273.

International members studied in their home countries. In other words, we cannot look at the educational background of SMHN members and draw any strong conclusions regarding the influence of the dogmatic positivism of Gabino Barreda. In fact, the members of the Society remained distant from the circles of other positivist naturalists such as Porfirio Parra.[28]

The institutions where SMHN members received their professional training were an obvious element that influenced the Society. Of the sample examined, the largest number of SMHN contributors (44%) studied in Mexico City at places like the National School of Medicine, the Mining College (after 1868 known as the National Engineering School), and San Carlos Academy (later known as the National School of Fine Arts). However, another 18% of SMHN's scientists attended professional school in regions outside the Valley of Mexico, such as Guanajuato, Yucatán, Veracruz, and Tabasco. Some contributors started their professional careers in their home city, and went to Mexico City to finish or take other coursework. As was often true of researchers during this era, a number studied in one career but devoted their profession to one or more other areas. The lawyer Orozco y Berra's works were mostly on geography; Alcocer studied engineering, but studied topics related to botany. A few studied some years abroad, including Francisco Cordero y Hoyos who spent five years in France after finishing his secondary training at the ENM, and Gabino Barreda who studied medicine in France.

[28] In 1877, students at the national School of Medicine joined in the "Asociación Metodófila Gabino Barreda" whose goal was "the methodical study of natural phenomena." This association's contributors perceived nature as an imperfect entity that humans had to modify because Nature generated misfortune and human degradation. At the large, contributors agreed with this ideas, however one of them Luis E. Ruiz defended that Nature was perfect because she was Divine creation. Ruiz later joined the SMHN and in 1879 belonged to the Board of the Society. Asociación Metodófila. FRBN-UNAM Asociación Metodófila "Gabino Barreda," *Annales de la Asociación Gabino Barreda*, [Methophilia Association "Gabino Barreda"], vol. 9 (México: Imprenta del Comercio, de Dublán y Chávez., 1877). 92-93.

Earlier historiography has emphasized the French influence that Mexican scientists received from professional training at ENP and abroad. However, this was no more influential than their experience in primary school, their work with French and other national scientific commissions, personal relationships with professors, mentors, contemporaries, and colleagues, and their participation in a diversity of other local and international associations. Several key SMHN contributors including José Fernando Ramírez, Gumesindo Mendoza, Miguel Iglesias, Leopoldo Río de la Loza, Francisco Díaz Covarrubias, Manuel Orozco y Berra, and Antonio García y Cubas had direct experience with governmental commissions charged with national exploration and the collection of natural history specimens, with a special emphasis on mining districts. These included the Commission of Borders between Mexico and the US (1854), the Scientific Commission of the Valley of Mexico (1856 and 1864), Scientific Commission of Pachuca (1865), French Exploratory Commission to Mexico (1864-67), Commission of the Isthmus of Tehuantepec (1870), and Commission of Geographical Exploration (1877) This experience provided the opportunity for older scientists such as Miguel Iglesias, Ramón Almaraz, Leopoldo Río de la Loza, José Fernando Ramírez, Antonio García y Cubas, Antonio del Castillo to train young disciples as Manuel Villada and Antonio Peñafiel as they explored national territory.).[29] These commissions constituted integrated scientific communities in their own right, and were responsible for reproducing, transmitting, and modifying understanding of the natural world produced by previous scientific communities in Mexico.

[29] Ramón Almaraz, *Memoria de los trabajos ejecutados por la Comisión Científica de Pachuca en 1864* [Memory of works accomplished by Scientific Commission of Pachuca on 1864] (México: Imprenta de J.M. Andrade y F. Escalante, 1865); Claudia Morales Escobar, "La Sección de Historia Natural de la Comisión Geográfico Exploradora (1882-1915)," (Universidad Nacional Autónoma de México, 2010); Norma Ortega Hernández, "Las comisiones científicas en el Diario del Imperio 1864-1867," (Universidad Autónoma Metropolitana, 2006); Hugo Pichardo Hernández, "La Comisión Científica Francesa y sus exploraciones en el territorio insular mexicano, 1864-1867 ", *Política y Cultura*, no. 16 (2001), http://www.redalyc.org/pdf/267/26701605.pdf. (accessed June 3, 2013)

Because one of the goals of the SMHN was to know about all the natural resources within the Mexican territory, it required the involvement of people interested in natural science from across the states, not just Mexico City. This is relevant because the historiography, at large, focuses on the center of the country and usually overlooks scientific work from other regions. In this sense, the geographical origin of members played an important role in widening the study of places outside the Valley of Mexico. According to SMHN statutes, if a member of number or corresponding members did not present scientific work (e.g., text or research) during a period of two years, they would be subject to expulsion from the SMHN; however, reports did not show any cases of actual expulsion.[30] Although the association's reports include some meetings and notices related to new members, the lack of consistent data hinders identifying the precise number, characteristics, and change in SMHN membership over time.

The SMHN frequently dealt with a shortage of capital needed to develop its activities. Although SMHN statutes stated that associates had to pay a monthly fee and the government promised to provide some financial support, the problems relating to capital shortages gradually worsened as contributors diminished their participation and monetary contributions. Even though *La Naturaleza* sold subscriptions, the earnings were minimal and frequently the association's treasurer asked correspondents to cover the journal's operating costs. (Reproducing the membership was a long-term problem of the Society.) Poor governmental support due to political instability during the Juárez and Lerdo presidencies (1869–1876) also handicapped the SMHN's financial situation during its early years.[31] In 1881, the SMHN signed a petition against plans to reduce the budget for the National Museum because several activities of the SMHN were carried

[30] SMHN, *Estatutos de la Sociedad Mexicana de Historia Natural* [*Mexican Society of Natural History Statutes*], 2.

[31] Ibid.

out with resources from that institution.[32] This relationship threatened to backfire in 1902, when the federal government restructured and a new secretary assumed responsibility for the museums and academic association, and the National Museum director petitioned the government for the rooms occupied by the SMHN, as well as for the SMHN's share of the budget. Therefore, the lack of monetary resources to develop research and to cover expenses repeatedly caused problems for the association over time.[33]

The National Museum and the SMHN held an inextricable relationship. Society associates José Fernando Ramírez, Ramón Alcaraz, Manuel Orozco y Berra, Gumesindo Mendoza, and Manuel Urbina served as museum directors between 1858 and 1900. SMHN members also played an indispensible role in improving the Museum's natural history collections over time, as they donated botanical, zoological, and mineral specimens collected during expeditions. Several SMHN founders and associates, including Antonio del Castillo, Gumesindo Mendoza, Antonio Peñafiel, Jesús Sánchez, Manuel Urbina, and Manuel Villada, taught at the museum and worked on diverse tasks, such as classifying and elaborating its catalog of specimens.[34] Others SMHN contributors—such as José María Velasco, whom the museum hired as draftsman—contributed to the museum's physical plant, restoring rooms, canvases, furniture, ladders—even polishing the doors.[35] These activities were not restricted to the Mexican capital. Society's correspondents in other Mexican states promoted the creation of regional museums. Alfredo Dugès established a natural history museum in Guanajuato (1891); Eugenio Dugès did

[32] Miguel Pérez, "El Museo Nacional [National Museum]," in *Sociedad Mexicana de Historia Natural*, ed. Museo Nacional (México: Filomeno Mata, 1881).
[33] Ibid
[34] AHMNA. SMHN Volumen 5, sección 28, año 1882, fs. 187–195.
[35] AHMNA. José María Velasco, 1896.

so in Michoacán; José N. Rovirosa in Tabasco; Mariano Bárcena in Jalisco; and Ignacio Blazquez established the natural history cabinet in Puebla.

SMHN members also worked to expand the scientific and academic work of Mexican schools and institutes through political instability and several changes in government. From the Second Empire through the Porfiriato, most SMHN founders and contributors taught in professional schools (sometimes at several simultaneously), and some of them served in positions of great political importance as directors of Mexico's national schools. Antonio del Castillo served variously as a professor at the *Academia de Ciencias y Artes* (Sciences and Arts Academy); the *Escuela Nacional Preparatoria* (a national high school); the *Colegio de Minería* (mining college), which later transformed into the *Escuela Nacional de Ingenieros* (the national engineering school); and as a principal at the *Instituto de Geol*ogía (geology institute).[36] Alfonso Herrera worked at the Sciences and Arts Academy and as a professor of natural history at the National High School where he served as director for seven years. He also served as a professor at the National Medical School, at the National Agricultural and Veterinary School, and at the *Escuela Normal de Profesores* (the teacher's training college), while belonging to the national medical institute. Six of the SMNH's early contributors had worked at the Imperial Academy under the Second Empire; fourteen were National High School professors; nine out of twenty-three physicians worked at the National Medical School; nine out of twenty-four engineers worked at the National Engineering School; twelve were employed at the National Museum; and fifteen worked at various institutes throughout the country. In sum, SMHN contributors

[36] Lucero Morelos Rodríguez, *La geología mexicana*.

maintained strong connections across the academic realm in Mexico City and in other states, where their work become the basis for the development of future scientific disciplines.

The scientific work of SMHN contributors went beyond schools. Most SMNH members belonged to renowned Mexican associations according to their respective professions—including the National Academy of Medicine, the *Sociedad Filoiatrica*, the National Institute of Geography and Statistics, the Humboldt Society, and the Antonio Alzate Society. Some Society´s associates had connections with international institutions or joined international associations due to their nationality—such as Alfredo and Eugenio Dugès—or because they had worked in another country. Others established international connections as part of their work with the French Commission or because they had travelled to world's fair exhibitions, starting with the centennial celebration in Philadelphia in 1876. Twenty-two of them belonged to associations such as the Academy of Natural Sciences in Philadelphia; the Academy of Science of St. Louis, Missouri; the Davenport Academy of Natural Sciences; the Boston Society of Natural History; the Imperial Society of Acclimatization in France; the American Academy of Arts and Sciences; and the New York Historical Society. Even though it was mainly honorary, membership in such societies demonstrated international recognition of their work.

International relationships also helped to increase exchanges of publications and specimens with a broad range of corresponding institutions and associations in United States, Sweden, Denmark, Russia, Switzerland, Austria, France, Prussia, Belgium, Italy, Cuba, Chile, and Argentina. The Smithsonian Institution played an especially important role in the SMHN's activities. The Institution and the Society frequently exchanged their own publications, research reports, and specimens. Likewise, the Smithsonian often requested other examples of Mexican research from the Society, such as *Birds of Valley of Mexico* by Manuel Villada and Jesús

Sánchez. This relationship also provided a conduit whereby Mexican intellectuals sent specimens to the institution in order to have them classified. Pedro Blasquez, a corresponding member from Puebla, followed the example of the Smithsonian Institution and collected natural history objects for them.[37] When the Smithsonian received publications from diverse countries, it often sent duplicate issues to the SMHN. Such interchanges lent the Society and its journal *La Naturaleza* prestige and helped Society associates improve their bibliographies and collection of foreign publications.

Some SMHN contributors, including François (Francisco) Sumichrast (1828-1882), served as correspondents for the Smithsonian Institution and range of other international scientific organizations. This French-born naturalist and professional dealer of animal specimens collaborated directly with the *Société Nationale des Parcs Zoologiques de France* and the Swiss Society of Natural Sciences and acted as a correspondent with the University Museum of Zoology at Cambridge and the Entomological Society of Philadelphia. Between 1855 and 1856, Sumichrast traveled to Veracruz where he and Auguste Sallé explored the zone, then joined Henri de Saussure (grandson of the aforementioned French scientist) in his travels throughout Puebla, the State of Mexico, and Tamaulipas to collect diverse species, which Saussure took back to Geneva. Sumichrast decided to settle down permanently in Oaxaca and lived the rest of his life in Mexico, including an extension of his work to Chiapas. He put together zoological collections for the Smithsonian Institution, the Academy of Natural Sciences in Philadelphia, universities in the Boston area, and museums in Switzerland, Germany, and France.[38] Some of his articles were published by the Smithsonian and later republished in Spanish in *La*

[37] Antonio Peñafiel, "Informe 1869–1871," 403, 413.

[38] Adolfo Boucard, "Apuntes biográficos del señor Francisco Sumichrast" [Biographical Notes of Mr. Francisco Sumichrast], *La Naturaleza* VII, 1ª. Serie (1887).

Naturaleza.[39] Another international SMHN contributor was Johann Wilhelm (Guillermo) Schaffner (1830–1882), a German pharmacist and botanist who settled in Mexico. He collected plants from the states of San Luis Potosí, Veracruz, and Mexico from 1859 until just before his death, which he sent on to Kew Botanical Garden and other European institutions for classification, where "much to the collector's frustration. . . his own manuscript names for plants he believed to be new to science were often ignored."[40] Other scientists, such as Alfredo Dugès and José Narciso Rovirosa, also sent specimens to Europe to be evaluated. Those activities allowed international institutions to increase their Mexican collections.

The participation of SMHN contributors in world's fairs of the era drew the interest of the United States and European countries to Mexican resources flora and fauna, mining, and agriculture—the most relevant elements of modern Mexico—while celebrating the activities of Mexican science abroad. At least ten SMHN members belonged to the exhibition teams, or "wizards of progress," that organized the Mexican participation in international fairs. José Segura (in the agriculture section) and Antonio García Cubas (in geography, statistics, and advertising) together participated in the largest number of fairs: Philadelphia's Centennial Exhibition in 1876, New Orleans in 1884, Paris in 1889, Chicago's Columbian Exhibition in 1893, and Paris in 1900. Meanwhile, Mariano Bárcena (statistics, education, and agriculture) and José Ramírez (natural history and bacteriology) participated in three events. Landscape painter José María Velasco (landscapes) attended Philadelphia in 1876, Paris in 1889, Chicago in 1893, and Paris in 1900, and contributed paintings of native animals to the natural history displays. Others including Antonio Peñafiel (ethnology, anthropology, and statistics) and Francisco

[39] Francisco Sumichrat, "Distribución geográfica de las aves del estado de Veracruz" [Geographical Distribution of Birds in Veracruz State], *La Naturaleza* II, 1ª. Serie (1873).

[40] JSTOR Plant Science, "Schaffner, Johann Wilhelm (Guillermo) (1830–1882)," (US: JSTOR, 2014).

Altamirano (medicine, hygiene, and natural history) attended a couple of events. The beauty and utility of nature's gifts to Mexico were thus exhibited to satisfy both the economic interests of Mexico's elite and the economic needs and cultural desires of Europe.[41]

SMHN contributors' participation in the academic realm via society publications, school exchanges, conferences, and world's fairs, as well as their links with national and international scientific institutions had deeper historical roots that on occasion intimately tied scientific activity to the exercise of power. Meanwhile, the international relations of the SMHN and its influence in the national academic realm influenced the gradual specialization of the natural sciences—an important factor in the eventual demise of the Society, while these natural historians contributed actively to the economic transformation of Mexico that occurred through industrial expansionism and the use of natural resources during the late nineteenth and early twentieth centuries.[42]

Science and Power: From Independence to the Fall of the Second Empire

The scientific and political realms have been closely intertwined over the years in Mexico. Science and technology have been relevant to key aspects of Latin American history, including colonization, the making of nations, as well as the region's economic development and inclusion in world trade systems. Early in the independent life of Latin America countries, the links between knowledge and power were very close and, "links born in this period became durable and decisive for both the realm of politics and science."[43] Prominent Latin American scientists who devoted themselves to political life include the Peruvian Hipólito Unanue (1755-

[41] Mauricio Tenorio-Trillo, *Artilugio de la nación moderna*, 199, 339–49.

[42] See Elías Trabulse, *Historia de la Ciencia en México* (*Versión abreviada*), 252.

[43] Juan José Saldaña, "La historia de la ciencia nacional. ciencia, sociedad y estado," in *Los orígenes de la ciencia nacional*, ed. Juan José Saldaña (México: Sociedad Latinoamericana de Historia de la Ciencia y la Tecnología/UNAM, 1992), 49.

1833), Colombian Francisco José de Caldas (1768-1816), Mexican Ignacio Ramírez (1818-1879), and SMHN members José Fernando Ramírez (1804-1871) and Mariano Bárcena (1842-1899).[44] As we have seen, intellectual concerns regarding geography, climate, and natural history had a role to play in the independence movements occurring across Spanish colonies in the Americas. Nature was a recurrent topic in the writings of key political figures, including Simón Bolívar and Tomás Heredia.[45]

Influenced by international trends, Latin America states took on the responsibility for creating scientific infrastructure and promoting research aimed at the development of natural resources. The leaders of these new states widely believed that state-organized science and technology contributed to material and intellectual development of the nation, and some governments, such as those of Colombia and Mexico, officially protected science through constitutional law and took control of its development. (In 1857, when Congress promulgated Mexico's first constitution, it enshrined the promotion of science as a responsibility of the state.) Links between the scientific and political realms were essential to the regional development of science and technology—and in mining were essential to the exploitation of nature. While state officials looked to use science and technology to improve the circumstances of these new nations, Latin American intellectuals sought to use scientific activities to help maintain their status as elites and strengthen their relationships with international scientists and institutions.

From its independence in 1821 to the outbreak of the Revolution in 1910, Mexico underwent a series of political transformations, including severe clashes among conservatives

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[44] Gregorio Weinberg, "La ciencia y la idea de progreso en América Latina, 1860-1930," in *Historia social de las ciencias en América Latina*, ed. Juan José Saldaña (México: Universidad Autónoma de México/Miguel Ángel Porrúa, 1996), 357.

[45] Simon Bolivar's texts, Tomas Heredia's poems, and other authors also highlighted the abundant and diverse flora and fauna in Latin America owing to its favorable climate.

and liberal groups, the French intervention and Second Empire of 1862-67, and a dictatorship lasting 33 years. However, throughout this period, government officials and scientists often shared ideas on how to promote natural history studies—some of them founded on the ideals of liberalism and utilitarianism, others from a more organicist viewpoint compatible with conservatism, all in order to aim for progress. Historian Juan José Saldaña points out that the Mexican state frequently promoted and organized national scientific activity for overt political reasons: initially influenced by philosophical and juridical doctrines related to liberty and democracy, and later on, because the state claimed the ability to organize local power groups.[46] In Mexico, government was widely considered to have the essential task to educate to new citizens, train the technicians that the country required, and develop knowledge of geography, population, public health, and agriculture in order to provide for "common happiness."[47]

Governmental interest helped revive interest in natural history quickly after the Independence Wars. In 1826, the Mexican state established the Instituto de Ciencias, Literatura y Artes with fifty members from geology, chemistry, and other sciences, and encouraged its correspondence with diverse cities and countries in Europe and Latin America. Governmental interest in promoting science coincided with a trend of the period of creating groups of intellectuals devoted to scientific research for practical application. Government and scientific communities strengthened their relationships as instruments of powerful elites.[48] In 1831, a decree from the Mexican Chamber of Deputies stipulated the creation of the *Museo Nacional Mexicano* (Mexican National Museum; as part of the Royal and Pontifical University of Mexico, now UNAM). The museum was divided into four sections: antiquities, industry, natural history,

[46] Juan José Saldaña, "La historia de la ciencia nacional," 43.
[47] Ibid., 47.
[48] Ibid.

and the botanical garden.[49] The National Museum offered classes on natural history and ancient history and enhanced classification activities through its cabinet of natural history, although natural history collections only occupied a small space within the museum. The Spanish King Charles V had established this oldest of universities on the American Continent three centuries earlier, but in 1865, the French-installed monarch Maximilian temporarily closed the university, thereby halting the activities of the National Museum.[50]

Nevertheless, science had a vital role to play in the Second Empire under the Austrian Archduke Maximilian. In 1863, after violent confrontations between conservatives, liberals, and participants in the French military intervention of the previous year, conservatives favoring adoption of a monarchical government organized an Assembly of 215 notable Mexican citizens to decide what kind of government would best suit Mexico. Prominent scientists initially named to the Assembly of Notables included Leopoldo Río de la Loza, José Fernando Ramírez, and Manuel Orozco y Berra. All three refused to take part. Río de la Loza did so arguing that he did not have "vocation and intelligence to occupy a public charge, not related with scientific issues. [I] cannot accept the appointment that could endanger my conscience" after seeing the organization threaten to "destroy in one day, the strong decision of more of thirty years" to continue as a Republic.[51] José Fernando Ramírez, curator of the National Museum and director of the National Library, resigned using the face-saving argument that he "had been far from political issues during last years," while Orozco y Berra more overtly stated his opposition to the

[49] Enrique Florescano, "The creation of the Museo Nacional de Antropologia of Mexico and its Scientific, Educational, and Politic Purposes."

[50] Ibid., 1246.

[51] "No debo admitir un nombramiento que comprometería mi conciencia y que destruiría en un solo día la fundada resolución de más de treinta años." AGN Fondo: Segundo Imperio, Caja 1, expediente 13. 21fs.

new political order, which was incompatible with his ideals.[52] As they feared, the Assembly proposed a moderate hereditary monarchy with a Catholic European prince to govern the country. On June 12, 1864, Maximilian was crowned emperor of Mexico and added Belgian, German, French, Hungarian, and Mexican members to his cabinet, creating inevitable national tensions among the members. Maximilian had himself long demonstrated affection for science, especially botany, which was strengthened by his European education as a member of the Austrian royal family and ties to Austrian scientists.[53]

Although none of these Mexican scientists accepted admission into the Assembly of Notables, Ramírez and Orozco later joined Maximilian's administration. Early on, Maximilian named José Fernando Ramírez as Secretary of Foreign Relations, and eventually shuffled him to several other key positions, including Secretary of State, Secretary of Development, and Secretary of the Interior. French members were particularly disappointed with Ramírez. "Unfortunately, Ramírez [like many other Mexican ministers] belongs to the old school of Hispanic-Mexicans, none of them less than sixty years old, and they are [all] persons that have taken advantage of that French intervention, at the same time as they continued to be hostile to the Empire."[54]

Nevertheless, political interest in the scientific study of Mexico's natural resources persisted through the French intervention of the 1860s. The participation of prominent Mexican

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[52] AGN Fondo: Segundo Imperio, Caja 1, expediente 13. 21fs.

[53] Although traditional imperialistic interest in natural history sought out knowledge of nature to gain control of resources and cultures from other lands, some scholars posit that the late Renaissance literature and science provided to Europeans empires a stimulus to value "tropical environments" held by the colonial state; Grove, *Green Imperialism*: 475.

[54] July 10, 1864 report signed by Montholon. Lilia Díaz López, *Versión francesa de México. Informes diplomáticos*, ed. France. Ministère des affaires étrangères. Archives, 1. ed., 4 vols. (México: Colegio de México, 1967). 4.

scientists and intellectuals in French-sponsored projects had direct scientific and political repercussions for the institutionalization of natural history in Mexico. In 1864, Napoleon III created La Commision Scientifique du Mexique (The Scientific Commission of Mexico). It was comprised of a number of important French scientists, whose goal was to "set out to map the land, study mineral wealth, excavate and reproduce ancient ruins, collect botanical and zoological specimens, assess human races and cultures, and monitor disease and public health."[55] Victor Duruy, president of the commission, believed that science would be an ally in the continued conquest, regeneration, and civilization of Mexico. French scientists posited that those goals would be reached more quickly if they helped to retrieve and reconstruct the Mexican past, catalog and use its present resources, and work on establishing a "French cultural hegemony."[56]

A number of Mexican scholars took part in this French scientific "intervention." Twenty-six French intellectuals and "fifteen voyagers and junior scientists" comprised the French contingent of this scientific commission, together with forty-five Mexican scholars, diplomats, army officers, and government officials. These included the director of the National Museum José Fernando Ramírez, Antonio del Castillo, Francisco Pimentel, Antonio García Cubas, Manuel Orozco y Berra, Alfonso Herrera, Gumesindo Mendoza, Francisco Cordero y Hoyos, Leopoldo Río de la Loza, Gabino Barreda, Lauro María Jiménez, Santiago Ramírez, and German mining engineer Joseph Burkart. Some of these men were already members of the Sociedad Mexicana de Geografía y Estadística, and a few years later, many joined the SMHN.[57] At the

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[55] Paul N. Edison, "Conquest Unrequited: French Expeditionary Science in Mexico, 1864-1867," *French Historical Studies* 26, no. 3 (2003): 459.

[56] Ibid.

[57] Scientific Commission of Mexico activities are analyzed in Chapter 4. Ibid., 467; Hugo Pichardo Hernández, "La Comisión Científica Francesa y sus exploraciones en el territorio insular mexicano, 1864-1867 [The French Scientific Commision and its Explorations into Insular Mexican Territory, 1864-1867]," *Política y Cultura*, no. 16 (2001), http://www.redalyc.org/pdf/267/26701605.pdf (accessed on June 3, 2013); Armelle Le Goff and Nadia

same time, Mexicans organized the Scientific Commission of Pachuca (1865)—similar to the French Commission—to learn about the geology and natural history of that region.[58] Many of this same group of intellectuals, as well as some disciples such as Apolinario Nieto, Leonardo Oliva, Alfonso Herrera, Gumensindo Mendoza, Antonio Peñafiel, and Manual Villada (who was responsible for the natural history section), were set to participate in this commission. However, their work seemly halted due to financial problems.[59]

In 1865, Maximilian further mandated the creation of a new *Museo Público de Historia Natural, Arqueología e Historia* (Public Museum of Natural History, Archaeology, and History) to replace the old National Museum, and announced that the museum's goal was "to protect scientific objects that were in our country, which we unfortunately do not sufficiently know, and […to] elevate our homeland to the level that she should have."[60] Even though the museum had three divisions, natural history was to be its top priority. During the planning stages, Maximilian selected one Mexican and three European scientists to organize the museum: Mexican engineer, lawyer, historian, and Commission member Manuel Orozco y Berra became the museum director; Austrian naturalist Domingo Billimeck was responsible for natural history; Austrian archeologist Leo Simon Reinish organized the archeological collections; and German priest Agustin Fisher coordinated the library. The museum began its activities on July of 1866, but less

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Prevost Urkidi, "Commission de l'exploration scientifique du Mexique (1862-1893) [French Scientific Commission of Mexico] " *Archives Nationales (Site de Paris)* (2009); La Commision Scientifique du Mexique, *Rapport sub Divers Memories de Geologie*, ed. Archives de La Commision Scientifique du Mexique, vol. III (Paris: Imprimerie Imperiale, 1867).

[58] Ramón Almaraz, *Memoria de los trabajos ejecutados por la Comisión Científica de Pachuca en 1864*; Morales Escobar, "La Sección de Historia Natural"; Ortega Hernández, "Las comisiones"; Pichardo Hernández, "La Comisión."

[59] Lilia Díaz López, *Versión francesa de México*: vii.

[60] "[…] proteger los objetos científicos que había en nuestro país, que por desgracia no son bastante conocidos,[para que] eleve a nuestra Patria a la altura que le es debida." Luz Fernanda Azuela, Rodrigo Vega y Ortega, and Raúl Nieto García, "Un edificio científico," 110.

than a year later, the Empire crumbled after years of civil war, and the triumphant liberal government executed the Austrian emperor, although the museum's activities continued under the new government.[61]

To help provide continuity to Mexican natural history through this chaotic situation, in 1868, engineers Antonio del Castillo and José Joaquín Arriaga and physician/pharmacologists Gumesindo Mendoza, Alfonso Herrera, and Francisco Cordero y Hoyos—all former participants in the French Scientific Commission—along with twenty-five other prominent intellectuals with ties with the natural sciences stepped forward and founded the SMHN. Under those circumstances, a number of liberal intellectuals expressed their opposition to this new Society and labeled the association's members as conservatives and followers of the empire due to their participation in these scientific commissions, governmental positions, and publications in *El Mexicano* (The Mexican)—an official newspaper that published laws, civil code, decrees, and governmental documents for the Second Empire.[62]

There were other scientific associations in Mexico that promoted research and publication related to natural history. These included the Sociedad Mexicana de Geografía y Estadística (SMGE) [Mexican Society of Geography and Statistics] (1833-present) and Sociedad Científica Antonio Alzate (SAA) [Antonio Alzate Scientific Society] (1884-1930). Like the SMNH, these associations took it upon themselves to take a leading role in organizing national science and joining with the Mexican state to promote modernization of the country.[63]

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[61] Luz Fernanda Azuela, Rodrigo Vega y Ortega, and Raúl Nieto García, "Geografía e Historia Natural," 121.

[62] Guadalupe Curiel, Miguel Angel Castro, and Marta Celis de la Cruz, *Publicaciones periódicas mexicanas del siglo XIX. 1856-1876 [Mexican Periodical Publications of the Nineteenth Century]* (Mexico: Universidad Nacional Autónoma de México, 2003), 386-87.

[63] Luz Fernanda Azuela, *Tres sociedades*.

The Sociedad Mexicana de Geografía y Estadística was founded in 1833 by seventeen members named by a government committee of older contributors, and during its first decades dedicated itself to a number of projects in the Humboldtian mold.[64] By the 1860s, SMGE's membership had dwindled, and its library and its archives were in disarray. But in 1868, the new liberal government reestablished the scientific association, promoted its activities, and named new contributors. Its list of known associates included SMHN members Antonio García Cubas, José Fernando Ramírez, Manuel Orozco y Berra, and Francisco Díaz Covarrubias.[65]

Ties to the Empire had political repercussions for some members of these organizations, although these were usually short-lived. One of the problems of the relationship between scientists and the government emerged when contributors occupied political posts. Engineer Manuel Orozco y Berra had worked variously as an archives director, lawyer, cartographer, Minister of Development, and Minister of the Superior Court of Justice during the decade leading up to the French intervention. In 1864, Maximilian named Orozco y Berra Subsecretary of Development, although he later left that post and became a state advisor. In 1867, the new liberal government condemned Orozco to four years imprisonment due to his connection to the empire; however, the secretary of war released him only a few months later due to illness. Thereafter, Benito Juárez's liberal government recalled Orozco y Berra to work at the Academy of Literature and Science and to lead the Sociedad Mexicana de Geografía y Estadística—a

[64] Ignacio Manuel Altamirano, *Memoria presentada a la Sociedad Mexicana de Geografía y Estadística por el primer secretario Lic. Ignacio M. Altamirano en enero de 1880* [*Report Give to The Mexican Society of Geography and Statistic by The First Secretary Ignacio M. Altamirano on January, 1880*] (México: Imprenta de Francisco Díaz de León, 1887), 10.

[65] Sociedad Mexicana de Geografía y Estadística., "Comisiones que según el reglamento deben funcionar en el año de 1870" [Commissions to Work According to Rule During 1870] *Boletín de la Sociedad Mexicana de Geografía y Estadística de la República Mexicana* II, no. Segunda Época (1870): 70.

charge he held until 1879, when president Porfirio Díaz asked him to join his cabinet.[66] Physician José Fernando Ramírez had a different fate. Under the empire, he was involved in international and naval business, belonged to the empire's Academy of Science and Arts, and served as Secretary of State. After the empire crumbled, he was exiled to Europe but continued researching and writing before eventually returning to Mexico.[67]

Science and Power under the Porfiriato

According to historian Luz Fernanda Azuela, political interest fueled the relationships between these scientific associations and the Mexican government during the latter decades of the nineteenth century. Scientists became indispensable to governments because they had knowledge and techniques that could help the state resolve complex problems, particularly under the authoritarian government of Porfirio Díaz (1876-1911). "The State has a government comprised of two groups that share the power: on the one hand the men of science, such as engineers, administrators and other people with technical capacity, and on the another hand, politicians." According to Azuela, the country's important decisions during the Porfiriato often moved from scientists' minds to politicians' hands, and budget distribution was often allocated according to priorities set by science. These associations and the scientists who constituted them served as important designers and managers of the Porfirian policy and worked as influential negotiators within its main political blocs. In the process, the state garnered legitimatization for its activities and scientific groups gained the financial backing they needed in order to develop shared projects of "national modernization" and development of natural resources. But this

[66] Francisco Sosa, *Biografías de Mexicanos* , 747.

[67] Erasmo Sáenz Carrete, "José Fernando Ramírez: su último exilio europeo y la suerte de su última biblioteca" [José Fernando Ramírez: His Last Exile in Europe and the Luck of His Last Library], *Signos Históricos* enero-junio, no. 25 (2011).

relationship had practical limitations. If these societies shared the same research goals as government projects, they received economic and political support. Conversely, if they had opposing objectives, the government would keep these associations far from the inner power circles and would reduce their funding.[68]

Azuela's thesis on the mechanism of interchange between science and governance reveals nuances differentiating each association. Since the founding of the SMGE, it boasted strong and direct links to the state; it was a branch of the Ministry of Development and the ministry's director was the president of the association. Unlike SMGE, the SMHN and the SAA were independent of the Ministry of Development and only received financial support from it. Government interference was therefore much stronger in the SMGE. Several of its contributors were politicians, such as Manuel Payno, and its activities were often interrupted when its associates could not attend meetings due to their intense political schedules.[69] Some SMHN contributors became congressional deputies, such as Antonio del Castillo who occupied this charge from 1851 to 1853 and from 1880 to 1884. In 1880, Gumesindo Mendoza became a deputy. Antonio Peñafiel became involved in the rebellion that brought Porfirio Díaz to power, and President Díaz promptly named Peñafiel director of statistics, responsible for the first census in Mexico. He also became a congressmen. Meanwhile, Mariano Bárcena served as a member of the municipal government of Mexico City, worked as a senator during five consecutive periods from 1890 to 1899, and for a brief period between 1888 and 1890 he substituted for the governor of Jalisco. José Rovirosa served as municipal president (1890–1891) and a local deputy (1892–1896) of Tabasco.

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[68] Luz Fernanda Azuela, *Tres sociedades*., 13, 130, 132, 133.
[69] Ibid., 139.

However, Azuela's interpretation overlooks that only some scientists were involved in the political realm, and their connection to political power also varied over time. Even the aforementioned politicians belonging to the SMNH contributors did not belong to the inner circle surrounding President Díaz. In reality, the SMHN admitted men who had worked with either Maximilian or Juárez, who had different political leanings—liberal, moderate, conservative—or who like José María Velasco and Alfredo Dugès were politically unaffiliated. Most members shared an interest in natural history along with involvement in educational institutions, various forms of political activism, and sometimes as owners of businesses related to the extraction of natural resources. But other prominent members, such as the landscape painter José María Velasco and the physician Alfredo Dugés stayed out of both politics and business. Others were diametrically opposed to the liberal politics and oligarchical tendencies of Porfirian governance. In 1904, when the government celebrated the centennial of the birth of prominent SMNH member Leopoldo Río de la Loza, he was remembered him as a fervent Catholic who nonetheless pledged to enforce the liberal Constitution of 1873 while serving as director of the national School of Medicine.[70] It is important to emphasize that most scientists who worked in Mexico taught in schools. Doing so, they typically conducted most of their scientific activities outside of the auspices of the associations to which they belonged or governmental support they received. Furthermore, sometimes the viewpoints of scientists and governments contradicted each other. For instance, five long-time contributors to the SMGE and scientific commissions of the Second Empire—Leopoldo Río de la Loza, Manuel Orozco y Berra, Gumesindo Mendoza, José Fernando Ramírez, Antonio García y Cubas—played a role in establishing the SMHN, but

[70] AGN, Instrucción Pública y Bellas Artes, vol. 354, exp. 80, 3fs. Año: 1904. D.F.

continued as SMGE contributors and worked for the new government. The majority of the intellectuals involved continued to participate in these associations despite political changes. This reveals that, in the political realm, individual work was more significant than the association's as a whole—unlike the scientific realm where a groups' production was relevant.

Although personal alliances between politicians and scientists played a key role in the Díaz government, governmental involvement in the economic transformations of those years had a clearer influence on natural history research and the activities of the SMNH. In order to achieve modernization, according to liberal ideology, Mexico required means to widen its international markets and needed ways to increase access to natural resources. Although the idea that natural history knowledge and economic improvement went together was already well established during Maximilian's regime, the economic and political winds of Porfirio Díaz's second phase of government were more favorable in fostering nature studies and promoting international investments for their use. During the first period of President Díaz's rule, from 1876 to 1880, regional powers put pressure on central authorities, hindering presidential control. Rather than stand for reelection, Díaz handpicked his battlefield friend, Manuel González, to succeed him. González governed Mexico from 1880 to 1884 and carried out significant economic changes. For instance, González increased international loans, mainly from London, and promoted foreign investment (e.g., British, US, Canadian, and French), much of which went toward railroad construction, which in turn contributed to expansion of the national telegraph, establishment of the first central bank, and expansion of mining, agriculture, and other export sectors.

The Secretary of Development (Fomento) was most responsible for the creation of projects related to the advancement of scientific activities and the use of natural resources and

was, therefore, a significant liaison between scientists and the government. The position was established in 1853 in order to attend issues (both pressing and superficial) related to statistics, agriculture, fairs, communications, mining, business, colonization, and the draining of the Valley of Mexico. During the Porfiriato, the Secretary of Development became the most important cabinet position of the presidential administration because it charge of activities considered most important to the modernization of the country.[71] The men who held the position are listed in succession: from 1867 to 1876, Blas Balcárcel; from 1876 to 1880, Vicente Riva Palacio; from 1880 to 1881, Porfirio Díaz; from 1881 to 1892, Carlos Pacheco; from 1892 to 1907, Manuel Fernández Leal; and from 1907–1911, Manuel Olegario Molina. Olegario Molina particularly exemplifies the ties between science, economic development, and power that developed during the Porfiriato. Like his predecessor as secretary of development, he was trained as an engineer, but was also a businessman, a politician (congressman and governor), and the founder of a professional school in his home region—the *Instituto Científico y Literario de Yucatán*. "During thirty years [he] constructed an unprecedented financial empire in the peninsula (Yucatán) based on his use of henequen trade" (a fiber produced by the agave plant vital to the industrialization of farming on the North American Plains). He owned the largest exportation company of henequen and controlled the total plant production via the Committee of Hacendados Henequeros.[72]

Because the Ministry of Development promoted the exploration of territory to uncover resources in order to use them to improve national circumstances, it created scientific institutions

[71] Mireya Blanco Martínez and José Omar Moncada Maya, "El Ministerio de Fomento, impulsor del estudio y el reconocimiento del territorio mexicano (1877–1898)" [Ministerio de Fomento, driver of the study and recognition of the Mexican territory (1877–1898)], *Boletín del Instituto de Geografía. Investigaciones Geográficas*, no. 74 (2011): 75.

[72] *Hacendados* were owners of haciendas. Francois-Xavier Guerra, *México. Del antiguo régimen a la revolución* [*Mexico. From Ancient Regimen to the Revolution*], 2 vols., vol. 1 (México: Fondo de Cultura Económica, 2012), 86.

such as the National Astronomical Observatory (1876), the Geographical-Exploration Commission (1877), the Central Meteorological Observatory (1877), and the Statistics Directorate (1883), as well as providing resources to scientific associations such as the SMHN.[73] The Secretaries of Development maintained a close relationship with the SMHN, and in many cases had preexisting relationships with the society before assuming office. As a symbol of this connection, they were always made honorary associates of the SMHN. Thanks to this relationship, SMHN associates participated in national commissions such as mining rehabilitation (Mariano Bárcena, Pedro López Monroy, and Santiago Ramírez), the mining industry (Mariano Bárcena and Santiago Ramírez), geographical exploration, (Mariano Bárcena and Ezequiel Ordoñez), and agricultural expansion (Mariano Bárcena).[74]

During this period, the Ministry of Development also sought to bolster international investment by promoting Mexican natural resources at international events, and its members were always included among the "wizards of progress" who planned Mexico's participation in world's fairs. The metallurgical engineer Mariano Bárcena (1842–1899) was one of the most conspicuous members of the SMHN—politically, economically, and culturally—involved in these activities. He was a professor at four of the most important national schools in Mexico, and belonged to ten national and seven international associations related to scientific issues. He briefly governed Jalisco (his home state), and served as congressman for nine years, and worked in one of the country's most important cultural offices as organizer of Mexico's participation in the world's fairs in 1876, 1884, 1893, and 1900.[75] Moreover, Bárcena combined his scientific and political activities with economic affairs. He owned two haciendas and worked to ensure that

[73] Mireya Blanco Martínez and José Omar Moncada Maya, "El Ministerio de Fomento," 77.
[74] Ibid., 80.
[75] Bárcena did not actually attend the 1900 World's Fair in Paris because he passed away in 1899.

railroad construction in the state of Jalisco passed near them, at one point serving as a representative to international investors.[76] Mariano Bárcena was an outstanding businessmen; he owned two haciendas in his hometown, Ameca, Jalisco. In 1881, he proposed a railroad construction project, between Guadalajara (capital of estate) and the Valley of Ameca, to facilitate the trade of products from his haciendas. In 1892, he lobbied, as a senator, for international investors Niendorff, Dick, and Clark to construct railroads in Jalisco.[77]

The SMHN's relationship with the Mexican government peaked under during the 1880s when military man Carlos Pacheco (1839-1891) served as Secretary of Development. Pacheco commissioned several studies from the SMHN, including on the deforestation of Mexico City, the draining of the Valley of Mexico, and strategies to promote the *Ni-in* insect trade.[78] In addition, Pacheco and the Ministry collaborated with SMHN contributors as part of an institutional network that linked the agricultural school, the Escuela Nacional Preparatoria, and the medical and engineering schools where SMHN members worked. Azuela notes, however, that the Sociedad Científica Antonio Alzate (est. 1884) expanded its political involvement in order to limit Pacheco's influence, and was joined by several associates to cultivate relationships with other authorities, businessmen, and scientists—some with quite different goals regarding the relationship between science, nature, and development. Mining engineer and SMHN contributor Santiago Ramírez, for example, claimed that the results of mineralogical studies were

[76] Cámara de Senadores, "Diario de Debates de la Cámara de Senadores," ed. Congreso de la Unión (Mexico, 1893).

[77] Cámara de Senadores, "Diario de Debates. Sesión del día 28 de Mayo de 1892," ed. Cámara de Senadores (México, 1892).

[78] These topics are analyzed in Chapter 4.

of little interest to industry, although they were very important to scientists because they contained new geological data.[79]

A crucial point to consider is to evaluate the relationship between natural historians and the second, dictatorial phase of Díaz's presidency lasting from 1884 to 1911. During this period, the Mexican government encouraged the most significant era of industrial expansion the country had yet seen, which massively affected nature in many regions of Mexico. Díaz's 1884 reelection and this subsequent expansion were famously backed by a powerful political group of technocrats, many of foreign ancestry, known as *los Científicos* (the scientists). They came to be known as the *Científicos* because their discourses underscored the use of science to resolve national problems via the implementation of positivist theory to accomplish their slogan "order and progress." This "new generation" of advisors (most of them were born in the 1850s) stepped into the shoes of the aging liberal veterans of the civil wars and *la Reforma* to which Diaz belonged.[80]

The *Científicos*' rise to prominence corresponded with the rise to power of José Yves Limantour (1854-1935). He was a graduate of the Escuela Nacional Preparatoria when Comtean positivist Gabino Barreda was director, began working in government in during Díaz's first term in 1877. From 1893 to 1911, he served as the Secretary of Finance for the Porfiriato and was the acknowledged leader of the group in charge of economic development. Several prominent *Científicos* followed Limantour into important posts in Díaz's cabinet, including Ramón Corral who served as secretary of the interior in 1903 and from 1904 to 1911 as vice president. From 1907-11, the multimillionaire businessman Olegario Molina served in the key position of

[79] Mireya Blanco Martínez and José Omar Moncada Maya, "El Ministerio de Fomento," 84; Luz Fernanda Azuela, *Tres sociedades*.

[80] Alan Knight, *The Mexican Revolution*, 2 vols. (Lincoln: University of Nebraska Press, 1990), 22.

Minister of Development. In addition to investment strategies, the *Científicos* recognized that Mexican development faced a number of social obstacles—squalor, diseases, illiteracy, crime, and alcoholism—and began to promote scientific research in public health and other social topics. In 1905, Díaz's government established a new the Ministry of Public Instruction and Fines Arts, which was responsible for public education as well as activities related to science and the arts, including museums and scientific associations. It was led by another *Científico*, Justo Sierra, who in 1884 had engaged in a political campaign against SMNH member Alfonso Herrera's directorship of the ENP that resulted in Herrera's exile and the end of his promotion of natural history education in Mexico. The *Científicos* increasingly monopolized positions within the inner circle of President Díaz and almost without exception were far removed from the intellectuals of the SMHN. Crucial to involvement of natural historians in Mexican politics, *los Científicos* increasingly made decisions related to the management of natural resources.[81]

Opposing groups tended to identify *los Científicos* as mainly interested in increasing their personal wealth, subservient to international capital, and dismissive of indigenous people and their homeland. The *Científicos* are particularly well known for favoring foreign investment, mainly from the United States. About one-third of direct international investment went into railways, a quarter into mining, and the remainder into banks, utility companies, property ventures, textile factories, and oil. The *Científicos* often directly involved themselves in company operations. According to Alan Knight, even though the *Científicos* saw international investment as a crucial factor for Mexican development, they believed that future domestic capital "would

[81] Luis Cabrera, "El partido Científico. ¿Qué ha sido, qué es y qué será. Para qué sirve 'la Ciencia'?" [The Scientific Party. What had been it, what is it, what will be. What is science use?], in *La Revolución Mexicana. Textos de su historia*, ed. Altamirano Graziella and Villa Guadalupe (México: Secretaría de Educación Pública/Instituto de Investigaciones Dr. José María Luis Mora, 1985), 115.

assume a greater, determining role within the economy."[82] Knight argued the *Científicos* were "politically inflexible and authoritarian, economically progressive, and they were fervently committed to social and economic changes and their resistance to political reform brought about their eventual downfall."[83] They concentrated decision-making and controlled several activities, such as the banking system, because they obtained advantages from the favorable conditions of international markets. They were politicians and businessmen. They owned textile, paper, tobacco, match, explosives, and cement industries. Some of them had mines, invested in railroads, and owned sugar plantations and haciendas (located around large cities), which produced *pulque*, milk, tobacco, and cereals. They were agents of international industries and members of their board of directors. The *Científicos* controlled a number of key economic and political sectors, until the international economic crisis of 1907-1908 generated growing conflict between regional landowners and central power, small producers and large industries, labor protests and peasant claims against the government. In the end, Díaz and the *Científicos* could not resolve these crises and Mexico's inner power structure dissolved, opening the way for revolution. Ultimately, the term *científico* became synonymous with the abuses of Díaz's regime.[84]

The *Científicos* were not related to those Mexican scientists interested in natural history. They also had different opinions regarding natural resource studies and the uses of natural resources. As a result of their influence, during the last period of Porfirio Díaz's presidency, interest in maintaining a balanced use of resources—a major preoccupation of writers in *La*

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[82] Alan Knight, *The Mexican Revolution*, 23.
[83] Ibid.
[84] Juan Felipe Leal, "El Estado y el bloque en el poder en Mexico: 1867–1914" [State and the group in power in Mexico: 1867–1914], *Historia Mexicana* 23, no. 44 (1974).

Naturaleza, as discussed in the next chapter—declined among politicians, economic powers, and scientists. The *Científicos* occupied positions of political and economic control, while SMHN contributors did not. The *Científicos* owned sources of natural resources such as mines and lands, whereas only a few contributors of the SMHN, such as Bárcenas, actually owned property. Other examples of wealthy members of the SMHN include founder José Joaquín Arriaga, an engineer with obvious conservative leanings who was the owner and founder of Catholic newspapers such as *El defensor católico*, *El Semanario católico*, the *Apostolado de la Cruz*, and other papers with different characteristics such as *Revista Universal* and *El Nacional*. Another SMHN founder, mining engineer Antonio del Castillo invested in mining companies in Taxco-Guerrero and Pachuca-Hidalgo and engaged in liberal politics. He sometimes worked as a mining judge, and during the 1870s diversified into railroad construction and the Coal Using Company. Similarly, Pedro López Monroy served as a mining judge, investor in the Mining Catorceña Coalition Company, and traveled to the United States in order to study new mining technology. In the same way, Leopoldo Río de la Loza owned three pharmacies (1828), a sulfuric acid factory (1843–1852), and chemical factory (1868–1870). Gumensindo Mendoza also owned a pharmacy. Even though a number of SMHN members were involved in business as company representatives and consultants and benefited in many ways from the economic growth of the Porfiriato, these scientists were far from holding economic power. Many toiled away as poorly paid members of Mexico's professional class, and some even experienced economic problems, such as Alfredo Dugès who frequently asked Alfonso L. Herrera for loans.[85] Their lack of

[85] Enrique Beltrán, Aurora Jáuregui de Cervantes, and Rafael Cruz Arvea, *Alfredo Dugès*.

connection with the *Científicos* played a small but significant role in the decline of the Society and fragmenting of the natural history tradition at the turn of the twentieth century.

The Decline of the Natural History Tradition in Mexico

Ironically, the ascent of science as an ideology of governance in Mexico corresponded with a drop in the prestige and influence of scientific practice within Mexico's national government, at least where natural history was concerned. However, the natural history tradition as represented by the activities of the SMNH and related institutions was already starting to decline well before the *Científicos* rose to prominence. Beginning in the 1880s, several members of the SMHN began to note a lack of enthusiasm among their colleagues regarding participation in Society meetings, research, and publications. Several other factors began to suck away the life of the SMHN. For instance, interest in the broad field of natural history decreased while there was an increase in disciplinary research, competition with new scientific societies, institutes and commissions, as well as variation in the government budget and political support. All over the scientific world, natural history studies were dividing gradually into professional, specialist disciplines including anthropology, biology, climatology, geology, and medical geography. Meanwhile, the government established other specialized associations and institutions such as the *Comisión Geográfico Exploradora* (1878) [Commission for Geographic Exploration], *Instituto Médico Nacional* [Medical National Institute] (1888), and *Instituto de Geología* [Geology Institute] (1888)—often led by SMHN contributors—that provided new, better funded institutional homes for scientific researchers. As we have seen, the SMGE and newer SAA sometimes competed with the SMHN for political influence. In 1912, the first Mexican Scientific Congress summed up the last fifty years of science research in Mexico and revealed the new epoch of natural sciences. Natural history had fractured into zoology, botany, mineralogy,

geology, and paleontology.[86] These new branches were mirrored in the establishment of new specialist institutions that focused their studies on biology, medicine, geography, geology, and meteorology. Symbolically, the SMHN did not attend this conference.

At the National Museum, increasing interest in anthropological and archeological research came at the expense of natural history and eventually led to eviction of the SMHN (and the few surviving contributors) from the museum. In 1902, the National Museum reorganized its staff and exhibitions and the director reclaimed the rooms of the SMHN archives and library for the Anthropology and Ethnology collections. He justified his actions by noting that the SMHN had not met for a long time. In 1904, Manuel Urbina y Altamirano proposed the creation of a separate Natural History Museum and Botanical Garden not far from the National Museum, but he died a year later and the proposal languished. In 1905, the government created a new Ministry of Public Instruction and Fine Arts, led by Justo Sierra, a positivist member of the *Científicos* who had conflicted earlier with naturalist Alfonso Herrera. This new ministry was responsible for the management of education and museum administration. Sierra planned to move the natural history section of national museum to a new place, and he even commissioned one of the SMHN's aged founders Jesús Sánchez to visit natural history museums and botanical and zoological gardens in the United States and Europe to conceive the best model for Mexico. Sánchez visited the *Jardin d'Acclimatation* in Paris and museums in Bern, London, New York, and Washington, and gave a complete report suggesting the establishment of a new place for natural history.[87] Four years later, the National Museum director still insisted that the

[86] Elías Trabulse, *Historia de la Ciencia en México*, 252.

[87] Jesús Sánchez, "Informe acerca de la visita a algunos de los principales museos de Historia Natural y jardínes zooógicos-botánicos de Estados Unidos y Europa" [Report Related to Visit to Main Natural History Museums and Zoological and Botanical Gardens in the US and Europe], *La Naturaleza* I, 3ª. Serie (1910).

archaeology, ethnology, and history collections had increased and needed more space, as well as an increase in budget—far more so than the natural history section, which "was almost inactive."[88]

These pleas eventually led, on January 28, 1909, to a presidential agreement, which required that the natural history section as well as the SMHN's archive and library be moved to another place and converted into the Museo Nacional de Historia Natural. At the same time, the National Museum would become the Museo Nacional de Arqueología e Historia.[89] The Natural History Museum began its activities with a minimal staff: five professors and seven people to clean and to assume guard tasks in an inadequate building. Three SMHN contributors joined the new museum—Jesús Sánchez (as director), Manuel Urbina (as secretary and botany professor), and Manuel M. Villada (as professor of mineralogy, geology, and paleontology). Because bricklayers and dyers continued working in the rooms, its natural history collection was put at considerable risk of damage. The museum was sparsely furnished, and its library was limited and increasingly becoming obsolete because the SMHN relied almost exclusively on donations. Jesús Sánchez asked the Secretary of Development for donations of specimens from the past thirty years of exploration commissions to improve the new museum's research collection, but the request was rejected.[90] The earlier idea of establishing a zoological and botanical garden was also quickly forgotten due to a lack of financial resources.

By this time, most of the original contributors to the Society had passed away (Fig. 6), and few intellectuals from the new generation had joined its ranks. In when Mexico celebrated

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[88] Jesús Sánchez, "Fundación del Museo Nacional de Historia Natural" [Foundation of Museum of Natural History], *La Naturaleza* I, 3ª Serie (1910): 1.

[89] AHMNA Justo Sierra, "Circular [Notice]," ed. Museo Nacional (México, 1909), f.171 bis.

[90] Sánchez, "Fundación del Museo Nacional de Historia Natural," 6.

the centennial of its liberation from Spain, Villada warned of the impending end of the association, though he still hoped to give it new life, starting WITH the creation of a new SMNH board. To make matters worse, Jesús Sánchez died in 1911. In 1914, as the capital city descended into revolutionary violence, its aged members published the last issue of *La Naturaleza*, and the SMHN ended its operations.

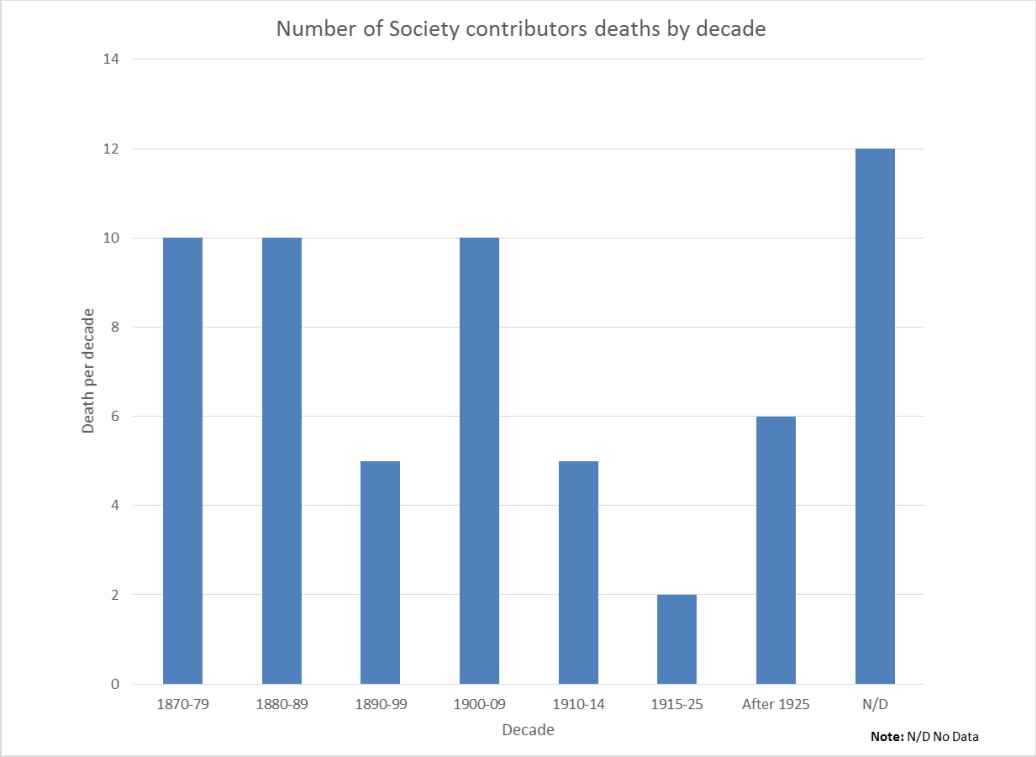

Figure 6. Number of Society contributors' deaths, by decade.

Sources: SMHN *La Naturaleza*, Morelos Rodríguez, *La geología mexicana*; Rafael Guevara Ferfer, "La danza de las disciplinas"; Santiago Ramírez, *Estudio Biográfico del Sr. Ing. Don José Joaquín*; Fernanda Azuela, *Tres sociedades*; Huerta Jaramillo, *El gabinete de historia natural de Puebla*; Aurora Jáuregui de Cervantes, *Vicente Fernández Rodríguez*; María Elena Altamirano Piollé, *José María Velasco*; Enrique Beltrán, et.al., *Alfredo Dugés*. **Note**: The final bar denotes important contributors whose date of death is unknown.

Conclusions

The demise of the SMHN—along with a host of other institutions belonging to *La Reforma* and the Porfiriato—should not obscure its many accomplishments as an institution. It

was established in 1868 to integrate Mexico's collective knowledge of the three natural kingdoms. Over the next 45 years, dozens of contributors carried out diverse explorations and original research, which they cataloged in *La Naturaleza*—the focus of the next chapter. A diverse collection of engineers, physicians, pharmacologists and chemist, lawyers, painters, and a handful of professional naturalists established themselves as authorities in the academic realm, during a period when the use of natural resources accelerated as part of the strongest industrial expansionism the country had yet seen. Contrary to the way they are sometimes portrayed, SMHN contributors worked in the full range of governments from the conservative-led Second Empire of Maximilian I, through the sometimes chaotic liberal governments of Benito Juárez and Sebastián Lerdo de Tejada, to the end of the long and increasingly authoritarian regime of Porfirio Díaz. Even though many of those intellectuals had differing political affiliations, their shared interest in natural history studies overcame political issues.

Several historians have noted that in the nineteenth century the success and failure of scientific associations depended on alliances and support linking politicians and scientists. However, my analysis of the SMHN's trajectory reveals that its accomplishments and failures were influenced by other factors. First, scientists' personal characteristics, such as their age, training, and involvement in political and economic activities, influenced their interest in natural history and regularity of their contributions to the association's activities. The Society's decline was in large part generational: its most conspicuous associates were born before 1850, and by 1910 most of them had passed away. Although historians have identified the SMHN as a national homogeneous group, my analysis demonstrates that the group was far more diverse in background, with much less connection to Comtean positivism and liberal politics than had been supposed.

Second, economics had an important influence on political strategies of the Mexican government, as it supported natural science studies in order to identify which natural resources could provide more benefits; to promote natural resources at world's fairs and conferences; and to extract international loans and investment for railroads, mining, and export industries aimed at exploiting them. Since the government needed scientists to back their plans and decisions, the Secretary of Development played a key role in strengthening the relationship between power and science. Some men with old links with scientists of the SMHN—notably Carlos Pacheco and Manuel Fernández Leal—took advantage of them to promote these projects. While the *Científicos* controlled the economy and politics of Mexico for several years, the surviving scientists of the SMHN remained outside the inner circles of power.

A third factor that contributed to the rise and decline of the SMHN was a change in the natural sciences over time. In the early nineteenth century, studies relating the three kingdoms of nature were common among scientists, but this approach gradually shifted toward specialization. Government establishment of specialized institutions—such as the Medical Institute and Geological Institute—accelerated this process, as did its reduced interest and budget for the field of natural history at the National Museum. The attempt of the *Científico* Justo Sierra to establish a new national museum of natural history was probably doomed to fail, even if the Revolution had not intervened. As a group, as the next chapter will detail, SMNH members achieved important advances in the collective knowledge of natural history. Conversely, their ability to maintain these endeavors aimed at the balanced use of natural resources proved difficult during the formative industrial expansion of Mexico.

Chapter 3 Natural History's Influences on Mexican Thought

In 1887 José Ramírez, a member of the *Sociedad Mexicana de Historia Natural* (SMHN), depicted the contemporary natural sciences as a result of a "vertiginous career of advances" in scientific progress. Ramírez argued in *La Naturaleza* that this progress in the field of natural sciences had begun with the seed planted by Linnaeus and the naturalists of the eighteenth century and had flourished and been synthesized one century later in Darwin's evolutionary theory. "This result has not been fortuitous. There is a chain that links two prodigious [authors], Linnaeus and Darwin. Between these geniuses, history has picked up the immortal names of Bonnet, Buffon, Lamarck, Geoffroy Saint-Hilaire, Goethe, Spencer, Huxley, and Wallace."[1] Even though Ramírez highlighted the "progress" of natural science theories in evolutionary terms, three years later Alfonso L. Herrera lamented to his colleagues the lack of interest in theories on natural history and the "waste of time and wisdom on depicting new species and ordinary issues."[2]

By the beginning of the twentieth century, articles published in the journal *La Naturaleza* showed a different approach regarding the field of natural history. Most of them focused on discovering, collecting, naming, classifying, and comparing species with those of other international naturalists, but few authors discussed theoretical and methodological topics. Despite those differences registered in the society's journal, we can say that SMNH members shared one objective: to study the natural world in order to improve the country's circumstances, thereby leading Mexico into a more civilized era.[3]

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[1] José Ramírez, "Fundamentos Botánicos de Carlos Linneo que en forma de aforismos exponen la Teoría de la Ciencia Botánica," *La Naturaleza* I, 3ª. Serie (1910): L.

[2] Alfonso L. Herrera, "El clima del Valle de México y la biología de los vertebrados," *La Naturaleza* II, 2ª. Serie (1897): 41.

[3] Manuel Villada, "Información Oficial," *La Naturaleza* I, 3ª Serie. (1910): n/d.

From 1870 to 1914, the Society published and reported changes, contradictions, nuances, and continuities about ideas on nature. In this context, some questions emerge: What theoretical and methodological frameworks influenced these natural historians' works during the second half of the nineteenth century? What role did European naturalists play in the development of the field of natural history in Mexico? And what role did indigenous knowledge on natural resources play in shaping the field of natural history? This chapter provides a background for understanding the thought and activities of natural historians in Mexico during the second half of the nineteenth century. The first part focuses on an overview of Mexican environmental thought during the colonial era. The second part explains European influence on the frameworks and practices of Mexican natural history in the nineteenth century and seeks to identify interconnections, controversies, omissions, and critiques that existed between European proposals and the research of Mexican intellectuals—with a focus on their expression in the journal *La Naturaleza*.

I argue that the SMHN's main goal focused on looking for new specimens and natural resources in order to use them to promote the country's progress and to maintain equilibrium in the natural world—influenced by a teleological viewpoint. On the one hand, Mexican intellectuals mainly followed Humboldt's ideas about Mexico as a country with many unknown natural resources. The idea was that it had not progressed nor reaped the benefits of a civilized country due to the lack of an effective government and to the racial degeneration of its indigenous people. On the other hand, members of the SMHN considered natural history a medium through which to learn about this natural wealth, and that men could amass to increase social benefits and growth in the Mexican economy—enabling the country's progress and leading Mexico to become a civilized nation. Articles published in *La Naturaleza* reflected a

diversity of viewpoints regarding the relationship between nature and the social world but maintained the idea that mutual influences existed that could improve or worsen them.

The editors of *La Naturaleza* possessed two major preoccupations. The first entailed a strong influence of French thought on the journal's theoretical and methodological approach, notably its positivist ideology—the search for objectivity by applying the scientific method, in this case involving close observation of plants, animals, and mineral specimens within their habitat in order to collect, name, and classify them. Influenced by their quest for objectivity, the journal's authors also incorporated some elements from the German scientific ideas and *Naturphilosophie*, such as vitalism, a fascination with the balance of nature's forces, and the dynamic role these forces play in organizing the geographical order of plants, animals, and minerals.[4] Moreover, for some members of the SMHN, nature was an animate being, with its own inherent forms of organization and decision processes, which human society helped to maintain. *La Naturaleza* also provided a platform for opposing Darwinian ideas on evolution, adaptation, the struggle for life, and their ramifications for the natural and social worlds, particularly in well-known discussions about the causes for changes in the *Siredon* (*axolote*) species of amphibian.

The second feature involved concerns about the loss of valuable natural resources due to the troubled relationship between the natural and social worlds. Articles explained how these close links between fauna, flora, minerals, and the activities of men had led to the wanton destruction of forests and extinction of bird species. However, some authors recognized that the loss of trees could derive mainly from natural causes such as climate change, lack of rain, as well

[4] Nicholas Jardine, "*Naturphilosophie* and the Kindogms of Nature," in *Cultures of Natural History*, ed. Nicholas Jardine, James A. Secord, and Emma Spary (Cambridge: Cambridge University Press, 1996).

as specific human activities (e.g., railroad expansion and overexploitation of wood for fuel and ornamentation). Some SMHN members revealed different opinions and influences in their works, but practically all shared concern about the loss of resources. Contrary to historiography that refers to them as a relatively homogeneous, liberal, and utilitarian group of governmental advisors with weak affection for the protection and conservation of nature, they nearly had an interest at some level in the use of natural resources in equilibrium.

Between Conservative and Liberal Ideas on Order and Progress

Scientific interest in natural history had actually grown during the Second Mexican Empire and amidst the civil wars that surrounded it. The founders of the SMNH all stressed the role of nature in constructing an independent and prosperous nation through a balanced use of resources. Because they understood that nature and humans held a close and reciprocal relationship, these scientists posited that they had to learn how nature worked in order to evenly manage the use of natural resources, thereby improving Mexico's circumstances. For this same reason, natural history became an important subject for the liberal governments that dominated Mexican politics during the late nineteenth and early twentieth centuries, during the era known as La Reforma and Porfiriato.

The founders of the SMHN wanted to identify Mexico's geographical, meteorological, geological, and biological characteristics, as well as work to develop the multiple resources described by Humboldt and other authors of the late eighteenth and early nineteenth centuries. Members of the SMHN often noticed that despite being engineers, physicians, botanists, pharmacists, and professors of natural history, they themselves still did not know much about the country's abundant resources. Even though these Mexican intellectuals were all outspoken promoters of development, their affiliation with natural history nevertheless led them to stress

balance over exploitation. Knowledge of the three natural kingdoms—flora, fauna, and minerals—was essential if these scientists were to distinguish useful from useless species and more effectively guide man's effective use of these resources, thus promoting Mexico's progress.

Influenced by Humboldt, Comte, Lamarck, Spencer, and Darwin, as well as Creole and Hispanic authors from the late eighteenth century, the Mexican scientists who constituted the SMNH encouraged the study of natural history, believing that there was a strong and reciprocal relationship between the natural and social world. They had clear goals for this research—which was not the aimless Humboldtian fact-gathering it is sometimes portrayed: learning how nature worked would result in the effective management of natural resources (i.e., flora, fauna, minerals, etc.), as well as improve the environment (i.e., climate, soil, air, water, geography, etc.) and the Mexican people (e.g., issues of race and public health). Indeed, scientists believed that learning about natural history could help construct a modern, civilized, and progressive country—similar to other powerful Western nations.

Philosophical theories of positivism and liberalism not only guided Mexican intellectuals, but also the course of political life during the second half of the nineteenth century. Historian Leopoldo Zea has argued that positivism in Mexico followed its own path, apart from European counterparts, because it was applied to specific political strategies and conflict between political groups. In Mexico, Comte's scientific theory achieved realization as a political tool of liberal politicians.[5] Above all, it promised to provide an antidote to nineteenth-century Mexico's chronic instability. The War of Independence, almost constant civil wars, military interventions by the United States and France, and the brief Maximilian I government occasioned struggles amongst

[5] Leopoldo Zea, *El positivismo en México: nacimiento, apogeo y decadencia*, 1. ed. (México: Fondo de Cultura Económica, 2005). 24-28.

several groups, most of whom could be labeled as “liberal” or “conservative.” After the execution of the French monarch, Mexican president Benito Juárez and his liberal supporters undertook reforming the economic and educational system. Juárez established a commission to restructure the national education system with Gabino Barreda (a disciple of Comte), Francisco and José María Díaz Covarrubias, Leopoldo Río de la Loza, Alfonso Herrera, and other intellectuals—the last four scientists belonged to the SMHN’s later years. They elaborated the *Plan de Instrucción Pública* (Public Educational Plan) based on positivist theory that tried to “reeducate Mexicans” into the promotion of order and progress, in part by promoting research and scientific knowledge.[6] Positivist ideas underpinned the plan’s promotion of scientific method of observation and experimentation as a way to approximate truth.

It is important to recognize that there were marked distinctions within these broad political categories. Even though Díaz Covarrubias, Río de la Loza, and Herrera collaborated with Barreda, they did not belong to his close group of Comte’s disciples, and positivists involved in the SMNH often had different viewpoints on nature and political issues. In 1877, Barreda and his followers—many of them students of medicine—established a separate *Asociación Metodófila “Gabino Barreda”* (AMGB; Methodological Association “Gabino Barreda”), but the group’s attendance records do not show any other members of the SMHN and *La Naturaleza* did not publish any of its works. During some AMGB sessions, Barreda and his followers discussed nature’s role, and the theories of Darwin and Spencer were topics of discussion. Some members considered nature a threat and the cause of human degradation; thus,

[6] Lourdes Alvarado, "Saber y poder en la Escuela Nacional Preparatoria 1878-1885," in *Saber y poder en México, siglos XVI al XX* ed. Margarita coord. Menegus (México: Centro de Estudios sobre la Universidad, UNAM, 1997), 49;Leopoldo Zea, *El positivismo en México: nacimiento, apogeo y decadencia*: 84.

humans had to control it. For other members, nature was the product of God's creation.[7] Moreover, Gabino Barreda and Alfonso Herrera had different viewpoints on positivist theory that had broader political consequences. When president Díaz exiled Barreda, Herrera replaced Barreda as the director of the *Escuela Nacional Preparatoria* (the National High School), one of the most important educational centers in Mexico, and discarded much of its Comtean emphasis.

Between 1876 and 1910, Porfirio Díaz and his group governed for thirty-four years backed by positivist ideas aimed at ensuring order and progress through several economic and social strategies, for instance, industrial enhancement, development of natural resources, and the improvement of racial and public health. In 1880, a group close to Díaz began to actively acquire political positions, including the positions of deputy and minister. Their actions went beyond politics into business, finance, and administration, and they played a key role in keeping Díaz in the presidency.[8] Those technocratic politicians, referred to then and now as *Los Científicos* (The Scientists), found justifications in Comte, Spencer, and Darwin's theories to legitimate their hold on power, arguing that they were most suited to lead Mexico toward order and progress and to improve the circumstances of Mexicans. Liberal ideology also maintained that Mexico could progress socially and economically through the use of natural resources and the application of scientific knowledge. According to Charles Hale, liberalism turned into a "united myth" during Díaz's period because he and his group used the liberal flag as a strategy to reconcile with conservative groups, who received support from the government for their activities.[9]

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[7] FRBN-UNAM Asociación Metodófila "Gabino Barreda," "Annales de la Asociación Gabino Barreda,"[Methophilia Association "Gabino Barreda"], vol. I (México: Imprenta del Comercio, de Dublán y Chávez., 1877).

[8] A. Charles Hale, *La transformación del liberalismo en México a fines del siglo XIX* (México: Fondo de Cultura Económica, 2002), 44.

[9] Ibid., 165.

Similar to *Los Científicos*, members of the SMHN also believed that scientific knowledge provided a way to foster the country's progress. In their writings, members of the SMHN combined positivist and liberalist points with their earlier "conservative" interests in researching natural science.[10] Although many political used positivism and liberalism in order to gain, maintain, and reproduce their control over the country, the SMHN's members found in both theories a way to defend studies on natural history as activities vital for obtaining the country's progress. Díaz often provided funds to the SMHN. Some members of the SMHN served as congressmen and staffers within Díaz's government, or had links to secretaries and politicians within the administration. Their influence was much greater within the educational system than the political system. For example, Alfredo Dugés, Porfirio Rovirosa, and Pedro López Monroy were professors of medicine, engineering, and agriculture in the principal educational institutions in Mexico City and in several cities across the country (in Guanajuato, Tabasco, and San Luis Potosi, respectively).[11] However, none of the SMHN members belonged to the favored presidential group known as *Los Científicos* or to Díaz's inner circle, nor did they treat positivism as dogma. Some members of the SMNH such as Manuel Orozco and Antonio del Castillo even identified as conservative and were heirs of the old regime because they had participated with the French government.[12]

La Naturaleza

In 1869, the Society founded the journal, *La Naturaleza* (*Nature*)—the same year that Norman Lockyer edited the first issue of the far better-known *Nature* in London. Between 1869

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[10] A. Charles Hale, *La transformación del liberalismo en México*, 17.

[11] Mauricio Tenorio-Trillo, *Artilugio de la nación moderna*; Tenorio-Trillo and Gómez Galvarriato, *El Porfiriato*; A. Charles Hale, "Political and Social Ideas"; Luz Fernanda Azuela, *Tres sociedad científicas*.

[12] AGN Francisco Rodríguez, "Carta," ed. Instrucción Pública y Bellas Artes (México1903); Lourdes Alvarado, "Saber y poder."

and 1914, the SMHN published eleven volumes of *La Naturaleza*, which were divided into three series.[13] Manuel M. Villada was the journal's director for almost its entire run, from 1869 to 1910. Society director Alfonso L. Herrera urged his colleagues to study nature in a manner that was reflexive and philosophical, not just descriptive, and its articles reveal changes, contradictions, nuances, and continuities exhibited by Mexican scientists regarding their ideas on nature—many speaking to the principles of positivism and liberalism of the age—and reflect the diversity of scientific interests of the Society's members.

Over the years of its existence, *La Naturaleza* published 740 articles on diverse topics related to natural history, civil history, biographies, and necrologies of scientists from Europe and the Americas, as well as reports of the activities of the SMHN's board.[14] Of those articles, most of the titles related directly to one of the three kingdoms of nature (vegetable, animal, or mineral), that is zoology (36%), botany (28%), or mineralogy and geology (13%). In terms of regional coverage, the majority of the articles focused on the Valley of Mexico and Veracruz. According to a content analysis by Izquierdo, traditional topics related to morphologic and taxonomic criteria of organisms received the most attention (50%), 23% of articles were devoted to history and education, 13% to physical or geographical attributes of the earth, 5% to the disciplines of physics and chemistry, 8% to problems in human's relationship with nature or evolutionary thought, and 4% related to disease and public health.[15]

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[13] The first series compiled seven volumes from 1869 to 1886, the second compiled three from 1887 to 1904, and the third contained only one volume from 1910 to 1914.

[14] Elías Trabulse, *Historia de la ciencia en México,* 5:53.

[15] José Joaquín Izquierdo, "Contactos y paralelos de la nueva Sociedad Mexicana de Historia Natural, con su precursora, y divergencias que convienen para su futuro" [Contacts and Parallel of the New Mexican Society of Natural History with Its Precursor and Convenient Divergences to its Future].

The journal also republished articles by SMHN members published in other venues such as the *Anales de la sociedad entomológica de Puebla* (*Annals of the Entomological Society of Puebla*) and translated into Spanish texts published in international journals such as *Revue Scientifique* and *Bibliothèque Scientifique* in France, and the *Proceedings of the American Academy of Arts and Science*. As was typical for society publications of the day, other international organizations, such as the Zoological Society of France, asked for publications or researcher assistance in exchange. Society members sometimes published reviews of international publications, such as Eugenio Dugès' 1882 review of *Birds from North America* by the secretary of the Smithsonian Institution Spencer Fullerton Baird.

The journal's editors intended *La Naturaleza* to be, at a minimum, a sixteen-page monthly. This idea changed over time because of a lack of monetary resources or interest. During the organizations early years from 1869 and 1876, the SMHN released regular editions bound in volumes of 470 to 540 pages. It is important to note that the quantity of pages did not mirror quantity of original research. The largest volume covering 1891 to 1896 was published in two parts with a total of 1,265 pages, but consisted mostly of the translated works from US journals. In the 1882 and 1884 volumes, the majority of its articles were translations from French journals or reports from the secretary of development, and original works from SMHN contributors were few. This publication pattern led López Monroy and SMHN Vice President José Maria Velasco to express concern regarding the lack of enthusiasm of Society membership and lack of governmental resources for the work of Mexican naturalists.[16] A 300-page appendix to volume 6 of the first series included a "collection of documents" on Mexican flora and fauna

[16] José María Velasco, "Discurso."

by much older intellectuals, some of it never before published, including Francisco Javier Clavijero, José Antonio de Alzate y Ramírez, Vicente Cervantes, Pablo de la Llave, José Mariano Mociño, and Martín Sessé, that played a role in consolidating knowledge of a Mexican tradition of natural history extending far back into the colonial period. The SMHN editors only included research from Spanish and Creoles, however, dismissively referred to botanic and medical knowledge produced by indigenous peoples and commoners as empirical information from "*naturales*" (natives born in Mexico).

At times, the SMHN editors worried about having publishing the findings from only sixty-six Mexican contributors. Four contributors, however, distinguished themselves as by far the most constant writers between 1869 to 1914: Alfredo Dugès published eighty-four articles; Manuel Villada, fifty-nine; Mariano Bárcena, thirty-three; José Ramírez, twenty; all of them were widely published in other journals and pamphlets too. Through their writings, *La Naturaleza* becomes a window into the development of the natural sciences in Mexico and ideas regarding the natural world.

A survey of the ideas expressed in *La Naturaleza* reveal utility and equilibrium as two core concepts that deeply concerned the articles' authors and were applied to a range of topics—for instance, the economic utility of insect control, pearl harvesting, and mineral exploitation; regarding the social utility of draining the Valley of Mexico; and protecting forests to improve public health. Antonio del Castillo, president of the SMHN, stated in the first meeting that the society had "a huge field of useful scientific studies to exploit" and served to protect both the government and citizens; once all the society's plans were realized, "the nation [would] someday

reap the benefits."[17] Three years later, the society's secretary Antonio Peñafiel gave a summary of the SHMN's activities from 1869–70. He highlighted Eugenio Dugés' work on a new species of *Meloideos* (a beetle), which he found abundant in the regions of Guanajuato, Mexico State, Hidalgo, and Jalisco. *Meloideos* had medicinal uses due to its vesicant effects, and Peñafiel recognized that, thanks to Dugés' discoveries, Mexico would not need to import *Meloideos* anymore.[18] In another article physician Leopoldo Río de la Loza stressed that many people still disregarded the extent of the country's natural resources because they had focused narrowly on mineral exploitation, ignoring the country's abundance of fauna and flora. He asked, "Why do we not exploit this *inexhaustible resource* that nature gives us?" Río de la Loza was confident that promoting zoological and botanical studies would produce many more stories of this sort, and several articles underscored the utility of flora and fauna for medical uses.[19]

The SMHN continued to highlight works on natural resources that could reap high profits for the country throughout its existence. For instance, physician Jesús Sánchez carried out research on the *Meleagrina margaritífera* (mother-of-pearl) shell in Baja California. He thought that this shell was one of the most interesting products for Mexico's science and economy. First, shell studies were fundamental to the study of biology—to draw comparisons with other mollusks on the planet. Second, Sánchez was aware of the high value that mother-of-pearl shell boasted within international trade and industry, and Sánchez believed that an industry based on

[17] Antonio del Castillo, "Discurso," 5.

[18] Antonio Peñafiel, "Informe rendido por el secretario que suscribe acerca de los trabajos científicos ejecutados por la Sociedad Mexicana de Historia Natural durante los años de 1869 y 1870 [Report of Secretary who sign up related to scientific works of the Mexican Society of Natural History from 1869 to 1870]," *La Naturaleza* I, 1ª. Serie (1870): 402.

[19] Emphasis added; "¿Por qué no explotar esa fuente inagotable que nos dio la naturaleza?" Río de la Loza, "Discurso de Leopoldo Río de la Loza," 411.

mother-of-pearl shell production in Baja, California could be a source of great wealth for Mexicans—if its organization "was skillfully and wisely guided."[20]

Sometimes the SMNH translated or republished articles from European scientific literature to make a similar point. The *capullo de madroño* (cocoon of the butterfly *Encheira socialis*) was another product, minimally exploited, which scientists insisted had great economic potential. In 1856, the *Annals of the Entomological Society of France* published an article by entomologist Auguste Sallé (1820–1896) explaining that Humboldt had confused the cocoons of the *Encheira socialis* butterfly with *Bombyx* cocoons traditionally used for producing silk fiber during his travel to the Americas. Sallé was excited to report that the silk of *Encheira socialis* cocoons was even more abundant and beautiful than silk from *Bombyx*; thus, its exploitation could yield significant benefits for Mexicans, although entomologists warned that the butterflies had to remain in their natural habitat and the collection of cocoons had to be done in prudent manner.[21] In 1884, the physician Jesús Alemán continued studies on *Encheira socialis* and insisted on the use of the species in the textile industry and in paper production.[22] However, to the regret of SMNH members, the federal government instead promoted the production of silk from *Bombyx*, and gave the contract for Mexican production to an Italian company.[23]

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[20] "Siempre que la explotación fuese hábil y prudentemente dirigida" Jesús Sánchez, "Nota sobre la concha madreperla de la Baja-Caifornia," *La Naturaleza* VI, 1ª. Serie (1884): 10.

[21] Auguste Sallé, "Sobre el capullo del madroño [About the Cocoon of Madroño]," *La Naturaleza* III, 1ª. Serie (1876).

[22] Jesús Alemán, "Apuntes acerca de la mariposa del madroño eucheira socialis de Westorroel," *La Naturaleza* VII, 1ª. Serie (1887).

[23] Ángel Nuñez Ortega, "Apuntes históricos sobre el cultivo de las seda en México [Historical Notes Concerning Silk Cultivation in Mexico]," *La Naturaleza* VII, 1ª. Serie (1887); AUI-PD Porfirio Díaz, "Informe del ciudadano general Porfirio Díaz presidente de los Estados Unidos Mexicanos a sus compatriotas. Acerca de los actos de su administración en los periodos constitucionales comprendidos entre el 1 de Diciembre de 1884 y 30 de Noviembre de 1896," ed. Presidencia de la República (México: Imprenta del Gobierno, 1896).

In contrast, the government put its support behind the exploitation of *Coccus axin.* Insects known variously as *axe*, *aje*, or *ni-in* in the Mayan language were the object of a number of studies promoted by the government in 1883-84. Alfredo Dugés, a SMHN member and professor of the National Agriculture School (NAS), researched this species from the south and central regions of Mexico. Centuries earlier, indigenous people had extracted the grease from the body of this insect for medicinal and artisanal uses. A range of SMHN scientists commented on the industrial possibilities for this species, including Joaquín Dondé, the owner of a soap factory. Dondé underlined the economic relevance of *axe*'s exploitation because "this industry will release the country from buying linseed oil from abroad, which is often diluted with fish oil." Encouraged by these reports, the government encouraged *axe* exploitation, requested more studies in several regions, and asked the NAS to attempt transplanting specimens to places where these insects were uncommon. The Mexican government sent samples of products with grease extracted from *axe* specimens to the US, France, and Germany. Two companies from New Jersey and New York showed interest in the product, but ultimately did not invest.[24]

Engineers belonging to the SMNH (unsurprisingly) argued that studies on mineralogy were particularly valuable because mining was the elementary "force and power of Mexico" and could directly increase public wealth.[25] Society president Antonio del Castillo underscored the government's interest in supporting the SMNH's research in order to gain fuller knowledge of

[24] BJA-UdeG Secretaría de Fomento, "Trabajos de la Secretaría de Fomento de la República Mexicana sobre el axe," ed. Secretaría de Fomento (México: Imprenta de la Secretaría de Fomento, 1884); Alfredo Dugés, "Informe acerca del axe," *La Naturaleza* VI(1884); Alfonso Herrera, "El aje," *La Naturaleza* VI, 1ª. Serie (1884); Joaquín Dondé Ibarra, "El Ni-in," *La Naturaleza* VI, 1ª. Serie (1884); Víctor Bloede, "El Nün de Yucatán," *La Naturaleza* VI, 1ª. Serie (1884).

[25] Antonio del Castillo, "Discurso"; Antonio del Castillo, "Resumen de los trabajos que sobre reconocimientos de criaderos y minas de azogue se practicaron el año de 1844 " *La Naturaleza* II, 1ª. Serie (1873); Pedro López Monroy, "Observaciones sobre una presunta especie mineral nueva nativa de México," *La Naturaleza* I, 1ª. Serie (1870); Santiago Ramírez, "Informe sobre los depósitos carboníferos del cerro de El en el distrito de Huachinango," *La Naturaleza* VI, 1ª. Serie (1884).

Mexican mineral wealth and to protect it from foreign expropriation, warning that Mexicans should not give other nations the "merit of coming and reaping the glory from this venture."[26] Engineers wrote frequently in *La Naturaleza* on new discoveries of metal sources—confirming Humboldt's ideas on the existence of abundant resources in Mexico, aside from gold, silver, sulfur, charcoal, and mercury. However, in too many cases, these articles lamented, the lack of roads hindered their exploitation, and required government intervention in order to improve roads and transportation. Like promoters of *madroño* silk and *axe* grease, engineers insisted that mercury mine production could satisfy the national demand for an important industrial article, thereby avoiding imports. The Mexican government and the SMHN's engineers saw in mines a source of wealth for the country and undertook legal and economic reforms to improve the mining industry. In the same way, some engineers belonging to SMNH, such as Pedro López Monroy and Mariano Bárcena, had close links with mining companies, and sometimes offered their consulting services and occupied government administrative positions related to mining issues.[27]

The worshipful attitude of SMNH contributors toward Alexander von Humboldt is particularly clear in the engineers' case. In a typical passage, Castillo noted that Humboldt had foreseen that greater Mexican involvement the mining industry was necessary because "the prosperity of the country depended essentially from the prosperity of mines," and echoed Humboldt's idea that agriculture in Mexico had improved due to mine production during the

[26] [...] el mérito de venir a recoger la gloria de la empresa. Antonio del Castillo "Discurso," 5.

[27] CDHI-UASLP. Pedro López Monroy, "Informe sobre Máquinas de Barrenar presentado a la Junta Directiva de la Compañía Minera "Unión Catorceña" del mineral de Catorce," (México: Imprenta de Francisco de León 1878); Díaz, "Informe del ciudadano general Porfirio Díaz presidente de los Estados Unidos Mexicanos a sus compatriotas. Acerca de los actos de su administración en los periodos constitucionales comprendidos entre el 1 de Diciembre de 1884 y 30 de Noviembre de 1896."

colonial period.[28] (In fact, this was a misreading. Humboldt believed that agricultural activities were the core of societies because they promoted the progress and welfare of the population. For the Prussian traveler, land was the basic source of wealth, interior trade, communication, roads, and military defense.)[29]

The SMNH was not only interested in the economic utility of natural resources, but also in their utility in an ecological and teleological sense. They sometimes proposed that resource exploitation that would truly enable the country's progress be done in such a way to maintain equilibrium in the natural order, even while serving human use. In this sense, scientists from the second half of the nineteenth century demonstrated a combination of organic and utilitarian viewpoints on nature, reflecting the influence of Humboldt's works, these scientists believed in the close and reciprocal relationship between nature and societies.

The physician Manuel Villada, one of the founders of the SMHN, highlighted the material and spiritual utility of birds, from a notably teleological perspective.

> Nature has destined them [birds] to populate the air, give life and animation to other beings […], to represent the image of happiness […] and to hear their harmonious songs, where they had heard the cries of wild beasts; […] to consume some of the seeds that had been too abundant, to contain the excessive fertility of insects, reptiles, and fish, [as well as] to avoid infection of the air that had caused their corpses.[30]

As with the republication of Sallé's work, the editors of *La Naturaleza* frequently reproduced international articles that strengthened this dimension of the journal's portrayal of

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[28] Antonio del Castillo, "Resumen de los trabajos sobre reconocimientos de criaderos y minas," 40.

[29] Alexander von Humboldt, *Ensayo político*, 21.

[30] La naturaleza las ha destinado [a las aves] para poblar el aire, dar la vida y animación que los demás seres difunden en otros elementos; para representar en la tierra la imagen de la felicidad, e inspirar en ella la alegría que sin ellas hubiera sido desconocida, y dejar oír sus armoniosos cantos, en donde se hubieran oído los gritos de las fieras; para consumir una parte de las simientes que hubieran sido demasiado abundantes y contener la excesiva fecundidad de los insectos, de los reptiles y de los peces y evitar la infección del aire que hubieran causado sus cadáveres.[…]. Villada, Peñafiel, and Sánchez "Aves del Valle de México."

nature. One example of the organic viewpoint is the article "Fauna Indígena" [Indigenous Fauna] by late eighteenth-century French scientist Horace Benedict Saussure. The French author explained what we would now call the ecological advantages of birds of prey, such as buzzards. He noticed that these birds were very important in nature's balance because they destroyed miasmas, filth, and other hazards: "In this way, the evil has itself its remedy, thanks to the equilibrium of nature's law, which almost never fails."[31] Meanwhile Manuel Villada underscored the significant role of birds in nature because they excel at "facilitating the spread of organized beings, destroying [the beings] that due to excessive fecundity can be pernicious to humanity."[32] The botanist Alfonso Herrera focused on flora as essential element for life. According to him, the vegetable realm is the most important of nature's three realms because it is the most fecund and nourishes everything immediately. In addition, Herrera emphasized the enduring aesthetic value of flora, "[it] is the most beautiful ornament on the Earth."[33] For this reason, he once again points out the importance of studies on Mexican flora because national and international travelers had examined vegetation, yet still many plants remained unknown or undiscovered.[34] Both scientists, Villada and Herrera, published in *La Naturaleza* on the organic perspective of nature and its relationship with humans over time.

The naturalists of the SMHN adopted another characteristic: the teleological approach. They distinguished between the species that would and would not be useful. Francisco Cordero y Hoyos emphasized the role of plants in human life. He held that, in addition to their ornamental characteristics, plants autonomously decided to help humans via the natural law of the struggle

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[31] Horace Benedict Saussure, "Fauna Indígena. El Zopilote," *La Naturaleza* I, 1ª. Serie (1870): 51.
[32] Ibid., 94.
[33] Alfonso Herrera, "Apuntes para la Geografía Botánica de México [Notes to Botanic Geography of Mexico]," *La Naturaleza* I, 1ª. Serie (1870): 81.
[34] Ibid.

for existence: "Multiple plants surrounding us fight in order to satisfy our necessities."[35] On the other hand, regarding the animal kingdom, Alfredo Dugés posited that the Chihuahua dog (*Canis gibbus*) was a curious and useless breed, which was disappearing. Chihuahuas, Dugés found, were useless to human because they were shivery, fearful, and their bark was weak. Dugés explained that naturalists were only interested in the breed because they wanted "to preserve the memory of this peculiar Mexican dog" before this ancient breed went extinct.[36]

During the early years of *La Naturaleza*, some authors framed nature as a divine creation. References to Catholicism and the Christian argument are found throughout *La Naturaleza* between 1868 and 1870. For instance, mining engineer Pedro López Monroy wrote "Geological Hypothesis," in which he analyzed the earth's geological periods from a Catholic perspective and predicted that the end of the world would be due to changes in climate. He described the creation of the universe and identified heat as the element brought forth by the Creator that drove the earth's natural history.[37] In a similar manner, Leonardo Oliva narrated the history of botany. The author affirmed that an affinity for plants existed in all cultures and in all theogonies (geneaologies of the gods), exemplified by their portrayal in wonderful landscapes. He explained that the so-called "science of plants" had its origins in the biblical paradise and in the divine mandate after the fall of man that established agriculture as a science. According to Oliva, God mandated agriculture when he said, "by the sweat of your face you will eat bread."[38] Meanwhile, Manuel Villada in his text "Apuntes para la mamología mexicana" underscored that fauna's

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[35] Francisco Cordero y Hoyos. "Géneros nuevos de gramíneas descubiertos por el Sr. Vicente Cervantes en los alrededores de México, " *La Naturaleza I, 1ª. Serie (1870)*: 343.

[36] Alfredo Dugés, "El perro de Chihuahua," *La Naturaleza* V, 1ª. Serie (1882): 16.

[37] Pedro López Monroy, "Hipótesis Geológica [Geological Hypothesis] " *La Naturaleza* I, 1ª. Serie 1870): 238-40.

[38] "Cultivarás la tierra con el sudor de tu rostro." Leonardo Oliva, "Sobre la historia de la botánica, extranjera e indígena [About History of International and Indigenous Botany]," *La Naturaleza* I, 1ª. Serie (1870): 57.

habits were a revelation of the "superior intelligence of the Creator" because the actions of animals depended on their organisms, and this dependence was evidence of divine creation. Consequently, natural history through comparative physiology and anatomy led not only to knowledge on the habits of fauna but also an understanding of God.[39]

Other authors, however, presented different perceptions of nature. As we have seen, many were driven by aesthetic concerns. Antonio Peñafiel, in his first report as the SMHN's secretary, stated that the Botany Commission endeavored to study the multitude of "beauties that still hide in the virginal forest, and in the fertile prairie that the nature pleased dressing soil of our homeland."[40] Some adopted ideas from the German *Naturphilosophie* movement, such as vitalism and the idea that the dynamism of nature maintained the order and balance of the world. Moreover, several members of the SMHN repeated the old Baconian doctrine stating that the study on nature meant extracting its secrets.[41] One of nature's secrets was the equilibrium and organization of beings. For instance, Mariano Bárcena analyzed the communal bird *Quiscalus macrourus*, named by Mexicans as "zanate," or "urraca" and to northerners as the great-tailed grackle, for whom it is widely considered a pest. He hypothesized that nature had given the *urraca* the sagacity to play a dual role—either favorable or harmful to agriculture—because they could follow the furrows of a plowed field and steal seeds, or they could destroy harmful larvae and insects. Bárcena explained that during the first period of Spanish colonization *urracas* had severely damaged their fields, and Europeans had offered rewards to people who brought them

[39] Manuel Villada, "Apuntes para la mamología."

[40] "…bellezas que aún permanecen ocultas en los bosques vírgenes y en las fértiles praderas con que a la naturaleza le plugo decorar el suelo de nuestra patria." Antonio Peñafiel, "Informe 1869-1871," 401.

[41] Sebastián Camacho et al., "Dictamen aprobado por la Sociedad de Historia Natural, en la sesión del 17 de abril de 1873, y que fue presentado por la comisión nombrada para dilucidar la cuestión suscitada con motivo del fraccionamiento del aerólito de "La descubridora"," *La Naturaleza* II, 1ª. Serie (1873): 287.

dead *urracas*. For this reason, they almost extinguished the species. However, this caused the owners of the land another big problem when insects invaded their fields, but "the *quiscalus* came to the fields to exterminate them."[42]

Several contributors related natural history study directly to conservation. Bárcena and Villada insisted on promoting a detailed study of the habits of fauna, arguing that intimate knowledge of this life would help with its protection.[43] In this sense, equilibrium was an important topic within publications *La Naturaleza*. Some members of the SMHN warned that the destruction of some species had already occurred due to people's ignorance. Villada, Peñafiel, and Jesús Sánchez stated that studies on ornithology could help to "delete the pernicious custom of our peasants who exterminate them without discerning what birds may be beneficial."[44] Joaquín Dondé joined the conversation and advocated increasing the studies of fauna because he observed how people had destroyed the *axe* insect, which could have developed into an industry with high benefits for the country, as was explained earlier.[45]

Scientific Methodology in SMHN Research

SMHN researchers rigorously followed what they viewed as the scientific method of the natural sciences. The most prolific writers were consistent in presenting themselves as maintaining objectivity: they collected plants, animals, or minerals species in order to observe, name, describe, and classify them.[46] Analyses on zoology and botany were samples of those careful studies that described physical characteristics, and habitats. In this sense, drawings were

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[42] Mariano Bárcena, "Apuntes para la ornitología mexicana," *La Naturaleza* II, 1ª. Serie (1873): 205.

[43] Manuel Villada, Antonio Peñafiel, and Jesús Sánchez, "Aves del Valle de México [Birds of Valley of Mexico]," 100.

[44] Ibid.

[45] Joaquín Dondé Ibarra, "El Ni-in," 204.

[46] Alfredo Dugés, published eighty-four researcher's result from 1870 to 1911, Manuel Villada fifty-four from 1870 to 1914, and Mariano Bárcena thirty-three between 1870 and 1899.

an important tool to hold this objectivity, and authors often attached black and white or colorful drawings to their articles.[47] Although illustrations of flora, fauna, and minerals were common in scientific publications in the nineteenth century, painter José María Velasco stated that the universal iconographic flora helped natural history to learn "to go to the farthest limits of our homeland."[48] Velasco and other authors followed principles of the French Revolution on democratic science, promoted by the Muséum d'Historie Naturelle in the eighteenth century. He stated that drawings had a clear language and helped most people to understand science.[49] Several articles published in *La Naturaleza* included drawings, and by 1910, authors had begun to attach photographs of their expeditions. For many years, Velasco helped colleagues to illustrate their texts, whereas others, such as Alfredo Dugés, drew the images themselves (Fig. 7 and 8).

[47] Alfredo Dugés, "Apuntes para la monografía de crótalos de México," *La Naturaleza* IV, 1ª. Serie (1879); Dugés, "El perro de Chihuahua."; Joaquín Ibañez, "La Tlatlancuaya de Izucar de Matamoros," *La Naturaleza* IV, 1ª. Serie (1879).

[48] José María Velasco, "Informe," 5.

[49] Jean-Marc Drouin and Bernardette Bensaude-Vicent, "Nature for the people," in *Cultures of Natural History*, ed. Nicholas Jardine, James A. Secord, and E. C. Spary (Cambridge: Cambridge University Press, 1996).

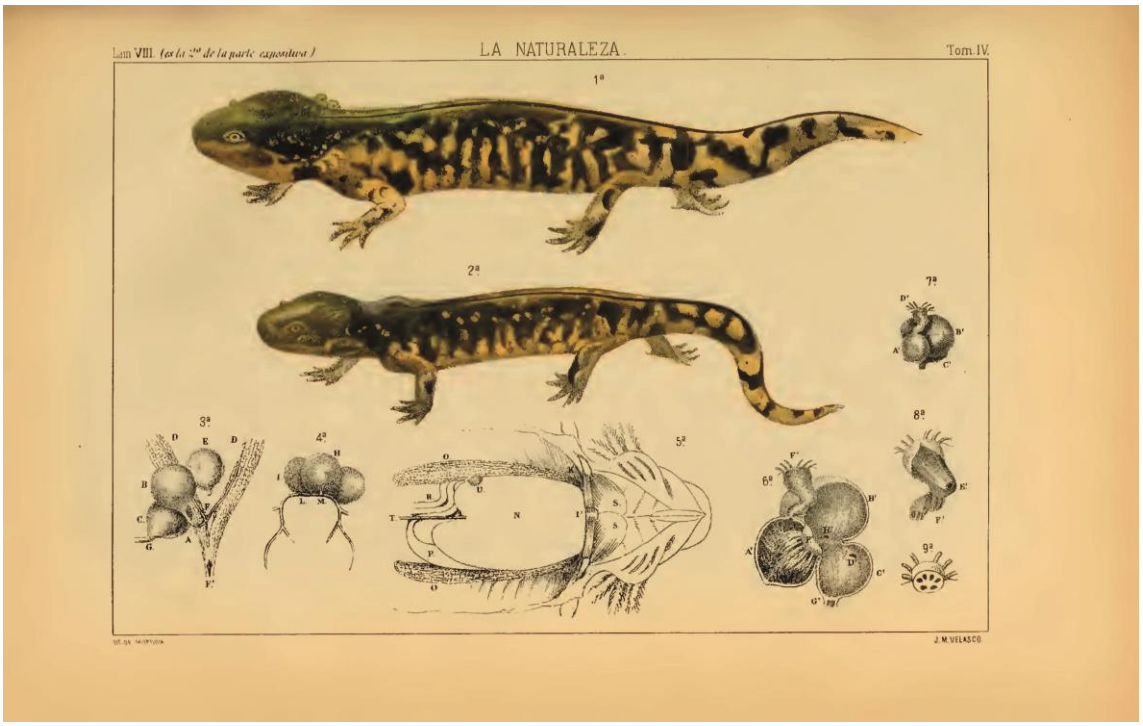

Figure 7. Axolotl by Velasco
Source: *La Naturaleza* T.4 2ª. . Serie

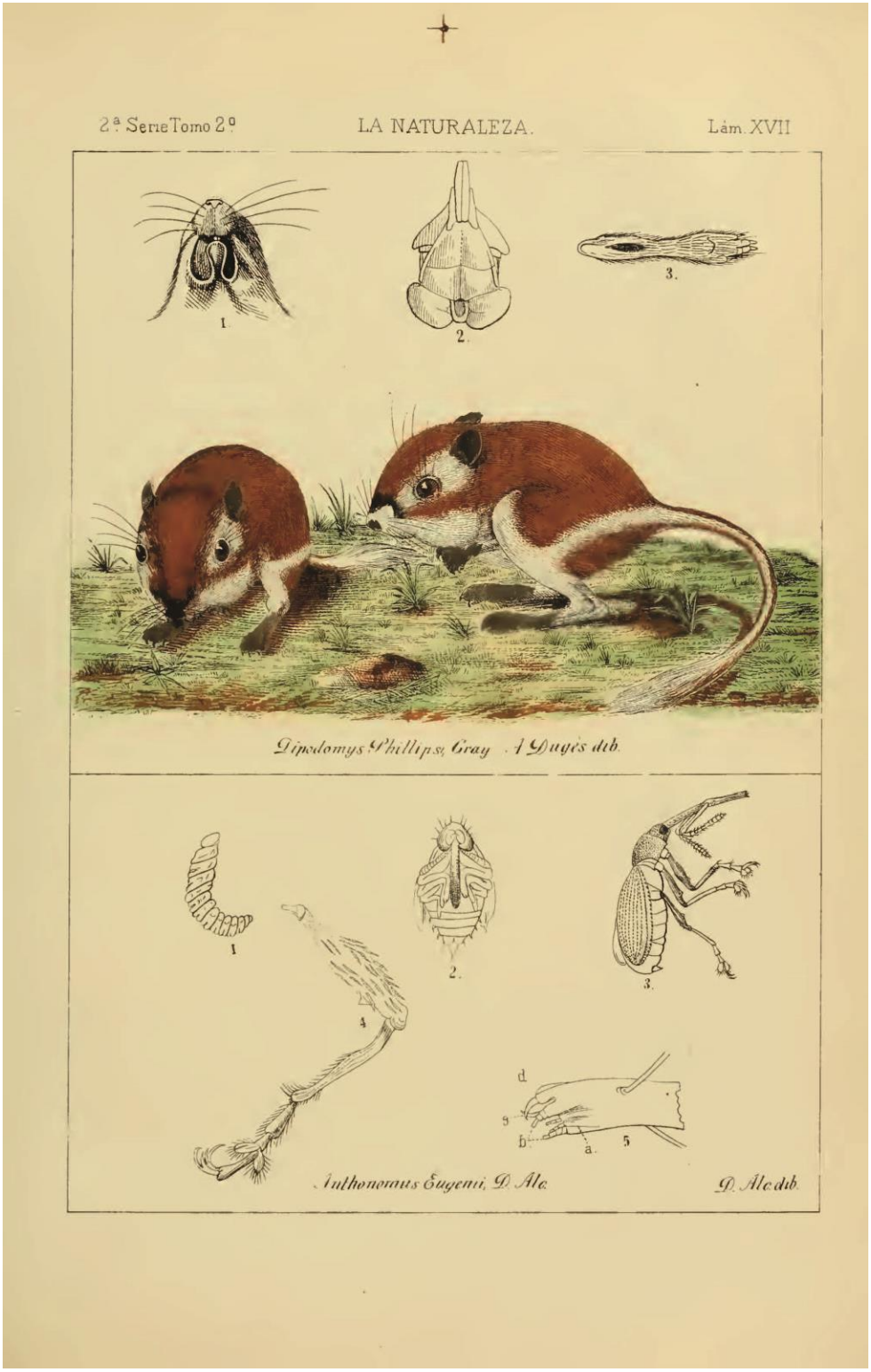

Figure 8. *Dypodomis Phillipsi Gray* (Phillips Kangaroo Rat) by Alfredo Dugés.
Source: SMHN, La Naturaleza T.2. 2ª. Serie

When members of the SMHN discovered what they thought to be a new species, they would send it to be compared and verified by institutions abroad (e.g., Smithsonian Institute, Society of Nature of Philadelphia, etc.) and by international scientists (e.g., Frederick Burkart in Berlin). Alfredo Dugés and his brother Eugenio shared a particularly close relationship with French scientists and scientific institutions; thus, they habitually sent their works to the Medicine School of Paris to be validated.[50]

European authors and indigenous testimonies provided two contrasting sources used to construct Mexican natural history; however, they occupied a different status in the SMHN's articles. Mexican natural historians routinely cited the work of European scientists as authoritative. Humboldt and Burkart provided the most influential data, as did the older classificatory work of Linnaeus, Le Candolle, Buffon, Saussure, and Cuvier. Mexican intellectuals used this literature to assess differences between European information and their own discoveries to notice gaps in information about specimens or to confirm that a specimen was in fact a new species. Mexican intellectuals, however, carefully omitted negative critiques of the Americas by their foreign counterparts; for example, *La Naturaleza* ignored Buffon's environmental determinism and his viewpoints on the degeneration of American inhabitants. In addition, the SMHN also touted Spanish-American science as an authoritative source, and often made reference to Clavijero, Alzate, Sessé, Cervantes, Mociño, de la Llave, and other Creoles and resident Spaniards who were pioneers in the study of natural history in Mexico. In fact, between 1887 and 1891, editors of the journal increased the page count in order to make room for publication of some of their recovered "basic documents to Mexican natural history studies,"

[50] Manuel Villada, "Información."; Dugés, "Apuntes para la monografía de crótalos de México."; Joaquín Ibañez, "La Tlatlancuaya de Izucar de Matamoros."

many of which remained unpublished and scattered, because they considered it their responsibility to disclose this information. Physician Jesús Sánchez warned that some earlier documents "[had] flaws inherent of the epoch that they were written in," but he admitted that "others had indisputable scientific merit."[51]

In spite of their reverence for contemporary European science, the members of the SMHN tended to overlook indigenous knowledge that was being gathered from codices as well as Acosta's work. Some authors gave attention to the sixteenth-century Spanish naturalist Francisco Hernández's contribution to natural history and yet discounted its basis on indigenous societies' erudition on Mexican flora. In an article about botanic history, the author praised Hernández contribution because he "recovered the indigenous names of flora, fauna, minerals, and medicinal tradition."[52] For some authors, this belittlement of earlier indigenous groups went even farther: they merely admired the beauty of species such as the hummingbird, but they did not study them.[53] Few authors highlighted indigenous societies' contributions to natural history studies, although Ibañez stated that older Mexicans had used a botanic classification system that deserved praise despite its weak empirical nature because, as he suggested, indigenous people had no relationship with the civilized world. For him, the indigenous classification system demonstrated a natural method of taxonomy, which had similarly arisen in Europe from older classification systems before the triumph of Linnaean taxonomy.[54]

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[51] Jesús Sánchez, "Apéndice. Colección de documentos para la historia natural de México," 4.

[52] J. Eleuterio González, "Discurso sobre el estudio de la botánica dirigido a los alumnos de la escuela de medicina de Monterrey," *La Naturaleza* V, 1ª. Serie (1882): 179.

[53] Rafael Montes de Oca, "Ensayo ornitológico de la familia trochilidae o sea de los colobries o chupamirtos de México," *La Naturaleza* III, 1ª. Serie (1876): 15.

[54] Joaquín Ibañez, "La Tlatlancuaya de Izucar de Matamoros," 90.

Ideas regarding pre-Hispanic indigenous groups as "civilized societies" were part of SMHN discourses on archaeology and civil history. The existence of groups such as the Aztecs, for example, deserved discussion as an example of the first stages of societies, reflecting Comte's ideas, in which pre-Hispanic cultures belonged to the "theological stage." In 1873, Antonio Peñafiel regretted that a country with a memorable history had abandoned significant archeological sites, such as Mitla in the state of Oaxaca. This area supported the most important trading post when the "Aztec civilization conquered territories as far as Guatemala."[55] Nevertheless, contemporary indigenous people did not have "a civilized condition" because they had transformed. According to Peñafiel, they had degenerated due to Spanish abuses, rules, and behavior, with the exception of Catholicism, which they argued had benefited the indigenous people.

Transformism, Evolution, and Darwinism

In the minds of most members of the Society, nature changed over time. In 1870, Pedro López Monroy explained that material existence was neither stable nor ageless; he underlined how pressure and temperature were factors that determined changes in the Earth. Although he wrote from a Catholic perspective that identified Earth's origin in chaos, with heat as "the first agent of the Creator," following Buffon's old natural history, he stated that changes over time had generated a kingdom of solids, wherein temperatures drop to freeze the whole globe, thus determining the geological ages of the earth.[56] In 1873, *La Naturaleza* published "Plant Populations: Their Origins, Composition and Migration" by French scientist Carlos Martins. José Joaquín Arriaga translated the text, which discussed how current vegetation was the continuation

[55] Antonio Peñafiel, "Apuntes de viajes," *La Naturaleza* II, 1ª. Serie (1873): 262.
[56] Pedro López Monroy, "Hipótesis geológica," 239.

of earlier vegetation "modified by physical changes of the globe and by diversity of climates over time, and recently by man's intervention, whose power is more irresistible and more extensive in terms of its action.[57] Martins exchanged correspondence with Darwin between 1872 and 1877 and generally agreed with his theory of biotic evolution.[58] Martins, however, held the Lamarkian notion that favorable conditions produced seeds that grew differently.[59]

Even though members of the Society discussed the transformation of species, few of them took an active interest in Darwin's theories. Some prominent intellectuals within the Society such as Alfredo Dugés and José María Velasco stated that they did not agree with the author of *The Origin of Species*. After 1876, the scientific community in Mexico could not ignore that the Catholic Church, conservative groups, and some followers of Comte's philosophy all opposed Darwinism. Nevertheless, Alfonso L. Herrera, José and Ricardo Ramírez were the most outspoken adherents to Darwin's theories. Herrera's interests related to diverse topics in natural history, such as the environmental adaptation of ancient indigenous groups, Ricardo Ramírez viewed them as relevant to forest conservation from a legal standpoint, while José Ramírez was interested in the idea of the species and the origin and diversification of indigenous groups.

José Ramírez explained that the development of racial diversity adhered to biological laws, ensuring that primitive races in America were autochthonous, as mentioned earlier. Moreover, in his article "Teratological Origin of Varieties, Races, and Species," José Ramírez focused on the laws of inheritance and adaptation. He explained that these were the two major

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[57] Charles Martins, "Las poblaciones vegetales su origen, su composición y sus emigraciones," *La Naturaleza* II, 1a. Serie (1873): 20.

[58] Jim Secord to Darwin Correspondence Project, 2013.

[59] Charles Martins, "Las poblaciones vegetales," 250.

activities of vital organisms, whose combination produced the diversity of organic species. Inheritance included two kinds: inheritance of bequeathed character and the other of acquired character, and both were constant laws.[60] For Ramírez, the origin of some local species stemmed from anomalies (referred to by evolutionary biologists elsewhere as "monstrosities" or "saltations"), which had suddenly appeared and which were maintained by artificial or natural selection, because if "we study carefully all organizations anomalies we could find the multiple origins of race."[61] Although Ramírez mentioned several of Darwin's examples, his understanding was far more strongly influenced by Lamarck's *Zoological Philosophy,* even though the Mexican naturalist did not cite him.[62] José Ramírez's translation of Martins for *La Naturaleza* provided another avenue for introducing evolutionary ideas.[63] The editors of *La Naturaleza* were aware of the controversy the "descent doctrine" would generate—and in Velasco's case actively opposed it—but thought it had generated such fruitful discussions among naturalists, that the journal decided it would devote several articles to this topic.[64]

In an 1898 article focused on teaching, Ricardo Ramírez explained the relevance of the studies of natural history from what is best described as a Social Darwinist perspective. He underscored that all living beings suffer under unfortunate conditions in the struggle for existence because they experience neither truce nor rest during their combat against the destructive forces of nature, other organized beings, and beings of the same species. In the article, Ramírez summarized Mexico's economic and political problems of the nineteenth

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[60] José Ramírez, "Origen teratológico de las variedades, razas y especies," *La Naturaleza* IV, 1a. Serie (1879): 239.

[61] Ibid., 246.

[62] Jean Baptiste Pierre Antoine de Monet de Lamarck and Hugh Samuel Roger Elliott, *Zoological Philosophy; an Exposition with Regard to the Natural History of Animals* (London: Macmillan and Co., 1914).

[63] Charles Martins, "Las plantas carnívoras (Carnivorous Plants)," *La Naturaleza* IV,1a. Serie (1879): 53.

[64] José María Velasco and Manuel Villada, "Prospecto," *La Naturaleza* IV, 1ª. Serie (1879).

century and found that their causes could be traced to the struggle for existence. For this reason, he believed that natural history studies were important for how they helped to show how species, including man, could work to improve Mexico's circumstances.[65] In his proposal on conservationist forest legislation, Ramírez, highlighted links between law and political economy in which man was permanently engaged in a struggle to obtain and conserve his subsistence and livelihood. In this sense, he cited Malthus' work and mentioned Darwin's because they showed that the law applied to all beings and that the rules accounted for all the organized transformations, which "nature shows us in endless variety."[66] In both texts, Darwin's theory explained the relevance of natural history studies and the legislation directed toward conservation.

Other authors sometimes highlighted concepts such as transformation, adaptation, evolution, the struggle for existence, and survival of the fittest as part of their explanation of the natural and, sometimes, social worlds. The debate within positivist philosophical circles closely paralleled that in the natural sciences and social sciences, including the writings of Gabino Barreda and Justo Sierra. However, those positivists did not accept the theory of evolution completely. In 1895, Agustín Aragón, one of Barreda's disciples, published the article "Positivists' Appreciation of the Struggle for Existence." The text contained multiple quotations and references to Darwin, Spencer, and other evolutionary theorists. Aragón asserted that Darwinism was illogical because the theory did not fit positivist scientific conditions and it did not help to improve societies' conditions, but it did offer a distressing viewpoint of the future.

> Positivists study conditions of existence and the laws that govern them in order to improve them for their benefit. To know in order to foresee, to foresee in order to work is and will

[65] Ricardo Ramírez, "La enseñanza de la historia natural," 25.

[66] Ricardo Ramírez, "Legislación acerca de los bosques [Legislation Related to Forests]," *La Naturaleza* II, 2ª. Serie (1897): 24.

> always be an aphorism that anyone who lives consecrated to the service to his neighbor will not forget. Positivists, from the study of natural laws deduce that they are fatal to man's existence. He gives all his activity in order to contribute to modifying these laws for the benefit of the species. Darwinists cross their arms and say: the law of progress is fatal, and let those who are apt perish.
>
> Acceptance of the transformers' ideas guide us to recollection, because if we do not know if we are apt or not what do modification then do we introduce into ourselves? Fortunately, in presence of these distressing doctrines, which do not have a scientific basis, Positivism stands up and continually stimulates its own. It does not show us a future where alcoholics, grungy, and degenerate people will survive, contrary it shows us a future where the greatest will be those best and most systematically had cultivated their feelings.[67]

Within Mexican natural history circles, discussion of the *axolotl* species most vividly displayed conflicting opinions regarding Darwin's theoretical concepts, including environmental adaptation, evolution, and the struggle for life. According to Roger Bartra the fact that "the axolotl persist in its aquatic existence, without undergoing metamorphosis so as to go around salamander, was one of the great problems facing the evolutionist of the nineteenth century."[68] In 1870, Alfredo Dugés discovered a new amphibian species from Pátzcuaro Lake, Michoacán, which was different from *Bolitoglossa mexicana*, *Siredon humbolditii*, and *Siredon harlanii*, that he called *Siredon dumerilii*, *Alf. Dug*. In honor of Augusto Dumeril, a professor of herpetology from the *Muséum d'Histoire Naturelle* in Paris who had studied axolotl species earlier. Dugés

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[67] *Apreciación positiva de la lucha por la existencia*. "El positivista estudia las condiciones de la existencia y las leyes que rigen esas condiciones para mejorarlas en su provecho. Saber para prever, prever para obrar es y será siempre un aforismo que no olvidará seguramente todo aquel que viva consagrado al servicio de sus semejantes. El positivista, del estudio de las leyes naturales deduce que ellas son fatales para la existencia del hombre, pone toda su actividad a contribución para modificar esas leyes en beneficio de la especie. El darwinista se cruza de brazos y dice: la ley del progreso es fatal, los no aptos que perezcan. La aceptación de las ideas de los transformistas nos conduce al quietismo, pues si no sabemos si somos o no aptos ¿qué modificaciones vamos a introducir en nosotros? Afortunadamente, en presencia de esas doctrinas desconsoladoras que carecen de base científica, se levanta el positivismo que estimula sin cesar a la acción y nos presenta no un futuro en donde sobrevivirán los alcohólicos, roñosos y degenerados sino un porvenir en donde los grandes serán aquellos que mejor y más sistemáticamente hayan cultivado sus sentimientos." Roberto Moreno, *La polémica del darwinismo en México, siglo XIX: testimonios [Darwinism polemic in Mexico, the nineteenth century: testimonies]*, Segunda Edición ed. (México: Universidad Nacional Autónoma de México, 1989). 135.

[68] Bartra uses the metaphor of axolotl to analyze the "Mexicanness" as hybrid idea, consequence of intellectual creation. For the author, Mexican intellectuals created a hybrid identity with the image of Mexico uniqueness but with universal concepts. Roger, Bartra. *La jaula de la melancolía. Identidad y metamorfosis del mexicano* [*The Cage of Melancholy: Identity and Metamorphosis in the Mexican Character*] (México. Grijalbo, 1996), 141.

simply described and explained parts of new species via illustrations, but he did not add theoretical comments on the *axolotl*'s changes. Although Dugés did not discuss the theory of evolution, he confessed to Alfonso L. Herrera in personal letters that he did not agree with theories of evolution nor Darwin's proposals.[69] However, in 1879, Jose María Velasco published his own research on another new species of *Siredon* found in a lake in the Valley of Mexico. He described the species and explained its changes and habits and its transformation from a gill-breathing aquatic animal to a pulmonary-breathing animal due to its lack of gills. The author explained that after Cuvier began discussions on *Siredon* specimens' changes twelve years prior, followed by Augusto Dumeril, several natural scientists from Europe and the Americas had experimented with diverse *siredon* specimens.[70] Velasco analyzed seventy specimens from Santa Isabel Lake and Lake Xochimilco. He discovered that the *axolotl* specimen from Santa Isabel Lake underwent a transformation, whereas the specimen from Lake Xochimilco did not—confirming Dumeril's theory. Velasco explained that the causes for the species' transformation could be the fluctuating conditions of the lake; in other words, Santa Isabel Lake was not permanent: it was dry in February, March, and May, whereas Lake Xochimilco was permanent. However, he inquired whether metamorphosis was common in all species or whether it occurred accidentally in different cases. Velasco admitted that he did not have an answer to his question, nor did other scientists from Europe and Mexico—such as Alfonso Herrera, who did not observe the transformation in the specimens he analyzed. Velasco believed that the main cause of its metamorphosis was of divine origin, because the Creator had given the *Siredon* species an

[69] BJA-U de G. Enrique Beltrán, "Alfredo Dugés y el transformismo," in *Enrique Beltrán* (México: Biblioteca Pública "Juan José Arreola" Universidad de Guadalajara, w/y).

[70] José María Velasco, "Descripcion, metamorfósis y costumbres de una especie nueva del género de Siredón, encontrada en el lago de Santa Isabel cerca de Guadalupe Hidalgo, Valle de México," *La Naturaleza* IV, 1ª. Serie (1879): 210.

instinct to effect its transformation over time in order for it to determine its survival and, consequently, the survival of its species.[71] Velasco saw the validity of some of Lamarck's ideas when he recognized the influence of environment on the transformation of *Siredon* specimens. Nevertheless, he fell back on his religious viewpoints for his explanation of the origin of metamorphosis. Manuel Villada pointed out transformations in *Siredon* specimens occurred not only in mature adults; on the contrary, changes occurred whenever environmental conditions were favorable to changes, "simply by virtue of the phenomenon of adaptation."[72]

In 1882, as a contribution to this budding debate, *La Naturaleza* republished the 1866 article "Transformation of the Mexican *Ajolote* in Ambystoma" by German zoologist August Weismann. Weismann followed evolutionist ideas and he posited that external influences and the lesser use of certain organs promoted the transformation of a *Siredon* specimen to adapt to its environment. However, Weismann's ideas about this adaptation did not fully adhere to Darwin's ideas because *Siredon* specimens did not show morphological changes, as Darwin's theory stated. In fact, he went so far as to claim that the external environment had caused *Siredon* specimens to revert back to the *Ambystoma* species.[73] In other words, he explained that the *Siredon* had evolved into a better species.

Velasco rejected this idea regarding the evolution of the *Siredon* species and wrote a detailed critique of Weismann's approach. Velasco argued that Darwin's theory of evolution did not show that all organisms changed for the better because nature did not give proof of this

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[71] Su metamorfosis es debida al instinto que el Creador ha dado a estos seres para efectuarla con la oportunidad debida a fin de tener un medio de conservación individual y por tanto de la especie que representan. ibid., 231.

[72] Manuel Villada, "Dictamen acerca del trabajo anterior," *La Naturaleza* IV, 1ª. Serie (1879): 234.

[73] August Weismann, "Transformaciones del ajolote mexicano en amblistoma," *La Naturaleza* V, 1ª. Serie (1882).

phenomenon, nor did "current knowledge of natural science prove this theory."[74] In addition, Velasco stated that evolution theory not only could not explain this case but also that the facts surrounding other species in diverse regions proved otherwise.[75]

Conclusions

Since the pre-Columbian period, studies on the relationships between nature and society have occupied a central place in the world of Mexican intellectuals. In this sense, analyses of the natural history of Mexico maintain close links with commercial, scientific, cultural, and political interests. On the one hand, natural resource exploitation plays a key role in enhancing economies. On the other hand, diverse generations use elements from nature to construct their identity and establish their ideals of order and progress for their country. From the sixteenth to the eighteenth century studies of nature focused on the search for resources to exploit and on discussions about the differences between Europe's and the Americas' inhabitants as affected by nature (i.e., climate, geography, etc.). Tensions between European and Spanish-American intellectuals promoted natural history studies, publications, and interest in knowledge of the natural world of the Americas. In the early nineteenth century, the Spanish, French, and British Empires saw natural history as a tool to improve their political and economic power strategies; thus, they supported the expeditions of explorers such as the Prussian naturalist and geographer Alexander von Humboldt, whose voluminous works about Mexico strongly influenced Mexican intellectuals.

Ideas on natural history as a tool to increase national wealth and its close links with political and economic interests persisted throughout the centuries. In the nineteenth century—after

[74] José María Velasco, "Anotaciones y observaciones al trabajo del señor Augusto Weismann, sobre las transformaciones del ajolote mexicano en amblistoma," *La Naturaleza* V, 1ª. Serie (1882): 83.
[75] Ibid., 84.

Mexico's political and economic independence from the Spanish Crown— governments of France, Germany, England and the US continued to explore Mexican territory via "exploratory commissions," initiated by researchers interested in natural history (e.g., naturalist, zoologist, botanists, physicians, and engineers). Napoleon III carried out a military and scientific intervention in Mexico. He created the Scientific Commission of Mexico alongside French scientists and their Mexican counterparts such as Antonio del Castillo, José Joaquín Arriaga, Gumesindo Mendoza, Alfonso Herrera, and Francisco Cordero y Hoyos. In addition, those Mexican scientists worked with the ephemeral Second Mexican Empire (1864–1867), led by the imposed French monarch Maximilian I who demonstrated interest in learning about natural history and established the Public Museum of Natural History. Consequently, French theories guided works of the commission and had a strong influence on Mexican intellectuals that persisted during the existence of the SMHN (1868–1914) and its journal, *La Naturaleza*.

The liberal government that followed executed Maximilian I; however, scientific interest in natural history lived on in the works and publications of the SMHN and *La Naturaleza*. Intellectuals connected to the SMHN continued their studies during the liberal republic and occupied political positions in Porfirio Díaz's dictatorial government. In this sense, both conservative and liberal Mexican governments found a common interest in natural history studies because they shared the same teleological and utilitarian viewpoint of nature—using natural resources would advance Mexico's progress as a civilized country. Even though the SMHN had an interest in discovering new species and the natural realm in order to exploit them and to promote Mexico's progress, they were also interested in learning how nature worked in order to maintain an equilibrium and to avoid loss of resources (e.g., flora and fauna). In this sense, ideas from the SMHN, expressed in *La Naturaleza*, exhibit two main characteristics: a

strong influence of European thought and the concern about the relationship between nature and human activities, which was resulting in a loss of natural resources.

In the second half of the nineteenth century, European authors such as Humboldt, Comte, Lamarck, Spencer, and Darwin influenced theoretical and methodological frameworks and practices in Mexican natural history. Humboldt was one of the more influential authors upon the SMHN. His concept of vitalism and the dynamism of nature seemingly explained the order and balance of the world, and his ideas on the existence of abundant resources in Mexico frequently permeated the articles of *La Naturaleza*. Humboldt also affirmed that the causes of Mexico's problems were the lack of good government and the degeneration of the contemporary indigenous society. Members of the SMHN used Humboldt's ideas to defend the political regime and to promote the improvement of the race through European migration. In addition, Humboldt's works contained vast amounts of geographical, historical, anthropological data, which most Mexicans scientists of the second half of the nineteenth used to compare or carry out their own studies. Despite Humboldt's influence, Mexican engineers blatantly ignored the Prussian's idea about the wealth of a nation. For Humboldt, agriculture was the core of a country's wealth; however, Mexican engineers argued that minerals were Mexico's biggest asset. Their idea led the government to open and favor international investment in the mining industry for many years.

Members of the SMHN adopted a natural science methodology. They observed plants, animals, and minerals specimens within their habitats in order to collect, name, and classify them. Later they sent them to institutions or scientists abroad to have their discoveries validated. Few of them worried about exploring new theories. For this reason, some scientists, such as Alfonso L. Herrera, criticized the members of the SMHN for their lack of interest in theories

such as evolution, adaptation, and Darwin's proposals. Some members of the SMHN even held opposing viewpoints about evolutionary theories, as demonstrated in research conducted on the transformations of the *siredon* (*axolote*) species. In addition, they discussed transformation and inheritance laws but omitted opinions on the origin of the species because some of them, such as José María Velasco, maintained a religious viewpoint on nature.

The sources that constructed Mexican natural history were based on the writings by European authors and on indigenous documents and testimonies; however, the SMHN did not give the indigenous sources the same credence. Mexican intellectuals accepted European information as scientific knowledge, whereas they portrayed indigenous data as the results of an old civilization that ignored scientific knowledge. Hence, Mexican intellectuals used European information and avoided discussing topics about the disadvantages experienced by the population of the Americas' resulting from environmental determinism. Even though members of the SMHN often displayed different opinions, they shared concern about loss of natural resources such as forest and birds. They participated in conferences and published research with alarming results in order to back acts and propose laws. This sample of their interests and work in the exploration of natural resources to maintain an equilibrium contrasts existing historiography, which portrays them as a homogeneous, liberal, and utilitarian group of government advisors. For forty-five years, their ideas on nature reflected changes and contradictions; however, their idea that nature can help improve Mexico's circumstances persists.

Chapter 4 Natural History and the Economic Development of Porfirian Mexico

After the French Empire crumbled, Mexican liberal groups asserted lasting political power in the country beginning in 1868. After five decades of on-and-off war, however, Mexico had a weak economy, was politically divided, and even after losing its northern half to the United States had a large area of unoccupied land—or inhabited by indigenous communities—with environmental problems relating to drought and health. Consequently, during the second half of the nineteenth century, the Mexican government looked for ways to use these undeveloped regions to transform Mexico into a developed and civilized country. In this sense, the liberal government believed that the country's progress depended upon improving the economy and the state of its indigenous race. Both of these strategies required transnational contribution—the first strategy included capital investment in the use of natural resources (e.g., mines, forest, land, etc.) and transformation of wild nature into civilized zones, whereas the second promoted improving the indigenous race by integrating European immigration, who could farm uninhabited lands and who would set an example for the indigenous people.

SMHN contributors who had previously pointed out the benefits of improving the Mexican economy and race during the Empire of Maximilian, generally agreed with the new liberal government's efforts to transform the country. They found in natural history a medium to achieve their goals. These intellectuals turned to scientific knowledge to search for patterns and laws that would guide the country toward the order and progress that some European countries, such as France, had already achieved.[1] National and international geopolitical reorganization, the opening of mass markets in Europe and the United States, positivist and evolutionary theories,

[1] Luz Fernanda Azuela and Rafael Guevara Fefer, "La ciencia en México."

and changes in the anthropological study of races influenced not only demand for resources from Latin America, but also the interest in civilizing or eliminating indigenous people because they were a sign of "backwardness" and were obstacles to achieving progress.

For example, in 1870, engineer Santiago Ramírez underscored the need for metallurgical studies as a way to decrease the costs of the extraction of gold and silver from minerals and to improve the efficiency of mining industry processes. He stated that "mining is one of the main branches of national wealth" and believed that increasing investments in mines would help improve the welfare of the population.[2] Four years later, physician José G. Lobato—an honorary member of the SMHN—brought attention to the climate and atmosphere and presented them as the basis of additional sources of wealth for Mexico. Lobato stressed that intertropical boreal zones (i.e. montane areas), such as the ones found in Mexico, were the most favorable to human settlement in the world because of their altitude, temperature, light, atmosphere, and vegetation were beneficial for inhabitants' health.[3] However, one year later, this physician noted severe modifications to the landscape and the atmosphere of the Valley of Mexico that had been caused by *civilized* man. He explained that the city had transformed into an urban zone filled with swamps and plagued by the emanation of miasmas and that made it rife with infectious diseases, turning the atmosphere into an unhealthy environment. Moreover, the degraded state of the atmosphere had modified the constitution of the region's superior animals—as evidenced by the development of new rachitic, apathetic, and weak race of humans that inhabited Mexico City. He explained that the city's pre-Columbian inhabitants had enjoyed much better biological

[2] Santiago Ramírez, "Mineralogía aplicada" [Applied Mineralogy], *La Naturaleza* I, 1ª. Serie (1870): 335.

[3] José G. Lobato, *Consideraciones generales sobre la geografía, meteorología y climatología de la zona intertropical de la República Mexicana con relación a la aclimatación del hombre* (Mexico: Impr. de J.M.A. Ortiz, 1874), 8.

conditions than those living there in 1875 because the atmosphere had been healthier due to optimal hygienic circumstances. According to Lobato, through logging and agriculture, humans had had modified watercourses, water evaporation, vegetation, climate, and the atmosphere itself. He accordingly proposed the need to carry out studies on arboriculture and forestry in order to replant the region and encourage improvements in the city's hygiene.[4]

> Trees modify climates, stop winds, increase humidity of the atmosphere, produce equilibrium between day and night temperature, modify rain regime, integrate electric atmosphere favorable, produce oxygen, made a curtain that stop miasmas and break down organic matter, made healthy regions, in summary trees are the more secure hygiene medium of sickly regions.[5]

During the second half of the nineteenth century, Society contributors underscored the advantages of studying natural history in order to better allocate Mexican resources (e.g., metals, flora, fauna, and the favorable climate) for the nation's benefit. Likewise, they believed Mexico had vast stretches of fertile and uninhabited lands—"just inhabited by indigenous people"—suitable for improvement via hard work and agriculture. In this sense, natural historians agreed with other Mexican intellectuals and politicians that contemporary indigenous people were different from their ancestors because they had degenerated to become lazy, unhealthy, alcoholic, superstitious, ignorant, and unskilled people. However, they disagreed as to the causes of this transformation; some of them thought the origin of change lay in cultural issues, whereas others blamed the atmosphere and climate.[6] The study of indigenous peoples was considered an important part of studies in natural history because indigenous people were considered part of

[4] José G. Lobato followed hygienist ideas of Jean-Baptiste Fonssagrives, a doctor and hygiene professor in Montpellier who analyzed the close links between tree transpiration and biology. José G. Lobato, "Meteorología de México," 14–18; Richard Stephen Hopkins, Jr., "Engineering Nature: Public Greenspaces in Nineteenth-Century Paris" (PhD dissertation, Arizona State University, 2008), 148.

[5] José G. Lobato, "Meteorología de México," 131.

[6] Despite of diversity of indigenous groups in Mexico, SMHN contributors referred to them as the "indigenous race"—as one race.

nature.[7] For this reason, Society members routinely stated that studying how nature worked would allow them to find the best ways to use minerals, flora, and fauna to "improve" indigenous people in order to boost Mexican circumstances and propel the country into economic and social progress.

However, the work of these intellectuals also reflected a tension between their objective of study of how nature works in order to maintain its equilibrium, and a sensibility to the consequences of exploiting resources, and how climate variation occurs over time. Civilization could also pose a barrier to the country's progress, and they frequently noted problems of deforestation, lack of rain, faunal extinction, dry lakes, public health problems, as well as changes in the environment of the Valley of Mexico, the Isthmus of Tehuantepec, and other zones. As such, the Society constantly studied ways to change Mexico into a developed and civilized country by studying the effects of government subsidies for the mining industry (the most egregious breach of the economy), the effects of Mexico's expansion into international mass markets, and the effects of new forms of colonization by the United States, England, Germany, and France. In accordance with the holistic viewpoint of Humboldt, SMNH contributors saw environmental problems as the result of interdependence between nature and society. Although local and transnational economic and political frameworks promoted the exploitation of natural resources, SMHN members did not agree with doing so in an uncontrolled manner, and they looked to natural history studies to maintain the balance and equilibrium between these interdependent relationships.

[7] In *La Naturaleza*, contributors identified local flora, fauna, and people as indigenous to differentiate them from those brought from Spain or hybrid mixes formed during the colonial period. For this reason, editors used "indigenous fauna," "indigenous flora," and "*naturales*" to refer local plants, animals, and people, respectively.

Historian Lane Simonian contends that, during the second half of the nineteenth century, Mexican concerns over the conservation of natural resources could be attributed to emerging utilitarian economic interests and the influence of romanticism. He argues that romanticist ideology, positivism, and the decimation of uninhabited lands were the leading factors motivating strategies to regulate the logging industry.[8] I argue that this explanation is indicative of the influence of Mexican scientists concerned with a broader set of issues regarding the relationship between nature and culture. Even though some Mexican scientists shared utilitarian and romantic interests regarding the defense of natural resources, such as forests, other groups had different perspectives. For instance, some physicians, engineers, chemists, and painters joined the Society to follow an interdependent approach of natural history and proposed regulation to halt the felling of trees, for example, because they perceived the significance of the sustained disturbance of flora, fauna, and human beings. Authors such as José María Velasco, Porfirio Rovirosa, Mariano Bárcena, and Alfonso L. Herrera went beyond a purely utilitarian or romanticist narrative and analyzed the interdependencies between flora, fauna, minerals, and human actions. This demonstrates an important aspect of the natural history scholarship of this era.

This chapter analyzes the range of ideas regarding the relationship between nature and society expressed by Mexican natural historians—for example, how Society contributors understood the links between the natural elements (i.e., climate, soil, and air) and social factors (e.g., race, economy, public health, etc.). This chapter examines growing concerns about the changes on climatic conditions favorable to agriculture, flora, and fauna diversity;

[8] Lane Simonian, *La defensa de la tierra del jaguar*, 81–82.

acclimatization of flora, fauna, and immigrants, overexploitation of forests, environmental change in the Valley of Mexico and links between climate, geography and public health (Fig.9).

Figure 9. Environmental problems identified by Society contributors in the nineteenth century.
Source: SMHN, *La Naturaleza* (Map by María Gabriela Torres and Jesús Izaguirre)

The interdependent relationship between climate and society

During the second half of the nineteenth century, the concerns of SMNH contributors continued to be influenced by memories of civil wars and national instability, all the way to the breakout of the Mexican Revolution. Other transformations impacted this obsession with stability. Between 1880 and 1910, Mexico experienced a boost in industrial development (mainly in mining) and actions derived thereof, such as the expansion of railroads and the cultivation of

land for export products such as sugar cane and cotton. Meanwhile, strong droughts and poor harvest yields during the late 1870s and 1891–1902 severely affected several zones of the country, as did cyclical outbreaks of typhus, malaria, and yellow fever in some central states of Mexico.[9] Although the Mexican government and businessmen tended to focus on increasing mining investments, others called attention to the use of other resources, such as land. In 1872, Francisco Fernández, president of the agricultural society in the Valley of San Martín Texmelucan, Puebla, argued that since the War of the Reform, many local members of the agricultural society had emigrated to Mexico City, which had generated an agricultural crisis, not only there, but in many parts of the country, and if left unresolved by governmental assistance, threatened the downfall of the nation.[10] Fernández was hardly alone in these sentiments. In a speech to the Sociedad Mexicana de Geografía y Estadística twenty-one years later, Othón Brackel Welda argued that Mexicans had held mining as they country's essential source of wealth and showed contempt for agriculture for too long. He described how peasants had been exposed to all sorts of abuses to their persons and property during the civil wars of mid-century, only then to suffer abuses from big farmers during peacetime. This situation had generated a state of barbarism and the abandonment of lands in many areas; hence, he demanded that "mining has to cede its place to agriculture."[11]

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[9] Carlos Contreras Servín, "Las sequías en México durante el siglo XIX," *Boletin del Instituto de Geografia*, 056 (2005); Enrique Florescano and Susan Swan, *Breve Historia de la Sequía en México* [*Brief History of Droughts in Mexico*] (México: Universidad Veracruzana, 1995); Enrique Florescano and Elsa Malvido, *Ensayos sobre la historia de las epidemias en México* [*Essays on History of Epidemics in Mexico*] 1a ed., 2 vols. (México, D.F.: Instituto Mexicano del Seguro Social, 1982).

[10] Francisco Fernández, "Informe presentando por el presidente de la Sociedad de Agricultura del Valle de San Martín Texmelucan, Puebla- a la Junta General" (México: Sociedad de Agricultura del Valle de San Martín Texmelucan, Puebla, 1872), 1–2.

[11] Othón E. de Brackel-Welda, *Apuntes sociológicos leídos en la Sociedad de Geografía y Estadística. Tres artículos sobre los campesinos y su influencia en la vida de las naciones, educación agronómica y escuelas agrícolas y de horticultura* (México: Imprenta del Sagrado Corazón de Jesús., 1893), 4–5.

In the view of most Mexican natural historians, one of the nation's most favorable resources was climate. According to the SMHN, climate was not responsible for the poverty of the country. On the contrary, many contributors argued that the diversity of climates in Mexico was beneficial the productivity of flora, fauna, land, and people and they saw no reason why it should hinder either international investment or national progress.

In support of these views, SMHN contributors continued to cite Alexander von Humboldt, the French Commission, and international scientists' works as they sought to organize and broaden information related to the country. Some Society members followed Humboldt's path and studied geography and its interactions with plants, animals, and people with respect to climate, which greatly enhanced the botanic and medical geography traditions. *La Naturaleza* published several translations from international journals supporting the idea that Mexico boasted an abundance of resources and diverse, unique, favorable, and unknown climates and geographies. For example, in 1878, the editors of *La Naturaleza* translated the text "Mexican *gramineae"* by Eugene Pierre Fournier (1834–1884). The author, who had presented this work in the French Academy of Science, explained the difficulties he had in understanding the relationships between the vegetation and geographical characteristics of Mexico due to the size and the diversity of the country. Fournier maintained that altitude and climate were so different that he had to classify the ferns into big families in order to analyze the geographical relationship between them.[12] Likewise, in 1884, *La Naturaleza* published a translation of *Domaine Mexicane* (Mexican Zone)—a chapter in *Vegetation of Globe* (1878) by August Grisebach (1814–1879).[13] Similar to Humboldt, Grisebach analyzed the vegetation of Mexico in relation to climate,

[12] Eugene Fournier, "Las gramíneas mexicanas" [Mexican Gramineae], *La Naturaleza* VI, 1ª. Serie (1884): 323.
[13] August Grisebach, "La vegetación de México" *La Naturaleza* VI, 1ª. Serie (1884).

morphology, and formation throughout regions with similar characteristics. However, he stated that Humboldt had wrongly compared Mexican and Peruvian vegetation because the situation of both countries was different. Mexico had a different orography and climate, its mountain ranges did not follow the littoral like the Andes, and consequently, Mexico's flora had a strong strain of autonomy.[14] In *Domaine Mexicane*, Grisebach highlighted the abundance of Mexican flora and the country's diverse climates. In other words, he showed a country with multiple resources and a benign climate—contrary to the derogatory opinions of many foreigners from the colonial period.

From 1884 to 1887, *La Naturaleza* published a series of studies that reinforced the idea that the abundance and diversity of flora in Mexico was the result of Mexico's favorable climate. In 1887, *La Naturaleza* translated and republished two foundational works on the geographical distribution of Mexican ferns by Martin Martens (1797–1863) and Henri Guillaume Galeotti (1814–1858), which classified numerous species of ferns of "this vast country." During a tour of the country around 1840, Martens and Galeotti collected diverse species of flora in Mexico and took them to the Botanical Gardens of Brussels in the newly independent state of Belgium to be studied. They classified ferns according to climatic regions, which they divided into three large groups: warm, temperate, and cold—each one with several subdivisions.[15] Similarly, Swiss entomologist and mineralogist Henri de Saussure carried out several studies in Mexico. (According to Léon Lejeal, Mexico became Saussure's favorite object of study.[16]) In "Vegetation of the High Mountains of Mexico," Saussure explained that vegetational distribution was the

[14] Ibid.

[15] Martin Martens and Henri Guillaume Galeotti, "Observaciones sobre la distribución geográfica y geológica de los helechos en México" [Observations on Geographical and Geological Distribution of Mexican Ferns], *La Naturaleza* VII, 1ª. Serie (1887).

[16] Léon Lejeal, "Henri de Saussure," *Journal de la Sociéte des Américanistes* 3, no. 1 (1906).

result of a complex process related to several factors, such as climate and altitude, and that comparisons with diverse regions of the world was therefore difficult. Following a line of inquiry began by his grandfather and Humboldt, he compared vegetation found in the Alps and Mexican mountains and concluded that the characteristics of Mexican mountains were different from those of the Alps and Europe.[17]

Climate also had a strong influence on the physical characteristics, behavior, and reproduction of fauna. In an article on North American mammals coauthored with Alfonso Herrera, US naturalist Joel Ashap Allen (1838-1921) explained how animals achieved their maximum physical development under favorable conditions and how the majority of species of each sub-grouping (i.e., genera, subfamily, and family) were located in climates where the group developed best.[18] From the point of view of Mexican natural historians, publicizing these international works accomplished three goals. Besides improving local knowledge of the region's natural history, their data demonstrating a benign climate and abundant resources contradicted a major strand of the environmental determinism of the eighteenth century. Such international recognition helped to create the image of a civilized nation, and would hopefully attract international capital and people to Mexico.

Mexican intellectuals involved in the SMHN also contributed to expanding idea that the region's diverse climates resulted in multiple and unique botanical species. In 1887, Porfirio N. Rovirosa depicted in detail the geography, zoology, and vegetation of the mountains of Tabasco, a tropical lowland state in southeast Mexico. Rovirosa originally presented his *Memories of the*

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[17] Henri Saussure, "La vegetación en las altas montañas de México" [Vegetation Over the High Mountains of Mexico], *La Naturaleza*, VII, 1ª. Serie (1887): 333–342.

[18] J. A. Allen and Alfonso L. Herrera, "Variaciones geográficas en los mamíferos norteamericanos, especialmente del tamaño" [Geographical Variations of North Americans Mammals, Specific on Size], *La Naturaleza* II, 2ª. Serie (1897): 404.

Ascent of a Mountain on Horseback to the Geographical Society of France. In this romanticized narrative, Rovirosa highlighted the abundance and particular characteristics of this tropical zone, calling the region the

> Heart of virginal jungle. … The greatness of its proportions, the dark green of plants' leaves of New World gives to landscape a serious and severe appearance that we do not find in European forests. This landscape causes much admiration to overseas inhabitants when they leave the Old continent to visit the warm community of America.[19]

Rovirosa affirmed that the distribution of flora and fauna depended on temperature and topographical influences, making botanical geography essential to nature studies. Alongside other SMHN contributors, Rovirosa's writings reveal some ambiguities. On one hand, he enumerated the abundance of resources and their utilitarian advantages. He described the productivity of several plants such as cacao, ferns, sweet gum tree, palm tree, oaks, as well as the multiple uses for leaves and wood. He believed that an industrious population could improve the country.[20] On the other hand, Rovirosa valued the blessings that "savage nature" that had not been touched by man could bestow on the civilized visitor.

> It is wonderful to spend days into savage nature! We do not remember any injustice of men, nor vain pleasures of opulent cities! […] the various scenes occur at this place, in those silent meetings, and the unique thoughts come back for a few minutes, to the first ages of humanity, which we confuse with men in his primitive state, come to sweeten and relax our sufferers.[21]

In addition, Rovirosa agreed with other authors who linked the appearance of trees with the healthfulness of the air. In this sense, he explained that in southeastern Mexico the good climate promoted the development of plants because many travelers wanted "to exhale their last sight looking for conifers and oaks, where [healthy climates] do not produce yellow fever or

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[19] Porfirio N. Rovirosa, "Recuerdos de una ascención a la montaña de lomo de caballo" [Memories of a Climb to the Mountain on Horseback], *La Naturaleza* VII, 1ª. Serie (1887): 273.

[20] Ibid., 280.

[21] Ibid., 275.

damages."[22] As we will see, Rovirosa built on these experiences to reveal the damages that had been done to nature by human activities and advocated passing laws to maintain equilibrium in the use of resources, particularly in proposed laws to protect birds.

Migratory species provided an interesting test for the view that Mexico was a place where species accomplished their best development due to a favorable climate. In 1873, Jesús Sánchez and Manuel Villada published "Palomas Viajeras. Notas sobre las que últimamente han emigrado a México" ("Traveling Doves: Notes Regarding the Doves That Lately Have Migrated to Mexico"), in which the authors highlighted that peasants, hunters, and naturalists observed the regular migration of many species of birds to Mexico.[23] They quoted Saussure as to the causes of this migration,

> The geographical situation of Mexico and its climate serve as a limit to the migration of birds from Septentrional [North] America, as for the birds from Meridional [South] America. According to season, [Mexico] hosts one or the other. [The birds] that come from *mediodia* [the equator] find the same tropical climate, the same humidity, the same forest; but at the same time [they reach] the limit of all those conditions toward the northern border of the country. [The birds] that come from boreal America, find a diversity of temperate altitudes convenient to them.[24]

The authors mentioned birds such as the roseate spoonbill (*platalea ajaja*), parrots, scarlet ibis (*Eudocimus ruber*), black-crowned night herons or *savacu* (*Nycticorax nycticorax*), herons from Brazil, wild turkey from the United States, waxwings (*jaseur*) from Canada, and *tetrao* or black grouse. In addition, Saussure noted that Mexico "is one of the most beautiful ornithological regions that we can find, because the immense number of species that hunters kill [….] highlight the number of individual [species]."[25]

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[22] Porfirio N. Rovirosa, "Recuerdos de una ascención a la montaña de lomo de caballo" [Memories of a Climb to the Mountain on Horseback].

[23] Jesús Sánchez and Manuel Villada, "Palomas Viajeras. Notas sobre las que últimamente han emigrado a México" [Traveling Doves. Notes regarding the doves that lately have migrated to Mexico], *La Naturaleza* II, 1a. Serie (1873).

[24] Ibid., 251.

[25] Ibid.

While underscoring the favorable climate in Mexico, these scientists had observed some variations over time. Sánchez and Villada stated that the variety of regular migrations were due to "atypical circumstances," such as temperature changes. According to US newspapers, the winter of 1872 and 1873 had been especially rigorous because in some places snow depths reached ten to fifteen feet and the thermometer registered minus ten degrees Fahrenheit. For the authors, unamenable climate and lack of food resulted in the migration of birds, including the passenger pigeon (*Ectopistes migratorius*)—which naturalists had seen in several places of the country. Even though the authors claimed that pigeons destroyed trees and crops and considered their prolonged presence a risk to agriculture, they also noted that pigeons could be a good source of food for humans.[26] In his 1879 study of "Migrations of Arctic Birds to Mexican Valley," Villada also commented on the extraordinary appearance of a web-footed bird species in 1873, 1875 and 1878, when "atmospheric perturbations" caused a "descent of temperature and lack of food," as well as impetuous northern winds—all of which brought their "accidental" appearance in the Valley.[27]

In 1891, Alfonso L. Herrera applied Darwin's theory of evolution by natural selection to this problem in relations to a catalogue of 207 different species of migratory and resident birds of the Valley of Mexico, which he published in *La Naturaleza*.[28] He again cited the same Saussure quote regarding the benign nature of Mexican climate, but proposed that migration to Mexico promoted the birth of new varieties of the same species.[29] In another article, "Notes on

[26] Ibid., 165–66.

[27] Manuel Villada, "Aves de las regiones del Círculo Ártico en las Lagunas del Valle de México" [Birds of Artic Circle Regions on the Valley of Mexico Laks], *La Naturaleza* VI, 1ª Serie (1884): 195.

[28] Alfonso L. Herrera, "Apuntes de ornitología. La migración en el Valle de México. Apuntes para el catálogo de las aves inmigrantes y sedentarias del Valle de México." [Notes of Ornithology. Migration in the Valley of Mexico. Notes to the Catalog of Immigrants and Sedentary birds Valley of Mexico], *La Naturaleza* I,.1ª. Serie (1891).

[29] Ibid., 173.

Vertebrates of the Valley of Mexico," Herrera analyzed the influence of the environment on the physical characteristics, behavior, survival, and adaptation of vertebrates in the Valley of Mexico, with commentary on their utility to humans. In this work we can clearly see the emergence of an ecological point of view regarding Mexico's natural history. For Herrera, exterior conditions (e.g., climate, food, etc.), factors influencing reproduction (i.e., population density), as well as a species' relation to other life forms (e.g., natural enemies, human influence, and animals of the same "regimen") were all vital to its survival. In the case of mammals belonging to the order *Chiroptera*, bats developed abundant, long, and silken hair to protect themselves from the rain and cold. Environmental adaptation influenced behavior as well as structure. Because these small animals were highly sensitive to low temperature, they sheltered themselves in dry and warm sites such as roofs, or grottos—never in the holes of trees, which could be damp and cold.[30] Herrera also observed that they were useful to men because they had demonstrated their help during a recent invasion of *Culex* mosquitos by stopping the propagation of this insect. However, Herrera was also acutely aware of the ways in which human activities could disrupt these relations. The ocelot (*Leopardus pardalis*), wild cat (*Felis silvestris*), and *oncilla* or *tigrillo* (*Leopardus tigrinus*) had all become rare in the Valley of Mexico, even though they seemed well adapted to its climatic conditions.[31] Herrera blamed the changes in these feline populations primarily on human hunting, and warned that these felines could easily become extinct because they reproduced slowly, struggled for their lives surviving their enemies, and had problems obtaining food. He viewed this possibility as a tragedy for humans, as well, arguing that these felines were useful mammals because they destroyed rodents and their spotted skins

[30] Alfonso L. Herrera, "Notas acerca de los vertebrados del Valle de México" [Notes on Vertebrate of Valley of Mexico], *La Naturaleza* I, 1ª. Serie (1891).

[31] Ibid., 306.

were an important commodity.[32] In "The Valley of Mexico as a Zoological Province," Herrera explained the links between vegetational and invertebrate abundance, the seasons, and human actions. For instance, the amount of terrestrial vegetation and invertebrates reached a maximum in July through October, whereas those numbers decreased in December and January when valley climate was at its coolest and driest.[33] The abundance of flora and fauna from valley lakes, however, differed seasonally from terrestrial creatures due to human actions. When comparing old forested zones in the Valley with lake areas, he lamented that logging had destroyed the alpine forest in the Valley of Mexico and had transformed these upland sites into arid zones. "Unfortunately, [the government] is draining the Xochimilco lake nowadays, and people are sowing maize and cereals, causing alarming decreases in the population of [flora and fauna]," threatening to turn the valley bottom into a desert, as well.[34] Even so, Herrera believed that human actions had achieved an equilibrium and "natural harmony" over time within the Valley of Mexico.[35]

But Mexico's climate also presented Mexican natural historians with puzzles. Alfredo Dugés found that one species of insect could live in two distinctly different climates and geographies—a fact he observed in two different Mexican states: Guanajuato and Jalisco. He admitted that did not have the answer to explain why these two biological regions had such different mammals, birds, lizards, and vegetation, yet this insect exhibited the same characteristics in both regions.[36]

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[32] Ibid., 308.

[33]Alfonso L. Herrera, "El Valle de México considerado como provincia zoológica." (Continuación) [Valley of Mexico Consider as a Zoological Province. (Continuation)], *La Naturaleza* I, no. 2a. Serie (1891): 378.

[34] Ibid., 445.

[35] Ibid., 455.

[36] Alfredo Dugés, "Un punto curioso de geografía zoológica." [A Curious Point Regarding Zoological Geography], *La Naturaleza* I, 2ª. Serie (1891): 211.

Acclimatization of flora, fauna, and immigrants

Acclimatization—a concept coined in France in the eighteenth century—was a practical science intimately associated with botanic and zoological studies. By the mid nineteenth century, French and British practitioners used the term in two different ways.

> In France and its colonies, where the term came to signify a rationally forced adaptation to new environments, acclimatization connoted biological changes at physiological and sometimes structural levels. In the British sphere, the term tended to signify a transfer of so-called exotic organisms from one location to another with a similar climate. (In the parlance of the day, an "exotic" organism was one that originated nearly anywhere other than the country or place under study.)[37]

According to Michael A. Osborne, zoological, botanical, and medical acclimatization became an important issue not only for science, but also in European colonial practices in Africa and Australasia.

> In both the French and British Empires, acclimatization discourses influenced politics, settlement schemes, and regulations for the transport, hygiene, and length of duty of European armies in the colonies. Physicians and anthropologists pondered the ability of Europeans to survive in exotic environments, while colonial functionaries, landowners, zookeepers, and naturalists formed acclimatization societies to promote the rational exchange of aesthetically pleasing and "useful" flora and fauna. Unintended plant, animal, and disease introductions accompanied European colonization, and they were a bane to later farmers.”[38]

In Mexico, scientists and politicians also used the concept of acclimatization in both of these senses to explain natural and anthropogenic processes. Scientists applied the term when advocating the relocation of flora and fauna to diverse climates and regions that could improve the circumstances of the population. Likewise, politicians used the concept of acclimatization when proposing a new form of colonization—the relocation of intelligent, skilled, white inhabitants from Europe to Mexico in order to “improve” the indigenous race.

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[37] Michael A. Osborne, "Acclimatizing the World: A History of the Paradigmatic Colonial Science," *Osiris* 15, no. Nature and Empire: Science and the Colonial Enterprise (2000): 137.

[38] Ibid., 135.

Mariano Bárcena was one of the most enthusiastic SMHN contributors to extol the acclimatization of plants, and proposed the "reciprocal exchange of plants between Mexican states to enrich them with different species of useful vegetation."[39] He traveled to several places in the country to compare temperatures, wind directions, and soils and to analyze the conditions of growing plants. He observed that some plants needed specific conditions to develop, whereas others lived "[equally comfortable] in different climates and soils."[40] He identified four relevant factors that made acclimatization successful—temperature, humidity, climate, and the chemical composition of the soil. He exhorted his colleagues to carry out studies in their respective regions in order to obtain data on the geographical distribution of plants and to cultivate the beneficial flora, according to the physical and chemical characteristics of each region.

The successful transfer of economic animals and plants from one region to another could have tremendous implications for regional economic development, as exemplified by the difficulties of transferring of cochineal insects and prickly pear cactus, silkworms and mulberry trees into and out of colonial Mexico, and the fortunes made by Southeast Asian producers of quinine and rubber from *Cinchona* and *Hevea* trees transplanted from South America. Apolinario Nieto obtained several awards for acclimating plants including the quinine-producing *quina* tree (*Cinchona officinalis*) in Córdoba, Veracruz.[41] Similarly, Joaquín María Gómez successfully acclimatized opium poppies (*Papaver somniferum*) after he carried out several studies supported

[39] Mariano Bárcena, "Aclimatación de plantas en la República" [Acclimatization of plants on the Republic], *La Naturaleza* 2, no. 1a. Serie (1873).

[40] Mariano Bárcena, "Observaciones de plantas características de climas y terrenos" [Observation of the plants are characteristic of climates and soils], *La Naturaleza* II, 1ª. Serie (1873): 173.

[41] Antonio Peñafiel, "Discurso leído por el Sr. Dr. Antonio Peñafiel y Barranco, en la sesión solemne celebrada el día 20 de julio de 1873, en conmemoración del distinguido naturalista mexicano D. José Apolinario Nieto" [Speech Read by Mr. Dr. Antonio Peñafiel and Barranco, at the Solemn Session Held on July 20, 1873, in Commemoration of Distinguished Mexican Naturalist D. Jose Apolinario Nieto], *La Naturaleza* III, 1ª. Serie (1876).

by members of the SMHN over several years beginning with seed that had been brought over from Europe in 1873. Thanks to similar efforts elsewhere, opium was being cultivated in huge quantities in Turkey, India, Germany, France, Egypt, and the United States, leading Gómez to stress that cultivating opium could in Mexico become a large business due to increasing demand for the plant in the pharmaceutical field, as well as for recreational consumption.[42] Gómez successfully sowed the plant in the Valley of Mexico and the state of Morelos, but his quantity of production was never enough to meet even the local market demand.

Acclimatization projects often struggled. For instance, José María Velasco observed that hens of the *Brahma* variety had suffered degenerative changes due to the Mexican climate. He explained that these hens, imported from the United States, had severe reproduction problems because the climate was not favorable to the species; moreover, when they produced offspring, the chicks were smaller in size than the imported hens. The main purpose of Velasco's study, however, was to demonstrate that the theory of evolution could not apply to whole beings.[43]

Just as the acclimatization of flora had advocates, the acclimatization of European immigrants was the dream of many Mexican politicians and scientists. The idea that Mexico was under-populated had a long history. Because most Mexicans lived in close proximity to mining and agricultural regions in the middle of the country, the distribution of the population was unequal. In addition, the low annual birth rate and the lack of capable and skilled people in many economic sectors encouraged governments and scientists to search for ways to achieve their ideal of progress. In 1865, 8.002 million inhabitants lived within 1,964,375 km^2 (758,449.43 sq mi). By 1890, there were 9 million; and in 1910, over 15 million Mexicans lived in the country.

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[42] Joaquín María Gómez, "*Papaver Somniferum*. Ensayos para su aclimatación en México.[*Papaver Somniferum*." Experiments to its acclimatization in Mexico], *La Naturaleza* VI, 1ª. Serie (1884).

[43] José María Velasco, "Anotaciones y observaciones al trabajo del señor Augusto Weismann," 84.

Between 1865 and 1878, the annual growth rate was 0.86%, whereas between 1878 and 1910 it was 1.5%.[44] Politicians and scientists were most concerned about the irregular population density in several zones of the country, as well as the ways in which insalubrity, epidemics, and climate affected the distribution and growth of the population.[45] In 1864 during the French intervention, the federal government proposed to resolve the problem of the lack of settlement on so-called wasteland while improving the Mexican race by attracting international immigrants. The government arranged with private companies to attract foreign families; for instance, American Jacob P. Leese signed a 5-year contract with the Mexican government that arranged for two hundred American families to colonize lands in Baja California.[46] From the onset of Porfirio Díaz's presidency, his government pushed for increased international migration and secured contracts with European companies, including Giovanni Barbieri e Armatori Italiani, Ribas Borrel Co., Biebuyck y Co., and with Gonzalo Ramos Alfonso. Even though each contract had different terms and conditions, the contracts generally required companies to arrange for the migration of a minimum of two hundred to three hundred families to Mexico over five, ten, or twenty years. Migrants were supposed to be expert farmers, artisans, or industrial workers and had to be healthy and have a reputation for good behavior. The Mexican government paid companies for each child and adult who settled in the assigned places and provided each person between thirty and fifty hectares.[47] Although contracts specified that European colonies would be

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[44] INEGI, "Estadísticas Históricas de México" [Historical Statistic of Mexico], ed. Geografía e Historia Instituto Nacional de Estadística (Mexico: INEGI, 2009), 3–4; INEGI, "México en Cifras" [Mexico in Data], ed. INEGI (México: Instituto Nacional de Estadística, Geografía e Informática, 2011).

[45] Antonio García Cubas, *Escritos diversos de 1870 a 1874* [*Diverse Writings from 1870 to 1874*], 24.

[46] Luis G. Saldívar, *Diccionario de la legislación Mexicana de 1863 a 1868* [*Mexican Legislation Dictionary from 1863 to 1868*] (Imprenta de la Constitución Social, 1868), 176.

[47] Manuel Dublán and José María Lozano, *Legislación mexicana o colección completa de las disposiciones legislativas expedidas desde la Independencia de la República* [*Mexican Legislation or Complete Legislative Mandate decreed from Independence to Republic*] (México: Imprenta y Litografía de Eduardo Dublán y Compañía, 1886), 506–08; 89–90; 784–85.

established in healthy climates with fertile soils, the plan failed. In 1880, President Díaz noted that immigration projects had not achieved the success that he hoped, but he believed that when the world became aware of the wealth of the country, many migrants would become excited by the prospect of coming to Mexico and would bring a "labor force, capital, and intelligence."[48] Efforts to attract European migration also accompanied the promotion of Mexican resources at international fairs and through incentives for these new settlements, such as lax laws on colonization from 1883 to 1894.[49]

Engineer Antonio García Cubas provides an example of an SMNH member who attempted to examine this question scientifically. He and his American co-authors underscored the influence of climate in the distribution of population. He pointed out that populations tended to grow "larger under the influence of the cold climates, reaching the proportions of 5.5 percent, whilst in the hot climate it only reaches 3.11 percent." According to "trustworthy sources," cold climates seemed to be more favorable to increase of the male population, while hot climates increased the female, explained García Cubas, with population growth in cold climates represented in the proportion of 5.57% male to 5.40% female, whereas population growth ratio of men to women in hot climates was 2.60% to 3.63%, respectively.[50] García Cubas went on to suggest that the southern zone in Mexico was most suited for European settlement because it had low rates of endemic diseases, had all the elements to lead to prosperity, and "it did not present

[48] Raymundo Vázquez Soberano, "Grandes esperanzas. Las ideas inmigratorias del Porfiriato y su manifestación regional en Tabasco: 1877–1910" [Big Hopes. Immigrations Ideas on the Porfiriato and its regional expression in Tabasco: 1877–1910] in *En Sociedad y procesos políticos e históricos*, ed. Freddy Domínguez Nárez and Juan Carlos Guzmán Ríos (México: Universidad Juárez Autónoma de Tabasco, 2005), 136.

[49] Mauricio Tenorio-Trillo, *Artilugio de la nación moderna*; Vázquez Soberano, "Grandes esperanzas."

[50] Antonio García Cubas, William Thompson, and Charles B. Cleveland, *Mexico, its Trade, Industries and Resources* (Mexico: Printed in the Typografical Office of the Department of Fomento, Colonization and Industry, 1893), 24.

the difficulties to the acclimation of the Europeans."[51] In support of these views, García Cubas underlined that vegetable products from a variety of other countries had thrived in Mexico's fertile and varied soils under the influence of the Mexican climate—some valued for their fruits and medicinal properties.[52] In 1874, José G. Lobato had also emphasized the advantages of climate and topographic conditions in Mexico with respect to the acclimatization of Europeans.[53] He affirmed that the Northern Intertropical Convergence Zone was the best region in the country for settlement because it met all requirements to achieve a healthy and prosperous life. These elements included favorable rainfall, temperature, altitude, light, and atmosphere, which were the factors that most determined the physiological phenomena relevant to human life. However, Lobato also acknowledged that some zones sported characteristics that promoted epidemics and exhaustion in people (due to irregular phenomena in soil, local temperature, and dominant wind), and were therefore unsuitable to European acclimatization, but the majority of regions close to the Central Plateau were very favorable to European migration.[54]

> Acclimatization is so much easier when the new counties where men are moved to differ less than the telluric region that they abandon. For those reasons the famous hygienist Saint-Vel has said "that the burning heat of the tropical zone is not propitious to the development and extension of the white race; even though this race can extend itself over the whole globe, acclimatize to, colonize, and prosper in the equinoctial zone, its real dominium is limited to the temperate latitude where it had its origin and its cradle."[55]

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[51] Ibid., 127.
[52] Ibid., xviii.
[53] José G. Lobato, *Consideraciones generales sobre la geografía, meteorología y climatología*
[54] Ibid., 7–10.
[55] […] La aclimatación es tanto más fácil, cuanto que las comarcas nuevas a donde se traslada el hombre, difieren menos de la región telúrica que abandona, y por estas razones ha dicho un célebre higienista, llamado Saint- Vel, "que el calor ardiente de la zona tropical no es propicio para el desarrollo y ensanchamiento de la raza blanca; que es cierto que esa raza puede extenderse sobre todo el globo, aclimatarse, colonizar y prosperar en la zona equinoccial, pero que su verdadero dominio se limita a las latitudes templadas en las que se encuentra su origen y su cuna."; Ibid., 12.

Others were not convinced that acclimatization was the real problem. In 1884, the engineer and politician Alejandro Prieto (1841–1921) published *Sobre la colonización del Itsmo de Tehuantepec* (Regarding Isthmus of Tehuantepec Colonization) which argued that the main cause of failure for European settlement was ignorance of the environmental particulars of this region southern Mexico. The Isthmus of Tehuantepec marks the shortest distance between the Pacific Ocean and the Gulf of Mexico, and was sometimes cited as a possible route for a transoceanic canal. Its climate is tropical with abundant rain as well as dense forests and jungles. In 1879, the Mexican government signed a contract with Gonzalo Ramos Alfonso to establish agricultural colonies with families from the Canary Islands on the Isthmus and zones close to Jalapa, Veracruz, and on the banks of the Coatzacoalcos or Uxpanapa rivers.[56] In Prieto's opinion, this project had failed for three reasons. First, plantations depended on the rainy season, but untimely flooding and droughts often destroyed crops, leaving farmers ruined. Second, these problems were rooted in new inhabitants lack of understanding of local productions and resources, such as sugar cane and the logging industry. Third, loss of harvests generated pessimism about the future, which coupled with alcoholism, contributed to the failure of the colonization project. Nevertheless, Prieto had to admit that the hot climate and mosquitoes also contributed to European abandonment of the Isthmus.[57]

Interpreting environmental change in the Valley of Mexico

Hydraulic management policies in the Valley of Mexico had been one of the most important concerns for scientists and governments over time dating all the way back to the great floods of the early seventeenth century. The Valley is a closed basin at an altitude of about 7,350

[56] Manuel Dublán and Lozano, *Legislación mexicana*, 784–85.

[57] Alejandro Prieto, *Sobre la colonización del Istmo de Tehuantepec* [*Regarding Isthmus of Tehuantepec Colonization*] (México Imprenta de I. Cumplido, 1884).

feet and covers 3,000 square miles. The Valley has streambeds, which during summer can turn into torrential flows, and when Europeans arrived, it had five interconnected permanent lakes—Texcoco, Xochimilco, Chalco, Zumpango and Xaltocan. During the spring and summer rains these lakes often overflowed to cover half of the Valley. In pre-Hispanic times, the Aztecs constructed a great dike "to protecting against floods in the rainy season and to conserve irrigation water during the dry season."[58] Lakes Xochimilco and Chalco were of special importance because of a form of agriculture practiced there that supplied food to the majority of the 500,000 people living in the immediate vicinity of the Aztec capital. Raised fields known as *chinampas* provided seedbeds between swamps and canals in the Chalco and Xochimilco lakebeds where the indigenous people created islands of crops with spectacular yields.[59] However, Spanish colonial governments gradually imposed different strategies of hydraulic management in this lacustrine ecosystem. The Spanish crown during its three-century rule invested heavily in drainage and sedimentation projects to reduce the surface area of Lake Texcoco, the largest and most brackish of the five lakes, to keep the city dry. Since the beginning of the colonial period, Mexico City—originally located on an island in the midst of these lakes—was the core of economic, political, and cultural life for a large region and depended on laborers and products from the countryside.[60] Its growth reflected the concentration of a powerful national elite who claimed urban privileges over the operation of its collective hydraulic infrastructure, "evacuation of *aguas negras* (dark waters) […] sanitary codes, and new forestry policies that

[58] Matthew Vitz, "Revolutionary Environments: The Politics of Nature and Space in the Valley of Mexico, 1890–1940s" (PhD diss.,New York University, 2010), 3.
[59] Ibid., 5.
[60] Ibid.

sought to conserve a healthy climate and precious water resources under the rubric of rational forest management."[61]

During the nineteenth century, postcolonial governments continued to search for options to improve the Valley of Mexico and its troubled relationship with water and dampness. Physicians insisted that climatic variation and an unhealthful atmosphere had caused an increase in disease in Mexico City and its vicinity. Since the great typhus epidemic and El Niño drought of 1875-1878, medical conference participants began to highlight the close relationship between the lack of rain, the scarcity of water, and the outbreak of epidemics. Some physicians supported the ground water theory of hygienist Max Joseph Pettenkofer (1818–1901), which suggested that some diseases, such as typhus and malaria, were caused by an imbalance between the water on earth's surface and in subterranean aquifers. In other words, fermentation of organic matter in the subsoil released germs into the air, causing infection in vulnerable people. Mexican physicians also explained that during periods of abundant rainfall, the water seemed to cleanse this organic matter, dissolving some mineral salts into the putrid water, which then filtered into the subsoil. However, when water was scarce, it could not cleanse organic matter; indeed, clean water mixed with putrid water and stayed concentrated in the soil. The level of concentration of the water depended on the permeability of soils; the Mexican Valley had boggy soils that facilitated filtration of putrid water to subterranean aquifers and to the more permanent level of ground water at three feet of depth.[62] Nevertheless, SMHN members had differing opinions on this matter. In 1883, Manuel Urbina pointed out that the fecal matter of the population from the city

[61] Ibid., 12.

[62] NLBL-U-TX Ministerio de Fomento de la República Mexicana, "Escasez de agua potable en el Valle de México" [Scarcity of Potable Water in the Valley of Mexico], ed. Ministerio de Fomento, Anales del Ministerio de Fomento de la República Mexicana (México: Imprenta de Francisco Díaz de León, 1881), 514–20.

was the most direct cause of the problems in Lake Texcoco because people deposited this matter directly into the canal that fed into the lake. In a similar manner, water pollution from gas factories had harmful effects on insects that lived in the lakes, such as *ahuautle* flies (*Coryza femorata* and *C. mercenaria*), which produced huge quantities of edible eggs, and the *axaxayacatl* or backswimmer (*Notonecta unifasciata*), an important mosquito predator.[63]

The revival of plans to drain Lake Texcoco completely was controversial. Some SMHN members strongly disagreed with the proposal, such as physician Fernando Urbina who presented two reasons to reject the project. First, the water from the Valley of Mexico was not the site of the infections, and there was no evidence that its emanations caused diseases. Second, he reminded everyone that levels of *tequezquite* (a valuable mineral salt) and faunal abundance were intertwined and that if the lake was drained, both of them would decline. Alfonso L. Herrera also opposed the draining project, noting that the depth and salinity of the lake had already decreased from the time of the conquest to the present time, and he did not believe that the gas factory negatively affected the animals of the lake because the factory was located 40 *leguas* away (around 100 miles). Meanwhile, Jesús Sanchez argued that animals on the lake could live very well if they ate fecal matter and that "this matter should [be used] as fertilizer in similar manner to other cities."[64]

Despite differences of opinion regarding the advantages and disadvantages of draining of the Valley of Mexico, the drainage project went forward at Lake Texcoco, only to be stopped again in 1880 due to budget cuts. Fourteen years later, the government resumed studies of the

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[63] Ibid.

[64] José Ramírez, "Informe rendido por el primer secretario de la Sociedad Mexicana de Historia Natural, en la junta general del día 25 de enero de 1883 [Report by First Secretary of the Mexican Society of Natural History on Meeting of January 25, 1883] " *La Naturaleza* VI, 1ª. Serie (1884).

impact of drainage. Minister of Industry Manuel Fernández Leal asked Fernando Altamirano, director of the Medical National Institute, to carry out an analysis of Lake Texcoco in order to know what kind of crops, if any, could be cultivated on drained lands and study which industries could be established in the zone.[65] A number of SMHN contributors participated in these analyses, including Fernando Altamirano, Francisco Río de la Loza, José Ramírez, and Alfonso L. Herrera, of the chemical, climatological, bacteriological, and zoological characteristics of the lake, as well as its natural history. These scientists agreed that Lake Texcoco had turned into "the great cloaca of the Valley of Mexico" due to a huge accumulation of organic matter, which when exposed to sunlight and oxygen "have produced modifications to [the] atmosphere" with significant consequences to the city's hygiene.[66] The scientists concluded that draining the lake would not change the average humidity of the Valley of Mexico's atmosphere and that planting *peru* and *huizache* trees were the most suitable for the site. Likewise, Jose Terrés was optimistic that the zone would remain salubrious, and likely be affected only a short while after the draining works, as long as it were re-vegetated before the rainy season. Others sought utilitarian reasons for preserving the lake. Herrera suggested that mosquitoes and flies could be turned into bird feed and exported, for instance for the French pheasant. In addition, he noted that the controlled hunting of ducks, geese, and herons could provide increasing benefits to people living close to the lake.[67]

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[65] UIA-Collection Porfirio Díaz. Porfirio Díaz, "Informe que en el último día de su periodo constitucional da a sus compatriotas el presidente de los Estados-Unidos Mexicanos Porfirio Díaz acerca de sus actos de administración" [Reporter that Porfirio Díaz, President of Mexican United States, Gives to His Compatriots on the Last Day of the His Consitutional Period, Regarding His Administration Actions], ed. Presidencia de la República (México: Tipografía de Gonzalo A. Esteva, 1880); Fernando Altamirano, *Estudios referentes a la desecación del Lago de Texcoco* [*Studies regarding dried of the Lake of Texcoco*] (México: Oficina Tipográfica de la Secretaría de Fomento, 1895).

[66] Fernando Altamirano, *Estudios referentes a la desecación del Lago de Texcoco*, 5.

[67] Ibid., 81.

In addition, SMHN contributors argued that close and reciprocal relationships between nature and humans had generated negatives consequences for the Valley of Mexico—far more than swamps or stagnant water. They explained that in the last decades of the nineteenth century problems relating to the changes in fauna and flora and human activities had promoted insalubrity in Mexico City.[68] According to Alfonso L. Herrera, humans had deeply modified their natural biological surroundings via agriculture and cattle raising, disturbing a wide array of organisms living close to him. Herrera admitted that human influences were generally harmful to most species, and those that eventually adapted to survive in urban areas could never return to the wild. Human alteration of plant cover in the Valley of Mexico had also had far-reaching consequences for other creatures. For instance, places with abundant flora also supported greater quantities and diversity of wildlife, while those places with few orchards and gardens, not only had less invertebrate fauna, but they were more domestic.[69]

Herrera also noted that cultural factors, such as habits and customs, also influenced changes in the presence of invertebrates in the Valley of Mexico. These modifications were more noticeable in indigenous societies rather than in the white population. “Among the indigenous population, there is more neglect, less hygiene, rooms are less warm than [communities of] white people.” In this sense, Herrera stated that native invertebrates adapted more easily to unfavorable outdoor conditions and lived better than imported species, whereas pests (e.g., vermin, insects, lice, etc.) survived better living with indigenous people because they typically lived in dirty surroundings.[70]

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[68] Alfonso L. Herrera, "El Valle de México considerado como provincia zoológica," 476.
[69] Ibid., 477.
[70] Ibid.

Another factor of zoological changes in the Valley of Mexico was the introduction of technology, such as gas lighting and electricity. According to Herrera, in 1891, the invertebrate population was different from the population in 1880 due to the advent of street lighting. Electric lights attracted nocturnal insects such as the *macroglossa* butterfly and had caused a high mortality rate in "palomillas de San Juan," a form of flying termite (*Incisitermes marginipennis*). Artificial lighting vigorously attracted the "palomillas de San Juan," and it burned or killed most of them.[71] Likewise, he believed other *hymenopteran* species, such as ants, had also suffered changes while adapting to domestic life and consuming sugary liquids that he thought led to their deaths.[72]

According to Herrera, the degree of influence of external factors on the survival of a species depended whether the species was domestic or wild. For example, climate was an important element for life to survive, and it affected domestic invertebrates in different ways compared to wild invertebrates. Household pests such as lice, bed bugs, arachnids, and crustaceans thrived in the humidity and dark conditions that could be found in basements, and all the more so in Mexico City's subways. Another relevant element in their survival was their struggle for food. Domestic invertebrates ate clothing and wood that they found in huge quantities in human homes. However, they also had to fight against society's attempts to get rid of them via improved hygiene and light.[73] In summary, even though SMHN members affirmed that the environmental problems in the Valley of Mexico were a result of the complex and reciprocal relationship between nature and society, they were optimistic in proposing several actions to maintain the balance of nature after draining the lake to improve people's lives.

[71] Ibid., 476–77.
[72] Ibid., 478.
[73] Ibid., 481.

The management of natural abundance

In the large, after the War of Independence, the Mexican government and scientific community gave greatest attention to mineral resources as the principal wealth creator in the country. A number of mines had been damaged, flooded, or destroyed during the political chaos of the early nineteenth century. The rehabilitation of mines required huge amounts of capital, and the government introduced fiscal stimuli and reduced taxes to make this possible, and encouraged investments by international capital. In 1824, the first British company began participating in silver, iron, and copper exploitation at Real del Monte, Bolaños, Tlalpujahua, and Real de Catorce in central and central-eastern of Mexico (Map 2). Despite the civil wars of mid century, the silver mines were able to maintain their production, as was the case of the mines in Real del Monte and Real de Catorce.[74]

Mining of Mexican minerals for export thrived during the Porfiriato—thanks to British, German, French, and US investments attracted by economic and political stability and pro-foreign investment policies enacted by Porfirio Díaz specifically to promote mining activities. By 1885, mining had grown into a foreign monopoly, mainly American, that operated in enclaves only weakly connected with the national economy.[75] By 1885, international mining corporations, which demanded maximum profits and limited labor, had increased their presence in Mexico. As a result, national independent mine owners dwindled. Historian Kenneth Dale Underwood note that Mexican landowners often leased their mining properties to foreigners for additional income. "These foreign renters often brought new mining technologies allowing them

[74] Atlántida Coll-Hurtado, María Teresa Sánchez-Salazar, and Josefina Morales, *La minería en México. Geografía, historia, economía y medio ambiente* [*Mining in Mexico. Geography, History, Economy, and Environment*], Temas Selectos de Geografía de México (México: Instituto de Geografía, UNAM, 2002), 34–35.

[75] Ibid., 35.

to extract silver and lead from mines long thought depleted, producing revenue for the Mexican landlord, the Mexican government, through taxes and export duties, and the foreign renters."[76] In the process, the state confiscated enormous tracts of lands owned by communities or haciendas "that [were] not routinely used as living space or active production" and gave them over to mining companies.[77]

Because most mineral deposits were in isolated or inaccessible zones, the mining industry greatly benefited from new modes of communication such as railroad and telegraph lines, and electrical power. In 1876, a mere 475 miles of railway tracks existed in all of Mexico, but from 1877 to 1884 new construction averaged 749 miles per year. This meant that total miles of track increased to 3,637 in 1885 and in 1910 topped 12,414 miles.[78] Railroads enabled the introduction of other new technology—including heavy furnaces to carrying out smelting—and in many cases directly connect mineral producers to international markets. The mining boom also prompted changes in the landscape. In addition to the need for lumber, water, and pack animals for mining work, new urban and industrial centers were created.

Mexican lumber was in particularly high demand during the late nineteenth century, both in international and local markets. The mining industry and railroad works required great quantities of this resource both for fuel and building material, especially pine. Meanwhile, Great Britain and the United States were the main international consumers of mahogany and cedar cut for furniture production from the Isthmus of Tehuantepec, from which 22,260 tons of lumber

[76] Kenneth Dale Underwood, "Mining Wars: Corporate Expansion and Labor Violence in the Western Desert, 1876–1920" (PhD diss., University of Nevada Las Vegas, 2009), 44.
[77] Ibid., 46–47.
[78] Francois-Xavier Guerra, *México. Del antiguo régimen a la revolución*, 326.

were exported during one year alone (1872–1873).[79] Local markets also demanded growing quantities of oak and mesquite trees for industry and firewood.[80]

Because forest properties rested under both private or government control, the management, handling, and felling of trees, as well as their subsequent processing was complex. In the Isthmus region, American Richard H. Leetch became the main concessionaire of lumber and of cattle haciendas that replaced felled tropical forests. Due to his economic influence, he obtained several influential positions in which his nationality seemed to have mattered little—the Lloyd's Insurance Company named him their commercial agent; between 1872 and 1887, he served as both German and US consul in Coatzacoalcos; and in 1886, he was named British vice-consul of Minatitlán on the Isthmus—sometimes even buying "indigenous rebels" as laborers for this dangerous work.[81] Local owners of forest tracts could sign one hundred year contracts related to the "buying and selling of firewood" with international companies or investors. In the state of San Luis Potosí, several railroad and mining investors signed contracts with *hacendados* (owners of haciendas), which included the sale of all oak and mesquite trees without any obligation to plant new trees.[82] In one case, American Robert S. Towne signed a contract with Mexican Ramón Othón to buy lumber from Othón's hacienda as well as to drill water wells needed for these activities according to a 100-year lease agreement.[83] Despite federal laws

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[79] Héctor Luis Zarauz López, "Integración comercial durante el siglo XIX: el caso de la explotación de caoba en el sur de Veracruz" [Commercial Integration during the Nineteenth Century: Mahogany exploitation in Southern of Veracruz case], *Ulúa. Revista de Historia, Sociedad y Cultura* 1, no. 2 (2003).

[80] Manuel Villada and Eduardo Armendariz, "Necesidad de la conservación de los bosques" [Necessity of Forest Conservation], *La Naturaleza* II, 2ª. Serie (1897).

[81] Héctor Luis Zarauz López, "Integración Comercial," 148.

[82] Andrés de González Argüelles, "Política forestal, El Porfiriato" [Forestry Policies, El Porfiriato], *El Pulso de San Luis*, November 1, 1990; Andrés de González Argüelles, *Explotación del Mezquite en San Luis Potosí. Una perspectiva histórica* [*Exploitation of Mesquite in San Luis Potosí. Historical Perspective*] (México: Archivo Histórico del Estado de San Luis Potosí, 1991); Tomás Calvillo Unna, "Hacia una historia de la ecología en San Luis Potosí" [Toward a History of the Ecology in San Luis Potosí], *El Pulso de San Luis Potosí*, September 11, 1989.

[83] Tomás Calvillo Unna, "Hacia una historia de la ecología de San Luis Potosí."

intended to limit cutting, the sale was legal because the forest was on a private land (Othón's hacienda); he had the right to sell the lumber to anyone. Robert S. Towne was one of the biggest investors in Mexico. Because he owned ten mines, a railroad company, and timber companies across the country, his capital was significant to Mexico's national economy, a fact which in itself discouraged governmental limitation. The scale of cutting was massive in some areas. Zenón and José M. Mier were calculated to have cut 638,843 pines and oaks in the twenty years they operated on the Miches Range in Durango in northern Mexico, despite regulations prohibiting this on federal lands.[84]

Although the Mexican government had established regulations to monitor the felling of trees on national soil and their exportation since 1839, those laws were never strictly enforced or well-known across the territory. In 1861 just before the French intervention, authorities of the Tehuantepec Territory began to monitor logging on private and federal property, and created a group of forest rangers who would control logging and who would keep wood scraps out of rivers. In April of that same year, an agent of Secretary of Development in Coatzacoalcos proposed that the federal government introduce a regulation on felling trees, similar to those found in Tehuantepec, in order to protect national property. This form of regulation soon spread to the states of Veracruz, Puebla, Yucatán, Campeche, Tamaulipas, and Chiapas.[85] Growing concerns about the overexploitation of forests by mining and railroad companies prompted the Porfirian government to introduce new regulations. Lane Simonian points out that during the Porfiriato, government officials grew concerned over forest conservation for both economic and

[84] Andrés Horcasitas, *Dictamen del Lic. Andrés Horcasitas sobre la responsabilidad que se contrae por el corte de árboles en bosques nacionales sin la competente autorización* [*Atty. Andrés Horcasitas Opinion About The Responsibility that is Contracted by The Cutting of Trees in National Forests Without Authorization*] (México: Oficina Tipográfica de la Secretaría de Fomento, 1889), 5.

[85] *Fomento agent* was a government official of the Secretary of Development.

utilitarian reasons. Moreover, they considered lumber a strategic resource for international mining, industry, and railroad investments, whereas some academics (and a few politicians) were interested in conservation from an environmental standpoint.[86]

Even though these regulations largely failed to provide meaningful controls due to the difficulties of satisfying the aforementioned ambiguities separating state and private economic interests and transnational and local investments, it is important to recognize some of the ways that Mexican scientists sought to defend nature's balance, influence attempts to regulate the felling of trees, and establish a correlation between the loss of trees and declining public health.

Following Humboldtian ideas regarding the reciprocal influence of trees on the hydrological cycle, a number of politicians and scientist argued for a close relationship between forests and climate change. According to this line of thinking, lack of trees had led to the lack of rain and, consequently, the increased occurrence of droughts. In 1864, as part of the French-led project to inventory the country's natural resources, Maximilian's government organized a scientific commission to draw up a topographic map and collect statistical data for the mineral districts of Pachuca, Real del Monte, Atotonilco el Chico, and Santa Rosa, and thereby "study in situ the three kingdoms, and determine their agricultural, mineral, and industrial wealth."[87] Ramón Almaraz—who later joined the SMHN—led the commission, while José Romero worked on geography and topography, and SMHN founder Manuel Villada worked on issues relating to flora and fauna. In his report, Romero emphasized the close and reciprocal relationship existed between forests, water, air temperature, and human actions. He explained that the lack of rain in certain zones impeded the growth of trees, and in other zones the lack of trees led to the absence

[86] Lane Simonian, *La defensa de la tierra del jaguar*: 74–87.
[87] Ramón Almaraz, *Memoria de los trabajos ejecutados por la Comisión Científica de Pachuca*, 8.

of rain. He warned that the British-owned Real del Monte Company had broken Mexican law on the felling of trees for many years—that and its mining waste had caused barrenness in the adjacent valley and plains.

> This spoil from mountains and nature inhibits thick cloud formations …. The imbalance in temperature gives rise to the prevailing North wind that drags away the few clouds that could form. These [clouds] run quickly [toward] the most [expansive part] of the valley, [and are] unable to sufficiently condense and [are undone before] rain [forms].[88]

In Romero's opinion, before the mass felling of trees, natural springs had been abundant and provided potable water to area cities, but now due to human action those springs had disappeared, and populations often went without water for two or three days. Romero explained that as a result of this damage, agriculture had been nullified, generating even more poverty in mining communities already hampered by the high price of grains and vegetables. Moreover, poor inhabitants paid dearly for precut wood sold by the monopolies of the lumber industry.

The famous liberal politician and educator Ignacio Ramírez, Ignacio Cornejo, and Gumesindo Mendoza belonged to a group with close ties to the SMHN and SMGE that defended the conservation of trees for economic reasons. In 1870, they joined a commission to assess Mexican sylviculture. Upon concluding their assessment, they claimed it imperative to regulate the felling of trees because "they are our main providers of wood for building and combustion!"[89] The commission rejected philosophical approaches, such as naturalism and druidism, and instead emphasized the relevance of trees in human life because, in their opinion, they played a vital role in the country's economy. Even though they noted that heat and humidity were essential to forests, they tended to minimize the relationship between forest cutting and the hydrological cycle, floods, and climatic stability.

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[88] Ibid., 86.

[89] Ignacio Ramírez et al., "Bosques y arbolados" [Forest and Woodlands], *Boletín de la Sociedad Mexicana de Geografía y Estadística de la República Mexicana* II, no. 2a. Época (1870): 19.

> Rains depend on general rules, any kind of vegetation could produce it […]. [To avoid floods] the most sure [way are] open wells and [controlling] water through canals […]. [We] have the temperature that corresponds to our elevation over sea level and our position related to the Tropics, [but we cannot improve the temperature with forest].[90]

The commission preferred to emphasize the natural abundance of Mexico's forests, which they believed could easily provide Mexicans with their lumber necessities—especially since lumber consumption in Mexico did not compare to that of the "first nations in the world" (i.e., Germany, France, England, and the United States). However, they were not oblivious to the destruction that human efforts were capable of: "despite the few necessities and much wealth, the hand of man [stripped] the soil until [whole districts were defaced]."[91] In reply, another founding SMHN member and a forest conservationist who extolled the economic benefits of trees, Leopoldo Río de la Loza assured the commission of the abundance of forests and the relevance of conservation for the improvement of Mexico's economy. Earlier he had proposed a forest ordinance to the government of Maximilian I, but it never took effect because the Empire fell soon after.[92]

In response, Manuel Payno—writer, politician, and honorary member of the SMHN—reemphasized that forests and woodlands influenced variations in climate. Although the writer agreed with Ramírez and Mendoza that wood was an essential element to "civilized life," Payno posited that it was sometimes necessary to halt the felling of trees to "avoid that climate change." He cited the example of Antonio Salonio, a governor of Veracruz, who in 1845 successfully enforced regulations on logging, slowing the destruction of the forest in the Jalapa region. Once the uncontrolled felling of trees resumed after Salonio's governance, the subsequent damages to the forests "contributed to many changes in climate from the earlier *veracruzano vergel* [garden

[90] Ibid., 23.
[91] Ibid., 20.
[92] Lane Simonian, *La defensa de la tierra del jaguar*, 74–76.

of Veracruz]."[93] Another SMHN contributor with ties to this region who regretted the loss of trees was Hugo Finck, from Cordoba, Veracruz. In 1876, he highlighted how wide expanses of montane forest close to the Pico de Orizaba at Veracruz had disappeared over time.

> It is sad watching from a distance of five *leguas* [about 15 miles], where twenty-seven years ago I saw [a land] covered with oaks and conifers, today they are only covered with oak stumps, some regrowth, and conifers, [but] there [is only] one species of medium size, dispersed […]. Everything has been destroyed, and this situation keeps going, in few years the beautiful [ornament] of our mountain will disappear. I have seen huge maize sower among huge trunks of conifers—[that people] cut with axes, without any kind gain, and the next year all of them [trunks] will be burned, without giving more [than mere] fertilizer with their ashes [to] a land [already] remarkably fertile.[94]

Finck was worried not only by the aesthetic changes but also by the loss of diversity. He described how twenty-five years prior he had identified twenty oaks species previously unknown to botanists in this vicinity, and had collected twenty-six different species of acorn within the county of Huatusco. The variety of species, however, had disappeared. Similarly, mining engineer José Haro noticed the very rapid depletion of forest that had occurred in the vicinity of a Michoacán copper-mining city, whereas in regions without inhabitants, pine and oak trees covered huge tracts of land.[95]

Physician Fernando Altamirano identified several causes of forest decimation, stemming from both natural and anthrogenic origins. For natural origins, he identified disease, landslides and other disturbances, and climate extremes as important. Altamirano argued that forest fires caused by humans were the worst aggressors, including the felling of forests to cultivate lands by indigenous people. He also targeted the wasteful system of exploitation—free from taxes and

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[93] Manuel Payno, "Bosques y arbolados [Forest and Woodland]," *Boletín de la Sociedad Mexicana de Geografía y Estadística de la República Mexicana* II, no. 2a. Época (1870): 81.

[94] Hugo Finck, "Una excursión a las faldas del Pico de Orizaba." [A Trip to Slaps of Pico de Orizaba], *La Naturaleza* III, 1ª. Época (1876): 234.

[95] José Haro, "Los criaderos de cobre de Michoacán," *La Naturaleza* VI, 1ª. Serie (1884): 50.

other restrictions—that drove the consumption of lumber for the railroads and industry. To solve these problems, he proposed a change of fuel for industry and railroads, and echoing Rodolfo Río de la Loza, Ignacio Ramírez, and Manuel Payno, called for more laws to control forest exploitation.[96]

Ignacio's son, lawyer Ricardo Ramírez, responded that legislation regarding forest conservation existed, particularly at the regional level, but that Mexico lacked one homogeneous law that would apply to the whole country, as well as any systematic means to collect forestry statistics to determine if these laws were being followed. He summarized the inefficacy of existing laws to monitor resources, from both the colonial and early national periods, and particularly targeted rules from 1813 that gave individuals the right to claim forested tracts of land and graze or cultivate unused portions of them in any manner they chose. For Ramírez, this was the main mistake in forest conservation legislation, and he explained how current ideas regarding common uses of resources could better protect them.[97]

Even though utilitarianism primarily motivated these scientists' attitudes towards nature, they insisted that the use of resources had to be balanced according to the dictates of nature's law. In 1880, an honorary member of the SMHN who a short while later he became Minister of Development during the fastest period of Porfirian-era industrial and railroad expansion, engineer and politician Manuel Fernández Leal, warned in an official circular that each day felling trees was increasing devastation of Mexican forests and woodlands.[98] Interestingly,

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[96] Fernando Altamirano, "Necesidad de la repoblación de los bosques [Necessity of restock forests]," *La Naturaleza* II, 2ª. Serie (1897): 15.

[97] Ricardo Ramírez, "Legislación acerca de los bosques."

[98] Manuel Fernández Leal, "Circular de 15 de Febrero de 1880," in *Código de colonización y terrenos baldíos de la República Mexicana. Años de 1451 a 1892* [*Code of Colonization and Uninhabited Terrain of the Mexican Republic*], ed. Francisco F. de la Maza (México: Oficina de Tip. de la Sría. de Fomento, 1893).

Fernández made one of the clearest expressions from this era of the need for conservation in order to maintain the balance of nature, in which trees play a key role in maintaining soil fertility, public health, moderate temperature and humidity, and the hydrologic cycle. He believed that government and the general populace were ignorant of how forests worked as part of the natural order and that to understand nature and the evils generated by forest destruction was imperative. Echoing other natural historians, Fernández explained that the loss of trees created the lack of an efficient medium to purify the atmosphere and to disinfect unhealthy places and resulted in the impoverishment of natural springs and creation of devastating torrents of water. Large tracts of forest zones were being wastefully lost to agriculture and cattle ranching in the mountains, resulting in a loss of lumber for combustion and with which to build. Simply stated, for politician Fernández, forest conservation was important for reasons that went far beyond its significance for the lumber industry.

A problem of special interest to SMHN members based in Mexico City was the long-term loss of trees in the Valley of Mexico, particularly in one of the last remaining large tract left in the immediate vicinity of the capital, the Chapultepec Forest. Most observers concurred that either a desiccating environment had resulted in forest loss or forest loss had resulted in the lack of rain—an issue of direct relevance to governmental projects to drain Valley lakes. In 1884, Mariano Bárcena and other SMHN members established a commission to propose the reforesting of the Valley of Mexico and the mountains around it. It argued, among other things that permanent vegetation would help sanitation in the Valley and suggested systematic planting of diverse eucalyptus species.[99] In 1894, members of the SMGE invited the SMHN to form a joint

[99] Mariano Bárcena et al., "Dictámen sobre la repoblación vegetal del Valle de México," *La Naturaleza* VI, 1ª. Serie (1884).

commission to discuss the best ways to impede forest destruction caused by excessive logging and to determine strategies to efficiently replant trees.[100] The problems continued, however, and four years later, Urbina proposed a study on places close to Villa de Guadalupe in Valley of Mexico to implement efficient strategies in "preventing the ruin of the historical forest of Chapultepec."[101]

During the optimistic first years of the SMHN, Society co-founder Leopoldo Río de la Loza had underlined the abundance and "inexhaustible source" that nature had given to Mexicans, but as the pace of economic development during the 1880s and 1890s, SMHN members became aware of problems in nature that went well beyond the focus on mining and timber resources (see Map 3). In addition to deforestation, they noted a progressive fall in the jaguar population, proliferating fish kills, and loss of birds—mostly caused by human activities. In 1881, Swiss naturalist Frederick Sumichrast published an article summarizing his collection of Mexican animals during more than thirty years.[102] One of his observations was that the jaguar (*Panthera onca*) population had decreased considerably because ranchers killed them, although considerable populations still survived in certain unoccupied zones. Like most conservationists of this era, Sumichrast did not necessarily see this as a bad thing. Jaguars and mountain lions were a threat to cattle owners leading some "haciendas to have a *tigrero* whose work [was] to chase jaguars, mountain lions, and all kinds of carnivorous animals."[103]

In 1878, Ángel Nuñez Ortega, a journalist and politician interested in natural history studies, wrote about a spectacular fish kill in the Gulf of Mexico and pointed out that people,

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[100] Jesús Galindo y Villa, "Informe de la secretaría" [Report of Secretary], *La Naturaleza* III, 2ª. Serie (1898): 17.
[101] Ibid., 13.
[102] Sumichrast Frederick, "Enumeración de las especies de mamíferos, aves, reptiles y batracios observados en la parte central y meridional de la República Mexicana.," *La Naturaleza* V, 1ª. Serie (1881).
[103] Ibid., 206.

dogs, horses, and other animals had suffered terrible respiratory problems at the same time. He knew that this phenomenon (known as red tides) had occurred at the port of Veracruz in 1853, 1861, 1865, 1871, and 1875. The author argued that, according to an analysis of air, the hydrogen sulfide levels in Veracruz's atmosphere during the most recent event were a cause for concern—perhaps because the multiple swamps in the city produced an abundance of hydrogen sulfide and somehow contributed to this problem.[104] Scientists from the Smithsonian Institute also observed high mortality of fish from 1881 to 1883 in Tampa Bay, Florida, and on the adjoining coasts. They argued that poisoned water was the cause of fish mortality and, subsequently, the deaths of birds that ate the dead fish.[105] *La Naturaleza* did not publish additional information about this problem, however.

The loss of birds was another problem identified by *La Naturaleza*'s authors. José Narciso Rovirosa from Tabasco noticed that heron populations from southern Mexico had decreased because of the trade for their feathers. The turn-of-the-century hat industry demanded enormous quantities of feathers to make hats, which women from a middle and high economic status wore—following a fashion emanating mainly from France and England.[106] Rovirosa between 1890 and 1896 proposed that the local government pass a law to protect the snowy egret and other birds. In 1899, Alfonso L. Herrera proposed a law that would protect all useful birds in Mexico in view of the impact that superstition, people's ignorance, inexperienced hunters, and

[104] Ángel Nuñez Ortega, "Ensayo de una explicación del origen de las grandes mortandades de peces que ocurren en el Golfo de México," *La Naturaleza* IV 1ª. Serie (1879): 189.

[105] M. A. Moore, "Fish Mortality in the Gulf of Mexico," *Proceedings of United States National Museum* 4 (1881); S. T. Walker, "Fish Mortality in the Gulf of Mexico," *Annals and Magazine of Natural History* (1883).

[106] Jaime Osorio Sánchez, email, July 20, 2013.

speculation of the ornament industry had on the the decline of owls, quetzals, hummingbirds, white herons and others that Herrera mentioned in his project.[107]

Links between environment and public health

Alfonso L. Herrera also used evolutionary concepts such as adaptation to environment and the laws of inheritance to explain what he saw as the fundamental natural processes directing the differentiation of humans. In 1895, he and physician Ricardo E. Cicero participated in The International Congress of Americanists, presenting a lecture on Mexican anthropology.[108] They claimed that the lack of anthropological studies in Mexico had obfuscated the characteristics of diverse indigenous groups, many of them with numerous populations. In addition, for the authors, anthropological studies would help to resolve medical problems and would provide evidence for an ancient human presence in Mexico. More specifically, they believed biological anthropology would be able to deduce instances in which environment influenced osteology: “In Europe [anthropologists] have demonstrated absolute influence of altitude on rib cage development,” and they affirmed that in Mexico altitude had influenced the exaggerated clavicle and sternum developed in inhabitants from the Central Mexican Plateau, and citing the work of Carlos Monge and vibrant school of altitudinal physiology in Peru, the lengths of the humerus and femur had decreased to compensate for an increasing rib cage capacity. Herrera and Cicero hoped that anthropological studies could find in the Mestizo race inherited characteristics from

[107] Alfonso Herrera, "La protección de las aves."

[108] Alfonso L. Herrera and Cicero Ricardo, "Estudios de Antropología Mexicana [Mexican Antrhopology Studies] " *La Naturaleza* II, 2ª. Serie (1897).

Spaniards and indigenous people, thus, "we could know if, as the Dr. Cicero deduces […], the atavistic power from indigenous race is minor."[109]

Herrera was not the only one interested in the connection between race, environment, and Mexican social development, which as we have seen, was an issue of perennial interest within the Mexican natural history tradition. The rapid emergence of the science of anthropology during the second half of the nineteenth century provided a primary stimulus for discussion of these subjects among the members of the SMNH. Although some intellectuals argued that contemporary indigenous people were ignorant, and infantile, the SMHN discussed racial problems based on a socio-behavioral and physio-anthropological approach.[110] Some scientists found in anthropocentric actions the causes for what they perceived to be a backward indigenous race. They focused their analyses on the indigenous race, not on Mestizos, because they considered indigenous people an obstacle to the progress of Mexico's civilization and linked the degeneration of the indigenous race with the unhealthy environment caused by human activities. *La Naturaleza* published a few race-related articles by José Ramírez, Jesús Sánchez, and Alfonso L. Herrera—who wrote about topics related to race from an evolutionist's perspective. Sánchez mentioned climate as an element that influenced physical characteristics of race, but he focused on anatomical studies to explain differences between Mexicans and Europeans and argued that the indigenous race was in the process of evolving, as evidenced by his studies of indigenous people's molars.[111]

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[109] Ibid., 465; see also Cueto, *Excelencia científica*.

[110] Carlos Martins, "Las plantas carnívoras (Carnivorous Plants)."

[111] Jesús Sánchez, "Historia Natural Médica [Natural Medical History]," *Gaceta Médica. Periódico de la Academia de Medicina de México* XXXV(1898).

During the second half of the nineteenth century, older ideas about environmental determinism seemed to persist in some intellectuals' thinking. Links between environment, health, and race that the ancient Greeks had first pointed out once again inspired a number of Mexican physicians and other commentators to affirm that the character, morality, and physical conditions of inhabitants of a region were greatly influenced by the geographic characteristics of the place. Although some authors recognized that nature influences humans, scientists involved in the SMHN did not rigorously use environmental determinism or racial degeneration as guides for action. Instead, they persisted in believing that the abundance of resources would enable the Mexican nation to achieve progress and highlighted humanity's capacity to change nature. Donald Worster has identified this mode of thought as the "imperial viewpoint on nature," in which nature is viewed as man's domain, to be altered and rearranged more or less as he chooses, both to improve or degrade the natural world. [112]

This discussion extended far beyond the pages of *La Naturaleza*. According to mid-century women's magazines, because Mexico was in a warm region, its high temperatures generated heat within the human body and modified biological functions. Therefore, Mexican populations had a weak appetite, languid digestion, and their nutrition did not give them much energy. The excessive temperatures of these conditions made the population weak and inclined to repose. Authors of such articles explained that, according to "scientific evidence," Mexicans had a physical disadvantage compared to Europeans. This explained poverty in the country. By extension, climate was the factor that had determined the emergence of more basic racial diversity between the Caucasian, Mongoloid, Negroid, American, and Malayan races.[113]

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[112] Donald Worster, *Nature's Economy*, 29–30.
[113] Rodrigo Vega y Ortega, "El conocimiento médico e higiénico en las revistas femeninas."

The most important thing these medical commentators looked for was geographical patterns that explained population features in way that might explain the causes of diseases and thereby help improve public health. For example, José Olvera underscored the importance of local weather and climate on public health.

> The inhabitants were under variable influences of temperature and stress in all seasons, principally during transition of each and other; thus the differences are remarkable, because they are between temperature maximum and minimum […] they are very important in many days per year […]. Rain is not certain nor constant in its season, because there come few clouds and many times they are dissolved or swept away by spontaneous winds. Those anomalies so much disturb our nature that their effects produce in us a malaise and we are caught for many hours per year in a situation that we called it the middle of healthy and sick.[114]

SMNH members tended to emphasize the ability of human actions to exacerbate or remedy these circumstances. For instance, the geographer Antonio García Cubas pointed out that Mexico's problems—including diseases, the lack of population, and slow progress—was not caused by nature. On the contrary, he attributed those evils to human activities. García noted that people often blamed the elevation of the land, its winds, and inconstant temperature had slowed population growth, but "it is necessary to point out that the true causes of illness in Mexico [were] not attributed to nature, as many people have claimed."[115] He warned that cemeteries emanating harmful miasmas, the dangerous location of landfills, hospitals, and cemeteries on sites close to population centers, and the interplay of the built environment with prevalent wind

[114] "[…] los habitantes están sometidos a influencias variables de temperatura y de presión en todas las estaciones, pero principalmente en las transiciones de una a otra; así que las diferencias muy notables que se encuentran entre la máxima y la mínima de la temperatura […] son de gran consideración en numerosos días del año […] Las lluvias no son tan seguras ni tan constantes en su estación, porque vienen ya pocas nubes, y muchas veces éstas son disueltas o arrastradas por esos vientos extemporáneos. Estas anomalías trastornan tanto nuestras naturalezas, que sus efectos nos produce malestar, y guardamos en muchas horas del año un estado, que se podría decir que es un medio entre la salud y la enfermedad." José Olvera, "Memoria sobre el Tifo," (1882) in *Ensayos sobre la historia de las epidemias en México*, vol. II, ed. Enrique Florescano and Elsa Malvido, (México: Instituto Mexicano del Seguro Social, 1982), 508–09.

[115] Antonio García Cubas, *Escritos diversos de 1870 a 1874* [*Diverse Writings from 1870 to 1874*] (Mexico: Impr. de I. Escalante, 1874), 68–69.

direction were causes of unhealthy places.[116] Mariano Bárcena also identified links between climatic phenomena and human actions as causing population decreases, enumerating the advantages of meteorological information to strengthen human activities in agriculture, medicine, engineering, geography. "Due to our living in the atmosphere, it is clear that it is part of life's phenomena, because the functions of our organism are related to the environment that surrounds us."[117] According to Bárcena, relationships between human organisms and the environment made it necessary to study elements of climate (e.g., temperature of air, rain, humidity, atmospheric pressure, and the direction and force of winds).

Other authors linked the degeneration of the indigenous race with the unhealthy environment caused by human activities. SMHN honorary member José G. Lobato argued that Mexico City had developed a new rachitic, apathetic, and weak race due to changes in the atmosphere caused by civilized man transforming the city into an urban zone filled with miasmas, water swamps, and infection: "Since atmosphere modifies the constitution of superior animals, the new city had modified the Mexican race." This physician stated that during pre-Columbian time, Mexicans had better health conditions than in 1874 because its atmosphere was more hygienic and had better biological conditions. For him, the lack of trees—due to loggings and agriculture—had modified watercourses, accelerated water evaporation, decimated vegetation, and altered the climate.[118] He also warned Europeans to avoid excesses that caused

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[116] Ibid.

[117] "Ya que vivimos en el seno de la atmósfera, es claro que ésta tiene parte en los fenómenos de la vida, puesto que las funciones que desempeña nuestro organismo están relacionadas con el medio que nos rodea." Mariano Bárcena, *Informe que el director del Observatorio Meteorológico Central presenta a la Secretaría de Fomento acerca de los trabajos verificados en aquella oficina durante los años de 1878 y 1879* [*Report of Central Meteorological Observatory Director present to Promotion Secretary Regarding Works Made on That Office During 1878 and 1879*] (México: Imprenta de Francisco Díaz de León, 1880), 11.

[118] José G. Lobato, "Meteorologia de México, conteniendo datos, estudios y observaciones [Metereology of Mexico, Containing Data, Studies, and Observations]," *Boletín de la Sociedad Mexicana de Geografía y Estadística de la República Mexicana* III, no. 3a. Época (1875).

diseases. Lobato explained that, in the past, indigenous people had been acclimated to their clean environment and did not suffer from vicious health problems. However, the diseases emerged when they adopted habitual alcohol consumption and a poor diet. Lobato underscored that people could prevent diseases by eating a good diet, with minimal spices, and drinking less alcohol and coffee.

For Lobato, these observations had direct ramifications for conservation. In this sense, he claimed that despite what the media and high social classes thought they knew about the relevance of forests, gardens, and agriculture, they did not pay sufficient attention to the hygienic benefits from trees. One example of this was the destruction of forests in favor of agriculture activities and to produce lumber. "Disorganized logging to produce charcoal and firewood, extract resin, and fine woods in Gulf coast as well as Pacific coast [has caused] irreparable damages that did not compensate for the particular advantages of owner of zones… [who based their wealth on earnings from the exportation of forest products." Year by year, in Lobato's view, Mexican lands were becoming unhealthier because of the destruction of the forests, causing people to further decline in vigor and in physical, moral, and intellectual energy. He insisted that government enforce the laws curtailing owners of railroad companies and newer companies that burned charcoal.[119]

Such beliefs had a noteworthy impact on the institutional research of Mexican scientists at the end of the nineteenth century. Mexican physicians—like doctors in many parts of the world—organized surveys that described the sanitary circumstances of different regions and tried to determine how environmental variability could influence human organisms and their tendency

[119] José G. Lobato, "Higiene Pública" [Public Hygiene], *Gaceta Médica. Periódico de la Academia de Medicina de México* XVI, no. 15 (1881): 252.

to serve as hosts for diseases. This data collection project was inspired by many of the same values that drove the inventory of Mexican minerals, flora, and fauna, for which the SMHN is best known. Research results were released in publications of *Medical Geographies*, which contained relevant data about resources, climatic variability, diseases that occurred frequently, and the characteristics of inhabitants.[120] In Mexican surveys, physicians added the *race* category in order to know what "races belong to the diverse inhabitants of the Mexican Republic."[121] In those surveys, the relationship among environment, race, and disease was evident.

To this end, in 1887, the Mexican federal government conducted a survey across the whole country on the geography in each city (i.e., rivers, seas, soils, flora, and basin water), geology, climate, diseases, as well as mortality rates and a number of other demographic characteristics. However, only 1,625 out of 2,863 municipalities answered the survey. Despite the unclear and incomplete information gathered, in 1889, doctor Domingo Orvañanos published the initial results of this research in a document, *An Essay of the Medical and Climatological Geography of the Mexican Republic*.[122] Several chapters, which the author called *cartas* (charts), comprised this publication, and each one depicted Mexican cities. In addition to racial distribution and other demographic data, the charts showed the rainfall in each district, where there was frost, the location of swamps, and referenced drought periods. Five charts were devoted to food production in Mexico; another gave information about food consumption. One represented places where *pinta* disease has occurred, another where goiters were prevalent. Still

[120] José Luis Urteaga, "Higienismo y ambientalismo" 5–6.

[121] "Razas que pertenecen los diversos pobladores de la República Mexicana." Domingo Orvañanos, Ensayo de Geografía Médica y Climatología de la República Mexicana [An Essay of the Medical and Climatological Geography of the Mexican Republic] (México: Oficina Tip. de la Secretaría de Fomento, 1889).

[122] Sofía González Díaz, "Coloquio Internacional Geografía e Historia Natural: hacia una historia comparada," *Investigaciones Geográficas* (2010); Orvañanos, *Ensayo de Geografía Médica y Climatología de la República Mexicana*.

another shows the districts where people stuttered the most and where the most deaf-mutes and mentally retarded lived. One was devoted specifically to showing the counties where yellow fever was endemic, and another represented the districts where it had developed into an epidemic.[123] These charts mirrored how natural historians and physicians addressed their research according to the relationship between natural, geographical, medical, and social knowledge, and reveal how racial ideas were a key element in scientists' minds. Moreover, they insisted on a comparison between native Mexican and European-derived peoples. For example, Orvañanos explained the links between breathing, people's chest capacity, levels of oxygen, and the regional altitude.

> Dr. Gaviño deduced from these experiences that there are a notable differences between the number of breaths that we take per minute in Mexico, compared with the 16 to 18 that people take [at] sea level, that result half in the breathing capacity in Europe of 3.50 to 3.70, that result corresponds with the prevision, […]and in the same way 16 or 18 breaths at sea level, or in low altitudes, such as Paris, is in relation of 4:3 with 22 or 24 breaths that in the Central Mesa of Anahuac we take in one minute.[124]

To this end, in 1888, the National Medical Institute began to use surveys applied across Mexico to conduct regional research on plants, animals, and medical effects to establish the relationship between diseases and climate.[125] This institutional scientific project was organized

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[123] "Las cartas representan además de la distribución de las razas, las lluvias que caen en cada uno de los distritos; aquéllos en que hay heladas, en donde se encuentran pantanos. A la procedencia del agua de que hacen uso los habitantes de la República están destinadas 5 cartas. Otra dio a conocer los alimentos que se consumen […] una representa en donde se observa el mal del pinto, una diferente para el bocio, otra señala los distritos en donde se encuentran mayor número de tartamudos, sordo-mudos e idiotas. Una destinada especialmente a señalar las comarcas en donde es endémica la fiebre amarilla, y otra representa los distritos en donde se ha desarrollado como epidemia." Domingo Orvañanos, *Ensayo de Geografía Médica y Climatología de la República Mexicana*, 8.

[124] "El Dr. Gaviño deduce de estas experiencias que como hay una diferencia notable entre el número de respiraciones que en México hacemos por minuto, comparado con 16 a 18 al nivel del mar, aproximándose en la capacidad respiratoria que por término medio es en Europa de 3.50 a 3.70, que el resultado corresponde con la previsión[…] y de la misma manera 16 o 18 respiraciones al nivel del mar, o a cortas alturas, como París, están en una relación también aproximada de 4:3 con 22 o 24 respiraciones, que en la Mesa Central del Anáhuac hacemos en un minuto." Ibid.

[125] Lilia González Díaz, "Coloquio Internacional Geografía e Historia Natural: hacia una historia comparada," 156.

into five sections: natural history, analytical chemistry, experimental physiology, climatology, medical geography, and clinical therapeutics. The institute's goal was to study Mexicans' special constitution from a physiological perspective within their surroundings in order to understand their "particular *receptibilidad morbosa*" (morbidity in relation to disease).[126]

In order to establish efficient policies to cure diseases, physicians gathered most of their statistical evidence through empirical methods and had practical goals such as reducing the level of mortality. However, behind those proposals was the government's interest in showing the international community that Mexico was a country committed toward progress in order to court European and US investors. Physicians, public health officials, engineers, along with national and local governments promoted hygiene policies in order to improve public health and to reduce the occurrences of epidemics. Governments focused on changing the urban landscape through public works such as drainage systems, water networks, the construction of dams and hospitals, and improvements in health education. In other words, by erecting those buildings, they would construct a new country and usher in a new era of order and progress. Furthermore, economic incentives were attached to hygiene campaigns, which encouraged several public and private health practices to eliminate microbes and bacteria.

During the last decade of the nineteenth century, frequent and intense droughts experienced in many parts of Mexico gave new impetus to investigations into the relationship between loss of trees, the lack of rain, and epidemics of typhus and other illness. The megadrought of 1891 to 1902 has been recognized as one of the most severe climatic episodes in

[126] Antonio Vega y Ortega, "La óptica metodista en la divulgación de la medicina científica. El Abogado Cristiano Ilustrado, 1877–1910," *Eä: Revista de Humanidades Médicas & Estudios Sociales de la Ciencia y la Tecnología* 1, no. 2 (2009). See also Fernando Altamirano's *Relación sucinta de los trabajos sobre climatología y geografía médicas* (1882) ("Succinct Relation of Works on Climatology and Medical Geography"), which summarizes much of this research.

Mexican history. Those droughts strongly affected the northern and central zones of the country and resulted in a series of poor harvests. For example, in the central highlands of the country, the crops depended greatly on adequate rainfall early in the growing season (April–June); the absence of rain meant a shortage of reaped grains. According to Virginia García Acosta, during the Mexican drought of 1891, the monopoly over crop distribution held by large landowners and merchants and their ability to hoard and charge high prices for grain increased the damages done to the population—even more so than the drought—because it generated a famine in central regions.[127]

In this context, SMHN members vociferously defended the idea that the conservation of forests due to the key role that trees played in regulating climate and public health. In 1895, Fernando Altamirano, Manuel Villada, and Eduardo Armendariz—all SMHN contributors—participated in the Conference of Metropolitan Scientific Societies and gave several lectures focused on the relevance of forest conservation relating to the balancing of climate and public health with industry and railroad companies. Villada and Armendariz stated that the transpiration of trees strongly contributed to atmosphere's humidity because "a forest represents, in a minor place, a wide lake."[128] Indeed, they noted that forests contributed to rainfall events because the scientists had observed that heavy rains fell more frequently in zones covered with trees than in places absent of vegetation. "Forest, could be considered a gigantic artifact of condensation, of powerful energy that precipitates the water steam of atmosphere."[129] Moreover, forests generate

[127] Virginia García Acosta, "Las sequías históricas de México" [Historical Droughts of Mexico], *Desastres & Sociedad. Revista Semestral de la Red de Estudios de Prevención de Desastres en América Latina.* 1, no. 1 (1993); Matthew D. Therrell et. al, "Tree Rings Reconstructed Maize Yield in Central Mexico: 1474–2001" *Climatic Change* 74 (2006); Enrique Florescano and Susan Swan, *Breve Historia de la Sequía en México*.

[128] Manuel Villada and Eduardo Armendariz, "Necesidad de la conservación de los bosques" [Necessity of Forest Conservation], 4.

[129] Ibid., 5.

high and dense atmospheric currents, which modify climate. Consequently, climate is calm or variable depending on whether the wind is cold or hot. The scientists noted that the influence of a forest on salubriousness was apparent in that abundant rains decreased disease. Because the roots of vegetation opened the soil in a way to allow water to filter into the ground, and subsequently circulated in subsoil, trees helped to replenish groundwater supply.[130] Altamirano, Villada, and Armendariz warned that severe conservation laws needed to be put in place because the rate of deforestation was increasing each day at an alarming pace. Physician Fernando Altamirano, quoting Humboldt, put forth forest destruction as the main reason for this lack of heat and water, and he underlined the relevance of understanding biological laws to the conservation of the forests. In his opinion, forests played a key role in the social economy, hygiene, meteorology, and hydrology, and he exposed the case of deforestation in the Valley of Mexico, which was clearly caused by human actions.[131] In 1901, The Antonio Alzate Society (SAA) organized Mexico's First Meteorological Conference "to understand all phenomena that occurred [in the] atmosphere in order to predict its greatest benefit and [to] avoid the worst that it could bring if it was adverse." SMHN participants José C. Segura and Ferrari underscored the necessity of controlling reservoirs of rainwater in the country to ensure their beneficial influence on public health and in the conservation of forests. In this way, conference attendants warned about the necessity of establishing laws on forest conservation and reforestation in Mexico.[132]

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[130] Ibid., 9.

[131] Fernando Altamirano, "Necesidad de la repoblación de los bosques" [Necessity of restock forests], 11.

[132] Manuel Moreno y Anda and Rafael Aguilar y Santillán, "Actas Resoluciones y Memorias" (paper presented at the Segundo Congreso Meteorológico, Ciudad de México, 17,18, y 19 Diciembre 1901), 12, 23-24.

By the mid 1890s, ideas about the influence of forest on climate change were common in publications from outside the capital, as well, and increasingly cited by local politicians.[133] In a September 1896 publication of the official governmental newspaper of the state of San Luis Potosí, Rafael Manrique de Lara highlighted the lack of rain and scarcity of potable water over the last eight years, particularly in states located at high altitude, which he blamed on high demands for lumber by the railroad and fuel industry over the last fifteen years. He said that the forest had been destroyed without consideration as to whether the forest could reproduce over time. "[They] had killed the hen that laid the golden eggs."[134] Lara proposed some actions to decrease the exploitation of forests, for example, transplanting trees such as the *peru* (pepper), *sauce* (willow), and *alamo* (cottonwood) which could produce fuelwood by pollarding and coppicing; and he advocated establishing an "Arbor Day" similar to Europe and United States, and for government programs providing economic incentives for planting trees. Similarly, in a pamphlet published in Querétaro in 1904,Valentín Frías claimed that many springs had reduced their levels and others had disappeared entirely, not only due to the lack of rain, but in order to quench loggers' "thirst of money that led to the extermination [of trees]."[135] Tension and ambiguities between the search for progress and use of resources amidst transnational economy expansion continued over time.

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[133] Castro Francisco de A., "Influencia de los bosques sobre el clima" [Influence of Forest on Climate], *Periódico Oficial del Gobierno del Estado de San Luis Potosí*, June 27, 1896.

[134] Rafael Manrique de Lara, "Bosques. Su Influencia atmosférica, su transplantacion en el Valle de San Luis Potosí" [Influence of forest and its transplantation on San Luis Potosi Valley], *Periódico Oficial del Gobierno del Estado de San Luis Potosí*, September 30, 1896.

[135] NBL-UTX-Austin. Valentín F. Frías, *Ligeros apuntamientos sobre algunas deficiencias de la agricultura en México*, (Santiago de Querétaro, México: D. Contreras Impresor, 1904), 28.

Conclusions

After the Wars of Independence in America, the natural resources of these newly formed states became an attraction in the new world's new geopolitical and economic order. Powerful nations such as Germany, France, and the United States led military and scientific interventions in Latin America throughout the nineteenth century. Some former colonies, such as Mexico, fought internally to organize their new country according to the theoretical principles of order, progress, and civilization. Transnational and local interests intersected particularly where the issue of natural resources was concerned. Overall, most of these contributors perceived nature in the Baconian sense, as a "world made for man," where humans could endlessly exploit resources for their benefit.

Nonetheless, these affirmations were subtly criticized by a number of groups, including the SMHN, who found in natural history and the study of environmental influence a medium to understand how to use resources without disturbing nature's equilibrium. SMHN contributors repeatedly underscored the strong and reciprocal relationship between natural elements (e.g. climate, soil, air, etc.) and social factors (e.g., race, economy, public health, etc.), as they sought to deal with the intellectual challenges posed by new theories of evolution and physical anthropology, as well as the emergence of problems derived from the widespread and uncontrolled exploitation of resources, droughts, faunal extinction, and public health problems, particularly evident in zones such as the Valley of Mexico and the Isthmus of Tehuantepec. A tension emerged within SMHN contributors between those—typified by Ignacio Ramírez and Gumesindo Mendoza—who thought learning more about how nature worked would lead in a straightforward manner to more effective exploitation of natural resources, and those—typified by Manuel Fernández Leal and José Lobato—who perceived an interdependent relationship

between nature and society, agreed with Lobato that “civilized man had damaged nature,” and thought the Mexican government needed to take action. The latter group attained increasing visibility in SMHN publications during the 1880s and 90s and gained increasing influence in medical circles, but by the time of the onset of the Mexican Revolution in the 1910s, there were just a few, elderly SMHN contributors left fighting to keep the balance between economic growth and the exploitation of natural resources. Scientists and politicians continued searching for ways to achieve Mexican progress during the revolutionary era, during which new generations and philosophies emerged that guided the dreams to improve the circumstances of the country. Unfortunately, those dreams continued to overlook and overshadow these natural historians’ belief in the reciprocal relationship between nature and society.

Conclusion: Rethinking Latin America Natural History

This dissertation has examined a significant case study following the development of Latin American perceptions, attitudes, and representations of their environment over the centuries, and how these intellectual currents were interconnected with the region's ecology and its scientific, geopolitical, and economic spheres. While European empires and later core economies (such as the United States) played a pivotal role in defining the international economic, political, and scientific policies that made-taking nature into account, local dynamics of colonized countries and peripheral economies played a key role too. This dissertation provided a close study of one such local group and its connections—the *Sociedad Mexicana de Historia Natural*, which was comprised of a heterogeneous group of Mexican and international men interested in scientific knowledge who worried about the relationship between nature and society during the formative industrial period in Mexico. Between 1865 and 1914, these intellectuals composed an association that did much to maintain a traditional, teleological understanding of the close links between nature and society. They generally agreed that amassing natural history knowledge would guide the country toward order, rationalize the use of resources, help accomplish "racial improvement," and ultimately transform Mexico into progressive country.

The work of the SMNH in many ways represents the culmination of a long natural history tradition in Mexico. Within all the Americas, the cultivation of knowledge of natural history had been a concern since the sixteenth century because European rulers believed that nature was essential for economic development and political and social control of their overseas empires. These motivations strengthened the perception of differences between Europe and the Americas and the supposed inferiority of inhabitants of the American continent, and were used to justify colonialism and racial discrimination. Ideas regarding nature's influence on human beings

took a new direction under the influence of Alexander von Humboldt, whose works represented a scientific and cultural milestone to nineteenth-century Latin American intellectuals as well as those around the world. He underscored the relationship between geography and the culture of societies. Humboldt also advocated technocratic ideas on free commerce, private property and stated that Spanish colonization had negatively influenced the Americas. Furthermore, while Humboldt critiqued the environmental destruction that had been accomplished by Spanish colonialism and the mixing of races in and consequent degradation of contemporary indigenous people in New Spain, he praised the advantages of private property and the higher skills of white people, and in doing so affirmed that they were morally justified in using Latin American resources. After the wars of independence, foreign travelers and locals, both inspired by Humboldt, promoted Mexico as a land filled with untapped resources readily to exploit once they were properly understood. During the second half of the nineteenth century the influence of Lamarck's, Spencer's, and Darwin's theories of evolution greatly strengthened Mexican interest in the influence of environment on social development, even though evolutionary ideas had a relatively weak influence on other branches of Mexican natural history. Evolutionary ideas encouraged the belief, particularly among physicians, that social circumstances and people's survival rates could be improved if the environment was modified appropriately—and if destructive modifications of the environment and climate were curtailed. Even though several studies have argued that Mexican intellectuals simply mimicked European ideas related to natural history, this dissertation has exposed many ways in which local scientists adjusted European ideas and incorporate their own perceptions according to their own contexts and interests. They did so most notably by molding ideas of inferiority to underscore benefits brought on by the abundance and diversity of nature in the Americas.

Political, economic, and social crises of the period all forced politicians to find strategies that improve the circumstances of these new nation-states. Where the development of natural history in Mexico was concerned, the French intervention of the 1860s, triumph of liberalism during the 1870s, and growing authoritarianism of Porfirian governance after the 1880s represented the most important political trends. As an important part of these projects of improvement, most Latin American nations established scientific associations that in close cooperation with government established inventories of flora, fauna, and minerals, created maps, museums, and botanical gardens to help with their control of political territories and to identify resources that would contribute to economic growth. These associations were typically comprised of men who maintained contact with European (and increasingly US) scientific circles. In Mexico's case, French influence was particularly strong. Several men within the SMHN participated in the conservative French-influenced government and received scientific training under the Second Empire.

Nevertheless, the group of more than sixty-six scientists held different perceptions on exactly how society benefited from natural history studies. Some SMHN contributors stated that people had to learn nature's laws in order to use resources in a balanced and controlled manner—so as to avoid disturbing the natural order. Others actively collaborated with government and private enterprise to maximize nature's output for the utilitarian benefit of industrialization and transnational investments. Most held a combination of organic and utilitarian viewpoints, though practically all thought it should be used to improve the country's circumstances. This analysis reveals that Mexican intellectuals tied to the SMHN had clear goals for natural history studies that went far beyond economic interests: first and more narrowly, to learn how nature worked in order to use natural resources in a responsible manner; second and more broadly, to provide

guidance as to how the Mexican environment and Mexican people could be improved to help construct a progressive and civilized country. Indeed, some SMHN members placed great emphasis on the balanced use of resources and claimed that many of the environmental troubles Mexico faced, such as deforestation, lack of rain, faunal extinction, dry lakes, and public health problems could be traced to lack of understanding of natural history. Part of these differences derived from their engagement with diverse zones of the country such as the Valley of Mexico, Veracruz, Tabasco, and the Isthmus of Tehuantepec. These different perceptions reflect the complex relationship that existed between scientists, politicians, and businessmen in Porfirian Mexico, while revealing the extent to which scientists were key actors in the industrialization process and cultural efflorescence of the late nineteenth century.

A deep analysis of the SMHN's trajectory as an organization found that its accomplishments and failures were driven by four societal factors: political alliances, the personal characteristics of its members, the increase of specialization in natural science studies, and the national and international economic context. A number of other Mexican scientists and government officials also seemed to share these broad concerns regarding natural resources. However, unlike other studies that have argued for the existence of a strong relationship between scientists and political power, a more thorough analysis reveals the varying degrees to which attachments to presidential cabinets, other scientists, politicians, and businessmen modified the SMHN's influence over patterns of economic development and may have contributed to the Society's decline with the ascent of the *Científicos* after the 1890s. Indeed, the term *scientist*, as used during the Porfiriato, can confuse researchers because two kinds of scientists may be identified in the literature: professional scientists of varying degrees devoted to studying diverse scientific fields that influenced the national education system, and the *Científicos* who belonged

to the political group directly advising the president and designing policies. In fact, among these sixty-six men, political affiliations were diverse. Some members such as the famous landscape painter José María Velasco lacked any affinity for politics. Others such as Mariano Bárcena, who had important political, business, and international connections, were exceptional cases, and even figures as influential as Bárcena remained unaffiliated with the *Científicos* and far from the inner circle of the oligarchy that governed Porfirian Mexico. A number of SMHN proposals, including reforestation and bird conservation, did not go beyond academic discussion—unlike Bárcena's proposals regarding railroad construction. SMHN contributors were far more significant in academic circles than in the political or economic spheres. Their most important influence was as directors of national schools and research institutes. Particularly between 1880 and 1884, various entities within the Mexican government frequently consulted these organizations and the SMHN regarding environmental problems However, the relationship between government insiders and the SMHN gradually weakened until it disappeared altogether with the death of members, the tensions between old and new theories in the natural sciences, the increasing degree of specialization of the natural sciences, and growing authoritarian tendencies of Mexican governance at the turn of the century.

Even though by 1911 most SMHN members had died, new generations began to join other scientific societies. And Manuel Villada showed optimism about beginning a new era in SMHN and natural history studies by creating a naturalist school, which contributed to Mexico's scientific progress.[136] However, the new generation rejected scientific theories associated with political regimes such as positivism and evolution. Young intellectuals joined the group *El*

[136] Manuel Villada, "Información Oficial."

Ateneo de la Juventud (Atheneum of Youth), led by José Vasconcelos, Antonio Caso, and Pedro Enriquez Ureña, showing little interest in natural history studies. They ushered in a new period regarding the national educational plan that actively opposed the ideas of Comte, Spencer, Lamarck, and Darwin. They also used a different theoretical framework, far removed from Comte's positivist, biological evolutionism or any theory that represented the old regime or scientists from nineteenth century. Enrique Beltrán noticed that the generation of the Revolution boasted few scientists. Instead, students focused on the arts, politics, finances, and literature—Mexican intellectual life became dominated by humanists with little interest in the natural sciences. [137] Remarkably, however, José Vasconcelos proposed that studies in natural history had been an important part of national education plan in the earlier 1920s.

One of the most relevant achievements of the SMHN was its access to the international community, which directly contributed to the development of the natural sciences in Mexico. This goes well beyond the influence of international thinkers such as Humboldt, Comte, Lamarck, and Spencer. Previous historiography has underscored the nationalism of the SMHN and overlooked the role of international contributors. Although most contributors were born in various Mexican states, others were born in Europe, such as the Dugès brothers from France, Burkart and Schaffner from Germany, Goode from the United States, Mallet from Ireland, and Sumichrast from Switzerland. These members did much to promote Mexican science via international conferences, publications, and establishing links with other scientists and institutions, such as the Smithsonian. Experience with French expeditions and institutions under the Second Empire had a particularly important formative influence on the Society and practice

[137] BJA-U de G. Enrique Beltrán, "Ciencias Biológicas," in *Historia de la Ciencia* (Biblioteca Pública "Juan José Arreola", 1989).

of natural history in Mexico. SMHN contributors did reveal that, in addition to mining, Mexico had a rich array of little-known resources available for domestic consumption and international trade such as insects, pearls, and plants for the pharmaceutical industry. Some SMHN contributors believed that these uses of national resources could benefit the country by limiting the imports of foreign products; however, governments overlooked their proposals.

This last point reveals yet another tension between the SMHN and their local and international economic context. SMHN contributors felt a tension between their goals as students of Mexican nature and the transnational expansion that promoted the exploitation of nature to satisfy the demands of distant mass markets, as well as to increase the benefits and power that local interests acquired thereby. Contrary to the opinions of authors such as Lane Simonian, I argue that the interest in the relationship between Mexican nature and society was not only evident in individual proponents of European romanticism—or liberals who regarded the material progress as sacrosanct. On one hand, the SMHN was a heterogeneous group of men with diverse approaches to nature: many influenced by a form of *Naturphilosophie* promoted by Humboldt; others emphasizing the divinity of creation; but with only a few embracing the evolutionary theories of Lamarck and Spencer. On the other hand, while the SMHN was dedicated to using resources to improve Mexico's circumstances, many favored taking a balanced approach toward resource development—using a wide array of natural resources, rather than just selling minerals or lumber, or conceiving of nature as contributing to other social goods, such as maintaining an amenable climate or protecting the Mexican population from disease. As a whole, they agreed with promoting international investment to serve available mass markets, but advocated doing so while maintaining equilibrium within the natural order. SMHN

publications warned of environmental problems and consistently highlighted that they derived from human actions due to ignorance of the laws of the natural world.

This analysis of the history of ideas and perceptions positing a reciprocal relationship between nature and society and the consequences thereof over time can help us to understand our contemporary environmental crisis. Environmental histories that focus on cultural influences can help us to pinpoint the roots of current environmental problems, propose possible solutions, or at the very least (to paraphrase Kimberly Coulter and Christof March) "offer hope."[138] Following Donald Worster, dynamics of the cultural realm such as ideologies, ethics, laws, and myths have greatly influenced the relationship between nature and societies and guided human behavior toward natural world.[139] In this sense, this dissertation is a sample of the historical development of a regional relationship between nature and culture that reveals how a group of Mexican scientists perceived natural history, worried about maintaining nature's balance, and dealt with the industrial demands of their era. This dissertation also responds to the necessity of examining global problems within the context of a local setting. The existing literature on global problems from diverse regions such as Latin America needs more local and empirical studies focused on the history of environmental ideas for us to understand our relationship with nature and to explain who we are and how we came to be.

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[138] Kimberly Coulter and Christof Mauch, *The Future of Environmental History*, ed. Coulter Kimberly and Mauch Christof, RCC Perspectives (Munich: Rachel Carson Center for Environment and Society, 2011).

[139] Donald Worster, "Transformations of the Earth: Toward an Agroecological Perspective in History," *The Journal of American History* 76, no. 4 (1990): 1090.

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