AGRONOMIA AFRANCEADA:

The French Contribution to Mexican Agronomy, 1880-1940

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Introduction

From 1860 to 1940 Mexican agronomy struggled through a protracted infancy. Until the Mexican Revolution (1910-1920), French agronomy was the most important foreign source of inspiration for the development of the discipline in Mexico. The French occupation and imposition of Maximillian (1861-1867) dampened francophillic sentiment among Mexico's elites to some extent, but during the administration of the liberal President Benito Juarez (1867-1872) and the long regime of Porfirio Diaz (1876-1910) love of things French was restored by the spread of the positivist ideology of Auguste Comte, which provided a "scientific" justification for Mexico's unjust social order. Further, to protect significant economic interests by forging bonds with elites, France took steps to transmit its culture, including agronomy and other sciences, to Mexico.

However, by 1900, as a result of massive investments, mutual self interest, and geographic propinquity, *estadounidense* (of or pertaining to the United States) agronomy began to have significant influence in Mexico. The Mexican Revolution disrupted French hegemony in the field of agronomy, but until the 1940s, when the *estadounidense* model defeated all competitors, France was one of several foreign sources of inspiration that influenced the evolution of the discipline in Mexico (1). Further, French-trained *agronomos* and French immigrant agronomists played an important role in the profession, and in policy making.

During this period, reflecting the profound political transformations in Mexico, there were significant changes in the social role of agricultural scientists. While Diaz ruled, the *agronomos* had problems finding a role in a country with a rural sector dominated

by the hacienda, many of which used extensive methods of production that discouraged innovation. The Mexican Revolution, caused in part by the agrarian grievances of the peasantry, transformed the profession from one of "liberal" practitioners trained to manage the haciendas into one of agrarian agitators serving the state's land reform program. From 1920 to 1940 the Post-Revolutionary state took shape in a process that included a civil war, several military rebellions, and widespread popular mobilization, which peaked from 1935 to 1938 under the populist President Lazaro Cardenas (1934-1940). Because of these tumultuous conditions, and the lack of an experimental tradition in many branches of Mexican science, research and experimentation languished (2). While some scholars have claimed that after the Revolution a type of "scientific nationalism" prevailed, especially during the Cardenas administration, in fact Mexico's dependency on foreign agricultural science and technology continued to be profound (3).

In 1943, in response to the failure of previous research and extension programs and a significant agricultural crisis that occurred during the late 1930s, and reflecting the Manuel Avila Camacho administration's (1940-1946) desire to promote industrialization and avert wartime shortages of farm products, the Rockefeller Foundation and Mexico's *Secretaria de Agricultura Y Fomento* (Ministry of Agriculture and Development, hereafter Ministry of Agriculture) established a cooperative research program and fellowships that enabled Mexican students of agriculture to obtain advanced degrees in the United States. The fellowship program and the research conducted by the Rockefeller Foundation's scientists led to the Green Revolution of the 1950s and 1960s. They also transformed Mexican agronomy into an experimental discipline, and institutionalized a profoundly *estadounidense* model of agricultural science.

Exporting French Agronomy to Mexico: 1780-1910

During the eighteenth century the Bourbon kings, blood relatives of the French dynasty, ruled Spain, which facilitated the spread of Enlightenment ideas into Latin America. They influenced many intellectuals, including José Antonio Alzate y Ramirez, the distinguished scientist who helped to found the discipline of agronomy in Mexico. To reinforce the bonds between New Spain and France, in 1771 the Paris Academy of Sciences accepted him as a corresponding member. French science was also transmitted to Mexico at the Mexican School of Mines, where students learned their chemistry from European-born professors and studied Spanish translations of Antoine Lavoisier's *Traité élémentaire de chimie* (4).

After Mexico achieved independence in 1821, Mexican scientists rejected their old metropolis, and looked to France for scientific inspiration (5). Commercial ties and travelers' accounts published in France reinforced these connections, despite the brief "Pastry War" of 1838 (6). However, political turmoil and economic stagnation after independence retarded the development of agronomy in Mexico (7). During the French intervention scientists accompanied the occupation forces, forming the *Commission scientifique du Mexique.* They made several contributions that had a lasting impact on the development of Mexican science, especially medicine, geography, and natural history (8). Mexican medical doctor Manuel M. Villada was almost killed by *juarista* rebels while gathering plants for the *Commission scientifique du Mexique.* After he was pardoned

for collaborating with the invaders, he reinforced Mexico's scientific ties with France by helping to found the *Sociedad Mexicana de Historia Natural* (Mexican Society for Natural History). He also taught botany at the *Escuela Nacional de Agricultura* (hereafter National Agricultural School), where the *agronomos* were trained (9).

After the restoration of relations, French capitalists poured money into Mexico, investing in textile manufacturing, banking, and the public debt, and attempted to expand exports of industrial goods. Several of Diaz's most important advisors, such as Minister of Finance Jose Yves Limantour, had close ties to French investors (10). Facing fierce competition for influence with Germany, Britain, and the United States, France used many weapons to promote its interests in Mexico, including cooperation in the science of agronomy.

During the 1880s the government of the Third Republic gave higher agricultural education in France a boost by assigning agriculture to an independent ministry. By World War I France also had a functioning *Institut national agronomique* (INA) in Paris and three major schools of agricultural instruction: one near Paris at Grignon that specialized in the growing and processing of agricultural products for the Paris region, one in the south of France at Montpellier that concentrated on viticulture and warm climate crops, and one in western France at Rennes that focused on dairy products, apple growing, and cider making. Other institutions, such as the *Ecole des eaux et forêts*, the *Ecole des haras*, and the *Institut supérieur d'agronomie coloniale* (after 1900), also trained men who worked in the agricultural sector and rendered service in foreign lands and the French colonies.

Here we concentrate on the INA and the school at Grignon because they had the most impact on the development of Mexican agronomy. Grignon was widely considered the strongest of the three major French schools of agriculture because it combined ready access to fields, plants, and farm animals with proximity to and integration with the Parisian scientific world. The INA traced its origins to the mid nineteenth century when French science was widely regarded as having revolutionized industry. The thinking of the day was that the application of science to agriculture would spark a revolution in agricultural and economic productivity similar to what had happened in other industries. To this end the INA was reorganized in 1876. Its course of study attempted to foster a "marriage between laboratory and farm" by combining received scientific theory and proven empirical techniques, thus elucidating the laws of agriculture. To Georges Wéry agronomy was an experimental science which proceeded according to the experimental methods of Claude Bernard (11).

Initially located at the *Conservatoire des arts et métiers* and utilizing the amphitheater of a former *Ecole de pharmacie*, until 1909 the INA graduated about 50 students a year. On the eve of the Great War, the tide of laboratory science became manifest as the INA constructed laboratories for the chairs of agricultural chemistry, general chemistry, zootechnie, physics, zoology, and microbiology. Most likely, the work undertaken was largely for instructional purposes. While paying homage to former Director of Agriculture Eugène Tisserand (1879-1896), Wéry noted that while the INA could not provide its students with "*la technique agricole*" the school strove to teach them the techniques of science (12). Nevertheless, laboratory science may have been appealed to, but

institutions of higher agricultural education in France had few research laboratories until after World War I, and graduates of the INA and Grignon learned the vast majority of their science from books, lectures, and demonstrations. In truth, very little at the INA prepared students to function effectively in Mexico or other foreign lands. Although students needed to have minimal knowledge of one foreign language to gain admittance to the INA, Spanish was not required (13). The French "model" of agricultural education that was transmitted to Mexico was mainly a text-based activity with some opportunity for practical studies. Whatever its practical merits in the context of the New World, this French model provided a cluster of enlightened ideas and ways of doing agronomy that Mexico's *agronomos* studied and emulated.

Most graduates of French institutes of higher agricultural education found work in the hexagon (14). In 1925, of the 3,000 or so former graduates of the INA, about 41% worked in agriculture as *propriétaires*, farmers, or estate managers, 12% worked in forestry, and about 7% worked in agricultural education. Something less than one percent (272) of all INA graduates worked in the French colonies or in foreign lands. More than half of this total went to French North Africa, and an additional tenth or so (22) found employment in Indochina. Latin America attracted only a smattering of graduates. Argentina led the way with 6, followed by Brazil with 5. The United States attracted 4, followed by Mexico and Chile with three each. No doubt similar career patterns were evident at the other institutions of higher education. Almost seven of every ten graduates of the Montpellier school, which had 171 student in 1900, found careers in French (domestic) agriculture. The majority of the other graduates also worked in France (15).

Thus, if numbers were the sole measure of influence, French-trained agricultural engineers could not have had much effect on the development of Mexican agronomy. However, we will demonstrate below that two of the three French immigrant agronomists, Gabriel Itie and Leon Fourton, did make important contributions to the development of the discipline in Mexico. We also argue that French science and patterns of instruction in agronomic science were models of frequent reference in the world of Mexican agronomy, at least until 1910. Further, French scientists and scientific institutions located in the metropolis also found ways to reinforce their ties with their Mexican colleagues. For example, biologists M. Georges Renaudet and Albert and Alexandre Mary submitted articles to the journal of the *Sociedad Cientifica* Antonio Alzate, one of Mexico's most prestigious scientific organizations. In 1906 more than two thirds of the Sociedad's 173 foreign corresponding members were French. Germany was second with 12 members. In 1909 the Paris Academy of Sciences donated 154 volumes of its Acts and 95 of its *Memorias* to the organization's library (16). These contacts also extended to the *agronomos*. For example, when Gabriel Gomez attended the 1900 Paris Exposition, the French government awarded him the *Insiania de Caballero de Mérito Agricola* (17).

The Spread of Positivism and the Evolution of Mexican Agronomy, 1860-1910

The French intervention and its defeat by Juarez led to a crisis in Mexican-French relations, but this did not disrupt the scientific connection between the two nations.

The ideology of positivism developed by the philosopher Auguste Comte became a vehicle that helped to sustain these bonds. Further, to provide a counterweight to the growing United States' domination of the Mexican economy due to investments in railroads, mining, and agriculture, Diaz actively sought French capital and trade (18). Cooperation in the sciences, including agronomy, gave Diaz another way to foster closer relations with France.

Gabino Barreda, who had studied with Comte in Paris, introduced the ideology of positivism to Mexico while teaching courses on physics and natural history at Mexico's School of Medicine (19). Barreda put his positivist stamp on the 1867 *Ley Orgfinica de Instruccion Publica* (Organic Law of Public Education), which established the *Escuela Nacional Preparatoria* (hereafter National Preparatory School), where many children of Mexico's upper and middle classes received their secondary education, and introduced reforms at the National Agricultural School, which trained the *agronomos* (20).

Barreda's positivist ideas had a profound influence on the development of Mexican science during the Porfiriato. The structure of scientific curriculum at the National Preparatory School was based on Comte's hierarchy of the sciences. The school used many French texts, including works on botany by Sach, Duchartée, Cauvet, Richard, Henfrey, Daguillon, and Colomb, and on zoology by Henri Milne Edwards and Claus (21). Prominent *agronomos* of the period such as Alejandro Brambila, Sr., who also attended the elementary school *Colegio Francés* de De Fosey in Mexico City, Andres Basurto Larrainzar, and Agustin Aragon Leon were graduates of the National Preparatory School (22). In 1895 Jesus Diaz de Leon, a member of the *Sociedad Cientifica* Antonio Alzate, urged the government to use French methods of agricultural education in other primary and secondary schools (23).

The curriculum at the National Agricultural School was also based largely on French works, and all students were required to take two years of French during their first two years of school, followed by two of English and one of German. In 1883 a course on "Rational Mechanics" was introduced that was based on the works of Delaunay (24). The school adopted *agronomo* Rafael Barba's 1890 text *Mecanica Agricola,* which discussed the use of plows as practised in France (25). An early dissertation (1885) on Rural Economy cited the agronomist Lezcano from Gembloux, Gœrtz's *Cours d'économie rurale*, and Brasseur de Bourbourg's *Les choses de Yucatan* (26). In 1893 the National Agricultural School adopted a new curriculum that was "almost the same as that of the School of Grignon" (27).

Like other members of the elite, many of Mexico's scientists accepted positivism, and were very francophillic. They looked to France for inspiration, maintained close contacts with their French colleagues, and sought to emulate their achievements. For example, Diaz de Leon called France "the [country] that we have thought of as the brain of the civilized world..." (28). The distinguished biologist Alfonso Herrera published his articles in the journal of the *Sociedad Cientifica* Antonio Alzate in French, as did some other Mexican contributors (29). These trends also prevailed among the *agronomos* (30). From 1900 to 1914 Aragon Leon edited the journal *La Revista Positivista*, which his junior colleague Marte R. Gomez later called "one of the most steadfast defenders of positivism in Mexico" (31). Reflecting their education, the *agronomos* believed that

France was the world's premier nation in the agricultural sciences. For example, prominent *agronomo* Lauro Viadas wrote: "these professors of the stature of Muntz, of Girard, of Ringelman, of Schribau, and all of those experts that for us, familiar with French agricultural literature more than any other, are a type of idol that represent the aggregate knowledge of agriculture" (32). The successes of French agricultural scientists made France "the preeminent agricultural nation" (33).

Reflecting the francophillic sentiment that prevailed, during the late nineteenth century some of Mexico's most prestigious scientists in fields related to agriculture went to France for advanced training. Basurto Larrainzar excelled in his studies at the National Agricultural School and won a government scholarship to attend the Institute of Agronomy in Paris, where he took courses from Pasteur in 1883 and 1884. In 1885 he graduated and returned to Mexico, where he conducted some research while working for the government. However, he preferred teaching, and he became a respected Professor at the National Agricultural School, where he passed his French training to the next generation of *agronomos* in his chemistry, agricultural chemistry, agronomy, and meteorology courses (34). Similarly, in 1891, as a reward for his distinguished academic record at the National Agricultural School, *agronomo* Juan E. Contreras won a scholarship to study the wine industry in France, Spain, and Italy, but the lack of positions in the government and the private sector forced him to seek employment as an engineer for railroad and mining firms (35). Other prominent Mexican scientists in fields related to agriculture of this period, such as the noted conservationist Manuel Angel Quevedo, also studied at French universities and scientific institutes (36).

From 1900 to 1910 the Mexican government began to support research related to agriculture by establishing an agency to address pest control problems and several experimentation stations. Funding and trained personnel were scarce, but the *Estacion Agricola Central* (Central Agricultural Station) managed to begin several research programs, including plant breeding experiments, under the direction of the Italian immigrant Mario Calvino. Several of the *agronomos*, including Brambila, Sr., Basurto Larrainzar, and Contreras, contributed to the station's research (37). However, reflecting the limited number of government-sponsored agricultural programs, Fourton's first publication in Mexico was about removing iodine stains from clothing (38).

Because little research was conducted in Mexico at this time, many of the government's agricultural publications relied on the results of research conducted in Europe and the United States, or were direct translations of foreign technical publications. French sources were used heavily or predominantly. For example, in 1909, to tell Mexican farmers how to raise hops, an exotic crop in Mexico, *agronomo* Eduardo Rodriguez relied on French and Spanish research (39). Luis Fernandez del Campo's 1913 monograph on sugar cane cited the "notable chemist" Payon, Damseaux, N. Bassett, and Boname, as well as several German and United States sources (40).

To 1900 the French model was an abiding ideal of Mexico's agricultural scientists, but profound reliance on it began to erode before the Revolution. Although interest in "science", philosophical discourse, and pseudo-scientific Spencerian Social Darwinism flourished in elite circles, Barreda did not succeed in introducing an experimental tradition, and laboratories and research languished (41). Some intellectuals stressed the

need to add practical agriculture and experimental science to the curriculum at the National Agricultural School, and claimed that the emphasis on foreign theoretical works in the *agronomos'* training was the source of their difficulty finding jobs on Mexico's haciendas (42). Prominent *agronomo* Romulo Escobar, the director of the *Escuela Particular de Agricultura,* a private agricultural college in Ciudad Jufirez, lamented that Mexico's *rancheros* "laughed" at his colleagues when they talked about fertilizers because their knowledge was purely theoretical, and claimed that the *rancheros* "know that cost effectiveness is the key question better than the mentors of European science"(43). Escobar asserted that "the agriculture of Montpellier and Grignon" had "failed" in Mexico, and thought that the situation might be remedied by introducing elements of German and *estadounidense* agronomy (44).

Mexico's proximity to the United States provided another and increasingly more important source of inspiration for Mexico's agricultural scientists. Taking advantage of their Northern neighbors' long expertise with the crop, as early as 1884 the Mexican government sent *agronomo* Alberto Ruiz y Sandoval to the Southern United States to study the cultivation of cotton (45). By 1908 the National Agricultural School required students to take three years of English before taking two years of French (46). Geographic propinquity and mutual self interest stimulated cooperation in pest control research. In 1905 entomologist Julio Riquelme Inda collaborated with Leland Ossian Howard, the distinguished head of the USDA's Office of Entomology, in a study of a pest of henequen (47). In 1910 the Ministry of Agriculture sent botanist and agricultural pest control specialist Guillermo Gandara to the USDA's Washington D.C. offices, the University of Florida, and Louisiana State University to study their plant pathology and parasitology laboratories, the teaching of botany and agricultural parasitology, and methods of combatting several plant diseases (48). Reflecting the ambivalence of transformation, after returning, he recommended that his colleagues read works by Erwin F. Smith and Charles J. Chamberlain, but also the *Manuel de technique botanique* by Paul y Gautier (49). New developments in plant genetics also attracted interest in Mexico. During the decade Enrique C. Creel, the Governor of Chihuahua, visited several agricultural experimentation stations in the United States, met Luther Burbank, and returned to Mexico with the great plant breeder's *New Creations and Fundamental Principles of Plant Breeding* (50).

French Contributions to Post-Revolutionary Agronomy

The Mexican Revolution overthrew the Porfirian system, and intellectuals rejected the Comtean positivism of the *cientificos.* This also affected Mexico's scientific community. After the Revolution new currents of thought emerged, such as *indigenismo,* which glorified Mexico's Indian heritage. Other foreign models, increasingly the *estadounidense,* began to have more influence on the agricultural science policy of the post-revolutionary regimes. Until 1940 Mexican agronomy moved toward internationalization. In 1913, reflecting the disillusionment with the *ancien régime,* Herrera began to publish his articles in the *Memorias de la Sociedad Cientifica Antonio Alzate* in Spanish (51).

The Soviet Union attempted to form bonds with its fellow "revolutionaries" in Mexico. A scientific expedition consisting of the botanists S. Bukasov and S. Juzepezuck, microbiologist G. Bossé, and agronomist G.N. Voronoff was used to help attain this objective. Their stories about Soviet advances in plant genetics stimulated the interest of the *agronomos*. Gandara was so taken by the visit that he became a corresponding member of the Leningrad Institute of Applied Botany, and East Indian immigrant agronomist Pandurang Khankhoje, who had a degree in botany from the University of Oregon, was inspired to begin the first plant breeding experiments in post-Revolutionary Mexico (52). In 1932 Gandara claimed France was the premier nation in the agricultural sciences when taxonomy was the cutting edge of research, but that the United States and the Soviet Union had taken over that role through their advances in plant breeding. He praised the work of the Soviets N.I. Vavilov, Verenov, Jakushkina, and Pangalo (53). During the 1930s the founding of the *Liga de Agronomos Socialistas* (Socialists Agronomists League), the profusion of debate about the collectivization of agricultural production, and the establishment of the organization Friends of the Soviet Union, to which the distinguished biologist Enrique Beltran belonged, reflected the *agronomos'* interest in Soviet agricultural science (54).

German agronomy also had some impact on the development of the discipline in Mexico. German purchases of Mexican farm products, such as hard fibers and coffee, and sales of seed potatoes, fostered these bonds (55). During the late 1920s and early 1930s representatives of German vendors, especially Hans Burbach of the Compania General de Analinas, assisted the government's tests of chemical fertilizers (56). After Hitler's coup the struggle for political influence also contributed to German interest in forging bonds with Mexico's agricultural scientists. In an attempt to maintain ties with German immigrant coffee growers in the state of Chiapas, the Nazi regime sent a representative to the 1937 National Coffee Growers Convention (57). The German immigrant entomologist Alfonso Dampf transmitted German science to Mexico while working in the Ministry of Agriculture during the 1920s and 1930s. He became one of Mexico's most prominent agricultural pest control experts.

The proximity of the United States and the accomplishments of its agricultural scientists stimulated the *agronomos'* interest in *estadounidense* agronomy. Many *agronomos* admired the agricultural science of the United States, and began to consider their Northern neighbor as the world's leader in the agricultural sciences. The Mexican government started to base many aspects of its agricultural science policy on *estadounidense* agronomy. For example, during the early 1920s, when *agronomo* Gonzalo Robles designed Mexico's extension service, he obtained information on such practices in France, but he chose to emulate the structure and programs of the USDA (58). This trend was especially pronounced in the field of pest and disease control. In 1931 Julio Riquelme Inda, one of Mexico's leading pest control experts, called the USDA's Bureau of Entomology "an organization of applied entomology that has no equal in any other country", and he especially lauded the agency's biological control campaigns, which he urged Mexico to emulate (59). However, reflecting the ambivalence of the time, he also praised the Soviet Union, and described France as a "great agricultural country" (60).

The plant breeding research conducted in the United States also attracted the interest of the *agronomos*. In a 1929 monograph *agronomo* Antonio Rivas Tagle, who developed the government's primary program to improve the cultivation of corn, the *campana en pro del maiz*, attempted to convince farmers to use the methods of plant breeding practised at the USDA's experimentation stations to develop their own high-yielding strains (61). During the 1920s and 30s the Ministry of Agriculture tested many foreign improved plant varieties, most of which came from the United States. In 1938 the Ministry of Public Education sent a special commission to the United States to study its plant breeding programs (62).

The Revolution led to the rejection of positivism, but not the wholesale abandonment of French science (63). For example, in 1926 Gandara dedicated an article on the plant life of the Valley of Mexico to the "distinguished French psychologist" Pierre Janet (64). In a brief history of the *Sociedad Cientifica Antonio Alzate*, Jesus Galindo y Villa first mentioned "members of the French Institute, like D'Abbadis, Bouquet de – la Grye, Faye, Haton de Goupiliere, Hermite, Janssen, Mascart, and Milne Edwards" when discussing its most illustrious foreign honorary members (65). This was also the case with French agronomy. For example, in 1923 the short-lived technical journal *Agros*, published by the *Sociedad Agronomica Nacional* (National Agronomic Society), contained translations of French technical articles on agriculture from *Revue Horticole* and *Journal d'Agriculture Pratique* that were translated by *agronomo* Arcadio Sanchez, including subjects such as fertilizers, plowing practices, and the cultivation of fruit trees (66). The Ministry of Agriculture adopted a curriculum to train specialists in agricultural meteorology that was "more or less the same plan of studies that they assign to that career in France" (67). Following the turmoil of the Revolution, the financially strapped Ministry of Agriculture devoted a significant share of its resources to reissuing old Porfirian agricultural bulletins based on the results of foreign, often French, research (68). Prominent *agronomo* Manuel Mesa A., who later helped to found the *Liga de Agronomos Socialistas*, admired the horticulture exhibits he saw at an exposition in Bordeaux sponsored by the *Sociedad Nacional de Horticultura* de Francia, and urged his younger colleagues to study them (69). In 1930, out of favor with the government, *agronomo* Marte R. Gomez went to France for "a study break" (70).

It is not too difficult to discover the sources of continued French influence. Competent agricultural specialists were a scarce commodity in Mexico, and those active or educated during the Porfiriato continued to play a significant role in the profession. Through them, French agronomy continued to influence the discipline in Mexico. For example, when the Revolution ended and the National Agricultural School reopened, Basurto Larrainzar was reappointed as a Professor. From 1921 until his death in 1928 Alejandro Brambila Sr. directed the Ministry of Agriculture's Department of Agronomy, Microbiology, and Chemistry (71). Similarly, in a 1930 study of the damage caused by insect pests, senior *agronomo* Riquelme Inda of the *Comision Nacional de Irrigacion* (hereafter National Irrigation commission) used estimates from both France and the United States to make his case for more support for entomological research and control campaigns (72). Mexican consuls in France continued to report on the activities of its agricultural scientists, such

as the research conducted on the use of trace elements as fertilizers during the 1930s by Bruno, the Inspector General of France's Agricultural Experimentation Stations (73).

Mexico's scientific connections with France continued to affect the government's agricultural programs. At the beginning of his career Beltran tested a biological method of controlling locust swarms using bacteria obtained from the Pasteur Institute. Unfortunately, Beltran's tests indicated that the bacteria was not a pathogen except when injected, or in very humid conditions, and further, that afflicted locusts did not spread the disease (74). Similarly, in February 1938, after *Sigatoka* disease attacked the banana plantations of Tabasco, the French engineer Gardiner toured the region with a Ministry of Agriculture control team, but his presence failed to make the agency's campaign more effective (75). The plague threatened to eradicate the industry, which contributed to the Mexican government's and research community's interest in seeking technical assistance for the agricultural sciences, particularly from the United States.

The immigrant French agronomists Fourton and Itie made important contributions to the development of post-revolutionary agronomy. To introduce an experimental method, while working as researcher for the Ministry of Agriculture's central laboratories Fourton conducted experiments with fertilizers in collaboration with Brambila, Sr. using the method of analysis developed by the German Newbauer (76). Along with a few of the *agronomos* and scientists like Beltran, he urged the government to provide more support for the agricultural sciences (77). While doing this, Fourton contributed to the development of Mexican "scientific nationalism". He wrote:

One can utilize, to a certain point, the research done in other countries, but, in the agricultural subject matter, the local conditions are so important, and those offered by almost all Mexican territory are so distinct from those in regions where research is conducted and published, that a local adaptation of research done in foreign countries cannot suffice, rather it is necessary to manufacture in that same country the agronomic rules that should in the future accompany agricultural progress (78).

During the 1920s and 1930s some of Fourton's Mexican colleagues made similar statements, and the Cardenas administration did provide more support for agricultural research and extension programs (79). However, the *agronomos'* lack of familiarity with experimental science, as well as other problems, condemned these efforts to failure, and "scientific nationalism" proved to be unfeasible during the 1930s. Like Fourton, Itie also urged the Mexican government to improve its agricultural programs by putting them on a more scientific foundation. In a 1936 report Itie blasted the government's approach to extension campaigns, claiming that they relied too heavily on written material, a major mistake in a country with many illiterate farmers, and that they lacked a solid foundation of research (80). A few of his Mexican colleagues also urged the government to make its agricultural programs more effective by putting them on more solid scientific foundations, and more of them did so after the onset of an agricultural crisis in 1938, but the Ministry of Agriculture did not change its approach to extension campaigns until 1941 (81).

As a harbinger of more recent ideas about "appropriate technology", Itie attempted to stimulate his Mexican colleagues' interest in studying peasant agriculture. During the administration of the great agrarian reformer Cardenas many of the *agronomos*

claimed that they wanted to make their knowledge serve the peasant sector (82). At the time the concept of *indigenismo*, which stressed the significant achievements of Mexico's indigenous peoples, flourished among intellectuals tied to the Cardenas administration (83). Itie was most prominent among the few *agronomos* who admired the practices of Mexico's peasant farmers and believed that they should be studied before trying to "modernize" them. He wrote:

Whichever system of cultivation, no matter how rudimentary, is the fruit of long observations made by successive generations of laborers, and is a true adaptation to the medium that increases its value unconsciously and eliminates or modifies diverse and multiple adverse conditions, until it arrives at an equilibrium, that, if it does not produce the best yields or the best quality, does present the maximum coefficient of security year after year (84).

However, the vast majority of the *agronomos* believed that the "scientific agriculture" they learned as students was superior to the practices of the *campesinos* (peasants) (85). Hence, they did not study them, but rather tried to replace them with foreign agricultural methods and technologies, such as imported hybrid corn, or more "modern" implements like iron plows, which they tried to convince peasant farmers of the mountains of Puebla to use in place of their traditional *estacas* (digging sticks) (86). The *agronomos* did not listen to Itie, and an *indigenista* agricultural science failed to emerge in Mexico during the 1930s. Mexico's agricultural experts did not turn their attention to the study of peasant farming systems until the 1970s, and most of them continue to consider their practices inferior to the Green Revolution model of agriculture.

During the late 1930s Mexico suffered through an agricultural crisis that included shortfalls in the production of basic food crops, including corn, that forced the government to resort to imports, the *Sigatoka* plague that was destroying the banana export industry, and problems with the production of various other crops (87). In response, Mexico flirted briefly with the Spanish model of agronomy. Taking advantage of the opportunity presented by the Spanish Civil War, Mexico accepted refugee scientists. They introduced experimental methods in several branches of the sciences, including agronomy (88). For example, several of them became professors at the National Agricultural School or accepted positions in the Ministry of Agriculture. However, in September 1937 the Ministry of Public Education realized that an insufficient number of Spanish agronomists were available to profoundly transform the discipline, and urged Cardenas to find such scientists in the United States (89).

Before 1938, ignoring the pleas of some advocates in fear of protests from its own farmers, the United States government was reluctant to provide technical assistance to Latin American agriculture (90). However, during the late 1920s the desire to protect farmers from pests in the border region led to cooperative projects between the USDA and the Ministry of Agriculture to control the pink bollworm of cotton and the Mexican fruit fly. These programs continued through the 1930s, despite the strains in relations that occurred as a result of Mexico's land reform, "socialist education" policy, and 1938 expropriation of properties owned by United States' oil companies. The cooperative work helped to strengthen the bonds between the pest and disease control experts of

the two nations (91). Reflecting this trend, in 1938 the Mexican government dedicated a new entomological laboratory to Ossian Howard (92).

In 1938, confronted with the specter of war in Europe and Asia, policy makers in the United States began to change their attitudes. To enhance United States' influence in the region and combat that of the Axis powers, technical assistance programs for Latin American farmers became part of the government's "cultural relations" campaign in the western hemisphere (93). Citing Cardenas's actions against *estadounidense* capitalists, the State Department was initially reluctant to include Mexico in these programs (94). However, with the outbreak of World War II these misgivings vanished, and the United States proposed various collaborative projects related to agricultural development and science in Mexico.

Even before the crisis and the United States government's change in position, the administration of Abelardo Rodriguez (1932-1934) expressed interest in receiving assistance for the agricultural sciences from the Rockefeller Foundation (95). During the crisis Mexico asked for technical assistance for the cotton industry, and sent more people to the United States for training in the agricultural sciences (96). In response to the "cultural relations" program, Mexico agreed to closer cooperation and joint planning to address pest and disease control problems affecting the border regions, responded favorably to general proposals regarding USDA assistance, and began discussions that led to a collaborative program to develop the production of Hevea rubber (97). To develop an experimental tradition in his discipline, prominent *agronomo* Marco Antonio Duran urged his colleagues to study the principles of agrobiology developed by *estadounidense* scientist O.W. Wilcox (98). By 1940 the *estadounidense* model of agronomy stood on the verge of hegemony.

During the late 1930s and early 1940s the *agronomos*' credibility as scientists was under assault as a result of their participation in a sweeping land reform at the same time that Mexico experienced a serious financial crisis that was made worse by the need to use scarce foreign exchange to purchase foodstuffs, including corn, the staple of the masses. They realized that the slow process of assimilating an experimental model through education, as Duran proposed, was an inadequate response to their professional crisis, and they agreed to find foreign scientists to teach them the methods of experimental science so that they could produce "scientific successes" that would end the need for imports and resurrect the public image of their profession. The window of opportunity to find such help in France, Germany, Japan, and the Soviet Union was closed by the outbreak of World War II, but one opened in the United States as elites worried about the national security implications of the conflict, and decided to promote hemispheric solidarity against the Axis threat. Reflecting the growing influence of *estadounidense* culture, the Mexican government and research community sought and accepted technical assistance for the agricultural sciences from the United States government and private institutions like the Rockefeller Foundation. In 1941 the distinguished geographer, Mexicanist, and early critic of the Green Revolution Carl O. Sauer observed that "the United States are the mode now, as France was before the Revolution" (99).

Conclusions: The Triumph of Estadounidense Agronomy

Although a few *agronomos* still looked to the Soviet Union for scientific inspiration, such as Hilario Mesa Cienfuegos, who admired Lyssenko, Mexico chose the *estadounidense* model of agronomy, a decision that Beltran today laments (100). The outcome of this policy has been negative for many of Mexico's peasant farmers, who have been unable to use its technologies, and harmful to the Mexican environment because of its reliance on agro-chemicals.

During the crucial early years of the development of the Mexican agronomy, Mexico used French agronomy and agricultural education as models. Given the cultural and economic links between the two nations, the French model prospered under Diaz while francophillic behavior was in vogue. French agronomy still had some influence after the Mexican Revolution, but it slowly gave way to other foreign models. However, from 1920 to 1940 the immigrant agronomists Fourton and Itie made important contributions to the development of the discipline. After 1940 *estadounidense* agronomy became the predominant model in Mexico, but these French connections still exerted some influence. Fourton taught at the National Agricultural School until 1950, where he urged Mexico's *agronomos* to devote more effort to research on organic methods of improving soil fertility (101). Itie was a professor at the National Agricultural School until 1958, and worked as an editor of the agricultural journal *Tierra* from its first edition in 1945 until his death in 1969. He supported the Green Revolution, but he also advocated more research on organic methods and urged the government and his colleagues to do more to bring its technologies to the peasant farmer. In Itie's obituary, the National Agricultural School's journal *Chapingo* called him "more Mexican than many Mexicans born and raised in our country" (102). During the 1950s agronomo Jesus Uribe Ruiz went to France to obtain an advanced degree in agronomy, rather than to the United States as most of his contemporaries did. He became a prominent critic of the Green Revolution, and his ideas laid the intellectual foundations for the *campesinista* faction of Mexico's *agronomos* (103). The *campesinistas* study peasant farming methods and advocate the development of "appropriate technologies" for the *campesinos,* rejecting those of the Green Revolution (104). It is difficult to asses the long-term effects of this implantation of French science in the New World, but one thing is certain, Mexico was unable to develop effective research and extension programs until the 1940s, when the *estadounidense* model triumphed.

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NOTES

1) We use the word "model" here and below in the sense of national "styles" of science.

2) For a brief discussion see Luis Gonzalez y Gonzalez, *Historia de la Revolucion Mexicana* 1934-1940 # 15 los dias del presidente Cardenas, México, D.F.: El Colegio de México, 1981, 290-1.

3) For "scientific nationalism" see Cynthia Hewitt de Alcantara, *Modernizing Mexican Agriculture Socioeconomic Implications of Technological Change, 1940-1970*, Geneva: United Nations Research Institute for Social Development, 1976, 19. This argument has influenced more recent interpretations of the origins of the Green Revolution, for example see Angus Wright, *The Death of Ramon Gonzalez, the Modern Agricultural Dilemma*, Austin: University of Texas Press, 1992. For dependency see Joseph Cotter, "The Origins of the Green Revolution, Continuity or Change?", in David Rock, ed., *Latin America in the 1940s: War and Postwar Transitions*, Berkeley: University of California Press, 1994.

4) Enrique Beltran, "Fuentes mexicanas en la historia de la ciencia", *Anales de la Sociedad Mexicana de Historia de la Ciencia y de la Tecnologia* 2 (1970): 78; Maurice Crosland, "Science Under Control: The French Academy of Sciences 1795-1914", Cambridge: Cambridge University Press, 1992, 392-3; David Wade Chambers, "Period and Process in Colonial and National Science", in Nathan Reingold and Marc Rothenberg, eds., *Scientific Colonialism: A Cross-cultural Comparison*, Washington, D.C.: Smithsonian Institute, 1987, 297-321.

5) *Ibid.*, 85.

6) Gary S. Dunbar, "'The Compass Follows the Flag': The French Scientific Mission to Mexico, 1864-1867", *Annals of the Association of American Geographers* 78,2 (1988): 230-2.

7) Adolfo D. Barriero, *Resena historica de la ensenanza agricola y veterinaria en México*, México, D.F.: Tipografia El Libro de Comercio, 1906, 1-25.

8) Dunbar, "The Compass", 237.

9) Gomez, *Biografias*, 516-7.

10) Friedrich Katz, *The Secret War in Mexico: Europe. The United States and the Mexican Revolution*, Chicago: University of Chicago Press, 1981, 24, 51, 59-61.

11) Georges Wéry, "L'Institut National Agronomique", in *Centenaire de Grignon*, Saumur, A. Roland, 1926, 45-61.

12) Ministère de l'Agriculture, *Annales de l'Institut National Agronomique (École Supérieure de l'Agriculture)*, 2e série, tome 1 [troisième Edition] "L'Institut Agronomique et son Enseignement, 1876-1926", Paris: J.B. Ballière et fils, 1926, 6.

13) *Ibid.*, 101. By the 1920s knowledge of one foreign language was required for admission to the INA (English, German, Spanish, or Arabic).

14) *Ibid.*, Chapitre X, "Carrières ouvertes aux ingénieurs agronomes".

15) *Centenaire de Grignon*, Saumur, A. Roland, 1926, 60.

16) Sesion solemne del 4 de octubre de 1909, *Sociedad Cientifica Antonio Alzate Revista Cientifica y Bibliografica* 29, 1-4 (July-October 1909): 11.

17) Gomez, *Biografias*, 240.

18) Katz, *The Secret*, 21-7.

19) Ramon Eduardo Ruiz, *Triumphs and Tragedy: A History of the Mexican People*, New York: W.W. Norton & Company, 1992, 260-1.

20) Eli de Gortari, *La ciencia en la historia de México*, México, D.F.: Tratados y Manuales Grijalbo, 1980, 298-308.

21) Guillermo Gandara, "La ensenanza de las ciencias biologicas en México: nacional y prenacional", *Memorias y Revista de la Academia Nacional de Ciencias Antonio Alzate* 53, 11-12 (1932): 397.

22) Gomez, *Biografias*, pp. 31, 72.

23) Jesus Diaz de Leon, "Disertacion sobre la importancia del estudio de la agricultura", *Boletin de la Sociedad de Geografia y Estadistica de la Republica Mexicana* 3, 6-7 (1895): 398-406.

24) Barriero, *Resena*, 60.

25) Gomez, *Biografias*, 47-8.

26) Lamberto Cabanas, *Reflexiones sobre economia rural*, México, D.F.: Oficina Tipografica de la Secretaria de Fomento, 1885.

27) Ramon Fernandez y Fernandez, *Chapingo hace 50 anos*, Chapingo: Colegio de Postgraduados, Escuela Nacional de Agricultura, 1976, 37.

28) Diaz de Leon, "Disertacion", 400.

29) For examples see Alfonso Herrera, "Sur les oxydases siliciques artificielles", *Memoria y Revista de la Sociedad Cientifica Antonio Alzate* 29, 7-12 (January-June 1910): 331-5; Juan D. Villarello, "Description des mines 'La Bella Union'", *Memoria y Revista de la Sociedad Cientifica Antonio Alzate* 23, 7-12 (January-June 1906): 395-411.

30) For an example see Gomez, *Biografias*, 510.

31) *Ibid.*, 31.

32) Secretaria de Fomento, *Algunos documentos para la historia de la ensenanza agricola en México*, México, D.F.: Imprenta y Fototipia de la Secretaria de Fomento, 1912, p. 71.

33) Leopoldo Palacios, "Importancia social y politica de las obras de irrigacion", *Memoria y Revista de la Sociedad Cientifica Antonio Alzate* 30, 10-12 (December 1911): 425.

34) Gomez, *Biografias*, 56-7.

35) *Ibid.*, 118.

36) "Fallecio el Ing. Manuel A. de Quevedo, 'El Apostol del Arbol'", *Siembra* 3,41 (August 1946): 6.

37) Gomez, *Biografias*, 58, 72, 118.

38) Leon Fourton, "Sobre la destruccion de las manchas de yodo", *Memorias de la Sociedad Cientifica Antonio Alzate* 28, 5-8 (January-April 1910): 275-84.

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41) George I. Sanchez, *The Development of Higher Education in Mexico*, Westport, Connecticut: Greenwood Press, 1970, 94-5; de Gortari, *La historia*, 298-308.

42) Othon E. Brackel-Welda, "Apuntes sociologicos leidos en la Sociedad de Geografia y Estadistica", *Boletin de la Sociedad de Geografia y Estadistica de la Republica Mexicana* 2,11-12 (1894): 683; Barriero, *Resena*, 37-43.

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44) *Ibid.*, 93.

45) Alberto Ruiz y Sandoval, *El algodon en México*, México, D.F.: Oficina Tipografica de la Secretaria de Fomento, 1884.

46) Secretaria de Fomento, *Algunos documentos*, p. 12.

47) Julio Riquelme Inda, "El 'Max' del henequen", *Memoria y Revista de la Sociedad Cientifica Antonio Alzate* 35, 5-12 (September 1921): 313-8.

48) Guillermo Gandara, "Visita a algunas instituciones de botanica y parasitologia agricola de los Estados Unidos", *Memoria y Revista de la Sociedad Cientifica Antonio Alzate* 30, 7-9 (July 1911): 341-65.

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50) Enrique C. Creel, "Agricultura y agrarismo", *Memoria y Revista de la Academia Nacional de Ciencias Antonio Alzate* 51, 5-6 (1929-1930): 149-52.

51) See Herrera, "Estudios experimentales de plasmogena", *Memorias de la Sociedad Cientifica Antonio Alzate* 33, 9-10 (March 1913): 288-94, and his subsequent articles.

52) "Necrologia", *Agricultura*, 11,13 (July-August 1939): 37; Gandara, "La Oficina de Botanica Aplicada y de Plantas del Cultivo del Instituto Agronomico de Rusia", *Memoria y Revista de la Sociedad Cientifica Antonio Alzate* 46, 3-6 (March-June 1926): 183-92. Pandurang Khankhoje, "Somera descripcion de los productos obtenidos por el autor en el campo de la Estacion Experimental de la Escuela Nacional de Agricultura de Chapingo, a cargo del mismo, desde 1924 a 1930", *Memoria y Revista de la Sociedad Cientifica Antonio Alzate* 51, 11-12 (1929-1930): 447-59.

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54) For examples see *Sociedad de Amigos de la U.R.S.S. a las organizaciones de obreros, de campesinos, de intellectuales, de professionistas, etc. del Distrito Federal*, (no date). Gonzalo Robles papers. Correspondence Section. Box 41. Folder 31. AGN; Secretaria de Educacion Publica, *Instituto Politécnico Nacional Anuario 1939*, México, D.F.: Talleres Graficos de la Nacion, 1939, 61.

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56) "Campana para la explotacion racional del suelo", *Extension Agricola* 1,2 (March 1933): 69.

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58) For an example of French material, see the documents in Gonzalo Robles papers. Agriculture Section. Box 5. Folder 69. AGN.

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64) Gandara, "Modo de estimar la flora del Valle de México", *Memoria y Revista de la Sociedad Cientifica Antonio Alzate* 45, 1-6 (January-June 1926): 93.

65) Jesus Galindo y Villa, "Breve resena historica de la Sociedad Cientifica Antonio Alzate", *Memoria y Revista de la Sociedad Cientifica Antonio Alzate* 54, 4-6 (1934): 334.

66) See *Agros*, June, August, and October, 1923.

67) Gomez, *Biografias*, 110.

68) For example see Julio Pembert y Manterola, *Beneficio del cacao noticia sobre un sistema especial que para esta importante operacion se practica en la Isla de Sao Tome, colonia Portuguese del Africa Occidental*, México, D.F.: Secretaria de Agricultura y Fomento, 1921.

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70) Gomez, *Biografias*, 246.

71) *Ibid.*, 72.

72) Julio Riquelme Inda, "La entomologia y la agricultura", *Irigacion en México* 1,6 (October 1930): 54-58.

73) Fernando Torres Vivanco, "El uso de fertilizantes secundarios en la agricultura", *Revista del Comercio Exterior* 3 (April 1939).

74) Beltran, "Contribucion al estudio del Coccobacillus acridiorium d'Her", *Memorias y Revista de la Sociedad Cientifica Antonio Alzate* 46, 3-6 (March-June 1926): 129-53.

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79) For example see Gandara, "Desarrollo del cultivo del maiz en México", *Agricultura* 1,3 (November 1937): 10-1.

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88) For a discussion of Spanish refugee scientists in Mexico see Gonzalez y Gonzalez, *Historia*, 279, 290-1.

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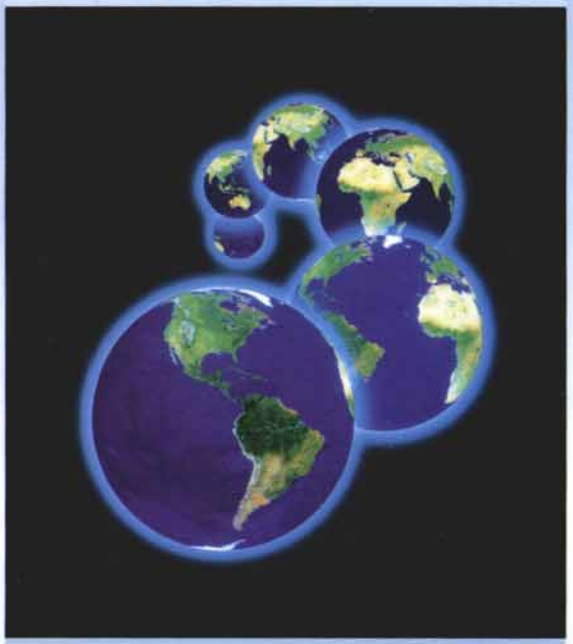

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