

**Drought in the *sertão* as a natural or social phenomenon:
establishing the Inspetoria Federal de Obras Contra as Secas, 1909-1923**
A seca no sertão como fenômeno natural ou social:
estabelecendo a Inspetoria Federal de Obras Contra as Secas, 1909-1923

Eve Elizabeth Buckley¹

Abstract: This paper examines interpretations of the drought problem in Brazil's northeast *sertão* during the First Republic. It compares analysis of drought as primarily a natural or climatic phenomenon – embraced by civil engineers working for the Inspetoria [Federal] de Obras Contra as Secas (IFOCS) – with analyses emphasizing social and political conditions that made drought a crisis for the *sertanejo* poor. The latter are evident in the report of doctors Belisário Penna and Artur Neiva describing their expedition through the *sertão* sponsored by IFOCS in 1912. This comparison allows for consideration of the intersection between natural (geographic, climatic) and social (political, cultural) factors that produced the region's periodic crisis. The analysis is informed by the work of social scientists who highlight the multi-dimensional causes underlying natural disasters in politically marginal communities. Technocrats' faith in the context-independent utility of their expertise lay at the heart of IFOCS's ultimate failure to rescue *sertanejos* from famine, migration and poverty. Because the drought agency's technical personnel never had the political will or muscle to confront the social organization underlying the *sertão*'s recurrent calamity, their ability to alleviate the human suffering that droughts precipitated was severely limited.

Keywords: Drought. Northeast Brazil. Development. Engineers. Public health.

Resumo: O artigo examina interpretações do problema das secas no sertão nordestino brasileiro durante a Primeira República. Compara as análises da seca como um fenômeno primeiramente natural ou climático – abraçadas pelos engenheiros civis trabalhando para a Inspetoria [Federal] de Obras Contra as Secas (IFOCS) – com análises que enfatizavam as condições sociais e políticas que fizeram da seca uma crise para os pobres sertanejos. Essa interpretação é evidente no relatório dos médicos Belisário Penna e Artur Neiva que descreve a expedição deles através do sertão, patrocinada pelo IFOCS no ano 1912. Essa comparação permite a consideração da interseção entre fatores naturais (geográficos, climáticos) e sociais (políticos, culturais) que produziam a crise periódica da região. A análise é informada pelo trabalho de cientistas sociais que destacam as múltiplas causas de desastres naturais em comunidades politicamente marginais. A fé dos técnicos na utilidade do seu conhecimento, independente do contexto social, coloca-se no centro da inabilidade do IFOCS em resgatar os sertanejos da fome, migração e pobreza. Em razão dos técnicos da inspetoria nunca terem tido a vontade política ou a força para enfrentar a organização social responsável pela calamidade periódica no sertão, a habilidade deles em aliviar o sofrimento humano precipitado pelas secas era severamente limitada.

Palavras-chave: Seca. Nordeste brasileiro. Desenvolvimento. Engenheiros. Saúde pública.

¹ University of Delaware. Department of History. Newark, Delaware, USA (ebuckley@udel.edu).

INTRODUCTION

Recent historiography of natural disasters emphasizes that the impact of such events on human populations depends on the political and economic organization of the societies affected (Davis, 2001). People who subsist on the margins of the political or economic order prevailing in their locales are most likely to suffer when hurricanes, droughts or famines strike, while those in more secure positions are better able to weather such calamities (Sen, 1981; Magalhães and Magee, 1994). Yet engineers involved in planning public works for Northeast Brazil's semi-arid hinterland (the *sertão*) during the early 20th century rarely discussed the social inequities that made periodic drought a catastrophe for the region's *sertanejo* poor. Instead, they focused their efforts on the *sertão*'s outdated hydrologic, transportation, and agricultural infrastructure. Developers' emphasis on technological problems overlooked the imbalance of power between social sectors that left millions of landless *sertanejo* families and small farmers vulnerable to droughts and subsequent famine.

Consequently, drought relief was not implemented in a way that increased the security of those most harshly affected by drought, such as by granting them ownership of small plots for irrigated cultivation. The dams and roads provided by Brazil's drought agency merely reinforced existing social relations in a place where land and production were controlled by a narrow stratum of the population. These social dynamics, which left the security of landless *sertanejos* in the hands of their employers and political patrons, were in many ways the root of the drought crisis.

Brazil's federal drought works agency, Inspetoria Federal de Obras Contra as Secas (IFOCS), oversaw the construction of hundreds of dams and reservoirs throughout the *sertão* starting in 1909. Nevertheless, contemporary observers believe that the suffering of drought victims did not alter substantially during the agency's first century in operation (Duarte, 1999, 2002). Few of IFOCS's reservoirs (many of which are on private property) were linked to irrigation networks in order to intensify agricultural

production. Corollary projects like agricultural extension stations, public health posts, and improved education for the poor were pursued only sporadically. As several of the agency's hydrologic engineers pointed out ruefully during interviews in 2002, the dams that they and their predecessors built were never intended to resolve the drought problem by themselves – they were constructed as the first step in a multi-faceted development plan. In the absence of other crucial components, water retention has had little impact on the plight of the poorest *sertanejos*. With no secure land rights or storage facilities for good harvests, insufficient food reserves, paltry access to credit, and poorly administered relief efforts, smallholders and the landless have been devastated repeatedly by drought.

This paper begins by examining the professional and political motivations that led civil engineers who oversaw IFOCS during Brazil's First Republic to focus on climate instability rather than social organization as the cause of the *sertão*'s wrenching drought crises. It juxtaposes this analysis with Dr. Beilsário Penna's vehement assertion, following his rural public health surveys in the 1910s, that the variety of hardships suffered by Brazil's *sertanejo* poor stemmed from their social and political marginality. Penna (1868-1939), a veteran of Brazil's early 20th century campaigns against yellow fever who would become the first director of its Rural Sanitation Service in 1918, was one of the first advocates of *sertão* modernization to counter the simplistic technological determinism of IFOCS's managing engineers.

In opposition to the argument that dams and irrigation canals would solve the *sertão*'s periodic drought crisis, some twentieth-century Brazilian intellectuals and social reformers, including Penna, argued that droughts simply revealed the persistent vulnerability of the landless *sertanejo* population. In order to achieve genuine political and social reform in the region, they asserted, development efforts must focus on increasing the economic security of sharecroppers by expropriating fertile land from estates and converting it to smallholder colonies. This would have several socially and economically beneficial effects, they

believed: transferring some land from the export-oriented production preferred by estate owners to cultivation of food crops for local sustenance; providing smallholder colonists with surplus food and greater economic security than they enjoyed as expendable sharecroppers; and reducing the stranglehold of elites on local resources (including labor) which was the source of their political power, as patrons of a dependent peasantry. This interpretation of the drought problem and its solution never gained significant influence over IFOCS's administrators during the agency's first half-century in operation. Their insistence on viewing drought as a fundamentally climatic phenomenon explains Brazil's failure to mitigate the *sertão's* periodic calamity over many decades.

SERTÃO GEOGRAPHY AND SOCIAL ORGANIZATION

Brazil's Northeast *sertão* (see Figure 1) is a semi-arid region, subject to erratic rainfall patterns even during ordinary years. The normal climate cycle consists of a rainy and a dry season (the timing of which varies between sub-regions), and some areas typically receive precipitation for only three months of the year. Occasionally part of the *sertão* experiences a 'green drought' (*seca verde*), in which the usual annual precipitation falls during a very short period of time, leaving the area dry for the rest of the year. A drought, in which the rainy season never arrives, is triggered by interactions between major wind currents off the Atlantic (Botelho, 2000). There is ongoing debate about whether droughts have increased in frequency or severity since Portuguese colonization. During the first half of the 20th century, significant droughts occurred in 1915, 1919-1920, 1931-1932, 1942, and 1951-1953. They have continued until recent years.

The primary goal of twentieth-century *sertão* developers was to retain more rainwater for use throughout the year, which would also serve as a reserve supply during droughts. Without manmade reservoirs, only about eight percent of precipitation is captured, for two reasons. As an equatorial semi-arid region, the *sertão* is subject to intense heat for most of the year. High rates of evaporation return precipitation rapidly to the atmosphere.

Secondly, soils in much of the *sertão* are shallow, underlain by an impermeable crystalline rock layer. The rock prevents rain from soaking in, so there are no subterranean water reserves in those places. This contributes to torrential runoff and soil erosion during rainy seasons. Unlike the semi-arid U.S. West, the *sertão* has no sources of snow-melt to replenish its water supply, and only the São Francisco river on its southern border runs year-round.

Despite its substantial climatic challenges, the *sertão* has received a steady stream of settlement since the late 18th century, due to its good pasture during many months in normal years. Ranching in the *caatinga* scrubland has long been the *sertão's* economic base. Ranches are typically unfenced and vast. In colonial times, they were a source of meat and leather goods for cities of the humid, sugar-producing coast. The *sertão's* cattle also fed and supplied interior mining towns. Agriculture has been the other backbone of the *sertanejo* economy, though it thrives only in limited areas – mostly those of higher altitude which tend to receive more rain (Souza *et al.*, 1992). Extensive ranching diminished the viability of agriculture over much of the *sertão* because cattle were commonly moved to river margins and more fertile areas during dry periods, damaging the scattered patches of cultivable soil. Scarce water sources have prohibited large-scale, commercial agriculture except in a few spring-fed areas like the Cariri mountains of Ceará (which have relatively rich, sedimentary soils). Cotton was widely cultivated in parts of the *sertão* during the second half of the 19th century. Its production expanded briefly in the 1860s when the U.S. Civil War reduced exports from the American South, considerably increasing the *sertanejo* population.

The *sertão's* large agricultural estates (*fazendas*) have historically been farmed by slaves, tenant farmers, or day laborers. Following abolition in 1888, many freed slaves became sharecropping *moradores*, paying their rent in both crops and labor. Landless farmers and ranch hands supported their families through a combination of subsistence farming, small-scale cultivation for local markets, and work for their

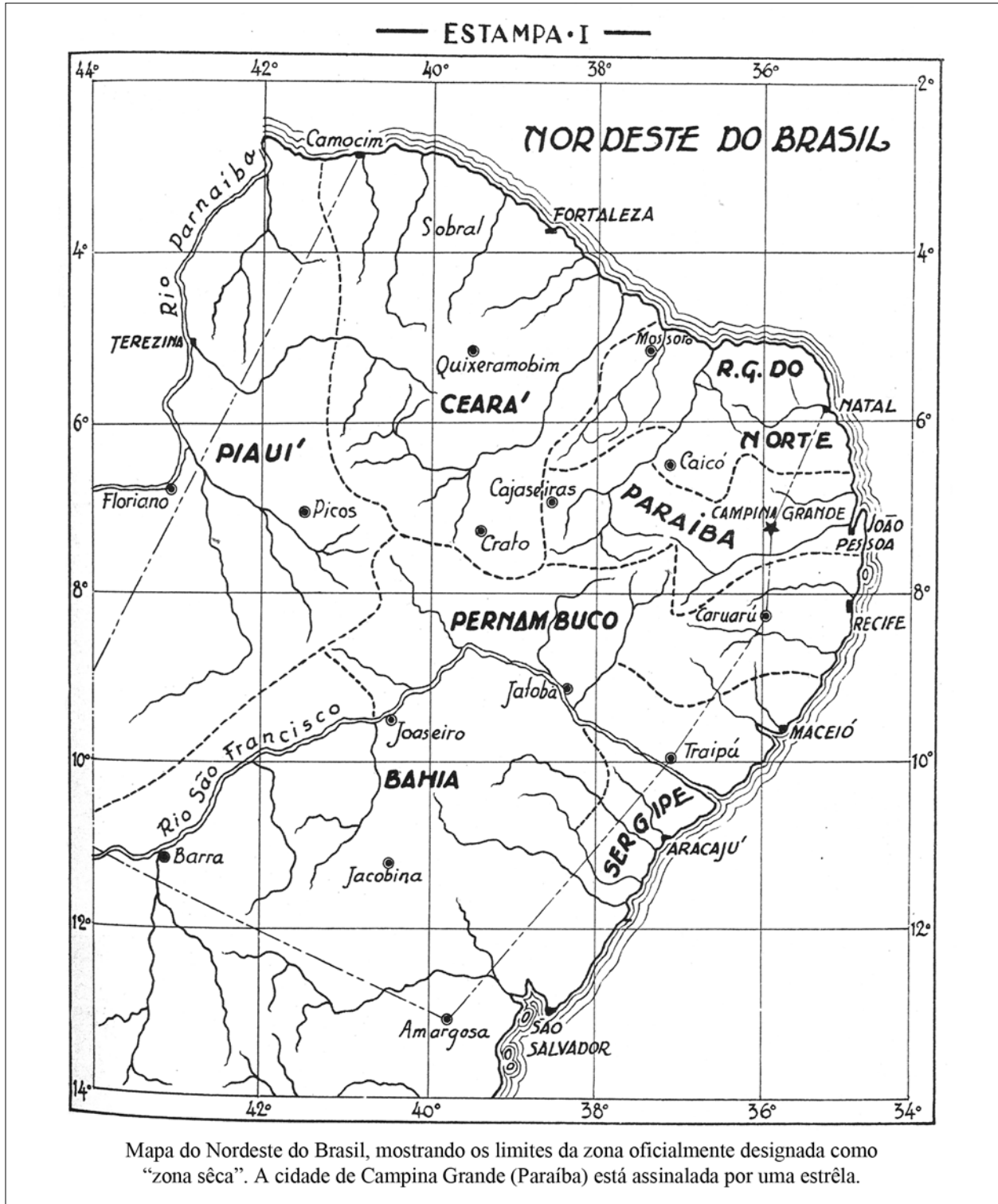
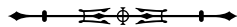


Figure 1. Map of Northeast Brazil showing the boundaries of the drought zone (Brasil, 1938).



landlords. They usually remained indebted to the land owner for seeds, cultivation supplies, and off-season food, and they generally owed half of their food crops to him, sometimes along with cash rent (Andrade, 1980; Hall, 1978; Dia, 1971). Sharecroppers' lack of secure work contracts and personal capital made them particularly vulnerable to climate fluctuations. They had few surplus crops and sold those through intermediaries, who took advantage of price fluctuations for themselves. Large landowners, on the other hand, remained relatively cushioned from the economic impact of drought. Farmers with surplus crops could sell those at a high price when supplies across the region were scarce. Ranchers move their cattle to less stricken areas during drought years, and use them as collateral for loans as needed.

In 1877, the *sertão* was stricken by a devastating drought that spanned three annual crop cycles. Families with no food reserves undertook arduous journeys toward the coast, often traveling many miles on foot in search of assistance. Ceará, a state with all but a strip of territory in the *sertão*, is estimated to have lost from one-quarter to one-half of its million inhabitants during those three years. Drought refugees were held in unhealthy and overcrowded encampments outside of Northeast state capitals before being shipped by the thousands to unaffected provinces and Amazon rubber fields. Photographs of starving migrants were reproduced in a Rio de Janeiro magazine in one of the first uses of photojournalism in Brazil (Andrade and Logatto, 1994)¹. These images and the accompanying stories of wrenching deaths conveyed the horror of *sertanejo* famine vividly to readers throughout the country. For liberal reformers in urban São Paulo and Rio de Janeiro who helped to establish the Republic in 1889, grim descriptions of drought victims' exodus from the *sertão* were painful

reminders of how far much of Brazil lagged behind their modernizing vision.

The political system and social structure prevailing in the *sertão* are as important as any climatic analysis for understanding the impact of drought on the *sertanejo* population. Semi-arid regions require particularly well-honed social adaptations to cope with the vagaries of climatic shifts; and yet because of their instabilities, they are often occupied by marginal populations who have no better option for making a living than to remain where they are and hope to weather the next calamity.

This holds true in the *sertão*. Most *sertanejos* share a mixed racial heritage: they are descended from native Brazilian *índios* who remained at the frontiers of white colonization; Portuguese settlers; and black refugees from the slavery and racism of coastal sugar plantations. Brazil's positivist modernizers in the early 20th century debated whether the *sertão*'s backwardness was the result of its inhabitants' mixed racial endowment or of the harsh environment in which they struggled to survive (Cunha, 1902). Pleas for assistance made on behalf of the *sertanejo* poor by Northeast elites often met with little sympathy. In the view of many southern elites, the culturally primitive and racially suspect *sertanejo* was not worthy of federal investment. Southern Brazilians also resisted aiding the *sertão* because they viewed its problems as the result of a feudal social order, bolstered by the corrupt patronage politics known as *coronelismo* (Nunes Leal, 1977; Bursztyn, 1984). Ranchers and estate owners benefited politically and economically from the dependency of their landless workers. Thus Northeastern elites' pleas for drought assistance on behalf of the *sertanejo* poor were met with skepticism by politicians from other states (Villa, 2000)².

¹ The photographs, taken by cearense J. A. Corrêa, were reprinted in "O Besouro", n. 20, p. 1 (July 20, 1878), an illustrated magazine that had been established a few months previously. They were provided to "Besouro" by journalist José do Patrocínio, whose series entitled "Viagem ao Norte" was being regularly published on the front page of the "Gazeta de Notícias", describing the drought and its impact on *nordestinos*. The "Gazeta" was a text-only publication.

² Historians note that this 'denunciation industry' is also suspect. Assistance to the Northeast has routinely been criticized as wasteful while lavish federal projects for other regions, such as the rapid construction of Brasília in the late 1950s, have not received equal scrutiny.

The designation of the 'Northeast' as a distinctive region encompassing the drought zone and the coastal areas to which its migrants flocked emerged in tandem with the establishment of a federal agency to ameliorate drought (Albuquerque Júnior, 1999; Blake, 2001). Development economist Albert Hirschman (1963, p. 23-25) suggests several reasons why federal aid to the *sertão* became institutionalized in the first decade of the 20th century. The U.S. federal Bureau of Reclamation had been established in 1902 and was undertaking surveys and constructing dams to make agricultural cultivation possible in semi-arid Western states. Its goals and successes were observed by Brazilian engineers, and American geologists familiar with the Bureau of Reclamation's work were hired during IFOCS's early years to conduct surveys of the *sertão*. In 1902, journalist and engineer Euclides da Cunha (1866-1909) published his epic account of a brutal and prolonged confrontation between the Republic's military and millenarian *sertanejo* monarchists during the late 1890s. Cunha's portrayal of *sertanejos* as a distinctive and atavistic racial type, adapted to their harsh environment, directed elites' attention to the profound challenge that Brazil's vast hinterland posed for their modernizing ambitions (Cunha, 1902; Levine, 1992). Finally, President Rodrigues Alves (1902-1906) conducted ambitious sanitation campaigns in Rio de Janeiro to reduce yellow fever and improve trade at its port. The success of these efforts led Brazilian leaders to embrace science and medicine as tools for national development. Alves directed engineers' attention to the problems of the interior Northeast and established a Superintendence of Studies and Works to Combat the Effects of Drought in 1906 to implement their proposed solutions. This became the Inspectorate for Works to Combat the Drought (Inspetoria de Obras Contra as Secas, IOCS) in 1909 and was renamed the Federal Inspectorate for Works to Combat the Drought (IFOCS) in 1919.

ENGINEERS, ELITE PATRONAGE AND TECHNOCRACY

Engineers who oversaw IFOCS's activities during Brazil's First Republic found themselves caught between the

self-interest of Northeastern elites and the skepticism of southern politicians who claimed that the *sertão* was too backward and poorly governed for federal aid to be of any use. In order to maintain Northeast elites' support for *sertão* development, IFOCS administrators catered to regional power brokers' priorities. They therefore focused on technical issues and neglected the social dynamics, such as land ownership and labor organization, that contributed at least as much to the disastrous effects of drought. Paradoxically, the infrastructure provided by engineers reinforced elite control over resources in the *sertão*. The Northeast's influential men appealed to engineers' expertise when this meshed with their interests, but they disregarded it when the scientists' recommendations conflicted with local political priorities (Albuquerque Júnior, 1987, p. 179-181). Many *nordestino* power brokers grew impatient with the drought inspectorate's surveys during its early years and accused the federal government of employing scientific experts in order to delay investment in the *sertão*. IFOCS's engineers described their initial efforts at drought alleviation as involving constant struggle with negligent or corrupt politicians (Rodrigues, 1919).

Along with serving Northeast elites' desire to obtain federal support for infrastructural improvements in their region, engineers' technical solutions to the drought crisis helped to elevate their profession's stature *vis-à-vis* the state. Brazilian engineers had been employed by the military since Independence. In 1862, the Ministry of Agriculture, Commerce and Public Works created a civil engineering corps to construct the railroads and other infrastructure required by Brazil's export economy. In 1874, the first engineering school fully separate from the military, the Escola Politécnica, was established in Rio de Janeiro. *Politécnicos* advocated a greater role for engineers in modern Brazilian society, particularly in the service of government. They wanted to replace the economic liberalism advocated by lawyers (*bacharéis*) with a more protective national economic policy that would foster industrialization (Ferreira, 1989). *Politécnicos*

were among several groups of Brazilian professionals who embraced scientific theories of social progress at the turn of the 20th century. Brazil's doctors, lawyers, engineers and military men adopted versions of Frenchman Auguste Comte's positivist philosophy and Englishman Herbert Spencer's evolutionary theory of societal change (Graham, 1972; Nachman, 1977)³. Comte and Spencer each advocated increased national integration through improved transportation networks and industrialization. Both philosophies represented a conservative approach to modernization as a process to be guided by an educated middle class. Brazil's engineers and other urban professionals saw themselves, rather than churchmen, landowners, or the untutored masses, as the appropriate agents of rational social progress. This posture was dramatically demonstrated during the 1889 coup that overthrew the Emperor and launched the Republic.

However, due to the dominance of São Paulo's coffee elite over Republican politics, engineers did not succeed in attaining a significant place among Brazil's public intellectuals until the Vargas era (Kawamura, 1981; Schwartzman, 1991). Their profession's relatively weak political position during IFOCS's early decades is one explanation for the agency's inability to transform the *sertão*. Additionally, their personal experience and education did not provide the intellectual and social background necessary to assess the region's problems in social terms⁴. Engineers were conditioned by their exposure to Spencerian views of social evolution to think of society as a unified organism that could be guided along a well-defined path toward modernization. Their primary goal was overall national and regional progress, and they rarely considered that some social sectors might benefit from their efforts more than others, or even at the expense of others. This perspective allowed many engineers to ignore the miserable circumstances of some *sertanejos* as long as measurable parameters, such as the volume of water

in reservoirs or the number of hectares available for irrigated cultivation in the region, were improving.

Engineers were most likely to encounter the humblest *sertanejos* as laborers on construction projects which were organized during droughts to employ starving migrants. In those circumstances, the desperate and often ill *sertanejo* men struck their more fortunate bosses as both pitiable, individually, and menacing, *en masse*. While many of the drought agency's engineers sympathized with the refugees' plight, they did not typically feel solidarity with their workmen as fellow Brazilians. Popular portrayals of poor *sertanejos*, most notably in Cunha's "Os Sertões", depicted them as a race apart, prone to religious fanaticism, superstition, and occasional violence. For members of a profession that prided itself on rationality in all things, such perceptions must have made lowly *sertanejos* seem foreign.

Miguel Arrojado Lisboa (1872-1932), a graduate of the engineering school in Ouro Preto, Minas Gerais, directed IFOCS from January, 1909, to August, 1912. He was reappointed in December of 1920 by Epiácio Pessoa – Brazil's first Northeastern president – and remained in the position until March of 1927. Lisboa saw both climate and economic organization as important influences on *sertanejo* society. He believed that the uncertain climate affected *sertanejos'* character, making them resistant to planning ahead. He even credited climatic instability with encouraging fanaticism, since people's imaginations could not be put to more productive uses while they waited to see what the seasons would bring. But Lisboa also thought that feudal labor conditions and landlessness adversely affected the *sertão's* economy, by discouraging farmers from making improvements on property to which they had no secure title. He was optimistic about new "islands of economic and social activity" in the *sertão* where democratic ideals appeared to flourish. These were mainly in mountainous areas which had been settled by

³ Brazilian professionals' adherence to the tenets of Comte and Spencer was tempered to fit their particular national milieu, e.g. by dismissing Spencer's criticism of racial mixing.

⁴ I owe this formulation of the engineers' predicament to my dissertation advisor, Steven Feierman.

drought migrants seeking fertile land on their way out of the parched interior. In such scattered pockets, like the Cariri mountains of Ceará, settlers adopted cooperative irrigation arrangements to channel stream water to their fields (Lisboa, 1913).

As the first drought inspector, Lisboa confronted two competing approaches to *sertão* development. The more radical option involved the creation of irrigated small-farmer settlements on the banks of reservoirs. A more conservative approach involved providing stored water for current landowners to sustain their production. This was often accomplished via ‘cooperative construction’ on private or municipal lands, in which the cost of construction was shared by the drought inspectorate and the landowner. The owner was technically obligated to provide water for his workers and neighbors during drought years (Souza, 1981 [1911]). Lisboa decided to begin with the more conservative strategy and move toward the more radical one. He assumed that the extension of irrigation canals from reservoirs would evolve naturally, despite initial opposition from rural dons. “What is most important is to satisfy the immediate aspirations of the Northeast; irrigation through canals will come as an inevitable consequence. In its own time, it will become an extreme political necessity” (Pessoa, 1925 *apud* Hirschman, 1963, p. 43)⁵. What Lisboa did not realize was that IFOCS’s work would increase the influence of rural *coronéis*, who funneled federal drought aid through their patronage networks. IFOCS could not ignore landowners’ preferences, since the federal government had little muscle in the *sertão* and state governors were allied to backlands power brokers as a matter of political expedience and class allegiance. *Coronéis* had no interest in seeing their political clients settled on independent small farms, since that would decrease the clients’ reliance on their patrons and thereby diminish the *coronéis*’ influence. Thus private reservoir building came to absorb the majority

of federal aid for drought works. Such projects were later criticized as a subsidy to the wealthy – part of the notorious “drought industry” (Callado, 1960).

Lisboa clearly believed that development planning for the drought zone required consideration of social factors as well as environmental ones. But he did not rigorously examine the differential effects of drought on social classes within the *sertão* and the political reasons for these differences. Such analysis might have led him to pursue the establishment of irrigated smallholder settlements more aggressively.

In 1912, following four months of work under Lisboa’s direction, American geologist Geraldo Waring published a review of IOCS’s efforts. He assessed the agency’s achievements very favorably and compared it to the U.S. Reclamation Service’s work (since 1902) constructing dams and irrigation systems in semi-arid Western states to facilitate settlement and farming there.

Since the organization of the Inspectorate two years ago the region has been mapped, the principal river basins have been examined and the feasible reservoir sites found, and general plans for the development of the region have been outlined. Besides these direct works, the Inspectorate has made studies of the agricultural capabilities of the various portions of the region, has established rain-gauging stations, and has initiated a systematic measurement of the discharge of the rivers (Waring, 1912, p. 8).

Waring summarized IOCS’s development strategy as follows, reflecting Lisboa’s confidence that the agency would soon begin building irrigated settlements:

It is believed that the people will migrate to the irrigated areas during times of drought, and will remain there. Thus the present scattered population will become collected into agricultural communities [through ‘the purchase of land with water-rights by individuals’], and a general advance will be made in the condition of the people and in the commercial

⁵ The book “Obras do Nordeste” includes an interview of Pessoa conducted February 12, 1925, by an “O Jornal” editor regarding Senator Corrêa’s criticism of Northeast drought works and accusations of fiscal abuses. It also contains further responses by E. Pessoa and Miguel Arrojado Lisboa, published in “O Jornal” during March and April, 1925.

development of the region. Provision will also be made for the [planned] colonization of some of the irrigated areas, in order that a more rapid development of the region may be aided by this means (Waring, 1912, p. 19).

Waring concurred with Lisboa's belief that immigration to the *sertão* would increase once irrigation works were constructed. The American advisor presumably imagined that *sertão* settlement would follow the pattern instigated by similar reclamation efforts in the U.S. West. Both Waring and Lisboa assumed that an influx of industrious, experienced farmers from Europe and elsewhere in Brazil would provide native *sertanejos* with strong role models. Waring perceived *sertanejos*, "of negro descent mixed with the native Indian and with Portuguese" to be somewhat lazy and ignorant, but he thought that they were held back as much by their environment as by any racial or cultural handicap, since "when the natural conditions permit, they improve their chances for betterment" (Waring, 1912, p. 7).

The civil engineer who oversaw IOCS's operations in Ceará agreed that the technological improvements provided by the agency would engender significant social progress. Thomas Pompeu de Sousa Brasil Sobrinho (1880-1967) suggested to Lisboa in 1912 that the material gains accruing to *sertanejos* as a result of reservoir and canal construction would create an atmosphere in which the social plagues of poor societies (including the Northeast, historically) could not flourish:

In agricultural regions in which artificial irrigation assures the complete success of many branches of industry, one does not encounter strikes; there are no socialists or, even less, anarchists; the agriculturists do not even concern themselves with politics. It is sufficient that an administration provide them regularly with the most important element for their production – water for the cultivation of their fields⁶.

A member of one of Ceará's prominent political families, Brasil Sobrinho portrayed IOCS's infrastructural

investments as a means of averting political frictions by enriching all residents of the drought zone.

Lisboa launched his administration of Brazil's federal drought agency with an agenda for addressing the climatic problem that appealed to the *sertão*'s ranchers and export farmers, focused on reservoir construction. He assumed that irrigated farming by smallholders would follow once reservoirs were built, thereby diminishing the social inequities that left many *sertanejos* impoverished and vulnerable to droughts. In preparation for reservoir construction, Lisboa commissioned scientists to collect data on the *sertão*'s physical environment. But IFOCS never undertook a parallel analysis of the region's social organization. Lisboa and his engineering colleagues were confident that their improvements to regional infrastructure would set the stage for general social progress. This perspective proved to be short-sighted, as the drought agency's subsequent history indicates. IFOCS became part of rural Northeast elites' bureaucratic apparatus for controlling resources in the *sertão*. Instead of eroding landowners' control over their domains, the agency provided yet another mechanism through which rural patrons could dole out favors and consolidate power. Rather than being made obsolete by federal development efforts, *coronéis* became the primary clients of government investment and expansion.

Explaining the drought crisis in strictly climatic terms was a politically expedient strategy intended to obtain federal aid for the *sertão* without overtly confronting its social imbalances. Northeast elites desired technological improvements without alteration to the region's social order. Most of the engineers who promoted drought works in the *sertão* were not particularly savvy about the obstacles to economic independence faced by a majority of *sertanejos*. Moreover, the confirmed positivists genuinely believed that scientific and technological progress were the fundamental engines of social change. They trusted that transferring technological solutions from places like the

⁶ Thomaz Pompeu de Souza Brasil Sobrinho. Açude Quixeramobim: Memória Justificativa apresentada ao Exmo. Sr. Inspector das Obras Contra as Secas, p. 14, 1912. Ildephonso Simões Lopes collection, ISL c 1910.08.25, pasta 5, 68 p. Fundação Getúlio Vargas, CP-DOC, Rio de Janeiro.

U.S. West would be sufficient to recreate the Northeast in the image of those societies. IFOCS's engineers were confident that the prosperity which they saw (somewhat unrealistically) as accruing to North America's Western settlers in particular was solely the result of technological infrastructure, and not of the broader political and legal context in which that technology functioned. This conviction reflected their positivist assumption that society was moldable through rational, scientific means. It also served their desire to assert themselves as the appropriate agents of transformation for a region that many Brazilians viewed as chronically backward. If problems of social organization were presumed to be at the heart of the *sertão's* drought crisis, then engineers would have had a less significant role to play in resolving it.

In the final years of Brazil's First Republic, most discussions of IFOCS's work continued to focus on questions of hydrologic infrastructure: how many dams and canals should be constructed, where they should be located, what their potential to increase agricultural output would be. The need for improved agricultural training, general education, and public health provision were mentioned only occasionally. More controversial issues like inequitable land ownership, the manipulation of the *sertanejo* electorate by *coronéis*, and the concentration of political and economic power in a narrow social stratum were almost entirely ignored by the politicians and administrators with greatest influence over the drought agency.

President Pessoa, son of a prominent family in the Northeast state of Paraíba, saw irrigated agriculture as among the most significant goals of his substantial investment in the Northeast during the early 1920s. Yet the majority of funds spent on the *sertão* during his administration (1919-1922) provided improvements to the region's transport and hydrologic infrastructure. Very little was used to initiate irrigation networks or establish

colonies of smallholders near reservoirs. Pessoa chose his first projects pragmatically, since the Northeast's agricultural and ranching elite supported them. This strategy for getting his ambitious agenda underway failed. Representative Cincinato Braga from São Paulo (in Brazil's southeast) warned the northeastern president that his increased expenditures on drought works would result in a discontinuation of IFOCS's projects by the next presidential administration. This in fact happened. Pessoa's successor, President Bernardes, eliminated the 'permanent' federal drought works fund in 1923 and halted construction in the *sertão* by 1925, leaving IFOCS with a skeletal budget (Hirschman, 1963)⁷. Bernardes exhibited little concern for the problems of the Northeast or the plight of *sertanejos*, and there was no severe drought during his tenure to spark renewed national interest in the region.

Epitácio Pessoa believed that irrigated farming had the potential to markedly improve the *sertão's* economy. But he did not address politically fundamental issues, like establishing policies for land expropriation around reservoirs, which had to be solved before irrigation could significantly impact *sertanejo* society. Because of his inability or unwillingness to tackle these more contentious issues, his commitment of funds for *sertão* development did little to provide security for the majority of *sertanejos*. Like most Northeastern politicians who advocated for federal drought relief, Pessoa did not rigorously analyze the political dynamics that shaped how *sertanejos* experienced drought and what forms of aid were tolerated by regional elites.

Irrigation works took a back seat to dam-building during the first several decades of IFOCS's work because they did not carry significant value within the Northeast's system of political patronage. The *sertão's* influential ranchers appreciated the security that reservoirs offered their cattle but had no use for irrigation canals. Large-scale farmers also had little interest in irrigation, since the

⁷ IFOCS was allotted 3.826:749\$300, compared to the 145.947:350\$000 that it had enjoyed three years before – a decrease of over 95 per cent (1:000\$000 is a *conto*, or 1,000 *milréis*) (Brasil, 1939, p. 29).

sharecropping system that prevailed in the *sertão* allowed them to profit handsomely from extensive cultivation. Irrigation was potentially threatening to the *sertão's* landholding elite. It promised to provide small farmers with a secure means of supporting themselves, which would have reduced their dependence on the *sertão's* traditional power brokers. Since the drought agency's managing engineers were not particularly invested in irrigation anyway, they focused on the projects that advanced both their own professional agendas and the interests of ranchers and export farmers.

Drought agency engineers convinced themselves that the dams which they constructed would be the first step in an evolving process of modernizing *sertão* agriculture and food production. They clung to assumptions about the social utility of reclamation efforts elsewhere in the world, particularly in the U.S. West, as verification that dams could form the cornerstone of a democratic agrarian society in semi-arid terrain. In retrospect, one could argue both with engineers' interpretation of reclamation's impact in other semi-arid places and with their selection of climatic similarities as the core features linking the *sertão* to regions with very different political and social histories. As *nordestino* economist Celso Furtado (1961, 1959) would argue in the 1950s, focusing on the drought *per se* as the *sertão's* fundamental problem distracted the region's first cohort of development agents from more basic issues of political and social organization in the Northeast.

Engineers were misled when they viewed drought as the *sertão's* defining feature and compared the *sertão's* development to that of other semi-arid regions in the world, such as the Western United States. In a profound sense, drought was not the *sertão's* central problem. As Drs. Belisário Penna and Artur Neiva (1880-1943) quickly surmised during their public health survey of the Northeast hinterland in 1912, widespread poverty and inequality were the core causes of economic stagnation in the region. In his later speeches and essays, Penna repeatedly stated that in order to help the *sertão*, Brazil's federal government

needed to focus not only on disease but also on the political factors contributing to *sertanejos'* malnourishment, which made their bodies easy prey for opportunistic microbes. Similarly, the drought inspectorate needed to focus not only on the *sertão's* climate but also on its landholding and labor practices, which were what made droughts such a crisis for the landless and smallholding poor. This alternate perspective began to be expressed by agronomists hired by IFOCS during the 1930s, and it became the dominant view of economists who oversaw Northeast development during a brief period of progressive political fervor from 1955 to 1964.

SANITARIANS' POLITICAL ANALYSIS OF THE DROUGHT CRISIS

Advocates of greater federal investment in the *sertão* during the early 20th century argued with increasing conviction that *sertanejos* were civilizable – or, to employ a term that reflects Brazil's Republican elites' assumptions about racial hierarchy, 'whitenable'. However, they required educational and medical assistance; improved transportation infrastructure; protection from corrupt elites; and the guidance of more culturally advanced citizens (or immigrants) in order to prosper. Among the most articulate and persistent proponents of this view in the 1920s was Belisário Penna. Penna was born in Barbacena, Minas Gerais, the son of a wealthy and socially established family in that politically central state. During a year at the medical school in Salvador, Bahia, he encountered environmental theories of disease causation adapted to Brazil's particular national predicament. Doctors there had been arguing since the 1860s that many diseases attributed to tropical climates were instead caused by the social conditions frequently found in such places, including poor hygiene and diet (Peard, 1999). Penna's frequent assertion that the living conditions of Brazil's rural poor must be altered in order to improve their health and productivity mirrored the views of Bahia's *tropicalistas* physicians. They embraced

a Neo-Lamarckian view of evolutionary change, believing that negative traits could be eliminated from populations over time by manipulating their environment, such as through sanitation measures (Stepan, 1991). These ideas were reiterated in the early 20th century by Afrânio Peixoto (1876-1947), professor of hygiene at Rio de Janeiro's medical faculty, who opposed environmentally and racially deterministic accounts of disease in Brazil and rejected 'tropical medicine' as a research discipline (Peixoto, 1907).

Following his education at the medical schools of Rio de Janeiro and Salvador, Penna began a clinical career in Minas Gerais during the 1890s. A decade later, he joined President Alves's sanitation campaign in Rio de Janeiro as a Sanitary Inspector under the renowned bacteriologist Oswaldo Cruz (1872-1917). In 1905, Penna was transferred to the prestigious Yellow Fever Prevention Service, where his recommendation of weekly home inspections to remove *Aedes aegypti* mosquito larvae increased the effectiveness of Cruz's eradication campaign. Cruz's successes combating yellow fever in Rio de Janeiro led many elites to embrace scientific medicine as Brazil's best means to escape a long-held fatalism about its prospects as a tropical nation (Stepan, 1976). In 1907, Cruz sent Penna and Carlos Chagas (1879-1934) to combat malaria along the Central do Brasil railway in the north of Minas Gerais. Penna remained on this mission through 1910. In the same year, Cruz invited Penna to accompany him in combating malaria along the Madeira e Mamoré rail line in the Amazon basin, and Penna subsequently spent a year organizing a yellow fever campaign in the Amazonian state of Pará. Penna thus had substantial exposure to living and sanitary conditions in Brazil's vast interior during the Republic's first two decades (Diniz, 1948, p. 10-24).

In 1912, Penna embarked on a seven-month sanitary survey of the Northeast, accompanied by doctor Artur Neiva, of the Oswaldo Cruz Institute, Brazil's premier medical research institution in Rio de Janeiro. Penna and Neiva's trip was sponsored by IOCS to assess health conditions in the *sertão* prior to initiating dam construction

there. This was a period when several federal agencies funded sanitary surveys of rural Brazil by the Oswaldo Cruz Institute, to aid their own infrastructural expansion projects (Lima, 1999; Sá, 2009). IOCS itself funded two additional medical expeditions to the Northeast. Drs. Albuquerque and Faria traveled to Ceará and Piauí but left no textual record of their observations. Drs. Adolfo Lutz and Astrogildo Machado, who surveyed the São Francisco river valley, published a report emphasizing the population's ignorance and racial degeneracy (Lutz and Machado, 1915; Lima, 1998). Penna and Neiva, in contrast, explained the backwardness of the *sertanejos* whom they encountered as arising in large part from cultural isolation. Their report, dated 1916, though published two years later as part of a campaign to reorganize and expand the federal public health agency (Kropf, 2009), became the most influential analysis of Northeast rural health in this period. It describes *sertanejos* as 'abandoned' by their government to primitive conditions and burdened by numerous illnesses which reduced them to a miserable existence. "We still retain vividly the sorrowful impressions of profound misery and abandonment in which thousands of human beings lie, and our testimony should in some form work to mitigate their suffering", the physicians wrote (Neiva and Penna, 1916, p. 165). *Sertanejos* were continually exposed to unsanitary living conditions and rampant disease, and they endured near-servile working conditions as sharecroppers on vast estates. Periodic droughts added to those hardships.

Penna and Neiva's rejection of fatalistic arguments about Brazil's racial composition and climate brought their analysis considerable attention, since it fit within a larger debate about whether the Republic could succeed as a modern nation (Castro Santos, 1985; Lima and Hochman, 1996; Lima, 1998; Hochman, 1998a). Nationalist intellectuals like Manoel Bomfim, Alberto Torres and Edgard Roquette-Pinto argued that education and modern technology would civilize Brazil's rural and hinterland population, which had been unjustly abandoned in debilitating environments. Their emphasis on culture,

social organization and education as more influential than race reflected a change in anthropological thought in Europe and North America during the early 20th century (Skidmore, 1993, p. 185-190). The emphasis on environment, broadly construed, as more influential than heredity became a central tenet of progressive 'civilizing' missions in urban as well as rural Brazil through the 1930s (Stepan, 1991; Coutinho, 2003, p. 82).

Like their contemporaries, Penna and Neiva believed in a hierarchy of races. This is evident in the disdain expressed in their survey for supposedly African traits exhibited by the Northeast's rural population, and in their recommendation that European immigrants be encouraged to settle the *sertão*. Yet they differed from other critics of Brazil's African and indigenous heritage in that they did not propose eliminating darker-skinned peoples through inter-breeding with whites (*branqueamento*). Instead, they suggested that the Northeast's rural poor would progress if guided by the 'example' of more vigorous white settlers and provided with infrastructure linking them to the civilized world (Lima and Britto, 1991, p. 17). In other words, the doctors advocated a cultural and technological 'whitening' or 'civilizing' process more than a biological one (Stepan, 2001).

Penna and Neiva believed that *sertanejos* had a potential for self-improvement that could make them positive contributors to national modernization, but they needed guidance and updated technology in order to advance. Their report emphasizes that education and hygiene together could redeem the *sertão*. Like Torres and Bomfim, the physicians believed that disease was rampant in the *sertão* due to the region's social environment rather than to racial vulnerabilities inherent in the population. In order to make the *sertão* prosper, the federal government needed to support empirical research into its social circumstances and natural resources. A stronger administrative presence would further the public good, the doctors argued, providing education, essential infrastructure, and the rule of law (versus brute force) in Brazil's hinterland. Public health measures in particular,

which defended the entire nation against infectious disease, could serve to strengthen federal authority in republican Brazil's vast interior (Hochman, 1998a).

Reports by the hygiene inspectors of Northeast states during the Republic's early years confirm the dearth of government presence in the *sertão*. Droughts and epidemics posed particular challenges to the region's highly inadequate public health administration. During droughts years, medical services in Northeast capitals were besieged by migrants from the interior (*retirantes*) who gathered in makeshift camps on the cities' outskirts. Refugees flocked to state capitals because they offered the greatest hope of receiving assistance, due to the concentration of public resources there. Recife's hospitals and philanthropic organizations were overwhelmed by an influx of *retirantes* from their own and neighboring states' *sertões* during the droughts of 1915 and 1919. The governor's annual report to the state legislature for 1915 describes the wave of desperate migrants as if they were all immigrants from other lands, even though many of them were from Pernambuco but had no recourse in their home *municípios*.

As in 1914, there occurred a noteworthy immigration of sick and infirm people of all sorts, originating from the interior of our state and neighboring ones, who, flogged by pressing needs and after completely exhausting the philanthropic potential of the *sertanejo* population (who had used up all of their resources and economic means as a result of the intense and prolonged drought that sterilized the soil), came to emigrate to Recife's hospitals, in order to obtain temporary or final rest for their bodies from ills, most of which had no cure (Mensagem..., 1916).

Of the 13,913 people registered as patients in Recife's hospitals that year, 62% were described as 'imports' from the interior of Pernambuco or nearby Northeast states. More than half of the city's 3,484 deaths that year were of *retirantes*, one third of whom died of tuberculosis, while a smaller but significant fraction succumbed to dysentery caused by unclean water. Smallpox and yellow fever epidemics were also reported to be raging among the

famished refugee population. But much of the available drought 'aid' was used to keep sick and malnourished *sertanejos* out of city centers, where their illness and desperation posed a threat to residents.

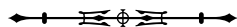
Ceará's hygiene inspector also described the public health impact of *retirante* migration to Fortaleza during 1915 in graphic detail. The city's death rate rose by 900% during the worst month, when insects – feeding on the unmanaged waste of 70,000 *retirantes* gathered in a disorganized refugee camp on the outskirts of the capital – began spreading diseases to urban residents. In the camp, there were only nine doctors available to treat the thousands of sick migrants. Young children died in large numbers from drinking infected water and milk. The health inspector estimated that 300,000 people were dislocated by the drought throughout Ceará, and perhaps 30-60,000 of these died, many of them on their way back from encampments where they received insufficient medical attention and unclean food. In response to these horrors, he proposed intensified sanitary measures in Ceará's interior, yet the state's hygiene staff was reduced as soon as the drought ended (Relatório..., 1916, p. 2-24).

By the time Penna and Neiva published their health survey of the rural Northeast, many Brazilians were frustrated by the decadence of a Republic whose policies benefited landowning oligarchs in the wealthiest states but overlooked the myriad needs of other regions and populations (Lima and Britto, 1991; Hochman, 1998a). World War I increased Brazilians' receptivity to the idea that their country needed a native nationalism that would free them from imitating European approaches to economic and social development. Penna's advocacy of greater investment in Brazil's countryside, particularly in the Northeast, placed him at the forefront of a nationalist movement that continued to gain adherents during the 1920s, culminating in Getúlio Vargas's overthrow of the First Republic's oligarchs in 1930.

Historian Gilberto Hochman observes that the term *sertão* as it came to be employed by rural sanitarians

during the 1910s was "more a medical, social and political category than a geographic one. Its spatial locale depended on the existence of the binomial "illness-abandonment" (Hochman, 1998b, p. 229). Even São Paulo and Rio de Janeiro states had *sertões*, just outside the borders of their capitals (Lima, 1999). In articles, books and speeches written from 1916 to 1930, Penna employed the term *sertão* (literally "large desert" according to Amado, 1995) expansively to refer to all of Brazil's insalubrious hinterland. This was politically astute, since no Brazilian with a stake in his country's modernizing ambitions could afford to overlook health issues crippling most of the national population. Penna demanded that politicians confront *sertão* poverty, misery and diseases as problems deserving federal resources. In order for *sertanejos* to enjoy and contribute to national progress, he argued, Brazil's Republican government would have to invest in public health, sanitation, and drought alleviation measures throughout the rural hinterland. The federal government also needed to halt the tyranny of regional oligarchs, by redistributing land to agricultural workers.

Penna's 1918 essay collection "Saneamento do Brasil" introduced a wide-ranging critique of the Republic's administration that he reiterated in speeches and essays during the following decade. He defined hygiene as a social and political as well as medical issue and emphasized the vicious cycle linking illness to poverty (Penna, 1918, p. 65-70). He argued that the apparent indolence of Brazil's poor was the result of poverty and disease, not innate racial handicaps or tropical malaise. In his conclusion, Penna called for a series of reforms. The "momentous sanitary problem...is not just medical and hygienic, but also social, political, and economic", he wrote. Along with treating the sick and improving their houses (by installing cesspools and drinking wells), the state needed to supply communication technologies, elementary schools, and agricultural extension, as well as to reduce prices on essential goods. For Brazil's rural population to reach their full economic and civic potential,



The most active, incessant propaganda must be conducted in order to inculcate in the spirit of all our patricians, in particular our public men, men of letters, journalists – intellectuals, in short: that alcoholism, *trypanosomíase americana* [Chagas' disease], malaria and hookworm to a great degree, and other endemic illnesses to a lesser degree, are the cause of our backwardness and of the shameful rearguard which we continue to occupy relative to other peoples. . . . When we liberate our people from these scourges, they will not envy any other people for their robustness, capacity to work, and intelligence. Then you will see the people elevate their moral level. They will shake the ignominious yoke of the satraps and factions; become conscious of their rights and dues; acquire love of country; and make themselves to be governed conveniently, by capable men, of their own free choosing (Penna, 1918, p. 172).

Penna expected a politically informed public health program to inspire a profound social transformation. People relieved of bodily suffering, he prophesied, would have the energy and self-respect to eliminate other pernicious aspects of national life that limited their prosperity and their country's progress. At his most ambitious, Penna hoped that expanded public health services would spawn a revolution in the politically retrograde interior.

Penna essentially proposed a form of scientific paternalism in rural Brazil as a replacement for the paternalism of the prior slave system, where workers had been valuable to their owners and consequently (he imagined) well cared for. He envisioned modern Brazil as a nation guided by scientists like himself, drawing on readily available resources in a development process suited to its own climate and population, independent of foreign capital or expertise. Penna saw hygiene science as a way to rationally incorporate the *sertão* and its inhabitants into modern economic and social life. In the process of doing this, the federal government would extend its reach into poorly served rural areas, which Penna viewed as a necessary means of weakening the hold of *coronéis* on their client populations. Several historians have argued that public health services became the wedge for extending federal administration into Brazil's interior during the First Republic and, in some cases, reducing rural oligarchs' stranglehold on local politics (Hochman, 1998a).

In 1918 Penna became the first director of Brazil's Rural Sanitation and Disease Prevention Service. Under pressure from Penna, Carlos Chagas and other 'sanitarian' reformers (Lima and Britto, 1996), President Pessoa created a National Department of Public Health (Departamento Nacional de Saúde Pública – DNSP) the following year, led by Chagas. The DNSP assumed half the cost of rural sanitation work for poorer states, aided by the Rockefeller Foundation International Health Board which agreed to cover one quarter of collaborating states' rural health expenditures. Hygiene inspectors of Northeast states enthusiastically embraced the federal government's offer to subsidize rural health services. Ceará's General Director of Hygiene wrote hopefully in 1919 that his state's rural population could be rescued by modern sanitation and medical care, with the addition of resources beyond those available in Ceará's coffers. He echoed Rio de Janeiro's and São Paulo's sanitarians in asserting that the *sertanejo* population was burdened by disease rather than racial endowment.

The struggle for improved sanitation in Brazil is no longer just an idea but has entered the domain of fact. A series of intelligent decrees has established regulations for Union intervention in rural sanitation of the states. Hookworm, plague, trachoma and malaria are in our backlands, hills and beaches crying to the state government to take advantage of those salutary federal resolutions and their arrangement with the Union or the Rockefeller Foundation in order to begin now a perfect and rational preventative course in place of the mere assistance or parsimonious distribution of medicines that we have achieved until now. That the health of our rural worker is the basis for the efficiency of his work, of our wealth and of our progress, it is unnecessary to repeat. Our sertanejo is more an invalid than a layabout, as they say: someone incapacitated by disease and by ignorance, but not by atavistic or regional inferiority – this has been demonstrated. It is thus rural sanitization [*saneamento*] which comprises an essential part of instruction, sanitary education the most relevant problem to resolve, the most elevated campaign to undertake, the most noteworthy deed to accomplish in our environment, from the point of view of hygiene and general progress (Relatório . . . , 1919, p. 57, emphasis mine).

In 1921, Penna published another book of essays on Brazil's public health crisis entitled "O Clamor da



Verdade" ("The Outcry of Truth"). In this and in speeches throughout the following decade, he conceived of economic and social progress as a set of steps that must be taken sequentially, in order to benefit the entire nation rather than merely a handful of landholders and industrialists. Rural sanitation was a vital stage that Brazil had overlooked, at significant economic and social cost. Policies that worked in other countries, under different environmental, political and social conditions, were not necessarily appropriate for Brazil. A strong critic of President Bernardes and supporter of the 'tenants' movement (for which he was imprisoned in 1924), Penna became increasingly forceful in asserting that Brazil's social ills were reflected in the physical ailments that its population suffered – and that these in turn exacerbated social fractures. He proposed rural colonization by small property holders as an antidote to latifundia's waste of Brazil's human and natural resources. The physician offered demographic and economic data from his study of the far southern state of Rio Grande do Sul to illustrate the significantly greater health and productivity of smallholders compared to workers on ranching estates and industrialized farms. Along with its economic and sanitary benefits, Penna asserted, smallholding had moral benefits. Residents of smallholder agricultural colonies typically embraced a family-centered morality and increased their religious devotion (*i.e.* Catholicity). Penna issued this warning to his compatriots:

The egoism of *latifundists*... industrialists... mercantilists... capitalists and usurers... businessmen... and politicians..., besides being inhumane, is blind, because it snatches the guarantees of a stable fortune, position, comfort and health for these egoists, a situation that is permanently in peril when one sees that the discontent and misery of the masses generate diseases, vices, disorder, crimes, revolts, and the economic, moral and financial ruin of the nation⁸.

By failing in their obligations to Brazil's poor, he cautioned, the country's elite were guaranteeing the failure of their modernizing project and engendering social disorder.

CONCLUSION

Unlike Dr. Belisário Penna in his rural health crusade, engineers rarely examined the problems of social organization that made drought such a crisis in the *sertão*. This was partly due to their firm belief in the transformative power of technology, regardless of the social context in which it operated. It was also due to their limited awareness of the social dynamics shaping ordinary *sertanejos'* lives. Whereas Penna examined the bodies of the *sertanejo* poor directly at rural health posts and was acutely aware of their hardships, his engineering colleagues rarely interacted with ordinary *sertanejos* on an individual basis in the course of their work. They came to understand the *sertão* primarily through maps and visits to or management of large-scale construction sites. They concerned themselves with the Northeast's geography, hydrology and transportation networks and paid limited attention to the living conditions and bodies of rural workers.

IFOCS attended only superficially to the *sertão's* dilemma. By explaining *sertanejos'* precarious existence as a problem of insufficient technical infrastructure, IFOCS deflected attention from the inequities that left landless families and small farmers vulnerable to myriad misfortunes, including drought. Republican elites' emphasis on drought as the *sertão's* central problem and public works as the appropriate solution designated engineers, rather than more radical reformers, as the key agents of transformation. Engineers, by their training and social position, generally embraced a moderate development ideology requiring little disturbance of the social order. They rarely examined how their construction works might differentially affect social groups, depending on their existing access to and

⁸ Belisário Penna. "O Cancro Nacional", 1929. Arquivo Belisário Penna. Casa de Oswaldo Cruz, Fundação Oswaldo Cruz, Rio de Janeiro. P/PI/TP/19290722.

control over land and water. Instead, they claimed that their projects addressed broad 'regional interests'.

In the view of some critics, Brazil's federal development agencies actively thwarted social transformation in the *sertão*. Government aid improved the security of large landholders who have no obligation to sustain their laborers through difficult times – though they are technically required to make water collected in reservoirs built with DNOCS's assistance publicly available during droughts. By failing to expropriate land from the wealthy, the drought agency ultimately added a water monopoly to Northeastern elites' existing land monopoly (Souto, 1992). In Darcy Ribeiro's biting summary:

A first permanent federal organization – the National Department of Works to Combat the Drought (DNOCS) – created to attend to the problem of droughts has been transformed into an agency of brazen service for the large breeders and the political bosses of the region (Ribeiro, 2000, p. 245-246).

At the heart of the drought agency's failure to rescue *sertanejos* from famine, migration and poverty lies faith in the utility of technical expertise regardless of the social context in which it is deployed. The political dynamics governing the *sertão* and Brazil as a whole were the central causes of poor *sertanejos*' vulnerability to climate fluctuations. Droughts were simply the episodes that revealed their social marginality most starkly. Because the drought agency's technocrats never had the political will or muscle to confront the social organization underlying the recurrent crisis, their ability to alleviate the human suffering that droughts precipitated was severely limited (Buckley, 2006).

The narrow impact of drought amelioration in Northeast Brazil is similar to the outcome of technical development efforts attempted in many parts of the world during the 20th century. Organizations like the Rockefeller Foundation International Health Board, which pioneered applying scientific knowledge to achieve social transformation during the 1910s and beyond, believed that their technical staff could provide rational solutions to pressing global

problems of disease, hunger and poverty (Cueto, 1994). The advantage of pursuing social change through science, as far as private and government aid agencies were concerned, was that science (and its practitioners) was understood to be apolitical. Scientific knowledge and its applications (medicine, engineering, modern agriculture) were understood to apply equally in all social contexts. They were therefore seen as rising above political confrontation. Given the high stakes involved in mitigating poverty in the nonindustrialized world, with revolution, mass redistribution of property and a profound realignment of political power as one possible route to that end, governments embraced science as a level-headed, manageable path to modernization and social betterment. The problem with this view is that scientists (or technicians using applied scientific knowledge) operate in a social and political landscape that constrains the impact and effectiveness of their recommendations. Because poverty is often fundamentally a product of social and political marginality, attempts to assist populations like landless *sertanejos* simply by targeting particular diseases or offering improved agricultural technologies had only modest impact.

ACKNOWLEDGEMENTS

Funding for this research was provided by the National Science Foundation STS Program (grant n. 0217479), the Josephine de Kármán Foundation and the University of Pennsylvania. Thanks to colleagues who commented on earlier versions of this research, particularly Steven Feierman, Nancy Stepan, and Henrika Kuklick. Thanks also to two anonymous reviewers for their very helpful comments, which I have endeavored to incorporate. All errors are my own.

REFERENCES

- ALBUQUERQUE JÚNIOR, Durval Muniz de. **A invenção do Nordeste e outras artes**. Recife: Massangana, 1999.
- ALBUQUERQUE JÚNIOR, Durval Muniz de. **Falas de astúcia e de angústia: a seca no imaginário nordestino, de problema à solução (1877-1922)**. 1987. Dissertação (Mestrado em História do Brasil) – Universidade Estadual de Campinas, 1987.



- ANDRADE, Joaquim Marçal Ferreira de; LOGATTO, Rosângela. *Imagens da Seca de 1877-78 no Ceará: uma contribuição para o conhecimento das origens do fotojornalismo na imprensa brasileira. Anais da Biblioteca Nacional*, v. 114, p. 71-83, 1994.
- ANDRADE, Manuel Correia de. **The land and people of Northeast Brazil**. Translated Dennis V. Johnson. Albuquerque: University of New Mexico Press, 1980.
- AMADO, J. Região, sertão, nação. *Estudos Históricos*, v. 15, p. 145-151, 1995.
- BLAKE, Stanley. **The invention of the Nordeste: race, region, and identity in Northeastern Brazil, 1889-1945**. 2001. Thesis (PhD in History) – State University of New York, New York, 2001.
- BOTELHO, Caio Lóssio. **Seca: visão dinâmica, integrada e correlações**. Fortaleza: ABC, 2000.
- BRASIL. **Service of Drought Control in the Brazilian Northeast**. Rio de Janeiro: Ministry of Transportation and Public Works, Federal Dept. of Drought Control Service, 1939.
- BRASIL. **Boletim da Inspeção Federal de Obras Contra as Secas**, v. 10, n. 1, 1938.
- BUCKLEY, Eve. **Drought and development: technocrats and the politics of modernization in Brazil's semi-arid Northeast, 1877-1964**. 2006. Thesis (PhD in History of Sciences) – University of Pennsylvania, Philadelphia, 2006.
- BURSZTYN, Marcel. **O Poder dos donos: planejamento e clientelismo no Nordeste**. Petrópolis: Vozes, 1984.
- CALLADO, Antônio. **Os industriais da seca e os “Galileus” de Pernambuco: aspectos da luta pela reforma agrária no Brasil**. Rio de Janeiro: Civilização Brasileira, 1960.
- CASTRO SANTOS, Luiz Antonio de. O pensamento sanitaria na Primeira República: uma ideologia de construção da nacionalidade. *Dados. Revista de Ciências Sociais*, v. 28, n. 2, p. 193-210, 1985.
- COUTINHO, Marília. Tropical medicine in Brazil: the case of Chagas' disease. In: ARMUS, Diego (Ed.). **Disease in the History of Modern Latin America**. Durham: Duke University Press, 2003. p. 76-100.
- CUETO, Marcos (Ed.). **Missionaries of science: the Rockefeller Foundation and Latin America**. Bloomington: Indiana University Press, 1994.
- CUNHA, Euclides da. **Os Sertões (Campanha de Canudos)**. Rio de Janeiro: Laemmert & Cia., 1902.
- DAVIS, Mike. **Late Victorian Holocaust: El Niño famines and the making of the Third World**. New York: Verso, 2001.
- DIA, G. Regional and subregional disjunctions: the case of Northeastern Brazil. In: GARCIA, Rolando V.; SPITZ, P. (Eds.). **Drought and Man. The Roots of Catastrophe**. Oxford: Oxford University Press, 1971. v. 3, p. 75-117.
- DINIZ, Alberto. **O dinamismo patrioticamente construtivo de Belisário Penna: esboço biográfico**. Rio de Janeiro: Jornal do Commercio/Rodrigues & Cia., 1948.
- DUARTE, Renato. **Do desastre natural à calamidade pública**. Recife: Fundação Joaquim Nabuco, 2002.
- DUARTE, Renato. **A seca no Nordeste: de desastre natural à calamidade pública**. Recife: Fundação Joaquim Tabuco, Instituto de Pesquisas Sociais, 1999. (Trabalho para Discussão, v. 89).
- FERREIRA, Luis Otávio. **Os politécnicos: ciência e reorganização social segundo o pensamento positivista da Escola Politécnica do Rio de Janeiro (1862-1922)**. 1989. Dissertação (Mestrado em Sociologia) – Universidade Federal do Rio de Janeiro, Rio de Janeiro, 1989.
- FURTADO, Celso. A policy for the economic development of the Northeast, 1958. In: SUDENE. **A policy for the economic development of the Northeast and a synthesis of the first guiding plan for the development of the Northeast**. Recife: SUDENE, 1961.
- FURTADO, Celso. **A operação Nordeste**. Rio de Janeiro: Ministério de Educação e Cultura, 1959.
- GRAHAM, Richard. **Britain and the onset of modernization in Brazil, 1850-1914**. Cambridge: Cambridge University Press, 1972.
- HALL, Anthony. **Drought and irrigation in Northeast Brazil**. Cambridge: Cambridge University Press, 1978.
- HIRSCHMAN, Albert O. **Journeys toward progress: studies of economic policy-making in Latin America**. New York: Twentieth Century Fund, 1963.
- HOCHMAN, Gilberto. **A era do saneamento: as bases da política de saúde pública no Brasil**. São Paulo: Hucitec/Anpocs, 1998a.
- HOCHMAN, Gilberto. Logo ali, no final da avenida: *Os sertões* redefinidos pelo movimento sanitaria da Primeira República. *História, Ciências, Saúde - Manguinhos*, v. 5 (Suplemento), p. 218-235, 1998b.
- KAWAMURA, Lili Katsuco. **Engenheiro: trabalho e ideologia**. 2. ed. São Paulo: Editora Ática, 1981.
- KROPF, Simone P. **Doença de Chagas, doença do Brasil: ciência, saúde e nação (1909-1962)**. Rio de Janeiro: Editora Fiocruz, 2009.
- LEVINE, Robert M. **Vale of tears: revisiting the Canudos massacre in Northeastern Brazil, 1893-1897**. Berkeley: University of California, 1992.
- LIMA, Nísia Trindade. **Um sertão chamado Brasil: intelectuais e representação geográfica da identidade nacional**. Rio de Janeiro: Revan/IUPERJ, 1999.

- LIMA, Nísia Trindade. Missões civilizatórias da República e interpretação do Brasil. **História, Ciências, Saúde - Manguinhos**, v. 5 (Suplemento), p. 163-193, 1998.
- LIMA, Nísia Trindade; BRITTO, Nara. Salud y nación: propuesta para el saneamiento rural. Un estudio de la Revista Saúde (1918-1919). In: CUETO, Marcos (Ed.). **Salud, cultura y sociedad en América Latina: nuevas perspectivas históricas**. Lima: IEP-OPS, 1996. p. 135-158.
- LIMA, Nísia Trindade; BRITTO, Nara. **Saúde e nação: a proposta do saneamento rural. Um estudo da Revista Saúde**. Rio de Janeiro: Casa de Oswaldo Cruz/Fiocruz, 1991. (Estudos de História e Saúde, v. 3).
- LIMA, Nísia Trindade; HOCHMAN, Gilberto. Condenado pela raça, absolvido pela medicina: o Brasil descoberto pelo movimento sanitário da Primeira República. In: MAIO, Marcos Chor; SANTOS, Ricardo Ventura (Orgs.). **Raça, ciência e sociedade**. Rio de Janeiro: Fiocruz/Centro Cultural Banco do Brasil, 1996. p. 23-40.
- LISBOA, [Miguel] Arrojado. O Problema das Seccas. **Anais da Biblioteca Nacional do Rio de Janeiro**, v. 35, p. 129-146, 1913.
- LUTZ, Adolpho; MACHADO, Astrogildo. Viagem pelo rio S. Francisco e por alguns de seus afluentes entre Pirapora e Juazeiro. **Memórias do Instituto Oswaldo Cruz**, Rio de Janeiro, v. 7, n. 1, p. 5-50, 1915.
- MAGALHÃES, Antonio R.; MAGEE, Pennie. The Brazilian Northeast (Nordeste). In: GLANTZ, M. (Ed.). **Drought follows the plow: cultivating marginal areas**. Cambridge: Cambridge University Press, 1994. p. 59-76.
- MENSAGEM do Exm. Sr. Manoel Antonio Pereira Borba, Governador do Estado, lida por ocasião da instalação da 1ª. sessão da 9ª. Legislatura do Congresso Legislativo do Estado, aos 6 de março de 1916. Recife: Imprensa Oficial, 1916.
- NACHMAN, Robert G. Positivism, modernization and the middle class in Brazil. **Hispanic American Historical Review**, v. 57, n. 1, p. 1-23, 1977.
- NEIVA, Arthur; PENNA, Belisário. Viagem científica pelo norte da Bahia, sudoeste de Pernambuco, sul do Piauí e de norte a sul de Goiás. **Memórias do Instituto Oswaldo Cruz**, v. 8, n. 3, p. 74-224, 1916.
- NUNES LEAL, Victor. **Coronelismo: the municipality and representative government in Brazil**. Translate June Henfrey. Cambridge: Cambridge University Press, 1977.
- PEARL, Julian G. **Race, place, and medicine: the idea of the tropics in nineteenth-century Brazilian medicine**. Durham: Duke University Press, 1999.
- PEIXOTO, Afrânio. **Clima e doenças do Brasil**. Rio de Janeiro: Imprensa Nacional, 1907.
- PENNA, Belisário. **O saneamento do Brasil: sanear o Brasil é povoá-lo; é enriquecê-lo; é moralisá-lo**. Rio de Janeiro: Typografia Revista dos Tribunaes, 1918.
- PESSOA, Eitácio. **Obras do Nordeste: resposta ao Exmo Sr. Senador Sampaio Corrêa**. Rio de Janeiro, 1925. Reprinted as part of the Coleção Mossoroense, série C, vol. 587 (Mossoró: Fundação Guimarães Duque, 1990).
- RELATÓRIO apresentado ao Exmo. Sr. Desembargador José Moreira da Rocha, Secretário dos Negócios do Interior e Justiça, pelo Dr. Carlos da Costa Ribeiro, Diretor Geral de Hygiene. Fortaleza, 1919.
- RELATÓRIO apresentado ao Exm. Sr. Dr. Aurelio de Lavor, Secretário dos Negócios do Interior, pelo Dr. Carlos da Costa Ribeiro, Inspetor de Hygiene. Fortaleza, 1916.
- RIBEIRO, Darcy. **Brazilian people: the formation and meaning of Brazil**. Translate Gregory Rabassa. Gainesville: University Press of Florida, 2000.
- RODRIGUES, J. A. Fonseca. **As Seccas do Ceará: ensaio teórico**. São Paulo: Secção de obras de O Estado de S. Paulo, 1919.
- SÁ, Dominichi Miranda de. Uma interpretação do Brasil como doença e rotina: a repercussão do relatório médico de Arthur Neiva e Belisário Penna (1917-1935). **História, Ciências, Saúde - Manguinhos**, v. 16 (Suplemento 1), p. 183-203, 2009.
- SCHWARTZMAN, Simon. **A space for science: the development of the scientific community in Brazil**. Pennsylvania: Pennsylvania State University Press, 1991.
- SEN, Amartya. **Poverty & Famines**. Oxford: Oxford University Press, 1981.
- SKIDMORE, Thomas. **Black into white: race and nationality in Brazilian thought**. Durham: Duke University Press, 1993.
- SOUTO, Francisco. **Nordeste, poder e subdesenvolvimento sustentado: discurso e prática**. Fortaleza: Editora UFCE, 1992.
- SOUZA, Eloy de. Um problema nacional: projecto e justificação [Rio de Janeiro: Typ. do Jornal do Commercio, 1911]. In: ROSADO, Vingt-Un (Org.). **Memorial da Seca**. Mossoró: Fundação Guimarães Duque, 1981. p. 24-35. (Coleção Mossoroense, v. 158).
- SOUZA, Marcos José Nogueira de; OLIVEIRA, José Gerardo B. de; LINS, R. C.; JATOBÁ, L. Condições geo-ambientais do semi-árido brasileiro. **Ciência e Trópico**, Recife, v. 20, n. 1, p. 173-198, 1992.
- STEPAN, Nancy Leys. **Picturing tropical nature**. Ithaca: Cornell University Press, 2001.
- STEPAN, Nancy Leys. **"The Hour of Eugenics": race, gender, and nation in Latin America**. Ithaca: Cornell University Press, 1991.

STEPAN, Nancy Leys. **The beginnings of Brazilian Science:** Oswaldo Cruz, medical research and policy, 1890-1920. New York: Science History Publications, 1976.

WARING, G. A. **Irrigation in Northeastern Brazil.** San Francisco: Western Engineering, 1912.

VILLA, Marco Antonio. **Vida e morte no sertão:** história das secas no Nordeste nos séculos XIX e XX. São Paulo: Ed. Ática, 2000.

Recebido: 31/01/2010
Aprovado: 29/07/2010

