Electric Revolution: Energy, Environment, and the State in Early Twentieth-Century Mexico[1]

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In the late 1920s, federal authorities launched a large-scale revolutionary campaign of irrigation, electrification and population resettlement across rural Mexico. Closely associated with the presidency of Plutarco Elias Calles (1924-1928), this "autocolonization" effort began in earnest in the subsequent *maximato* period (1928-1936), during which Calles continued to exercise informal control over the executive and, thus, the federal policy of the revolutionary Mexican state.[2] Conceived in response to decades of instability and lagging growth, autocolonization reflected post-revolutionary goals agrarian reform, social justice, and land redistribution enshrined in the Constitution of 1917.[3] In subsequent administrations, presidents Lázaro Cárdenas and especially Manuel Ávila Camacho continued and expanded this campaign of autocolonization, firmly institutionalizing it within various federal ministries.[4]

Early autocolonization projects were located primarily in national territories distant from Mexico City, especially the "precarious north" where deeply-embedded U.S. economic interests threatened the

[1] Note: The following is the product of a nine-month research trip to Mexico City and Chihuahua made possible with grant support from the History Project and the Institute for New Economic Thinking (INET), as well as Fulbright-García Robles student research grant. This paper represents the first attempt to grapple with the larger narratives and theoretical commitments of this research. Rather than definitive and fine-grained, this paper is intended as an interpretive, synoptic, and preliminary exploration of a dissertation project very much in formation. In its final form, the periodization presented here is expected to cover three or perhaps four chapters.

[2] It should be noted that *autocolonization* referred not to a discrete project in itself, but to a revolutionary ideal within which could be applied to a variety of large-scale state projects. The first use of the term *autocolonization* (or, in this example, *auto colonization*) in regards to Mexico dates back to at least 1916 at a conference on global colonization efforts; see Luis Palacios, "El problema latino americano," *Memorias de la asociación de ingenieros y arquitectos de México* 24 (1916), p. 55. By the 1930s, however, this term had moved from engineering and policy circles into public discourse, appearing regularly on the pages of such periodicals as *Excélsior, El Nacional, El Universal,* and *La Prensa,* for example. See BMLT-AE, Colonización, 1928-1938, 1939-1986.

[3] The terms "revolutionary" and "post-revolutionary" can be confusing when talking about Mexican history. Although conventional narratives date the end of the formal revolution to 1917, 1920, or even 1929 (in the case of the *cristero* war), many "post-revolutionary" officials and engineers very clearly and explicitly described their work as part of an ongoing "revolutionary" project. This calls into question not only the chronology of the revolution, but the very kinds of activities which might be considered "revolutionary" (such as damming and irrigation). Thus, for the purposes of this study, "post-revolutionary" will be purely chronologically, while "revolutionary" will used qualitatively in referring to activities in the period following armed hostilities.

[4] Most involved in this project were the Secretaría de Agricultura y Fomento (SAF) and the Comisión Nacional de Irrigación (CNI), departments of which were merged in 1947 to create the Secretaría de Recursos Hidráulicos (SRH).

sovereignty of Mexico City even after the revolution, especially in the capital-intensive mining sector.[5] In fact, among the many obvious threats faced by the post-revolutionary government — from stagnating industry to agrarian underproduction to the concentration of landless poverty in central Mexico — officials placed a high priority on mitigating U.S. activity along the border.[6] Because inviting foreign influence into domestic affairs was seen as one of the cardinal sins of the autocratic administration of Porfirio Díaz, post-revolutionary officials and engineers saw state-led settlement in vulnerable and underdeveloped regions as necessity, and projects were soon planned across Baja California, Sonora, Sinaloa, Chihuahua, and Coahuila. With no clear indication in the late 1920s that U.S. territorial acquisition along the border had finally ceased, officials attempted a feat which had eluded the authority of the central valley of Mexico for centuries — to control the north.

The means of this federal control was largely hydraulic, and in practice took the form of various *distritos de riego* (irrigation districts). A precondition for economic, political, and social control in rural areas was a settled population. And the precondition for a settled population in the challenging environment of the north, as in the contemporary U.S. West, was careful control of scarce water

[5] The term is borrowed from leading Mexican water scholar at El Colegio de México and Chihuahua native Luis Aboites, in reference to the chronic difficulty in exerting control over this region; see Luis Aboites Aguilar, *Norte precario* (México D.F.: El Colegio de México, CIESAS, 1995). As a supervisor of this research, the vast body of Aboites' work on water in Chihuahua has been central in guiding its direction. Among many others, the most important to this project has been *La irrigación revolucionaria: historia del sistema nacional de riego del Río Conchos, Chihuahua, 1927-1938* (México D.F.: SEP, CIESAS, 1988) and, to a lesser extent, *Agua y tierra en la región del Conchos-San Pedro, Chihuahua, 1720-1938: fuentes para una historia agraria* (México D.F.: SEP, CIESAS, 1986) and *Demografía histórica y conflictos por el agua: dos estudios sobre 40 kilómetros de historia del río San Pedro, Chihuahua* (México D.F.: CIESAS, 2000). In addition, this project has also benefitted greatly from the work of students and colleagues of Aboites working in similar fields, including Rocío Castañeda González, *Irrigación y reforma agraria: las comunidades de riego del valle de Santa Rosalía, Chihuahua, 1920-1950* (México D.F.: Comisión Nacional del Agua, CIESAS, 1995); Eva Luisa Rivas Sada, "Cambio tecnológico, dinámica regional y reconversión productiva en el norte de México: la comarca lagunera 1925-1975" (Universidad Complutense de Madrid, 2011); and Luis Arturo Salmerón Sangines, "La presa la boquilla historia de un proyecto hidroélectrico en el Río Conchos, 1905-1930" (México, D.F.: UNAM, BA thesis, 2006).

[6] In the words of eminent Mexican hydraulic engineer Adolfo Orive Alba, "It was thought, with good reason, that works in the center of the country could wait, and instead it was necessary to execute immediately works harnessing international waters, if we were not to lose them definitively, in light of the active policy of water development which had been practiced in the United States for many years." Thus, developing the north was meant to counter not only U.S. acquisitiveness near the border, but also to prevent valuable natural resources from falling to Mexico's neighbor to the north. See Adolfo Orive Alba, "La política de irrigación," *Irrigación en México* 26:1 (1945), 15.

resources.[7] Especially in these first northern *distritos*, large-scale irrigation infrastructure provided the material framework within which federally-organized resettlement and land distribution was effected. Yet this was not a triumph of political will, as later officials often described it. In the northern deserts, where climate and geography conspired against irrigation by gravity, it was electricity which made these *distritos* possible.

Electricity was necessary to support industry and spur development along the canals where resettled farmers were expected to cultivate the soil. In addition, federal development studies revealed what foreign promoters already knew from experience – carving self-sustaining settlements out of the desert was a financially risky proposal. Thus, revenues earned from electrical generation were also meant to offset some of the substantial costs of making the desert bloom. Nearly every early autocolonization project was a dual-purpose development using diversion dams and reservoirs to regulate water flows for both electrical generation and agriculture.[8] Throughout the 1930s and the decades which followed, increasingly large, state-led hydroelectric damming and irrigation projects were built in every part of the country, accounting for a major portion of Mexican electrical generating capacity. Thus, while autocolonization is typically associated with land, water and farmers, it was electricity which proved the transformative element in this process.[9]

[7] There are striking similarities between the peopling of the U.S. West and the Mexican *norte* through large-scale hydraulic engineering in the first half of the nineteenth century which, it appears, have not yet been treated comparatively. While not at the center of this project, these common transnational processes loom large in the telling of this story, though it is not yet clear to what extent they will be explored in detail. As a model, Robert S. Thompson's history of Houston (and indeed, most of the U.S. South and Sunbelt) through air conditioning, has figured heavily in my thinking. It is worth noting that, even in Thompson's argument, household plumbing and electricity are necessary prerequisites. See Robert S. Thompson, "'The Air-Conditioning Capital of the World': Houston and Climate Control," in *Energy Metropolis: An Environmental History of Houston and the Gulf Coast*, ed. Martin V. Melosi and Joseph A. Pratt (Pittsburgh: University of Pittsburgh Press, 2007).For an example of hydraulic settlement north of the border, see see Mark Fiege, *Irrigated Eden: The Making of an Agricultural Landscape in the American West* (Seattle: University of Washington Press, 2009).

[8] As much of the engineering literature of this period reveals, this dual purpose approach had become official federal policy, reflecting similar contemporary policy decision-making across the border in the U.S. West. See, for example, José Herrera y Lasso, *La fuerza motriz en México* (México D.F.: Secretaría de Industria, Comercio y Trabajo., 1927); Donald J. Pisani, *Water and American Government: The Reclamation Bureau, National Water Policy, and the West, 1902-1935* (Berkeley: University of California Press, 2002).

[9] This was not an entirely straightforward process, however, as noted by Mikael Wolfe. In the Laguna, for example, the sheer quantity of subterranean water used in irrigation led to issues concerning the mineral content of

What had begun in the 1920s as a handful of irrigation proposals eventually grew to over a hundred *distritos*, redistributing people, water, crops, and electricity across the Mexican landscape. In their many writings in both official and public documents, the *técnicos* who conceived and implemented these projects described these as major contributions to the ongoing Mexican revolutionary project.[10] It is interesting to note, then, that this project of state-led nationalist development was in many cases quite literally driven by foreign power.

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Despite its national importance, electricity at the end of the Mexican revolution was generated and sold mostly by privately-held foreign companies. While some federally-developed projects were undertaken in the 1930s, the nationalization of the Mexican electrical industry did not begin until the 1940s, and was not completed until 1960. At the outbreak of revolution in 1910, the foundations of what would grow to become the national grid had already been financed, built, and maintained by foreigners — at first mostly by Anglo-Canadian interests and various European competitors.[11] By the 1920s, however, U.S. interests in the form of a series of General Electric (GE) holding companies came to dominate the

surface soils. More broadly, Wolfe argues that the implementation of intensive hydraulic development in order to create arable land for redistribution was not a sustainable developmental path over the long run. See Mikael Wolfe, "Water and Revolution: The Politics, Ecology and Technology of Agrarian Reform in 'La Laguna' Mexico" (PhD dissertation, University of Chicago, 2009).

[10] The term *técnicos* refers to the cadre of Mexican bureaucrat-engineers who were tasked after 1920 with proposing, planning, and executing public works of all scales. Typically working within a government ministry (quite often the Department of Agriculture and Development), these engineers were given wide range to develop the projects seen as necessary by federal officials. In addition, many of these *técnicos* were also prolific and, in some cases, fluent writers, often promoting their ideas in industry journals and the popular press alike. In this sense, they were similar to the *científicos* of the Porfiriato, with the exception that the latter relied on explicitly attracting foreign capital and expertise. Notably, the *técnico* and *científico* alike worked in close cooperation with foreign engineers. Among the most distinguished *técnicos* of the post-revolutionary era were Oscar C. Enriquez, Pablo Bistraín, José Herrera y Lasso, Adolfo Orive Alba, and Gonzalo Robles. See, for example, Adolfo Orive Alba, *La política de irrigación en México; historia; realizaciones; resultados agrícolas, económicos y sociales; perspectivas.* (México, D.F.: Fondo De Cultura Económica, 1960); Adolfo Orive Alba, *La irrigación en México.* (México, D.F.: Grijalbo, 1970); José Herrera y Lasso, *Apuntes sobre irrigación: notas sobre su organización económica en el extranjero y en el país* (México, D.F.: IMTA, CIESAS, 1994); José Herrera y Lasso, *La industria eléctrica, lo que al público interesa saber,* (México, D.F.: Editorial "Cultura," 1933).

[11] This period of extensive Canadian utilities promotion, which eventually gave way to U.S. ownership in Mexico, is explored in depth in Christopher Armstrong and Henry Vivian Nelles, *Southern Exposure: Canadian Promoters in Latin America and the Caribbean, 1896-1930* (Toronto: University of Toronto Press, 1988).

electrical industry in Mexico and, indeed, much of the world outside of Europe.[12] In the years which followed, federal electrical and hydraulic projects in Mexico typically grew out of existing, privately-owned systems, with which they cooperated for decades. This meant that, despite the clear national interests which had inspired autocolonization, many of Mexico's earliest *distritos* were quite literally built upon electrical grids which paid dividends to North American shareholders. This is not meant to undermine the legacy of such systems, but rather to draw attention to complicated and interrelated constellation of interests through which such systems emerged and evolved – from Mexican politicians and *técnicos* to provincial elites to foreign engineers and promoters to the smallholding farmers who settled in these northern colonies. In thinking about post-revolutionary Mexico, this project offers the idea of viewing infrastructure as a valuable archive in understanding large-scale change over time.

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This research project takes as its unit of study the Boquilla-Francke electrical system, which began as a single hydroelectric dam in 1915 and, by the time it was incorporated into the national grid, directly powered two of the north's most important *distritos de riego* — Delicias (#5) and the Laguna (#17). More than just an electrical grid, Boquilla-Francke linked five large hydroelectric dams (three private, two federal), sprawling networks of canals and diversion dams, tens of thousands of hectares of farmland, and a countless number of subterranean pumps which consistently evaded the surveillance federal regulators. And this count does not include the innumerable uses to which this electricity was applied – streetcars, public lighting, electric irons and fans, ore smelters, elevators, refrigerators, and

[12] Chief among these were the holding company the Electric Bond and Share Company (EBASCO), created in 1905, and its sub-holding company, the American and Foreign Power Company (AFPC). EBASCO was created to manage the various stocks, bonds, and shares accrued by GE from smaller, cash-poor electrical utilities over decades in exchange for maintenance, marketing, and management services. AFPC in particular represented most of GE's Latin American holdings. While EBASCO was legally separated from GE due to U.S. federal antitrust regulation in the 1935, the continuity of personnel, expertise, and especially GE-manufactured technology, meant this break was largely formal.

jackhammers, among others. In an environment as inhospitable as the deserts and scrublands of Chihuahua, defined for centuries by transience, electricity was truly a transcendental force.

In the vicinity of *distrito* #5 in Delicias, Chihuahua, irrigation works linked to Boquilla-Francke transformed the arid canyon valley of the Río Conchos into one of the most intensively-farmed regions in Mexico in a matter of years. And by virtue of a groundbreaking high-tension transmission line, it also delivered electricity nearly 250 miles southward to the Laguna, a long-settled agricultural region along the Río Nazas.[13] There, in the absence of hydraulic works to regulate flows, farmers began pumping the Laguna's extensive underground aquifers after 1920, using electrical technology to harness the cascades of the Conchos hundreds of miles away to irrigate the banks of the Nazas with subterranean water. Boquilla-Francke was a massive *envirotechnical* system which spread across three of Mexico's largest northern states, but which was implicated in much wider political and economic networks touching El Paso, Mexico City, New York, Toronto, Montreal, London and Zurich.[14]

In taking the development and growth of the Boquilla-Francke system as a unit of study, this project seeks to understand the complicated nature of state-led development, especially in a place such as post-revolutionary Mexico where expediency made partners of domestic political will and foreign technology and capital. More specifically, it seeks to trace the process of coproduction between changing energy and political regimes.[15] While the system's first dam, called La Boquilla, was essentially a monument to the liberal economic policies of the Porfiriato, it became a very real engine of change for

[13] La Laguna (or Comarca Lagunera) is an extensive agricultural region located on the border the states of Durango and Coahuila. It is comprised of three distinct settlements: Ciudad Lerdo, Gómez Palacio, and Torreón, the last of which is the largest and the only one in Coahuila. La Laguna is located on the Río Nazas which, like the Conchos, experienced irregular flows and was prone to flooding at this time. Unlike the Conchos, however, the Nazas is part of an *endorheic* watershed with no outlet to the sea. The Nazas, instead, drains to a series of inland lagoons, giving the region its name.

[14] The term *envirotechnical* here identifies this project with the work of a growing group of historians and other scholars committed to destabilizing the conventional differentiation between environment and technology in historical thinking. In Mexico, Mikael Wolfe's work on irrigation systems is explicit in its *envirotech* approach. See Wolfe, "Water and Revolution." On the *envirotech* approach, see Martin Reuss and Stephen H. Cutcliffe, eds., *The Illusory Boundary: Environment and Technology in History* (Charlottesville: University of Virginia Press, 2010).

[15] Here, I borrow the STS term *coproduction* to refer to the mutual shaping and reshaping of technological and political knowledges in the material transformation of Mexican society. As an example, see Sheila Jasanoff, *States of Knowledge: The Co-Production of Science and Social Order* (New York: Routledge, 2004).

post-revolutionary officials who applied it to the transformation the Mexican landscape – a process with profound political and social implications. This analysis of the Boquilla-Francke system, then, seeks to challenge conventional narratives of exploitation and expropriation common to economic histories of the borderlands, and instead highlight the processes adaptation and negotiation through which this system evolved.

In conventional terms, the story of Mexican autocolonization might be viewed through the lens of expanding federal authority guided by the ideals of an emerging nationalist-revolutionary political project. One can make the case that the post-revolutionary government bears more than a passing resemblance to the paradigmatic "high-modernist state", especially in its explicit desire to rationalize society and stamp national authority onto the environment.[16] This interpretation aligns rather neatly with the major historiographical debates about the scale, nature, and endurance of the post-revolutionary Mexican state. Without altogether setting aside this essential and tested interpretive framework, this study is meant to complicate the concept of the post-revolutionary Mexican national state by locating the practice of power in large-scale (indeed, multiscalar) material transformation. In doing so, it identifies infrastructure, and especially the electrical grid, as a privileged analytical site.

[16] In thinking about the concept of "the state", this study draws much from the work of political scientist James C. Scott and historical sociologist Philip Abrams as both conceptual framework and critical point of departure. The post-revolutionary nationalist project of autocolonization in Mexico displayed many of the hallmarks of Scott's "high-modernist state" in a sustained and unmistakable way. The implementation of massive irrigation-electrification projects accompanied by extensive agricultural resettlement which occurred in Mexico reflects paradigmatically the "bracketed" vision of state activity proposed by Scott. Yet, departing from Scott, this study seeks explicitly to challenge the notion of "the state" as a distinct regime of interests which is necessarily outside and inimical to both society and the environment. In seeking to understand the multitude of interests embedded in such large technological projects, across scales of geography and economy and politics, this study seeks to push the analytical limits of the "high-modernist state." In the same spirit, this study draws on Abrams' notion that "[t]he state is not the reality which stands behind the mask of political practice. It is itself the mask…" While Abrams lays out a broad analytical framework which distinguishes between "state-system" and "state-idea," his main influence here is in attention toward relationships rather than things. In the case of the Boquilla-Francke system and the large irrigation projects within which it was embedded, rather than describe how "the state" operated, it instead seeks to describe the material practices and relationships ("state-system") implicated in these large-scale transformations and, thusly, understand how such practices come to be understood as unified ("state-idea"). See James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven: Yale University Press, 1998); Philip Abrams, "Notes on the Difficulty of Studying the State (1977)," *JOHS Journal of Historical Sociology* 1, no. 1 (1988): 58–89.

With the above in mind, this study of a large technical system seeks to complicate not only working concepts of "the state" in historical analysis, but also the many ways in which this concept is entwined with "empire," particularly in the historiography Mexico-U.S. relations. The creation and expansion of Boquilla-Francke was clearly transnational, but its relationship to empire was complicated. In the years after the revolution, it was the nationalist-revolutionary discourse of autocolonization which most explicitly framed projects like Boquilla-Francke and irrigation districts in imperial terms. At the same time, the ongoing Mexican project of state-building which intensified in the 1930s was, via electrification, an explicitly transnational process, mediated by flows of capital, technology, and expertise. What follows is intended to open a critical conversation around the complicated relationship between empire and the state in large-scale material transformation, as well as their analytical effectiveness in the discipline of history which has in recent years begun to embrace – perhaps too uncritically in some cases – the broad concept of *transnationalism.*[17]

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Construction was completed on La Boquilla on the Río Conchos in 1915, just as Chihuahua was about to be shaken by some of the most intense fighting of the revolution. Delayed at first by flash flooding, construction was held up again by train stoppages, labor shortages, and the general instability produced by the insurgency. Even after completion, the dam did not begin to provide power locally until 1918, as the isolated work site proved an easy target for the remaining vestiges of Pancho Villa's once-

[17] A brief note on the use of the term *transnational*: I use this term here as it has been conventionally used, albeit with some hesitancy. Theoretically, I believe the *transnational* turn has been among the most important (relatively) recent moves in the discipline of history, especially in the last decade and within the U.S. historiography, because it pierces the related discursive veils of nation and empire and decompartmentalizes the enduring assumptions of area-studies approaches. However, in practice, it often seems *transnational* is employed in a rather basic sense to refer to large-scale changes which cross international borders – a tendency which serves to reify rather than dissolve *the nation* as an analytical concept. Both my attraction to, and wariness of, *transnationalism* is related to this tendency, as the concept is of little use of it doesn't seek to disrupt national-imperial narratives.

dominant Northern Division, and fell prey to raids, hostage-taking, and sabotage which federal authorities struggled to contain.[18]

The concession for La Boquilla was granted to Chihuahua lawyer Joaquin Cortázar Jr. and his associate Pablo (sometimes Paul) Ginther in 1905, during the waning years of the Porfirio Díaz regime (1876-1911), in which modernization was pursued through the aggressive courting of foreign capital and expertise. In reality, two hydroelectric concessions were granted at this time on the same stretch of the Conchos. In addition to that held by Cortázar and Ginther, another was granted to Schondube & Neugebauer (S&N), the exclusive Mexican agent of German electrical giant Allgemeine Elektricitäts-Gesellschaft (AEG), responsible for infrastructural projects throughout the country. After reaching terms with S&N, Cortázar and Ginther were allowed to combine these concessions within a single contract upon promising to complete both – an obligation which federal officials would invoke in the years after the revolution. Facing capital shortages due to international recession in 1907, the concession was transferred to the newly-formed company which would operate much of the Boquilla-Francke system until nationalization in 1960 – the Compañía Agrícola y Fuerza Eléctrica del Río Conchos (CAFERC).

This process of concession and transfer was not as straightforward as it might seem. In fact, it was just one episode in a much larger wave of infrastructural, and especially electrical, promotion throughout much of Latin America. Although formally a Mexican company, the CAFERC was widely known to be an Anglo-Canadian investment enterprise for the Bank of Montreal and Bank of Toronto – institutions with virtually identical boards of directors and operating essentially as one.[19] As they had done elsewhere, this group of investors created a "free-standing company" in Mexico and another with

[18] Company officials described these attacks in requests for federal army protection via the SAF. This series of exchanges demonstrate the inability of federal forces to act in the north, as scattered *villista* forces regularly toppled transmission lines, looted work camps, and even threatened to dynamite La Boquilla to wash out railroad bridges downstream. Although company officials requested a detail of Yaqui natives to serve on a private guard detail, it seems a small federal detachment was ultimately assigned, allowing transmission of begin in earnest in 1918, a full three years after the dam's completion. See AHA-AN, caja 113, exp. 1097, leg. 146, f. 13.

[19] For example, in a letter dated 15 November 1909 to SAF minister Olegario Molina, CAFERC attorney Joaquín Casasús explicitly refers to his client as a "Canadian" company; AHA-AN, caja 102, exp. 1097, leg. 2, f. 37.

the same officers in Canada, in this case known as the Mexican Northern Power Company (MNPC).[20] Like the banks of Montreal and Toronto, the CAFERC and the MNPC were an interchangeable pair of concerns meant to bring together relatively lax Canadian finance law, British capital, and investment opportunities in Mexico. Flush with capital and wielding an extensive network of hydroelectric utilities promotors with decades of experience in Canada, this investment-promotion consortium was responsible for building some of the first grids throughout Latin America during this time, from Brazil to Cuba to Mexico.

The involvement of Cortázar and Ginther in this episode reveals the participation of yet another investment-promotion network within Mexico. Cortázar was not only a Chihuahua lawyer, but a member of a vast and well-connected society which ran the state as a virtual fiefdom before the revolution. In Porfirian Mexico, the apparent strength of the central government in promoting development was in fact rooted in the delegation of powers to state governors, who held almost total control over local affairs. This was especially true of the dynastic Creel-Terrazas family and their associates in Chihuahua, who exercised a controlling interest in nearly every productive activity in the state – mostly exporting cattle, cotton, silver and gold.[21] It was at the interface of these two social-economic networks that the original dam a La Boquilla emerged.

As the last Porfirian governor of Chihuahua, Enrique Creel's signature was literally all over the project at La Boquilla. Indeed, in his intermediary position between promotors and federal officials, Creel appeared to be among the project's most important advocates. But just as interestingly, Creel's signature

[20] This phenomenon is covered in William J. Hausman, Peter Hertner, and Mira Wilkins, *Global Electrification: Multinational Enterprise and International Finance in the History of Light and Power, 1878-2007* (Cambridge University Press, 2008). The specific case of the banks of Montreal and Toronto is covered in Christopher Armstrong and Henry Vivian Nelles, *Southern Exposure: Canadian Promoters in Latin America and the Caribbean, 1896-1930* (Toronto: University of Toronto Press, 1988).

[21] This extended family-client network, after retreating northward to the U.S. during the revolution, was largely able to reconstitute itself within Chihuahua after 1920. See especially Mark Wasserman, *Persistent Oligarchs: Elites and Politics in Chihuahua, Mexico, 1910-1940* (Durham: Duke University Press, 1993); also important to this project is the more recent Mark Wasserman, *Pesos and Politics: Business, Elites, Foreigners, and Government in Mexico, 1854-1940* (Stanford: Stanford University Press, 2015).

appears all over documents which reveal, like the Canadian investor-promotors, the extent of this investment-promotion consortium operating in northern Mexico.[22] Cortázar and Ginther were, from the beginning, well-connected Creel-Terrazas associates apparently acting in close coordination with prospective Canadian investors, local officials, and the office of President Porfirio Díaz.[23] While the official record describes a concession granted and legally transferred to Mexican corporate owners, private letters speak to a careful coordination of activities not only between state and federal officials, but also foreign corporate officers, engineers, and investors. No business happened in Chihuahua without approval of this network. While the economic liberalization of Díaz may have changed the rules and set the tone for Mexico's boom in foreign investment, it was local networks like those of the Creel-Terrazas of Chihuahua which turned potential into profit.

While capital to build La Boquilla was to be supplied by Canadian banks, hydraulic engineering expertise was, at first, contracted to S. Pearson & Son (SPS), the global engineering firm of Weetman Pearson (later Lord Cowdray), responsible for many of the largest engineering projects in the world at that time.[24] Although British, Pearson was a close associate of Díaz, and was responsible for Mexico's grand projects as well, including the final drainage of the lake bed around Mexico City and the construction of the port of Veracruz. For reasons not entirely clear, yet likely due to Pearson's general

[22] On this topic, the personal papers of Col. Ismael G. Zuñiga, *jefe politico* under Porfirio Diaz of Mapimí, Durango, are especially revealing. Held within the collection of Mexican politician and diplomat Fernando Iglesias Calderón, this group of mostly letters and telegrams reveals personal and professional interconnections across Mexico and the globe, including SPS agent John Body, sometimes CAFERC official Fred (Federico) Adams, Schondube and Neugebauer representatives, Laguna soap magnate Juan F. Brittingham, SAF secretary and Yucatecan henequen *hacendado* Olegario Molina, vice president Ramon Corral of Sonora, various state governors and presidential *científico* advisors, and even the president himself. In perhaps the most interesting series of exchanges, Diaz and Zuñiga discuss in partially-coded telegrams security arrangements for the historic Taft-Diaz summit in El Paso-Ciudad Juarez, including surveillance on potential Mexican agitators living in Los Angeles, California. Later telegrams from 1910-1911 document, albeit cryptically, Zuñiga's efforts to quell growing unrest in the north on behalf of the crumbling Porfirian government. See AGN-FIC, caja 16, exps. 9-21; AGN-FIC, caja 17, exps. 3, 4, 12-15, 20; AGN-FIC, caja 18, exps. 4-6, 15.

[23] And documents recording the creation of the CAFERC list another member, D. Juan A. Creel, as treasurer; AHA-AN, caja 102, exp. 1097, leg. 1, f. 73.

[24] Including the Blackwall Tunnel in London and most of the Hudson and East River tunnels in New York City. On Pearson's intimate involvement with the Porfirian government, see Paul Garner, *British Lions and Mexican Eagles: Business, Politics, and Empire in the Career of Weetman Pearson in Mexico, 1889–1919* (Stanford: Stanford University Press, 2011).

corporate reorientation toward oil exploration, SPS backed out of the project in 1912, leaving the CAFERC to develop the dam on its own.[25] The record is not entirely clear on the actual engineers who built La Boquilla, although evidence points to the involvement of General Electric via the MNPC.[26]

Upon completion, La Boquilla was one of the engineering feats of its time. Through its pioneering use of the concave arch and reinforced concrete, its increased strength allowed the creation of the reservoir now known as Lago Toronto. At over 30 miles long and 260 feet deep, the reservoir's sheer size was unprecedented in 1915. For about a decade after the revolution, La Boquilla's size combined with its 40,000 horsepower generating capacity (~30,000 kW) made it one of the largest and most powerful hydroelectric dams in the world.[27] Although large dams were also being built in Germany and British India, for example. La Boquilla was most similar to the methods of the U.S. Bureau of Reclamation which was also creating reservoirs out of isolated, arid canyons to open the U.S. West to industry, commerce, and human settlement.[28]

[25] A 1918 company letter to the SAF indicated that the CAFERC had differences with Pearson in 1912, but gives no details on the nature of this split; AHA-AN, caja 113, exp. 1097, leg. 145. Pearson's Mexican Eagle Petroleum Company came to control the majority of the Mexican oil industry by the time it was sold to Shell-Royal Dutch in 1919.

[26] Also unclear are the identities of the laborers who built the dam, although vague hints in the record hint at some possibilities. As it was built during the revolution, in a distant and inhospitable work camp, CAFERC officials regularly complained of labor shortages, suggesting an inability to retain local workers. As one of the premier engineering concerns of the British empire, with projects from India to England, Pearson was known to have used Asian laborers. In addition, his factotum in Mexico, John Body, mentions using *chino* labor in another Mexican project, although this might be interpreted in a number of ways. There is also evidence of a small community of people with Chinese surnames after 1920 in nearby Camargo, a town at that time known mostly as the train stop between Chihuahua and Torreon below the La Boquilla dam. This period also coincided with federal efforts to break up Yaqui communities in neighboring Sonora. Yaquis in this period were often resettled as agricultural laborers on the southeastern Yucatan peninsula or pressed into military service. So, although records have been hard to come by, it seems entirely plausible to suggest that La Boquilla was built in some combination of local, Asian, and perhaps Yaqui labor.

[27] Only the hydroelectric works at Necaxa, Puebla, which powered greater Mexico City, exceeded the generating capacity of La Boquilla, although the massive reservoir of the latter set it apart.

[28] German, and indeed most central European dams of this period, typically created relatively small but electrically powerful reservoirs high in the headwaters of Alpine rivers above dense human settlements. In British India, by contrast, engineers typically built massive, conventional gravity dams in rural areas, which used the weight of piled material to retain large reservoirs of water, used for both generation and irrigation. The creation of reinforced concrete arch dams with expansive and usually rural reservoirs used for both irrigation and electrification was a model unique to both the U.S. West and the Mexican *Norte*. See Fiege, *Irrigated Eden*; David P. Billington, Donald C. Jackson, and Martin V. Melosi, *The History of Large Federal Dams: Planning, Design, and Construction in the Era of Big Dams* (Government Printing Office, 2005).

At first glance, the rural upper Conchos valley might have seemed an unlikely site for such a massive capital investment — its isolation placed it far from consumer demand in an era when long-distance, high-tension transmission was still an emerging technology. But the site was ideally suited for serving the growing, U.S.-dominated Chihuahua mining industry centered in the nearby centers of Parral, Santa Eulalia, Santa Barbara, and San Francisco del Oro.[29] Electrification promised to transform the mining industry, long dependent on gasoline-powered generators, with cheap, smokeless and highly-fluid energy for motors, elevators, lights, and excavation machinery, among other uses. In addition, the auxiliary processing activities of the American Smelting and Refining Company (ASARCO) and public lighting and streetcar usage in the city of Chihuahua guaranteed future electrical demand. Although concessionaires had pitched the project as a public good meant to deliver electrical modernity to the underdeveloped Mexican north, the first and only transmission line after the revolution ran directly to Parral – a mining town with ownership ties to the CAFERC.[30] Rather than a "fountain of wealth," Cortázar, Ginther, and their associates had directed the hydraulic potential of the Conchos to generating profits for foreign investors and regional Creel-Terrazas associates.[31] As a relative stability returned to the north in the 1920s, a new cadre of nationalist *técnicos* in both Chihuahua and Mexico City turned their attention to the revolutionary potential this hydroelectric technology.

…

[29] Although most of these sites had been operating silver and gold mines since the seventeenth century, their output was limited by a variety of factors including labor shortages, native hostility, technological abilities and geographical isolation. Electrification dramatically altered the calculus of profit-making in the region, however, and La Boquilla, by its very existence, increased the potential value of nearby mines.

[30] It was not until 1925 that the CAFERC made serious efforts to expand its distribution system. Even then, most sites identified for service were mining camps, as well as the ASARCO plant in Ávalos, just outside the capital; see survey of CAFERC assets completed in May 1925, AHA-AN, caja 114, exp. 1097, leg. 151, fs. 38-171.

[31] This was the language used in the original concession request, AHA-AN, caja 102, exp. 1097, leg. 1, fs. 41-42. The same language also appeared in the 1916 report by Emil Bronimann, a surveyor and engineer involved with dozens of large-scale mining projects and related activities through both the U.S. West and Mexican *norte*. I am currently in the process of applying for grants to access Bronimann's personal papers, which are held at the Bancroft Library at the University of California, Berkeley. See AHA-AN, caja 115, leg. 1097, exp. 165, f. 18.

In the years immediately following the revolution, in keeping with Article 27 of the new constitution, a moratorium was placed on all concessions in the Conchos watershed.[32] Instead, following the urgings of Chihuahua governor Ignacio C. Enríquez, federal officials began to explore the possibility of a large-scale irrigation project on the valley. As the governor saw it, La Boquilla represented a windfall for the federal government, as it provided the energy and hydraulic control necessary to develop downriver projects along the notoriously irregular Conchos. And just as importantly, the significant costs incurred in construction, which were beyond the means of the federal government in the 1920s, had already been privately financed. Yet continuing political instability delayed federal involvement at the same moment that a series of legislation and executive decrees steadily reduced regional authority over Mexican natural resources. It was not until a few years after the creation of the Comisión Nacional de Irrigación (CNI) in 1926 that federal officials began the work of developing of large-scale irrigation districts in earnest.[33]

In the meantime, lacking the resources to develop projects at the federal level, officials began pressuring CAFERC officials to complete their two remaining contracted works on the Conchos.[34] The first, obtained from N&G almost two decades earlier, became La Colina, a much smaller dam just below La Boquilla used to regulate the larger outflows of the larger dam.[35] The other, granted during the revolution, became La Rosetilla, located even further downriver. Although individually these dams paled

[32] Article 27 of the Constitution of 1917 altered the relationship between the Mexican federal government and the environment, essentially making private ownership and exploitation of natural resources a privilege conferred by the state. It also granted expansive federal powers of expropriation in the name of public interest, and banned foreign landholding within 100 km of Mexican national borders.

[33] In practice, this moratorium involved not only denying new concessions, but invalidating exiting concessions which were deemed to be expired and expropriating lands for which no title could be found – a practice common to both pre- and post-revolutionary federal governments. See, for example, the 1924 invalidation of a water-use concession held Ausencio Urrutia by SAF officials: AHA-AN, caja 114, exp. 1097, leg. 150, fs. 73-74.

[34] CAFERC officials complained of the great hardships under which La Boquilla had been built, and attempted a series of legal maneuvers to free the company of these two concessions. SAF officials, however, responded that the revolution had not altered the legal status of these contracts and pleaded an inability to either dissolve these or return their associated deposits. This series of exchanges between SAF and CAFERC representatives is contained in AHA-AN, caja 114, exp. 1097, leg. 157, fs. 1-132.

[35] Today, Colina is known locally as a tourist destination, and is almost entirely encircled by hotels and dotted with boaters, fishermen, and waterskiers.

in comparison to La Boquilla, they were described by engineers as parts of an integrated hydroelectric system, allowing increased control over water flow and electrical generation in the Conchos valley. When these dams were completed in the late 1920s, they served as the foundation for what would become *distrito de riego #5* in Delicias, an integrated system of electrical and hydraulic management linked to colonization and federal land reform efforts. Granted during the Porfiriato to support mining and built during the revolution with Canadian capital, La Boquilla and its auxiliary dams were adapted to the new economic and political realities of post-revolutionary Mexico.

In 1931, the scale of this integrated system expanded dramatically. Facing drought conditions in Chihuahua and a general scarcity of electricity throughout the north, the Mexican Northern Power Company (MNPC) installed the massive Francke thermoelectric generator in the Laguna in an attempt to balance production throughout the system.[36] In addition, a high-tension aluminum transmission line was erected almost 200 miles across the largely unpopulated expanse between La Boquilla and the Francke generator, essentially doubling the system's capacity and greatly expanding its reliability and operational scale.[37] This not only electrically linked two distinct hydrological basins, but it began to reorient La Boquilla's energy toward a new kind of mining – water. While initial work had begun on the federal Palmito dam project upriver on the Río Nazas, the Laguna lacked large-scale hydraulic works like La Boquilla. As a consequence, local farmers had turned away from the unreliable flows of the Nazas and instead began irrigating crops with water drawn from the massive aquifer underneath the Laguna. The

[36] Although these chains of ownership and finance can be difficult to trace (indeed, that was often their purpose), it is reasonably clear that, by the late 1920s, the CAFERC and MNPC were two names for the same company, and that both were held by GE via EBASCO via AFPC. Thus, while the Boquilla-Francke system appeared on paper to be held by a series of different interests, I argue that the main organizational bodies were in fact two – GE-affiliated corporations and the Mexican federal government.

[37] The Francke thermoelectric plant was itself a state-of-the art engineering feat when it was installed, surpassing La Boquilla's generating capacity of 24,000 kW by about 17 percent, according to a joint CNI-CFE study in 1945, edited by eminent Mexican engineer Oscar R. Enríquez. This study served as the foundation for the nationalization and rationalization of the Mexican grid, a process which had already begun by the mid-1940s following nearly a decade of rural electrification efforts by the Comisión Federal de Electricidad (CFE). See *Estudio en cooperación: desarrollo eléctrico agrícola de los distritos de riego de la Laguna y Delicias y su relación con el sistema eléctrico interconectado Boquilla-Francke, Coahuila, Durango y Chihuahua,* in AHA-CT, caja 135, exp. 1120.

introduction of pumps powered by gasoline and, later, electricity, only intensified this practice.[38] By the late 1930s, federal authorities were unable to count all the *norias* (pumps), and estimated their numbers in the thousands.[39] With the Boquilla-Francke connection complete, this expanded system was primed to become a transformative force in the Mexican north.

…

The early 1930s also marked the beginning of the most intense phase of federal colonization within the new *distrito de riego* in Delicias.[40] And from the very beginning, this integrated system, a multitude of interests tied up in the system came into conflict. *Ejidos* granted within the federal lands of the Lago Toronto basin complained of losing their harvests to floods, for which the CAFERC was forced to compensate farmers.[41] The CAFERC, for their part, complained that flexibility of water storage was essential for electrical generation, and criticized federal officials for settling *ejidos* within the reservoir's limits in the first place.[42] Meanwhile, downstream farmers complained of both reduced flows of water and scarce electricity – two inputs equally essential to the intensive, large-scale irrigation which defined these *distritos*. Indeed, in times of drought sometimes lasting years, increased electrical generation only intensified exploitation of scarce downriver water resources, which again caused conflict between

[38] This history of this transformation of the Laguna is more extensive than that of either La Boquilla or the Boquilla-Francke system. See, for example, Wolfe, "Water and Revolution"; Mikael Wolfe, *Watering the Revolution: An Environmental and Technological History of Agrarian Reform in La Laguna, Mexico* (Durham: Duke University Press, 2016); María Vargas-Lobsinger, *La comarca lagunera: de la revolución a la expropiación de las haciendas, 1910-1940* (México D.F.: UNAM, Instituto Nacional de Estudios Históricos de la Revolución Mexicana, 1999); Eva Luisa Rivas Sada, "Cambio tecnológico, dinámica regional y reconversión productiva en el norte de México: la comarca lagunera 1925-1975" (PhD dissertation, Universidad Complutense de Madrid, 2011).

[39] A contract from 1941 shows that the CNI hired an inspector solely to inspect the pumps in and around the Laguna on a regular basis; AHA-CT, caja 137, exp. 1122, leg. 5, fs. 293-295. Engineer Paul Waitz reported that there were no pumps in use in 1920, but that by the late 1930s, at least a 1,000 were in use; AHA-CT, caja 137, exp. 1122, leg. 1, fs. 1-61.

[40] Formally founded in 1933, Delicias is popularly considered among the youngest cities in Mexico after Cancún.

[41] *Ejidos* were the basic unit of land redistribution and agrarian reform throughout Mexico after the revolution. While the nature of these places varied dramatically from place to place, they were essentially federally-granted agricultural lands held and worked in common by formerly landless or smallholding farmers. *Ejidos* represented the bulk of landholding within the *distritos de riego* #5 and #17.

[42] There is extensive documentation two instances of flooding as well in the 1930s and 1940s as well as droughts in AHA-AN, caja 115, exp. 1097, leg. 160, fs. 1-250. In addition, *ejidatario* complaints were also recorded in land tenancy documents, AGA-RD, mun. San Francisco de Conchos, pob. San José, leg. 4, exp. 3634.

farmers. In fact, a federal inspection of canals in the district found dozens of cases of farmers using illegal gas-powered pumps and hoses — often in the form of U.S.-built tractors — to access waters upriver from their own lands before they reached their neighbors. In a variety of ways, the dual factors which had transformed Delicias – water and power – came into direct conflict, forcing federal officials to constantly renegotiate the needs of agriculture, mining, industry and the federal credit agencies responsible for making these *distritos de riego* financially solvent. Over time, these overlapping claims on resources and energy invited, or perhaps demanded, increasing federal mediation, even more firmly establishing this growing agro-electrical system within the project of Mexican autocolonization. Caught in the center of these debates was the owner of La Boquilla and its electrical assets, the CAFERC-MNPC, still under foreign management.

While electrical demand for mining continued through the 1930s, CAFERC-MNPC activities in the Conchos basin became ever more integrated into the needs of federal irrigation projects. This was not entirely voluntary. As it became clear that the needs of irrigation and electrical generation would likely remain in constant conflict, for example, federal authorities began to require CAFERC officials to submit detailed monthly reports on water levels and electrical generation. With time, this obligation evolved into compulsory production schedules drafted and monitored by federal regulators, ensuring that La Boquilla and its associated works most effectively served national interests.[43] Facing a political environment in which, by the late 1930s, expropriation was a distinct possibility, company officials had little choice but to consent.[44]

This is not to say, however, that the CAFERC acquiesced to its important role in Mexican autocolonization. In fact, global economic depression of the 1930s marked a clear turning point in the

[43] Correspondence between SAF and CAFERC officials shows that, by the early 1940s, in practice, federal officials directly managed electrical generation, water storage, and user rates at the CAFERC's three Chihuahua dams. And although these letters appear to speak to a cooperative relationship, over the long run, federal regulation undercut the original profitability of foreign utilities promotion. See AHA-AN, caja 115, exp. 1097, leg. 160.

[44] Most infamously, for foreign investors, the Mexican petroleum industry was nationalized in 1938 by president Lázaro Cárdenas.

relationship between many foreign-owned electrical utilities and their Mexican assets. Increased strike activity in post-revolutionary Mexico, often with tacit government approval, raised worker salaries and thus reduced investors' returns. This, combined with a falling peso, rising tariffs, and chronic government delinquency in paying its own electrical accounts discouraged further foreign investment in the Mexican electrical industry. After 1932, many of these companies ceased paying dividends.[45] Seeing little future in Mexican utilities investment but holding significant material assets in the Boquilla-Francke system, CAFERC officials effectively chose to cut their losses and pass the costs of depreciation and amortization off to the system's future owner. Having begun in the mid-1940s, the federal development bank Nacional Financiera (NF) finalized the purchase of all foreign electrical assets in Mexico in 1960.[46]

…

By the early 1940s, the Conchos basin in the vicinity of Delicias had grown into a sprawling complex of irrigation canals, pumps, dams, and reservoirs. Having gained control over the Conchos through the CAFERC's three initial dams, federal engineers had built a canal running roughly parallel to the river's course all the way downriver to the next major tributary, the Río San Pedro. There, they build the K-105 diversion dam, allowing engineers to administer the waters of the San Pedro as well as the Conchos to the lands around Delicias. This established a large perimeter of hydraulic control within which the *distrito de riego #5* in Delicias was framed. As drought struck the north again in the early 1940s, electrical production at La Boquilla had to cease altogether to prevent air from entering the turbines. Partially for this reason, further upriver on the San Pedro, initial work by federal engineers began on the Francisco I. Madero federal dam, adding a second massive reservoir to the Boquilla-Francke

[45] This period of divestment in Mexican electrical assets is treated in Reinhard Liehr and Mariano Enrique Torres Bautista, "Las compañías eléctricas extranjeras y la modernización urbana e industrial de México, 1880-1960," in *Las compañías eléctricas extranjeras en México, 1880-1960*, ed. Mariano Enrique Torres Bautista and Reinhard Liehr (Puebla: Benemérita Universidad Autónoma de Puebla, 2010), 17–66.

[46] Interestingly, this included all existing grids in the country with the exception of Luz y Fuerza del Centro (LyFC), formerly the Canadian-owned Mexican Light and Power Company (1898), which supplied electricity to the federal district, the state of Mexico, and parts of central Mexican states Hidalgo, Morelos and Puebla. LyFC was combined with the CFE in 2009, though its distinctive logo still appears on manhole covers around Mexico City.

system. This dam, known colloquially as Las Vírgenes, would boost electrical capacity and increase control over hydraulic resources in the *distrito de riego #5* upon completion in 1949. In the meantime, Delicias grew into a major northern agricultural center specializing in cotton production, among a wide range of other crops and industrial activities.[47]

…

By the eve of WWII, Mexican engineers and planners identified energy scarcity as the primary threat to the ongoing project of colonization and industrialization, a problem which was acutely felt in the rapidly-growing northern states.[48] Having sought for years to develop a more export-driven economy, engineers saw in the demands of global warfare a major economic opportunity for Mexico. At precisely the moment that Mexico needed to move production onto war footing, it found its electrical system — regional, aging, undercapitalized, and still largely foreign-owned — unequal to the task. The push to nationalize the Mexican electrical industry was part of this deliberate effort to maximize potential, increase capacity, and achieve economies of scale in the national grid. Mexico experienced between 1940 and 1970 a boom in sustained economic growth, in large part driven by import-substitution manufacturing supported by ongoing electrification projects. Though electrical scarcity was a constant concern, especially as the country's electrical portfolio was heavily invested in drought-prone hydroelectricity, federal efforts to expand generation were, by and large, a success. While many privately-held grids were in various states of stagnation, their very existence represented a technological and capital investment which Mexican engineers adapted effectively into a national grid. At this time, federal officials began

[47] Both Delicias and the Laguna became major cotton centers as a result of federal colonization projects. With the collapse of cotton prices in the 1950s, both were forced to diversify into other activities such as dairy production. Today, the Laguna is home to one of Mexico's largest dairy companies, Grupo Lala, and Chihuahua also supports a thriving regional dairy industry.

[48] On this topic, the personal papers of engineer Gonzalo Robles offer a comprehensive view of the Mexican electrical industry as well as the federal financing of *ejidos* from the late 1920s to the 1950s. See especially AGN-GR, caja 28, exps. 13-28; and AGN-GR, caja 61, exps. 1-10.

efforts to consolidate and rationalize electrical production, which culminated in 1960 with the forced federal purchase of all remaining private electrical assets in Mexico.[49]

Owing in large part to the technical requirement and specifications of electrical generation and distribution, the process of consolidation and centralization alone increased system efficiency and output. This, coupled with ongoing federal damming and irrigation projects, laid the foundations for the economic boom often called the "Mexican miracle." In Chihuahua, as in the Laguna, this was a process very directly linked to the transformation of the landscape through hydraulic control – a process which began as an investment for foreigners and grew into a project of autocolonization in which federal power was projected through the flows of water and electricity and credit. Although the case of the Boquilla-Francke system and the *distritos de riego* within which it was embedded offer perhaps one of the clearest examples of this process, it was hardly unique. Virtually the entire Mexican grid was foreign-built before the 1930s and irrigation districts were eventually built throughout the country, rearticulating relationships between environment, technology, and society. In this sense, this "miracle" of agriculture, manufacturing, and export is not so miraculous when one considers the agro-electric revolution upon which it was built, already decades in the making. This is a story of land and water, of factories and farms, of engineers and investors and *ejido* farmers. But, critically, it is a story of energy.

…

By the late 1940s, this emerging hydroelectric system contained three private dams (La Boquilla, Colina, Rosetilla), two federal dams (Palmito on the Nazas, Las Vírgenes on the San Pedro), a private thermoelectric generator (Francke), two federal diversion dams (K-105 and Ojo Caliente) and many thousands of miles of private copper and aluminum transmission lines and federal canals and distribution channels. Until 1960, this was in system in which foreign utilities promotion and federal autocolonization

[49] This included all CAFERC-MNPC assets, as well as those of other companies in every part of the country. Although this purchase was compulsory, and was effectively a nationalization of the industry, sale records seem to indicate that the sale was amenable to both parties, and foreign electrical representatives felt fairly compensated. See AHA-AN, caja 115, exp. 1097, leg. 161, fs. 57-173.

efforts could not be meaningfully separated. Unwittingly, and often unwillingly, these projects were tied together through electrical technology – power lines made them parts of a common story.

The case of the Boquilla-Francke electrical system offers a chance to explore the emergence of a large envirotechnical system through a period of profound social, economic, and political transformation. Most obvious, in this case, are the dual projects of nation-making and state-formation in Mexico (under the cipher of autocolonization) within which the construction and expansion of Boquilla-Francke was integrated. Implicated in these ostensibly internal processes, however, are large-scale, global flows of capital and technology which, while ostensibly at odds with the evolving articulations of Mexican nationalism, were a materially important element of the state's expanding ability to act. In this sense, the agro-electric autocolonization of Mexico's rural borderland and the hydraulic peopling of the U.S. West were two instances of a common process. In thinking away from the national framings often favored in narrating change in post-revolutionary Mexico and toward the material relationships through which power is exercised, this study suggests a reconsideration of both "the state" and "empire" – both within and across conventional legal-political-economic frontiers.

Rather than narrating Boquilla-Francke as a story of simple electrification, this project seeks instead to offer an analysis of the relationship between technological change and the practice of power — especially political and economic. This is especially important to the history of electricity, or indeed of any energy system, as it is so transformative, fundamental, and all-encompassing.[50] Energy systems in particular are unique and promising material texts for exploring change across broad temporal and geographical scales — their naturally sprawling environmental arrays represent large capital and political investments, as well as potential for change. In Chihuahua, so historically inimical to human settlement, this transcendental potential is inscribed today in the landscape itself, where green polygon patches and

[50] In this underlying concern with the relationship between political practices and energy regimes, my thinking has been powerfully influenced by Timothy Mitchell, *Carbon Democracy: Political Power in the Age of Oil* (London; New York: Verso, 2011).

grids of water stand out from the sandy backdrop of the desert. Perhaps fittingly, from a bird's-eye view, the lines which deliver the energy in this system are practically invisible.

Power lines are so deeply embedded in our daily lives that we rarely notice their presence. But when the power goes out, and a blackout reminds us of the electrically-mediated existence of contemporary human society, power lines are impossible to ignore. An electrical system is not just a human artifact – a byproduct of our human tendency toward convenience – it is structure which both shapes and is shaped by society.[51] When one begins to seek out power lines, and considers the dizzying network implicit in even the seemingly mundane act of flipping a switch, new light might be shed in our thinking about change over time.

Electrification did not emerge in a vacuum, it was not apolitical, and it cannot be understood in the totalizing discourse of *progress* favored by the promotors, investors, and bureaucrats who built it. As a generation of STS scholars have proven, technological change does not unfold outside of the realm human society. It is not a self-propelled phenomenon.[52] In fact, the technological arrays within which societies are situated – quite literally "artificial" – are all too human, because they are inscribed with the goals, needs, hopes, and fears of their builders. Electrical systems, and the power lines through which we experience them, have been a historical fact of the last century of human existence. And these grids can be read in the contexts of the conflict and cooperation which shaped them, often across scales which defy conventional historical descriptions of anthropogenic change. That is to say, Boquilla-Franke is a material

[51] This important idea is drawn from Social Construction of Technology (SCOT) thinking, a subfield of science and technology studies. While the literature here is wide and dates back to the 1970s, two works in particular have informed this project's approach to electrical systems: Thomas Parke Hughes, *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore: Johns Hopkins University Press, 1983), and David E. Nye, *Electrifying America: Social Meanings of a New Technology, 1880-1940* (Cambridge: MIT Press, 1992). On SCOT, the classic text remains Wiebe E. Bijker, Thomas Parke Hughes, and Trevor Pinch, *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge: MIT Press, 2012).

[52] This is perhaps one of the more productive "problem spaces" in the history of technological change over the past two decades. For a survey of the debates on this topic, see Merritt Roe Smith and Leo Marx, eds., *Does Technology Drive History?: The Dilemma of Technological Determinism* (Cambridge: MIT Press, 1994).

text which both *reflects* historical change and *effects* ongoing changes today, often in ways which are not immediately obvious. This observation could not be more pressing in its implications on our contemporary intellectual climate. The revolution in the scale of human activity over the past two centuries is in essence an energy revolution. If we are to confront the grave consequences of our energy story, we must continue to read energy back into our history, as well as our everyday lives.

Abbreviations

- AFPC – American and Foreign Power Company
- AHPM – Acervo Histórico del Palacio de Minería
    - BAMA – Biblioteca Antonio M. Anza
- AGA – Archivo General Agrario
    - D – Dotaciones
    - RD – Reconocimiento de Derechos
- AGN – Archivo General de la Nación
    - FIC – Fondo Fernando Iglesias Calderón
    - GR – Fondo Ing. Gonzalo Robles
- AHA – Archivo Histórico del Agua
    - AN – Aguas Nacionales
    - AS – Aprovechamientos Superficiales
    - CT – Consultivos Técnicos
- ASARCO – American Smelting and Refining Company
- BMLT – Biblioteca Miguel Lerdo de Tejada
    - AE– Archivo Económico
- CAFERC – Compañía Agrícola y de Fuerza Eléctrica del Río Conchos
- CEMN – Compañía Eléctrica Mexicana del Norte (see MNPC)
- CFE – Comisión Federal de Electricidad
- CNI – Comisión Nacional de Irrigación
- EBASCO – Electric Bond and Share Company
- GE – General Electric Company
- miSci – Museum of Innovation and Science Archive
    - GEC – General Electric Collection
- MMOyB – Mapoteca Manuel Orozco y Berra
- MNPC – Mexican Northern Power Company (see CEMN)
- NF – Nacional Financiera
- SAF – Secretaría de Agricultura y Fomento
- S&N- Schondube & Neugebauer
- SPS – S. Pearson & Son
- SRH – Secretaría de Recursos Hidráulicos