

A stylized, grey-toned graphic of a tree with a thick trunk and several branches, set against a light grey circular background. The tree is positioned on the right side of the page, partially overlapping the main title area.

# Agrarian Nationalism or “Imperial” Science? “El Sabio” Moisés S. Bertoni and Paraguayan Agricultural Science

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## ABSTRACT

As a contribution to recent discourse over the practice of natural science in Latin America’s liberal years, this paper examines Swiss-born botanist Moisés S. Bertoni’s place in Paraguay’s agricultural development following the Paraguayan War (1864-70). The war forced leaders in a devastated Paraguay to promote the immigration of European scientific experts and farmers, with the expectation that their knowledge of modern agricultural science and practice would revitalize the nation’s agriculture and lift Paraguay out of its poverty. From the late nineteenth century Bertoni’s work and knowledge of Paraguay’s tropical and semi-tropical climate and botany shaped much of Paraguayan agricultural policy and practice. And while his contributions were influential in understanding the nation’s environment and agriculture, what is unclear is how much his approach was the product of deliberate introduction of European agricultural science or the result of autochthonous experience and his own trial and error.

**Keywords:** Agricultural Science; Natural Science; Paraguay; Tropical.

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For the serious study of nature – particularly from the point of view I have proposed – life in a town or near one is of very little use. It’s not done collecting muddled data from all over, by hurrying across fields and woods, or by following the most frequented waterways or highways with the desire to return to the delights and comforts of home. This is not how we can penetrate the secrets of the beings who inhabit the greatest solitudes. Nature jealously guards her secrets from those who do not faithfully dedicate themselves to her and do not admire her with their whole soul in the arena of her triumphs<sup>2</sup>.

These words, spoken at a conference in Asunción the year before their publication in *Las plantas usuales del Paraguay*, reveal the perspective of Moisés S. Bertoni, “El Sabio” of Paraguay, on pursuing scientific investigation. Yet like so many formally-trained scientists in Latin America, particularly expatriates, Bertoni (1857-1929) embodied the contradictions of engaging in agricultural science in the early twentieth-century in often frontier regions where local governments, elites, and foreign technicians saw economic development as paramount, and national and foreign scientists did not fully understand the diverse environments they encountered.

In the late nineteenth century when Bertoni arrived, Paraguay was still recovering from the devastating Paraguayan War (1864-70). In a country that had been relegated to the economic margins the path to restoration was seen to be unrestrained development, particularly of agricultural commodities. This approach simultaneously stimulated and concerned Bertoni. However, like others he was caught between the rule of formal science originating in the North Atlantic world and his experiences on the ground. In several ways he tried to link the two by introducing “modern” agricultural techniques from the North while also assessing and explaining the distinctiveness of the tropical and semi-tropical environments of the Americas, particularly compared to temperate ecologies. In part this included the contributions of local inhabitants, most specifically the Guaraní peoples of Paraguay. The legacy of his approach has been the subject of attention ever since<sup>3</sup>.

<sup>2</sup> Moisés Santiago Bertoni, *Resumen de Prehistoria y Protohistoria de Los Países Guaraníes: Conferencias Dadas En El Colegio Nacional de Segunda Enseñanza de La Asunción Los Días 26 de Julio, 8 y 21 de Agosto de 1913*, ed. Juan E. O’Leary (Asunción, 1914).

<sup>3</sup> In August 2019 the Swiss Embassy to Paraguay and Uruguay hosted celebratory events to commemorate the 90th anniversary of Bertoni’s death and the re-publication of a biography written by a Swiss couple. It appears Bertoni’s place as “El Sabio” (the Wise) of Paraguayan science was emphasized. Touring Club, “Moisés Bertoni, El Sabio Que Se Enamoró de Paraguay,” Touring Club: Revista Oficial del Touring y Automóvil Club Paraguayo, 2019, <http://touring.indusant.com/mois-es-bertoni-el-sabio-que-se-enamoro-de-paraguay/>.

## “CREOLE SCIENCE” AND KNOWLEDGE SOURCES

Stuart McCook has argued that science in late nineteenth and early twentieth century Latin America could be referred to as “creole science,” in that the works of scientists, national or foreign, tended to involve knowledge from multiple sources, including indigenous: “Creole science was at once transnational or hybrid in its form and practice and distinctively local in its goals. The models for scientific institutions were selectively appropriated from abroad...and adapted to local environmental, economic, and political conditions”<sup>4</sup>

McCook also states that frequently this knowledge was appropriated without acknowledgement, as both Latin American and foreign scientists “often elided the roles of local peoples in knowledge production...”<sup>5</sup>. While Bertoni could be considered a practitioner of “creole science”, he was sensitive to local knowledges, reflected in the considerable criticism he endured for his “unsystematic” approach to knowledge, especially from European scientists temporarily in Paraguay. Often, he was accused of coming to conclusions based on empirical observations and autochthonous knowledges that did not conform to the expected systematic methodology of North Atlantic scientific learning<sup>6</sup>. Yet despite his discomfort with the inflexibility of this latter approach, in many ways he did not stray so far from the formal science of the day.

Paradoxically, the influx of foreign scientists into Latin America in the late nineteenth and early twentieth centuries frequently contributed to receiving countries’ nationalist narratives through their scientific investigations, especially the discovery of “national” plants and animals, which helped to place these nations into the “civilized” world of modern science. Hence, scientific endeavor in the region frequently acquired a nationalistic character, even if the scientists themselves did not

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<sup>4</sup> Stuart George McCook, *States of Nature: Science, Agriculture, and Environment in the Spanish Caribbean, 1760-1940* (Austin: University of Texas Press, 2002), 5; There are several examinations of European science and scientists in Latin America during these years, too many to list here. One that is relevant to Paraguay, at least from a period before Bertoni, is: Stephen Bell, *A Life in Shadow: Aimé Bonpland in Southern South America, 1817–1858* (Stanford: Stanford University Press, 2010).

<sup>5</sup> Stuart McCook, “Focus: Global Currents in National Histories of Science: The ‘Global Turn’ and the History of Science in Latin America - Introduction,” *Isis* 104, no. 4 (December 2013): 773–76, <https://doi.org/10.1086/674943>.

<sup>6</sup> Danilo Baratti and Patrizia Candolfi, *Vida y Obra Del Sabio Bertoni - Moisés Santiago Bertoni (1857-1929): Un Naturalista Suizo En Paraguay* (Asunción: Helvetas, 1999), 113–17.

explicitly characterize themselves so<sup>7</sup>. For Bertoni, this was most notable in his admiring ethno-analysis of the Guaraní peoples of southern Paraguay. Much has been written about his overly romantic perception of Guaraní racial superiority, especially in terms of a rather fanciful interpretation and promotion of Guaraní culture, the result significantly contributing to the formation of modern Paraguayan ethnonationalism<sup>8</sup>.

Bridget Chesterton notes that Bertoni’s exalting of the Guaraní, deeply flawed in terms of ethnology, nonetheless fed into the concept of a “Paraguayan scientific nationalism” that was embraced by early twentieth-century Paraguayan intellectuals and politicians trying to define the distinctiveness of their oft-ignored nation<sup>9</sup>. Much of this side of Bertoni has been addressed by other studies, but given his importance as a natural scientist little has yet been written about that aspect of his life. In response, this paper will examine some of his agricultural and meteorological contributions and their scientific value, though to be clear some of his interpretations strayed into nationalistic territory, if less explicitly than his ethnic observations, and always contradictorily.

## BERTONI IMMIGRATION AND SETTLEMENT

Bertoni was simultaneously a naturalist, botanist, climatologist, geographer, agronomist, ethnographer, and in his early life, anarchist. When in 1884 he and his family arrived in Misiones in the northern frontier zone of Argentina from the Italian region of Switzerland, his intention was to establish a self-sufficient anarcho-socialist immigrant colony consisting of largely Swiss emigrants<sup>10</sup>. However, this was not his sole, nor apparently prime ambition, as he was incessantly obsessed with expanding

<sup>7</sup> Regina Horta Duarte, “Between the National and the Universal: Natural History Networks in Latin America in the Nineteenth and Twentieth Centuries,” *Isis* 104, no. 4 (December 2013): 777–87, <https://doi.org/10.1086/674944>; David Livingstone notes that Argentine science “was espoused as the means of escaping economic backwardness and creating a modernist cultural identity.” David N. Livingstone, *Putting Science in Its Place: Geographies of Scientific Knowledge: Geographies of Scientific Knowledge* (Chicago: University of Chicago Press, 2003), 133.

<sup>8</sup> See Danilo Baratti, “Moisés Santiago Bertoni y La Generación Nacionalista-Indigenista Paraguaya,” *Société Suisse Des Américanistes / Schweizerische Amerikanisten-Gesellschaft* 66–67 (n.d.): 41–47; Bridget María Chesterton, *The Grandchildren of Solano López: Frontier and Nation in Paraguay, 1904-1936* (Albuquerque: University of New Mexico Press, 2013), 25–27; José E. García, “El Pensamiento de Moisés Bertoni Sobre El Origen y La Psicología de Los Indígenas Guaraníes,” *Psicología Em Pesquisa* 8, no. 1 (June 1, 2014): 53–65, <https://doi.org/10.5327/Z1982-1247201400010006>.

<sup>9</sup> Chesterton, *The Grandchildren of Solano López: Frontier and Nation in Paraguay, 1904-1936*, 25–27, 62.

<sup>10</sup> The idea of emigrating to Misiones was suggested to Bertoni by the famed French geographer and anarchist, Élisée Reclus, when they met in Geneva. I have found no evidence there was any further contact between the two.

his scientific knowledge and understanding of the natural world in his newly-adopted homeland. When the colony proved a failure and initial colonists drifted away, at first Bertoni was preoccupied with the family’s struggle to survive in the difficult environment of alternate drought and flooding, exacerbated by local corruption and the constant predations of banditry that plagued Misiones in the late 1880s. The growing family’s precarious position caused them to move across the Paraná River to Paraguay four years later. At first motivated by the dream of establishing another immigrant colony and expected by his financial supporters to engage in the economic exploitation of the valuable timber on his newly-acquired property, within a few short years he tired of the activity, renounced his participation in the venture, and in 1893 was deeded a new concession to property further upriver near the Brazilian border that became Puerto Bertoni<sup>11</sup>.

Even though the concession was based on establishing a colony of European immigrants, here he was able to occupy himself more seriously in activities that stimulated his interest in the Americas in the first place, particularly meteorology and tropical agriculture. He soon set his energies to renewing agricultural endeavors begun in Misiones, but also in establishing a living laboratory where his work on climatology, agronomy, and botany could be tested and expanded. He had achieved a positive reputation even before his arrival and was highly respected for his outsized intellect and energy, though resources were limited and his location quite isolated from the scientific world of his origin. Eventually his endeavors in Puerto Bertoni attracted attention from the Paraguayan government, and in 1895 Bertoni was asked by the Paraguayan president to establish and direct a national agricultural school near Asunción (Escuela Nacional de Agricultura)<sup>12</sup>.

This proved to be a more difficult endeavor than its promise. He managed to make an impression for some years, including publishing the *Revista de Agronomía y de Ciencias Aplicadas* and the *Anales Científicos Paraguayos*, both of which became indispensable sources to Paraguayans for the most recent scientific knowledge, and

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<sup>11</sup> Baratti and Candolfi, *Vida y Obra Del Sabio Bertoni - Moisés Santiago Bertoni (1857-1929): Un Naturalista Suizo En Paraguay*, 49–62. Puerto Bertoni is located just downriver from the confluence of the Paraná and Iguazú Rivers, south of Ciudad del Este and not far from the famed national parks of the Iguazú Falls.

<sup>12</sup> This was common in Latin America at the time, as Stuart McCook has outlined in detail for the Spanish Caribbean basin: McCook, *States of Nature: Science, Agriculture, and Environment in the Spanish Caribbean, 1760-1940*, 36–39.

he was instrumental in the creation of the National Agricultural Society (Sociedad Nacional de Agricultura) in 1903. But by 1905–06 he had had enough with bureaucracy, financial stress, and empty promises, and left for Puerto Bertoni, never to return, despite various entreaties over subsequent years. According to Bertoni, much blame for the school’s frustratingly slow development was due to limited support from the Paraguayan government. With the Revolution of 1904, even minimal interest was withdrawn by the new Liberal government. Part of the rationale was that Paraguay did not need to produce its own agronomists, but instead should import them from abroad. The argument went that students had been receiving too much theoretical education and not enough practical, therefore the school was a wasted investment<sup>13</sup>. This is ironic, given Bertoni’s concern for accessing and promoting local knowledge, and his emphasis on including practical experience in the curriculum. The Liberal position also contradicted his recommendation in 1898 that in Paraguay there was no other option but to teach theory since there were too few agricultural facilities like experimental farms to engage in scientific experimentation, unlike in other countries. Despite efforts, he was unable to secure investment for such facilities<sup>14</sup>.

It’s likely Bertoni fell afoul of the personalism of Paraguayan politics, having been appointed director by a Colorado president, though there is little specific information on this episode besides his overall frustration with politics. The National Agricultural School closed definitively in 1909, becoming the nation’s Botanical Gardens in 1914, though in its waning years of mixed successes and failures it did contribute to Paraguayan agricultural development, setting a precedent for future endeavors<sup>15</sup>.

After his resignation Bertoni made his mark more on his own than as part of an official entity or through such support. Puerto Bertoni became an Agricultural Station (*Estación Agronómica*) where he engaged in almost all his work, and which became well-known to botanists and agronomists in Paraguay, and even to some

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<sup>13</sup> See Baratti and Candolfi, *Vida y Obra Del Sabio Bertoni - Moisés Santiago Bertoni (1857-1929): Un Naturalista Suizo En Paraguay*, 88–106.

<sup>14</sup> Moisés Santiago Bertoni, “Cuarta Conferencia Del Instituto Paraguayo, Por El Director de La Escuela de Agricultura,” *Revista Del Instituto de Agricultura (Asunción)* 2, no. 11 (1898): 199–202.

<sup>15</sup> Some years after this failure, in the 1930s other schools were started in various regions of the country, but a national school was not reopened until 1940, in another part of Asunción, and became part of the Universidad Nacional de Asunción (UNA) in 1956. See the website of UNA: UNA, “Reseña Histórica,” Una: Universidad Nacional de Asunción, accessed June 15, 2019, <https://www.una.py/la-universidad/institucional/resena-historica/>.

across the Americas and the world. A lot of this recognition was stimulated by Bertoni’s prolific letter-writing and publications, many self-published due to limited and expensive publishing outlets in Paraguay itself. He corresponded with botanists and natural historians from Mexico to Argentina, Chile to Costa Rica, as well as several in Switzerland, France, Germany, and the United States<sup>16</sup>.

### **BERTONI “ETHNOGRAPHER”**

Bertoni’s practical scientific approaches were also supplemented by a self-developed ethnography of the Guaraní. He wrote extensively about the practice of medicine by the Guaraní, an aspect that deserves greater attention than I have space for here. However, given the attention to Bertoni’s ideas on the Guaraní there is one observation I believe needs noting before I focus on his role as agronomist/climatologist/ecologist, particularly within the context of whether he was a representative of an alternative approach to understanding the environments of tropical America, or was simply another “imperial” scientist transmitting conceptions and ideas developed in the North Atlantic world to the South.

In his most famous publication, *Civilización Guaraní*, published in 1922, he made what could be considered a startling conclusion for the time about the demographic demise of aboriginal peoples of the Americas: “However, by far the principal cause [*la causa principalísima*] for the depopulation of the Americas wasn’t mistreatment but epidemics”<sup>17</sup>. As far as I can determine, this view was rare and only became widely accepted through the work of historian Alfred Crosby in the 1960s and 1970s<sup>18</sup>. This is not to say there weren’t others who had come to the same conclusion, but the fact that this was published so early stands out, illustrating Bertoni’s sympathetic approach to indigenous experience and history. It also underlines

<sup>16</sup> For example, he corresponded frequently with the famed Chilean naturalist, Carlos Porter, and the founder of the Museu Paulista in São Paulo, Brazil, Hermann von Ihering. He also exchanged letters with Henri Pittier in Costa Rica, a fellow Swiss who became famous for his naturalist work in that country and later in Venezuela. For more, see the “Colección Moisés Santiago Bertoni” in the Archivo Nacional de Asunción, Asunción, Paraguay (ANA).

<sup>17</sup> Moisés Santiago Bertoni, *Descripción Física, Económica y Social Del Paraguay. La Civilización Guaraní, Parte I: Etnología. Origen, Extensión y Cultura de La Raza Karai-Guaraní y Protohistoria de Los Guaraníes* (Puerto Bertoni: Imprensa y Edición “Ex Sylvis,” 1922), 122. To emphatically make his point, Bertoni italicized this entire sentence.

<sup>18</sup> Alfred W. Crosby, *The Columbian Exchange: Biological and Cultural Consequences of 1492* (California: Greenwood Publishing Group, 1972).

Bertoni’s unique place in the study of native peoples, since such views did not carry much weight in the hallowed halls of European scientific institutions<sup>19</sup>.

On the other hand, he was not so different from most of his fellow colleagues in believing that indigenous peoples should be “civilized” into becoming equal members of the nation, if possible through conversion to Christianity. While he eschewed violence as a manner of bringing natives into the nation, preferring friendship and education, he clearly held the traditional idea of what constituted civilization which, like most Latin American elites, was unabashedly European. But by extension he believed the Guaraní to be a different type of indigenous people, much more “civilized” due to their practice of sedentary agriculture and other European-like “ways.” This defined his concept of civilization, clearly no less ethnocentric than the notion of a European superior culture, illustrating the inconsistencies that characterized many of Bertoni’s views, sometimes reflected in his agronomic work<sup>20</sup>.

### **BERTONI AGRONOMIST**

While Bertoni’s articles and books are the sources of my assessment of his contributions to Paraguayan agricultural science, he was so prolific that in this paper I can examine only a few illustrative examples. Though limited, I am confident that these represent his perspectives well, particularly given that several were revised and republished in his lifetime. They also reveal the character of his views of the Paraguayan natural world, simultaneously involving selected practice of European-origin science combined with a more eager desire to understand the specific character of Paraguayan nature and the environment through investigation and, where applicable, engagement with local Paraguayan “folk” and indigenous knowledges.

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<sup>19</sup> It’s unclear whether Bertoni came to these conclusions independently or through reading others. In English, certainly, the debate over indigenous populations and demographic decline developed during the 1930s through such historical geographers as Carl Sauer, Sherburne Cook, Woodrow Borah, and others from the so-called Berkeley School of geography. See William M. Denevan, “Carl Sauer and Native American Population Size,” *Geographical Review* 86, no. 3 (July 1996): 385–97, <https://doi.org/10.2307/215502>. Also, Denevan notes that Karl Sapper, German geographer/ethnographer who worked in Guatemala, came to similar conclusions in the 1920s and may have influenced Sauer: note 13 in Denevan’s article. I have not seen any evidence that Bertoni corresponded with Sapper, but it’s entirely possible.

<sup>20</sup> Baratti and Candolfi, *Vida y Obra Del Sabio Bertoni - Moisés Santiago Bertoni (1857-1929): Un Naturalista Suizo En Paraguay*, 143–64.



Outside of his purely scientific interest, Bertoni’s first concern was with making his colony at Puerto Bertoni an agricultural success. In reality “colony” is rather a huge leap, since the endeavor essentially became a family venture, including the involvement of several of his children. It’s clear Bertoni was no administrator, nor much of an inspiration for aspiring colonists, hence the property remained mostly his living laboratory, which was fortunate in one way, a hindrance in others. At Puerto Bertoni he experimented with various crops, some for scientific reasons, but largely to try to grow enough food to support his large family and showcase how a colony could be successful. It was a constant struggle.

Still, through many years of laboring to survive and to publish his many observations, it appears applied science was more important than anything else for Bertoni, despite his constant lamentations about providing for his family and seeking some serious support from Paraguayan authorities. Bertoni has been considered Paraguay’s first ecologist, largely based on his field work and assiduous efforts to collect and catalog local flora and fauna. His work addressed multiple issues like pests in the agricultural sector, methods of treating the soil, climatological observations, and use of medicinal plants by the Guaraní. In this he was not alone, since for Latin American “creole scientists”, especially botanists, the knowledge of local residents was essential, above all in regions where there was a significant indigenous population. Raf de Bont calls this “place-based” research, which often involved non-academic scientists, and is what he considers the populist roots of ecology. Some scientists, especially those formally-trained, tried to meld both local and systematic models, Bertoni included, which reflects his contradictions regarding “populist” observation versus positivist approaches emanating from the North Atlantic<sup>21</sup>.

Certainly, Bertoni’s most comprehensive agronomic/ecological contribution was *Agenda y mentor agrícola*, published in 1903, 1926, and 1927. Revised and updated just two years before his death, *Agenda y mentor agrícola* illustrates much of Bertoni’s applied science over decades of observations. His intention was to provide something of value to the Paraguayan peasantry and to immigrant colonists, who could use the

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<sup>21</sup> Ibid., 122; Julia Rodriguez, “Beyond Prejudice and Pride: The Human Sciences in Nineteenth- and Twentieth-Century Latin America,” *Isis* 104, no. 4 (December 2013): 807–17, <https://doi.org/10.1086/674947>; Raf De Bont, *Stations in the Field: A History of Place-Based Animal Research, 1870-1930* (Chicago: University of Chicago Press, 2015), 8.

volume as a guide for their labors, which despite a high illiteracy rate among campesinos they did for some time. Exceptionally detailed, the volume addresses concerns ranging from the best times of the year to prepare planting for bananas, the uses of peanuts, a caution about burning before planting, how to deal with pests and plant diseases (in collaboration with his sons), and above all, meteorological observations that were taken daily for almost forty years at Puerto Bertoni.

In the Preface Bertoni established his basic principles of engaging in agriculture in Paraguay, arguing that general works of agricultural advice did not serve the Paraguayan farmer, since in most cases they explained what the farmer already knew. Therefore, this work was dedicated to helping the farmer with what he didn't know, or knew poorly: “pointing out new or better methods, necessary reforms that to my judgement are advisable, some errors that are unfortunately very common, certain dangers and many enemies, like widespread data and details that the peasant (*aldeano*) ignores or can forget”<sup>22</sup>. He went on to caution that adoption of agricultural methods from other environments should be done only with previous knowledge of local natural and economic differences, which he assured the reader he understood. In arguing in favor of his expertise, after over forty years of living, collecting, and experimenting in the country and despite criticism from others, Bertoni also acknowledged the scale of the field: “But so vast is this field of investigation that if in some cases I have managed to learn what others didn't know, by contrast the most humble farmer could have seen more and thus have greater knowledge”<sup>23</sup>.

These sentiments, undoubtedly expressed in part to defend his life's work, also indicate how important applied science was in his approach to agriculture in the region. Throughout the volume he repeatedly acknowledges local knowledge and practice, while simultaneously offering suggestions on how to improve production, based on his experience. And while he was criticized for not being “scientific” enough by some other scientists, there is plenty of evidence in the book of consultation of others' work, in the country and beyond. But perhaps in reflection of his later years, the presentation is rather personal and sociological, since in an essay to start the

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<sup>22</sup> Moisés Santiago Bertoni, *Agenda & Mentor Agrícola: Guía Del Agricultor y Colono Con El Calendario de Todos Los Trabajos Rurales y Estudios de Las Cuestiones Rurales Principales Para El Paraguay y Los Paises Limítrofes*, 4th ed. (Puerto Bertoni: Imprenta y Edición “Ex Sylvis,” 1927), 5.

<sup>23</sup> *Ibid.*, 5–6.

book Bertoni praised country life, in contrast to urban centers that were attracting (and corrupting) Paraguayan youth. He lauded rural over urban, spiritual over material, family over individual, and intriguingly for a man who started his adult life as a socialist/anarchist, an embrace of God and a reverence for what he called the “village soul” (*alma aldeana*)<sup>24</sup>.

Despite this sentimental introduction, the book is decidedly empirical in its approach. It is divided into various subjects but starts off with a discussion of seasons in Paraguay, followed by a series of meteorological observations, and weather, crop, and planting advice beginning in April, considered the best month to start “the agricultural year.” This assessment was made based on March still being true Summer and May basically Winter<sup>25</sup>. Since the seasons in Paraguay are generally semi-tropical, Bertoni knew that March still experienced plenty of hot and humid days, while May had many more dry and cool ones. Hence, in keeping with traditional agricultural practices April was a logical starting point, especially since it was the month when scorching sun and invasive vegetation began to diminish, permitting the growth of crops. Subsequently, it was accepted throughout the country as the time to begin preparation for the coming agricultural year<sup>26</sup>.

He continued along the same lines over subsequent months, interspersing his advice with specific articles on various aspects of agricultural maintenance, such as combatting pests and planting a wide variety of crops, maintaining the land and soil, market possibilities, etc. Most of these followed the same lines of outlining suitability (or not) to Paraguayan conditions and explaining the value and methods of cultivation of plants native to the country, such as yerba mate, manioc, peanuts, and the sweetener stevia (*Stevia rebaudiana* Bertoni - *ka'a he'ê* in Guaraní). Another aspect found throughout were plentiful environmental observations and suggestions, such as

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<sup>24</sup> *Ibid.*, 7–10. Perhaps reflecting a gradual transformation of his political sentiments, in a speech given in 1898 after a few years as director of the agricultural school, Bertoni lauded the habits of the Paraguayan campesino despite others' criticisms of laziness, presenting an environmentally deterministic argument that their lives were easy, in part due to generous nature and especially a “laudable spirit of companionship, the fraternal instinct, that type of Christian communism that honors the Paraguayan peasant, that proves irrefutably the goodness of his heart.” Bertoni, “Cuarta Conferencia Del Instituto Paraguayo, Por El Director de La Escuela de Agricultura,” 189. My italics.

<sup>25</sup> Bertoni, *Agenda & Mentor Agrícola: Guía Del Agricultor y Colono Con El Calendario de Todos Los Trabajos Rurales y Estudios de Las Cuestiones Rurales Principales Para El Paraguay y Los Países Limitrofes*, 18.

<sup>26</sup> Bertoni also included a page outlining how to use a barometer, phases of the moon, etc. It should be noted that all Bertoni's meteorological observations, and most of the others, were based on his experience at Puerto Bertoni, at the southern extremes of the country. Though useful generally and based on empirical evidence, this was less applicable to other sectors of the country, such as the Chaco, which Bertoni recognized.

the impact of field burning, use of smoke to combat frost, and the like. These reflected his experience on the ground, either what he had learned from local informants or from personal practice<sup>27</sup>.

#### CLIMATE AND CLIMATE CHANGE

The second part deals with climate, which attracted a good deal of Bertoni’s attention. In discussing Paraguayan campesinos’ approach to farming, he observed that they were not well organized and lacked some basic skills: “with difficulty they avoid unfounded opinions and erroneous beliefs that at times prevail among the rural population, due to the lack of direct and constant observation and access to comparative data”<sup>28</sup>. Once again, this reveals an ambiguity; despite a faith in local actors’ knowledge, he still believed in the power of a scientific approach, including comparison with other findings, presumably published in scientific journals. His solution to the lack of “constant observation” was to set up a series of meteorological stations, as found in neighboring countries. Again, he emphasized that study of the climate was indispensable, especially since in Paraguay the characterization of “tropical” or “subtropical” depended on where one was in the country, particularly if humidity is considered. He also pointed out that the region’s climate was relatively stable, with few unpredictable events like hurricanes or lengthy periods of drought, though he did recognize the occasional temperature extremes, especially in the winter months when cold fronts swept up from the south and southeast<sup>29</sup>.

Bertoni continued by arguing that the concepts of tropical or subtropical zones created by geographers were inaccurate and misleading, since there were so many variables. Instead, he suggested using agriculture as the criterion: tropical plants grew in tropical zones, temperate in temperate zones, while subtropical hosted

<sup>27</sup> Bertoni, *Agenda & Mentor Agrícola: Guía Del Agricultor y Colono Con El Calendario de Todos Los Trabajos Rurales y Estudios de Las Cuestiones Rurales Principales Para El Paraguay y Los Países Limitrofes*, 57, 67–69, 174–86. Bertoni classified stevia. See Bridget María Chesterton and Timothy Yang, “The Global Origins of a ‘Paraguayan’ Sweetener: Ka’a He’e and Stevia in the Twentieth Century,” *Journal of World History* 27, no. 2 (2016): 255–79, <https://doi.org/10.1353/jwh.2016.0107>.

<sup>28</sup> Bertoni, *Agenda & Mentor Agrícola: Guía Del Agricultor y Colono Con El Calendario de Todos Los Trabajos Rurales y Estudios de Las Cuestiones Rurales Principales Para El Paraguay y Los Países Limitrofes*, 283.

<sup>29</sup> *Ibid.*, 284–86; Baratti and Candolfi argue that his observations and predictions about climate in the region were “infallible for decades” until climate change caused by the construction of the Itaipú hydroelectric dam upriver from Puerto Bertoni in the 1970s. I’m not convinced of the “infallible” characterization, but certainly his observations were consistently accurate up to the building of the dam. Baratti and Candolfi, *Vida y Obra Del Sabio Bertoni - Moisés Santiago Bertoni (1857-1929): Un Naturalista Suizo En Paraguay*, 125.

both, though generally more temperate plants than tropical<sup>30</sup>. This was an opinion intended to correct the general designations given to climate zones by academic meteorologists and geographers, but perhaps his most cogent observations and analysis dealt with climate change.

Referring to his experience in Paraguay and reading of meteorological information from around the globe, Bertoni concluded that the world was undergoing significant climate change, particularly reduced rainfall. He attributed this to human action, but unlike today’s emphasis he concentrated on the local as the cause, most specifically extensive burning. He listed burning due to agriculture, logging, hunting, accidents, etc., and argued that this was far more serious in the tropics due to the absolute need for water. His solution was one familiar today: “*it is necessary to preserve a large forest reserve and create one where there are no more*”<sup>31</sup>.

Bertoni had elaborated on burning in a previous publication in 1901, but with a much more strident tone. In that case, his understanding was limited in terms of weather systems and the role of burning. He believed lands barren after burning and smoke from burning somehow deflected clouds and weather systems carrying moisture, and he did not mention microclimate at all. At the same time, however, he was much more willing to condemn large landholders for the lowered incidences of rainfall, and he believed in the power of the state to regulate burning<sup>32</sup>. In a remarkable foreshadowing of more recent conditions in Paraguay, he blamed Brazilian immigrant farmers for practicing a predatory approach to farming by using a form of slash and burn:

Brazilian cultivation is the most primitive and savage that exists; it destroys an immense amount of land, impedes sustainable cultivation, rapidly sterilizes the soil and reduces production to a minimum....Therefore it is the ideal that the idle dream of, he who tries to save time with the intention of resting more; and what’s more there are no disadvantages for those who think little of the present and nothing of the future<sup>33</sup>.

<sup>30</sup> Bertoni, *Agenda & Mentor Agrícola: Guía Del Agricultor y Colono Con El Calendario de Todos Los Trabajos Rurales y Estudios de Las Cuestiones Rurales Principales Para El Paraguay y Los Países Limitrofes*, 288.

<sup>31</sup> *Ibid.*, 291. Italics in the original.

<sup>32</sup> Moisés Santiago Bertoni, “El Cambio de Clima En La Cuenca Del Río Paraguay: Consecuencias Actuales y Futuras - Causas y Remedios,” *Revista de Agronomía y Ciencias Aplicadas (Asunción)* 2, no. 9 (1901): 407–8, 415–16. He also placed a good deal of blame on cattle ranching, a major activity in rural Paraguay since the nineteenth century.

<sup>33</sup> *Ibid.*, 417–18.

Bertoni went on to argue that this approach was beginning to spread across the country, therefore the only solution was to enact a law against such practices, at least on publicly-owned lands. And with extraordinary foresight he suggested that for private property deforestation should be limited to 20% of the total property, while the entire country should be divided into forested and cultivated zones protected by legislation<sup>34</sup>.

In *Agenda y Mentor Agrícola* he largely dispensed with legal solutions but made a further call for farmers to discard the long-standing practice. He began an article near the end of the manual by saying: “farming without burning is intimately linked to sustainable cultivation [*cultivo continuo*].” He considered this to be a necessary reform in Paraguayan agricultural practices since over many years of observation he had noticed that as fertile lands soon became sterile after burning, farmers were forced to move elsewhere to find suitable places to plant. He recognized the historical roots of the practice and acknowledged that in the early years of colonization burning could be practical and productive, but in the modern context it was no longer acceptable. In an explanation familiar to the tropics, he outlined the impact of progressive sterilization of the soil on farmers, which forced them to either reduce harvests or emigrate to other regions or even abroad, often selling their land in the process. In fact, he decried what he saw as a widespread abandonment of the land by rural youth, who emigrated to the cities or to other rural pursuits such as labor in the abusive yerba or timber industries<sup>35</sup>.

Bertoni outlined in detail the impact of burning on the soil and on forests, creating conditions of lowered rainfall and higher temperatures. He also explained what he considered the core of the impact, very much a part of his intention in writing the guide in the first place: “Finally, it arrests or hinders the progress of colonization, and makes the solution to the agrarian problem much slower and

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<sup>34</sup> *Ibid.*, 418–19. None of this came to pass in his lifetime. In 1973 a Forestry Law was implemented that required owners of property over 20 hectares in forest zones to maintain 25% of their land in forest. Paraguay, “Lei Nº 422/73. Florestal. El Congreso de La Nación Paraguaya Sanciona Con Fuerza de Ley.” (1973), [http://www.infona.gov.py/application/files/8414/2893/9388/Ley\\_N\\_422\\_Florestal.pdf](http://www.infona.gov.py/application/files/8414/2893/9388/Ley_N_422_Florestal.pdf); More recently, in 2017 the corrupt government of Horacio Cartes promulgated Decree 7702/17 that removed that requirement. Cartes benefitted by immediately deforesting much of his land in the Chaco to expand his ranching operations: Roque González Vera, “Horacio Cartes Tumbó Dos Millones de Árboles de Su Estancia En Un Mes,” *abc Color*, 2017, <http://www.abc.com.py/edicion-impresa/economia/horacio-cartes-tumbo-dos-millones-de-arboles-de-su-estancia-en-un-mes-1649785.html>.

<sup>35</sup> Bertoni, *Agenda & Mentor Agrícola: Guía Del Agricultor y Colono Con El Calendario de Todos Los Trabajos Rurales y Estudios de Las Cuestiones Rurales Principales Para El Paraguay y Los Países Limitrofes*, 459–61.

expensive, by being more difficult and of diminished benefit to hand over land to those who destroy it.” Indeed, Bertoni’s passion against burning is evidenced when he wrote: “What is burned? Capital... The future is incinerated”<sup>36</sup>. In this, he explained the negative economic impact in terms of time and investment inhibited by burning, while stressing the ecological effects like the destruction of the humus layer and a resulting drier microclimate. This latter point is significant because it reveals that by the 1920s he recognized the importance of microclimate. He went on to argue that few seemed to understand that air humidity and local rainfall were the products of extensive forest growth. This included some meteorologists in the United States, who failed to appreciate the role of snowfall in maintaining soil humidity in temperate climates. Ultimately, few voices were raised against tropical burning, a practice that, he lamented, showed no signs of abating<sup>37</sup>.

This advice was based on several decades of observations, and while still strongly condemning burning, the urgency of his first publication seemed to be somewhat diluted by 1927. It’s unclear why he became less adamant, since the conditions he observed hadn’t changed, but perhaps a greater understanding of the complexity of the process (environmentally and politically?) had modified his views<sup>38</sup>. At any rate, in *Agenda y Mentor Agrícola* he admitted that since he began more consistent climate observations only in 1915, ten years was not enough time to come to definitive conclusions on climate, and that probably another twenty were necessary. Still, he wrote with confidence that climate change had been consistent since at least that time, particularly increased drier and colder seasons. While admitting that there would be years that appeared like “old times” (*a la antigua*) he felt it was necessary to counsel farmers that likely this was a permanent phenomenon, and that to adapt they needed to substitute their crop selection, from tropical to subtropical<sup>39</sup>.

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<sup>36</sup> Ibid., 461–62.

<sup>37</sup> Ibid., 463–67.

<sup>38</sup> There was a sign of this in the original, as toward the end he made some suggestions to limit burning to certain times of the year, and with some specific geographical restrictions: Bertoni, “El Cambio de Clima En La Cuenca Del Río Paraguay: Consecuencias Actuales y Futuras - Causas y Remedios,” 422–26.

<sup>39</sup> Bertoni, *Agenda & Mentor Agrícola: Guía Del Agricultor y Colono Con El Calendario de Todos Los Trabajos Rurales y Estudios de Las Cuestiones Rurales Principales Para El Paraguay y Los Países Limitrofes*, 291–93; He also pointed out that even as early as the end of the nineteenth century he was observing similar conditions. This is not specifically mentioned in “El cambio de clima.” To be clear, I don’t suggest that Bertoni was a prophet of local climate change. Plenty of evidence indicates that as far back as ancient Greece philosophers like Theophrastus

**BERTONI METEOROLOGIST**

Bertoni reinforced this discussion with a detailed explanation of his meteorological observations throughout the year, especially rainfall measurement, including dewpoints (taken using a device of his own invention), and stressing the seasonal variation of precipitation that farmers needed to take into consideration. Much of this was based on detailed investigations over the years, including on the regularity of rainfall, studies he had begun in Switzerland and continued once settled in Paraguay. He published several observations, particularly in terms of pluvial regularity, as he centered his attention on weather forecasting. Those studies were tentative, but he concluded there was an annual periodicity of roughly eight periods, half of which he concluded were actual seasons. What is interesting about those studies is that while not rejecting folk observations outright, these were almost exclusively based on scientific research done in Europe and elsewhere over the previous century or so, combined with his own observations, particularly in Puerto Bertoni, and some by others in Asunción. The formal scientific rigor of this work was strong, though his conclusions were largely based on personal observation and calculations<sup>40</sup>.

In *Agenda y Mentor Agrícola* he continued with a similarly detailed discussion of temperature variations, including relative humidity. According to Bertoni, his observations were the most accurate in the region, not only in Paraguay, but also the whole Río de la Plata, including Argentina. He pointed out that while there were stations other than his, they tended to be in urban centers, such as Asunción or Buenos Aires, not in the countryside, which meant that they were not useful for the agricultural sector. Later in the discussion he emphasized that besides the lack of stations, data from all meteorological stations should be viewed with some caution

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decried the impact of agriculture on climate, an observation repeated many times over subsequent centuries in Europe alone. These writings may well have influenced Bertoni's approach. See Clarence J. Glacken, *Traces on the Rhodian Shore: Nature and Culture in Western Thought from Ancient Times to the End of the Eighteenth Century* (Berkeley: University of California Press, 1967), 129–30, 137, 317, 487–88, 542, 560, 659, 669, 689–91.

<sup>40</sup> Bertoni, *Agenda & Mentor Agrícola: Guía Del Agricultor y Colono Con El Calendario de Todos Los Trabajos Rurales y Estudios de Las Cuestiones Rurales Principales Para El Paraguay y Los Países Limitrofes*, 298–309; Moisés Santiago Bertoni, *Memoria Sobre La Existencia de Lluvias Periódicas En Determinados Días de Año: Un Factor Mas Para La Previsión Del Tiempo* (Puerto Bertoni: Imprenta y Edición “Ex Sylvis,” 1918), 5–10, 62–70.



since they did not take into consideration local conditions, such as altitude, temperature of the soil, types of plants, temperature inversions, etc<sup>41</sup>.

The work continued with a specifically agricultural approach through detailed examination of the impact of temperature extremes on plants and their abilities to resist severe cold and heat. He began by arguing that agriculturalists tended to make the mistake of following the empirical observations of the past when there were no instruments or scientific examination to refine planting decisions. He stressed that the reason for this backwardness (*atraso*) was that meteorologists were seldom, if ever, agriculturalists, hence farmers had no relevant scientific observations to complement their empirical experience. Of course, he expected his work to change this<sup>42</sup>.

In discussing the impact of temperature extremes on plants, he advised that there were several conditions that played a role in how easily a plant could withstand frosts or even freezes, above all the hardiness of the plant itself. He also outlined how to deal with chilling winds, advising in part to keep the moisture level of the plant as low as possible, limiting irrigation until the cold passed, though he recognized this was not always practical. And he suggested seed selection as an important part of protecting plants from the cold, with “*criollo*” seeds preferred over imported because they were better adapted to local conditions, foreign seeds more susceptible to climate, diseases, etc. He continued by counseling careful selection of resistant varieties, especially the imported that had adapted to their new conditions, and to engage in hybridization with indigenous seeds. And Bertoni advised farmers to keep a look out for mutations, which could signal new resistant and useful species<sup>43</sup>.

He then described the various forms of frost and freezing campesinos could encounter, using a formal botanical approach as to what happens to the plants under these conditions, but explained in laymen’s terms. He outlined the several errors of planters, particularly in how to deal with frost or a moderate freeze after the fact, which he suggested depended a great deal on the type and the plant. He strongly

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<sup>41</sup> Bertoni, *Agenda & Mentor Agrícola: Guía Del Agricultor y Colono Con El Calendario de Todos Los Trabajos Rurales y Estudios de Las Cuestiones Rurales Principales Para El Paraguay y Los Países Limítrofes*, 309–12, 319–20, 320, n.1.

<sup>42</sup> *Ibid.*, 313.

<sup>43</sup> *Ibid.*, 315–16.

criticized the common assumption that after a frost/freeze the sun was the enemy and summarized the various forms of saving plants after frost/freeze had struck. The details were extensive, as he explained how to save various commercial crops, like sugar, cotton, yerba mate, manioc. He continued with a short explanation of the limits of plants under cold conditions, stressing the utility of instrumentation, but above all the power of observation: “through a long series of observations in the same zone and climate.” At the same time, he promoted a simple thermometer called a bio thermometer, covered in muslin and suspended over water, which was an inexpensive way for farmers to determine temperature of their plantings<sup>44</sup>.

The general assumption that tropical plants could not resist frost/freezing was discounted by Bertoni as he provided a long list of tropical plants and their temperature limits, arguing that it was a fallacy that tropical plants succumbed to any temperatures near or below zero degrees. He explained that most plants maintained some resistance to sub 0° C. temperatures, though only if the cold was not constant. He observed that if temperatures were not freezing but maintained anywhere between six and thirteen degrees over several weeks, most tropical plants survived, explaining that in the tropics this was the case because soil temperatures remained relatively high, thus radiating heat for longer periods than in temperate zones<sup>45</sup>.

Bertoni spent several pages on the extremes of heat, which revealed nothing surprising about how to protect plants in the torrid periods. He also briefly examined the influence of the sun and moon in climate change and vegetation, spending some time explaining the role of sunspots in weather cycles, perhaps influenced by the popularity of connecting sunspots and weather in Britain and the United States at the time. Heavy rain years seemed to occur in roughly ten to twelve-year cycles, though Bertoni wasn't sure this was entirely solar influence, since he suspected some earthly impacts as well. At any rate, he concluded there was a relative consistency in the occurrence of rainy years but gave no explicit explanation why<sup>46</sup>.

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<sup>44</sup> Ibid., 326–27.

<sup>45</sup> Ibid., 328–31.

<sup>46</sup> Ibid., 337–42; The influence of sunspots on climate has led to some debate that today's global climate change is caused more by the sun than by greenhouse gases. There is no serious scientific evidence to suggest the sun could have such a dramatic impact over such a short period of time. For a useful comprehensive examination of this, see Spencer R. Weart, *The Discovery of Global Warming: Revised and Expanded Edition (New Histories of Science, Technology, and Medicine)* (Cambridge: Harvard University Press, 2008); Also, see the author's website: Spencer R. Weart,

Finally, in an appendix to Part II, Bertoni explained how easy it was for campesinos to observe their milieu successfully. The point, it seems, was to instruct farmers with limited resources in the best ways to monitor their cultivation. The subjects included how to select and apply thermometers, when to predict a frost, the hours of observation, etc. Much of this was a repeat of earlier information, which reveals again Bertoni’s intentions in spending over two hundred pages explaining the intricacies of climate and weather that impact the agriculturalist. No doubt this was a product of his insistence that campesinos have as much access to information as possible<sup>47</sup>.

### BERTONI ECOLOGIST

Part III begins with a warning to Paraguayan agriculturalists regarding pests and diseases. These articles are particularly intriguing since they illustrate Bertoni’s decidedly ecological perspective toward agriculture. Bertoni exhorted that the relatively passive attitude of the past regarding diseases and insect infestations should become just that – a thing of the past. He argued strongly that with international communications much more common and faster, diseases and pests were introduced more frequently, especially those not seen before. Here he made a point of the urgency of everyone working together to combat such introductions: “*the general interest is also everyone’s*”<sup>48</sup>. He praised the organization of an Agricultural Defense department (*Defensa Agrícola*) by the government in 1913, endorsing the effort in the face of considerable resistance from campesinos. He pointed out that this work was hampered by high illiteracy in the countryside and proposed that besides the publication of pamphlets on diseases and pests, teachers or “the intelligent agriculturalist” should take the responsibility to communicate advice directly to those who lacked information. There is no indication this advice was followed<sup>49</sup>.

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<sup>47</sup> “The Discovery of Global Warming,” 2019, <https://history.aip.org/climate/index.htm>.

<sup>48</sup> Bertoni, *Agenda & Mentor Agrícola: Guía Del Agricultor y Colono Con El Calendario de Todos Los Trabajos Rurales y Estudios de Las Cuestiones Rurales Principales Para El Paraguay y Los Países Limitrofes*, 342–45.

<sup>49</sup> *Ibid.*, 347 Italics in the original.

<sup>49</sup> *Ibid.*, 348–49.

The other part of his proposal was cooperation. He noted a strong resistance to collaboration in the countryside and suggested that the State was responsible for educating the population by encouraging cooperation in confronting these challenges, or if necessary, obliging recalcitrant farmers to work together: “the reluctant or careless neighbor harms everyone else.” His perspective is interesting, because he asserted that the spirit of cooperation had not entered the minds of the country’s rural class, since they were “distracted by an excessive individualism,” which is something of a contradiction of his view mentioned previously that campesinos lived a form of “Christian communism”<sup>50</sup>. What Bertoni observed was not unusual for foreigners, even those long-established in the country, but it seems that this indifference to the promotion of his projects with the Paraguayan government may have been product of two larger issues – the wealthier rural sector had no interest in investing in measures that limited their incomes, even minimally, while the overall trust average Paraguayans had for their leaders had been violated consistently over previous years. Certainly, education was seen then and now as an important step in rectifying this obstacle but given the slow pace of universal education in the country at the time, it was a hard row to hoe.

The next few articles were written by Bertoni and his sons, Winkelried and Guillermo Tell, who were close collaborators, and addressed diseases in fruit trees, application of insecticides, issues with the many destructive ant species, and the roles of birds and other animals in agriculture. Winkelried started with the affirmation that birds (*aves*) were indispensable partners in keeping insect pests limited: “...birds make up the most powerful aid in the struggle against rural infestations”<sup>51</sup>. He went on to explain that Paraguay was “privileged” to have so many insect-eating bird species and relatively few seed and fruit eaters. However, he lamented the “massacre” of bird species, which had led to an increase in predatory insects in the agricultural sector. He didn’t explain the reasons for such a “massacre”, but in his opening statement he noted how little laws were respected in the countryside. He then listed the various

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<sup>50</sup> Ibid., 348. See note 23.

<sup>51</sup> Ibid., 376.

species of bird and their eating habits, with the hope that once the farmer understood their usefulness the agricultural sector could be better managed.

Bertoni himself then wrote about the most serious freeze in modern Paraguayan history – the July, 1918 hard freeze when temperatures fell to minus 3 C. and maintained for several hours<sup>52</sup>. While this was devastating to agriculture, even if it did occur in the middle of the coldest month of the year, Bertoni argued that contrary to popular belief, it did not kill most insect species, but instead severely diminished the bird populations that preyed on insects. The result was several difficult years for the Paraguayan agriculturalist, with the situation returning to normal only in the mid-1920s as bird populations recovered. Referring to a previous publication in which he had tentatively proposed this theory, he noted that the intervening years of study confirmed his conclusion<sup>53</sup>.

Bertoni then continued with a discussion of the role of wild animals in rural life. Here, he confronted what he considered a general ignorance regarding native fauna, that they were always pests and as such eliminating them was good for farming. And foreshadowing a more modern debate, he came down strongly on the side of protection: “all and each one of the species have their use in nature...”<sup>54</sup>. He denounced hunting for sport as the cruelest of human pastimes since it took mothers away from their young, and was unnecessary for the survival of modern man, given the many alternatives for sustenance. Bertoni went further, denouncing hunting as “an offense against divine law”, clearly reflecting the religiosity he had been expressing in his later years. But he also invoked a scientific rationale against hunting, stating: “Only science can resolve the question of whether an animal is more useful than harmful, and vice-versa, and the public must obey the conclusions [*dictado*] of those who study for the good of all”<sup>55</sup>. Combined, these views reflect perhaps some of the fundamentals of the man. As stated previously, Bertoni’s early ideas of the solidarity of man through anarchism/socialism seemed to combine with a similar

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<sup>52</sup> *Ibid.*, 324.

<sup>53</sup> *Ibid.*, 381. Bertoni specifically mentions Antonio Berlese, Italian entomologist, who he argues was wrong in assuming the cold kills insects, and thus such an opinion “should be censured (*denunciado*)”: 381, n.1.

<sup>54</sup> *Ibid.*, 382.

<sup>55</sup> *Ibid.*, 383.

approach through religion and god, though apparently rejecting the concept of a “Supreme Intelligence”<sup>56</sup>.

He continued by outlining useful fauna, such as the anteater, some species of marsupials, deer, bats, and certain predators. His point was that these species had been declining, some to the point of extinction in certain parts of the country, yet they aided agriculture by eating other harmful species, such as ants, rats, and snakes. It’s clear that Bertoni revealed an appreciation for the balance of nature in the rural world, as he concluded with a warning on the role of nature and man:

Even without leaving the strict field of the scientific and the mere observation of events [hechos], the more one studies the more one is convinced that all is providential in nature, and that within her dominates a regulating equilibrium of all living things and all functions. We must respect this natural balance. Every time we break it with impulsive destruction, directly or indirectly, sooner or later we will suffer some damage. Just in case, we should limit ourselves to our defense and respect [nature]<sup>57</sup>.

It should be noted, however, that Bertoni had no problem in dealing severely with wild animals that preyed on barnyard animals, or poisonous snakes, since they were seen to be harmful to agricultural settlement. This apparent double standard reveals that while in some senses Bertoni may be considered an ecologist, we should be fully aware that his main concern, at least in this volume, was to promote the interests of the farmer. While he condemned the indiscriminate killing of wild animals, which apparently was quite widespread, he also condoned “selective” killing in the interest of human survival. In today’s world, I assume Bertoni might be considered a promoter of sustainability over preservation.

The last discussion of this section of *Agenda y Mentor Agricola* dealt with venomous snakes, especially how to deal with snakebite. Here, Bertoni addressed folk remedies, almost all of which he discounted, instead promoting the efficacy of anti-snakebite serum, much of it produced in Brazil. However, he also recognized the inability of campesinos to gain access to serum, whether due to availability, cost, or inability to preserve the serum in the basic conditions of the countryside. A solution he came up with was ammonia, which he had applied to several campesinos suffering

<sup>56</sup> Bertoni, “Cuarta Conferencia Del Instituto Paraguayo, Por El Director de La Escuela de Agricultura,” 189.

<sup>57</sup> Bertoni, *Agenda & Mentor Agricola: Guia Del Agricultor y Colono Con El Calendario de Todos Los Trabajos Rurales y Estudios de Las Cuestiones Rurales Principales Para El Paraguay y Los Países Limitrofes*, 389.

from snakebite near his home in Puerto Bertoni. He swore on the efficacy of this treatment, taken orally with water, though there has never been any scientific literature to confirm such an approach. In fact, ammonia had been used in Australia in the nineteenth century, but topically, and with dubious success (even when the victim lived)<sup>58</sup>. This confident reliance on applied science is part of what caused formally-trained scientists to distrust Bertoni’s conclusions, at least in this case for good reason.

Finally, the question of Bertoni’s “organic” credentials arises quite frequently in this work. While he made little claim to being organic as we might understand it today, he did follow and recommend many such practices. However, he wasn’t consistent nor outspoken about the options of organic versus non-organic, especially in terms of combatting pests and diseases, and in applying fertilizers. For example, in Part IV Bertoni outlined the many organic fertilizer options, including providing analysis of percentages of necessary minerals each contained. However, he also detailed the chemical makeup of inorganic fertilizers like Thomas slag (tetracalcium phosphate), other phosphates and nitrates, and field application quantities per crop. It seems his concern in largely concentrating on organic sources of fertilizer had to do with access by Paraguayan campesinos. At the time, chemical fertilizers were quite expensive since they had to be imported, and few agriculturalists had the means to purchase them. This apparently was the case in neighboring nations as well. In fact, this circumstance is indicative of the state of agricultural production worldwide, since before World War II use of chemical fertilizers was limited, a situation that changed dramatically after, including in South America<sup>59</sup>.

## CONCLUSION

In the late nineteenth and early twentieth centuries Paraguay was a marginal region in a little-known and understood continent. Scientists, especially botanists, largely from Europe or influenced by European study, descended on the Americas and

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<sup>58</sup> Ibid., 394; The Conversation, “Hisstory: How the Science of Snake Bite Treatments Has Changed,” The Conversation: Academic rigor, journalistic flair, 2017, <https://theconversation.com/hisstory-how-the-science-of-snake-bite-treatments-has-changed-71408>.

<sup>59</sup> Bertoni, *Agenda & Mentor Agrícola: Guía Del Agricultor y Colono Con El Calendario de Todos Los Trabajos Rurales y Estudios de Las Cuestiones Rurales Principales Para El Paraguay y Los Países Limitrofes*, 406–12.

began to uncover some of the mysteries of nature, though how to engage the tropics was always a challenge. Given this unfamiliarity for scientists trained in the temperate North Atlantic, in many ways “creole science” was the only possible way they could practice their craft among the alien and often exotic climates, plants, animals, and peoples of the Americas, something Moisés Bertoni came to understand early.

Much more research is needed to appreciate the broader impact of Bertoni, since this paper has only scratched the surface of his multifaceted contributions to Paraguayan agriculture, botany, and cultural character. What seems clear however, is that like others who practiced “creole science,” he considered himself to be a quintessential “man of science” and as such sought to promote the most advanced techniques for improving Paraguayan agriculture, and ultimately economic development, especially for the impoverished Paraguayan campesino. In doing so, he avidly read books and papers published by scientists across the globe, gaining knowledge that informed his observations and ideas. At the same time, he practiced an applied science in which he promoted local understanding and empirical observations of the environment and reacted with frustration to occasional criticisms of his approach from European scientists. No doubt this was a product of the many constraints he encountered in being recognized as a respected scientist with original ideas. He had good reason, for as James Scott states unequivocally, scientific agriculture of the late nineteenth and early twentieth centuries exhibited “a logic of homogenization and the virtual elimination of local knowledge”<sup>60</sup>.

In some ways, though, perhaps Bertoni might be considered a pioneer. His understanding of climate change and ecology impresses with its detail and logical conclusions, even if his work was localized, and not always correct in the face of later knowledge. While he was one of the least recognized of several European immigrant scientists who worked toward the agricultural development of their adopted nations throughout Latin America, Bertoni’s contributions were significant for Paraguay and Paraguayan agriculture, even when ignored. He taught, but also learned a great deal from the surroundings that he chose to settle in, and he became as much a part of the

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<sup>60</sup> James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven: Yale University Press, 1998), 302.



milieu in which he labored, a part of nature, as a representative of “imperial” science. He absorbed and promoted the modern when he felt it was suitable, but through his applied work he consistently advocated that the tropics were unique, and that science could benefit from local knowledges, especially of the Guaraní. While he took this too far anthropologically and in some of his empirical conclusions, he also drew attention to the complexity of the Paraguayan tropical environment and its many facets, a process we are still engaging today. And given the nationalistic inclination of science in Paraguay over the decades, Moisés Bertoni is considered a scientific patriot, endearing him to Paraguayans, who have celebrated him with the nickname “sabio” of the nation’s early agricultural science.

Map 01. Paraguay Today.



Source: Wikimedia Commons<sup>61</sup>.

<sup>61</sup> Wikimedia Commons, "Atlas of Paraguay," wikimedia Commons Atlas of the World, accessed March 31, 2020, [https://commons.wikimedia.org/wiki/Atlas\\_of\\_Paraguay](https://commons.wikimedia.org/wiki/Atlas_of_Paraguay).

## REFERENCIAS

- Baratti, Danilo. “Moisés Santiago Bertoni y La Generación Nacionalista-Indigenista Paraguaya.” *Société Suisse Des Américanistes / Schweizerische Amerikanisten-Gesellschaft* 66–67 (n.d.): 41–47.
- Baratti, Danilo, and Patrizia Candolfi. *Vida y Obra Del Sabio Bertoni - Moisés Santiago Bertoni (1857–1929): Un Naturalista Suizo En Paraguay*. Asunción: Helvetas, 1999.
- Bell, Stephen. *A Life in Shadow: Aimé Bonpland in Southern South America, 1817–1858*. Stanford: Stanford University Press, 2010.
- Bertoni, Moisés Santiago. *Agenda & Mentor Agrícola: Guía Del Agricultor y Colono Con El Calendario de Todos Los Trabajos Rurales y Estudios de Las Cuestiones Rurales Principales Para El Paraguay y Los Países Limítrofes*. 4th ed. Puerto Bertoni: Imprenta y Edición “Ex Sylvis,” 1927.
- . “Cuarta Conferencia Del Instituto Paraguayo, Por El Director de La Escuela de Agricultura.” *Revista Del Instituto de Agricultura (Asunción)* 2, no. 11 (1898): 199–202.
- . *Descripción Física, Económica y Social Del Paraguay. La Civilización Guaraní, Parte I: Etnología. Origen, Extensión y Cultura de La Raza Karáí-Guaraní y Protohistoria de Los Guaraníes*. Puerto Bertoni: Imprenta y Edición “Ex Sylvis,” 1922.
- . “El Cambio de Clima En La Cuenca Del Río Paraguay: Consecuencias Actuales y Futuras - Causas y Remedios.” *Revista de Agronomía y Ciencias Aplicadas (Asunción)* 2, no. 9 (1901): 399–426.
- . *Memoria Sobre La Existencia de Lluvias Periódicas En Determinados Días de Año: Un Factor Mas Para La Previsión Del Tiempo*. Puerto Bertoni: Imprenta y Edición “Ex Sylvis,” 1918.
- . *Resumen de Prehistoria y Protohistoria de Los Países Guaraníes: Conferencias Dadas En El Colegio Nacional de Segunda Enseñanza de La Asunción Los Días 26 de Julio, 8 y 21 de Agosto de 1913*. Edited by Juan E. O’Leary. Asunción, 1914.
- Bont, Raf De. *Stations in the Field: A History of Place-Based Animal Research, 1870–1930*. Chicago: University of Chicago Press, 2015.
- Chesterton, Bridget María. *The Grandchildren of Solano López: Frontier and Nation in Paraguay, 1904–1936*. Albuquerque: University of New Mexico Press, 2013.
- Chesterton, Bridget María, and Timothy Yang. “The Global Origins of a ‘Paraguayan’ Sweetener: Ka’a He’e and Stevia in the Twentieth Century.” *Journal of World History* 27, no. 2 (2016): 255–79. <https://doi.org/10.1353/jwh.2016.0107>.
- Commons, Wikimedia. “Atlas of Paraguay.” *wikimedia Commons Atlas of the World*. Accessed March 31, 2020.

[https://commons.wikimedia.org/wiki/Atlas\\_of\\_Paraguay](https://commons.wikimedia.org/wiki/Atlas_of_Paraguay).

Crosby, Alfred W. *The Columbian Exchange: Biological and Cultural Consequences of 1492*. California: Greenwood Publishing Group, 1972.

Denevan, William M. “Carl Sauer and Native American Population Size.” *Geographical Review* 86, no. 3 (July 1996): 385–97. <https://doi.org/10.2307/215502>.

Duarte, Regina Horta. “Between the National and the Universal: Natural History Networks in Latin America in the Nineteenth and Twentieth Centuries.” *Isis* 104, no. 4 (December 2013): 777–87. <https://doi.org/10.1086/674944>.

García, José E. “El Pensamiento de Moisés Bertoni Sobre El Origen y La Psicología de Los Indígenas Guaraníes.” *Psicología Em Pesquisa* 8, no. 1 (June 1, 2014): 53–65. <https://doi.org/10.5327/Z1982-1247201400010006>.

Glacken, Clarence J. *Traces on the Rhodian Shore: Nature and Culture in Western Thought from Ancient Times to the End of the Eighteenth Century*. Berkeley: University of California Press, 1967.

Livingstone, David N. *Putting Science in Its Place: Geographies of Scientific Knowledge: Geographies of Scientific Knowledge*. Chicago: University of Chicago Press, 2003.

McCook, Stuart. “Focus: Global Currents in National Histories of Science: The ‘Global Turn’ and the History of Science in Latin America - Introduction.” *Isis* 104, no. 4 (December 2013): 773–76. <https://doi.org/10.1086/674943>.

McCook, Stuart George. *States of Nature: Science, Agriculture, and Environment in the Spanish Caribbean, 1760–1940*. Austin: University of Texas Press, 2002.

Paraguay. Lei nº 422/73. Florestal. El Congreso de la Nación Paraguaya Sanciona con Fuerza de Ley. (1973). [http://www.infona.gov.py/application/files/8414/2893/9388/Ley\\_N\\_422\\_Forestal.pdf](http://www.infona.gov.py/application/files/8414/2893/9388/Ley_N_422_Forestal.pdf).

Rodriguez, Julia. “Beyond Prejudice and Pride: The Human Sciences in Nineteenth- and Twentieth-Century Latin America.” *Isis* 104, no. 4 (December 2013): 807–17. <https://doi.org/10.1086/674947>.

Scott, James C. *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*. New Haven: Yale University Press, 1998.

The Conversation. “Hisstory: How the Science of Snake Bite Treatments Has Changed.” *The Conversation: Academic rigor, journalistic flair*, 2017. <https://theconversation.com/hisstory-how-the-science-of-snake-bite-treatments-has-changed-71408>.

Touring Club. “Moisés Bertoni, El Sabio Que Se Enamoró de Paraguay.” *Touring Club: Revista Oficial del Touring y Automóvil Club Paraguayo*, 2019. <http://touring.indusant.com/mois-es-bertoni-el-sabio-que-se-enamoro-de-paraguay/>.

UNA. “Reseña Histórica.” Una: Universidad Nacional de Asunción. Accessed June 15, 2019. <https://www.una.py/la-universidad/institucional/resena-historica/>.

Vera, Roque González. “Horacio Cartes Tumbó Dos Millones de Árbores de Su Estancia En Un Mes.” abc Color, 2017. <http://www.abc.com.py/edicion-impresa/economia/horacio-cartes-tumbo-dos-millones-de-arboles-de-su-estancia-en-un-mes-1649785.html>.

Weart, Spencer R. *The Discovery of Global Warming: Revised and Expanded Edition (New Histories of Science, Technology, and Medicine)*. Cambridge: Harvard University Press, 2008.

---. “The Discovery of Global Warming,” 2019. <https://history.aip.org/climate/index.htm>.

## ¿Nacionalismo Agrario o Ciencia “Imperial”? “El Sabio” Moisés S. Bertoni y Ciencia Agrícola Paraguaya

### RESUMEN

Como contribución al discurso sobre la práctica de las ciencias naturales en los años liberales de América Latina, este artículo examina el lugar del botánico suizo Moisés S. Bertoni en el desarrollo agrícola de Paraguay después de la Guerra del Paraguay (1864-70). La guerra obligó a los líderes en un devastado Paraguay a promover la inmigración de expertos científicos y agricultores europeos, con la expectativa de que su conocimiento de la ciencia y la práctica moderna agrícola revitalizaría la agricultura de la nación y sacaría a Paraguay de su pobreza. Desde finales del siglo XIX, el trabajo y el conocimiento de Bertoni sobre el clima y botánica tropical y semi-tropical de Paraguay dieron forma a gran parte de la política y práctica agrícola paraguaya. Y aunque sus contribuciones fueron influyentes en la comprensión del medio ambiente y la agricultura de la nación, lo que no está claro es cuánto fue el producto de la introducción deliberada de la ciencia agrícola o el resultado de una experiencia autóctona y su propio ensayo y error.

**Palabras Clave:** Ciencia Agrícola; Ciencias Naturales; Clima Tropical; Paraguay.

Recibido: 13/12/2019  
Aprobado: 31/03/2020