East Asian Science, Technology and Society: an International Journal (2009) 3:231–256
DOI 10.1007/s12280-009-9092-7

The Scientist, the Governor, and the Planter: The Political Economy of Agricultural Knowledge in Indochina During the Creation of a "Science of Rubber," 1900–1940

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Received: 7 November 2008 / Accepted: 18 August 2009 / Published online: 30 September 2009
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Abstract From the turn of the twentieth century until shortly before the Second World War, private business collaborated with the colonial government in Indochina in the formative development of colonial agricultural science. This article focuses on that development with a particular eye to how research was conducted and influenced by the changing politics of French colonization, what was chosen as worthy of research, and how agricultural science projects were defined, structured, and funded.

Keywords Indochina · Vietnam · French colonialism · Rubber plantations · Agriculture · Development · Science

Abbreviations

AFC	Service de l'Agriculture, Forêt et Commerce
Agefom	Agence française d'outre-mer
APCC/I	Association des Planteurs de Caoutchouc en Cochinchine/Indochine or *Annales de Planteurs de Caoutchouc de l'Indochine*
BAISI	*Bulletin Agricole de l'Institut Scientifique de l'Indochine*
BEI	*Bulletin Économique de l'Indochine*
CAOM	Centre d'archives outre-mer
CCNEO	Compagnie de Commerce et de Navigation d'Extrême-Orient
CIRC	Comité International de Réglementation du Caoutchouc
EFEO	École française d'Extrême-Orient
FE	*Ficus elastica*
GGI	Gouvernement/Gouverneur Général de l'Indochine

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HB	*Hévéa brasiliensis*
HD	Résident de Hà Đông
IFC	Institut français du Caoutchouc
IP	Institut Pasteur
IRAI	Institut des Recherches Agronomiques de l'Indochine
IRCI	Institut de Recherches sur le Caoutchouc en Indochine
ISI	Institut Scientifique de l'Indochine
Goucoch	Gouverneur de Cochinchine
MDC	Ministère/ministre des Colonies
PV	Procès-verbal
RSC	Résident Supérieur au Cambodge
RST	Résident Supérieur au Tonkin
SACLC	Service Agricoles et Commercial Locaux au Cambodge
SE	Service économique
SICAF	Société Indochinoise de Commerce d'Agriculture et de Finance
SIPH	Société Indochinoise des Plantations d'Hévéa
SPCI	Syndicat des Planteurs de Caoutchouc de l'Indochine
SPTR	Société des Plantations des Terres Rouges
TTLTQG	Trung Tâm Lưu Trữ Quốc Gia/National Archives of Vietnam
UIPC	Union Indochinoise des Planteurs de Caoutchouc
UPCI	Union des Planteurs de Caoutchouc en Indochine

1 Introduction[1]

In *Colonisation ambiguë*, a sweeping overview of the history of French colonialism in Indochina, Daniel Hémery suggests in passing that the transformation of Vietnam's environment with the aid of science involved "a transfer, limited but real, of the technical systems and scientific knowledge of industrial societies, essential to the functioning of the colonial economy (Brocheux and Hémery 2001:130)."[2] At first glance, a history of the rubber industry in Vietnam seems to conform well to Hémery's description. Starting from a few hundred metric tons of forest-gathered rubber at the beginning of the twentieth century, production eventually surpassed 60,000 metric tons, with almost all of the rubber coming from large plantations. By the late 1930s, rubber had become a fixture in the agricultural sector of the economy, second only to rice in terms of export earnings. This growth caused one sympathetic observer to conclude that the rubber industry, after "a difficult

[1] A draft of this paper was presented at the conference on Emergent Science and Technology Studies in Southeast Asia, 14–15 January 2009, National University of Singapore. I would like to thank the conference organizers for their excellent work and the other participants for very stimulating conversation. I would also like to thank two anonymous reviewers for their critical comments. I have attempted to address their insightful suggestions for revision and have incorporated many of their ideas into this final version. Finally, I would like to thank Fae Dremock, who waded through and earlier incarnation of this paper.

[2] Original reads: "*La colonisation a été aussi une entreprise savante, la prise de possession scientifique de la biosphère indochinoise couplée à la domination et à l'exploitation de ses populations*." And "*un transfert, limité mais bien réel, du système technique et des savoirs scientifiques des sociétés industrialisées, indispensables au fonctionnement de l'économie coloniale*." Hémery's notion of a "transfer" of science and technology from metropole to colony echoes Basalla's model of the spread of science (1967, 1993).

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childhood and a turbulent youth, will enter into, at last, a period of maturity and equilibrium" (Bouvier 1947: 275, 295).[3]

Yet, Hémery's brief mention of the "transfer" of techniques and knowledge pays too little attention to the specifics of knowledge creation. Following Warwick Anderson's call to attend to "the history and politics of 'the case', and its colonial functionality," this article seeks to make a contribution to the body of literature on colonialism and science by relating developments in the knowledge and institutions involved in rubber manufacturing to specific changes in the political economy of Indochina (Anderson 2007: 250). This article especially focuses on the role played by private capital in creating and shaping the techno-scientific assemblages from which rubber emerged. More broadly speaking, this article tests the scope and character of technoscientific networks established during the first half of the twentieth century and the legacies of those networks.[4]

In this article, I put forward three arguments: (1) Institutions in France were largely unable to centralize rubber knowledge, demonstrating the need to qualify current estimations of the strength of colony-metropole techno-scientific links in the French empire. (2) The efforts of individual colons and joint-stock companies were vital to the manufacture of rubber, highlighting the importance of private initiative in the generation of scientific and technical knowledge. (3) The rubber industry in Indochina was dependent on trans-colonial connections, suggesting the growth of a Southeast Asian identity centered on agricultural production.

Each of the three sections of this article concentrates on a different time period in order to consider one of my three arguments. To analyze the competing interests of colonial governments and private enterprises, I employ a framework articulated by historians and anthropologists for conceiving of the global movement of techno-science in terms of networks, markets, exchanges and assemblages. Therefore, I track the origin, movement (including direction of flow and channels by which information traveled), and control of knowledge in the agro-industry of rubber in order to better understand agricultural developments in Indochina (Fig. 1), as well as the more general relationship between government and capital.[5]

[3] I have primarily drawn the material used in this essay from three archives. The French national archive in Aix-en-Provence, the Centre d'archives outre-mer (CAOM), was useful for high-level discussions that took place in France and at the level of the Governor General of Indochina (GGI). Two Vietnamese national archives, Trung Tâm Lưu Trữ Quốc Gia 1 (TTLTQG1) in Hanoi and TTLTQG2 in Saigon, provided material illuminating conditions in Vietnam. TTLTQG2 N.5/55 "*Note justifiant la nécessite et l'urgence de l'institution d'un droit de 4 francs par kilogramme sur les caoutchoucs d'origine étrangère introduits en France*," UPCI 1930, p. 14. Smallholder plantations are not discussed in this essay because they were not very relevant to issues dealt with in this essay. Original Bouvier reads: "*l'enfance si difficile et la jeunesse si tourmentée, entrerait enfin dans l'âge de la maturité et de l'équilibre*."

[4] Itty Abraham has also urged "a proliferation of historical and sociological accounts of science as practice…" (Abraham 2006: 210). Bonneuil (1997) offers an excellent analysis of the rubber industry in Vietnam in his dissertation.

[5] I thank Gregg Mitman for pushing me to focus on the role of capital. For an elaboration of a "postcolonial perspective", see Anderson (2002). David Turnbull has defined an assemblage as an "amalgam of places, bodies, voices, skills, practices, technical devices, theories, social strategies and collective work that together constitute technoscientific knowledge/practices" (Chambers and Gillespie 2000: 230). Two demonstrations of the importance of locality for science are Storey (1997) and Redfield (2000). Anthropological work on science has employed similar concepts, e.g., Tsing (2005) and Ong and Collier (2005).

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Much scholarship on colonial science has privileged the role of the state. David Arnold, for example, has skillfully analyzed the British colonial government in India and its "supreme confidence in the capacity of science and technology to rule nature and utilize it to the full" (Arnold and Guha 1995: 12).[6] Clearly, previous successes of scientific knowledge in controlling nature promoted a blind faith among some administrators in the ability of scientists to provide solutions to problems involved in colonial expansion. The state and its experts, however, did not necessarily act in concert and, following a recent trend among historians, this article reconsiders the ability of the colonial state to refashion society and nature.[7] Focus on the role of the government in colonial expansion has also highlighted metropolitan–colonial relations at the expense of inter-colonial and regional connections outside the purview of the state. This perspective, coupled with the fact that science is often seen as a product of Europe, has worked to elide the fact that scientific research on rubber in Indochina occurred in a Southeast Asia context.[8]

Finally, this article reflects briefly on the organization of difference surrounding the transfer of knowledge and the consequences of this transfer for Vietnamese identity. Rubber, as with the sulfa drugs Laurence Monnais writes about, constituted a "colonial property regime" over which the French retained a large degree control. It is important to keep in mind, however, that the rubber plantations, along with other "colonial heterotopias," maintained important connections with their surroundings. While techno-scientific ideas surrounding rubber may have likewise remained inaccessible to most of the population, Indochina's identity as a rubber-producing colony became, during the process of decolonization, an important part of a Vietnamese national identity. "A postcolonial perspective," Anderson suggests, "might show us how scientific and technological endeavors become sites for fabricating and linking local and global identities, as well as sites for disrupting and challenging the distinctions between global and local" (Anderson 2002: 644).[9]

[6] Likewise, Drayton (2000: xvii) maintains, "the professionals of Science and Imperialism found common advantage in the idea that knowledge might guide the best management of nature.". These observers have analyzed the material ways in which scientific, technological, and medical advances became the so-called "tools of empire," enabling European and Asian colonizers to carry out their colonial projects (Headrick 1981). On state scientism, see Scott (1998).

[7] "Challenging both colonialists' self-representation and the anticolonialist historiography that overestimated the success of European control over African lives," Bonneuil notes, "many historians have recently underlined the epistemic and political weakness of the colonial state" (Bonneuil 2000: 268). For work on agriculture in the "tropics," a subjective term defined by a combination of geography and climate, see Bonneuil (1991), Brockway (1979), and Osborne (1994).

[8] Though not commonly employed during the age of high imperialism, I use the term "Southeast Asia" to refer to the area including the American Philippines, British Malaya, Dutch East Indies, French Indochina, etc. By the early twentieth century, this region was a significant center for the production of world-class scientific knowledge, complete with research sites, published journals, and important scientific minds. Furthermore, after 1850, as colonialism became a state enterprise, economic activities such as industrial plantations came to resemble each other across the region. Tarling (1999) offers a useful overview of European colonial empires in Southeast Asia. Important work to challenge the idea of a monolithic colonial position has been done in Cooper and Stoler (1997).

[9] On property regimes, see Monnais. For examples of "colonial heterotopias," see Chang and Mrazek. For contemporary spaces of concentrated modernity, see Waldby. All papers were presented at the conference on Emergent Science and Technology Studies in Southeast Asia, 14–15 January 2009, National University of Singapore.

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2 Failure of Efforts to Centralize Knowledge Through Metropolitan–Colonial Links, 1890s to 1910

In a 1905 speech given to the Colonial Congress, the secretary of the colonial rubber group, André Spire, touched upon some of the key challenges facing the fledgling industry. He spoke of, for instance, the different contributions that could be made by "the isolated colon, the joint-stock company, and finally by the state" to increase rubber production. The colon, Spire admitted, was ill equipped to deal with the demands of rubber, in particular the 5- to 7-year waiting period between planting and rubber production. This delay in both production and profit meant that the joint-stock company, with its large reserve of capital, was the best instrument to exploit rubber, something, Spire lamented, the Americans already knew well. He also stated that the level of government backing of rubber in Indochina was a far cry from the support provided in the Dutch East Indies and on the Malaya peninsula. Although in practice, the government proved helpful for early planters, sending officials on study missions, as well as maintaining a network of botanical gardens, the French government balked at direct financial investment in rubber and was ambivalent about providing more than moral support for growers.[10]

The world market for rubber, a hydrocarbon polymer with properties including elasticity, flexibility, and durability, expanded dramatically at the turn of the twentieth century. This growth in demand was due to the substance's usefulness for a number of industries, in particular the automotive industry in the USA, which became the world's largest buyer. Increasing rubber consumption helped fuel, in turn, the development of the science and the technologies of rubber.[11] At first, agricultural topics dominated inquiry, as planters, botanists, and other natural scientists attempted to determine exactly the range of possible rubber production. This research dealt with life cycles and species' tolerances, soils, and climates. Later, technical questions came to the fore. These investigations, which initially involved inquiry into the most efficient methods of tapping, and plant health and diseases, came to be dominated by topics related to the industrial treatment of rubber, as production increased and a market for "synthetic" rubber grew.[12]

[10] TTLTQG1/AFC 446, "*Les caoutchoucs dans les colonies françaises*," *La Dépêche Coloniale*, July 12, 1905. There were many in this period that thought rubber had "a great future," e.g., TTLTQG1/AFC 451, Letter, Josselme to Goucoch, April 30, 1897.

[11] At the time, rubber was exclusively manufactured from the raw latex of several tropical plants. The increase in the plantation method for the production of latex, which was subsequently processed into rubber, required the growth of technologies and scientific knowledge that can be divided into two categories, agricultural and industrial.

[12] Chemists investigated ways of coagulating rubber, the fabricating of different qualities of rubber product for the market, and potential new uses. Grafting and clone production became an important issue as those manufacturing "natural" rubber sought to meet the challenge of synthetics. For a general history of rubber, see Coates (1987). The secretion of latex, a starting product for synthesizing of rubber, is common to a number of species of trees and vines, including *Hévéa brasiliensis* (often called "para" on the market), *Ficus elastica*, *Castilloa elastica*, *Ceara* or *Manihot glazovii*, etc. These latex-producing plants occur naturally in many tropical regions and most of the latex of the late 19th century was gathered by individual collectors in the forests of places such as the Amazon and the Belgian Congo. The methods employed were often scandalously brutal, and low plant densities limited production. Thus, many Europeans sought to grow latex-producing plants in plantations. Although medical questions relating to the increasing (and appalling) morbidity and mortality rates of workers and inquiry into ways of keeping the labor force healthy enough to tap rubber occupied planters and doctors in Indochina, they are not the subject of this essay.

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Fig. 1 Indochina map (*Source: Library of Congress Geography and Map Division Washington D.C. 20540-4650 USA. Call Number: G8005 1985 U51. Produced by the US CIA 1985. Accessed through*: http:/hdl.loc.gov/loc.gmd/g8005.ct001585)

The early period in the generation and movement of rubber knowledge in Indochina, which lasted roughly from the late 1890s to 1910, was a time of great hope, and hype, as high prices garnered by rubber planters in Southeast Asia during the first "boom" of the 1900s encouraged predictions of fantastic futures for the production and consumption of the material. A person as highly placed as the French minister of colonies (MDC) claimed "the culture of rubber was of

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great interest to the majority of our overseas colonies."[13] This period was also marked by both government encouragement of knowledge generation and a lack of coherent policy vis-à-vis rubber that left the development of rubber production dependent on individual colon initiative. The procuring of *Hévéa brasiliensis*, or *Hévéa*, seeds for the botanical garden in Saigon by a navy pharmacist named E. Raoul typifies colonial government intervention during the late nineteenth century. Although he acted under a general government initiative to explore the possibilities of rubber production and used pre-existing imperial networks to carry out his activities, it seems Raoul acted largely on his own when he sent *Hévéa* to Saigon (Robequain 1944).

The government-funded botanical research that did take place involved exploration, experimentation, and information gathering, as officials sought to create an inventory of rubber-producing plants throughout the French empire. This empire-wide project necessitated communication of ideas and personal travel between both metropole and colony and between the colonies of the different imperial powers. In the spring of 1907, for instance, an agricultural engineer based in Saigon, Edmond Carle, was sent to Singapore in order to buy one thousand *Ficus elastica* cuttings for planters in Tonkin. On his trip, Carle took the chance to visit Henry Nicholas Ridley, the famous director of the Singapore botanical garden, and used the opportunity to learn about the *Ficus* and *Hévéa* plantations on the Malaysian peninsula. In his report, Carle discussed a range of issues related to *Hévéa* and, to a lesser extent, *Ficus* plantations. His observations dealt with growing and tapping techniques, ranging from how to chose appropriate land to issues of plant disease and labor relations.[14]

Soon, a semi-private scientific institution in Indochina itself, the branch of the Pasteur Institute (IP) located near Nha Trang on the central coast of Vietnam, began to conduct research on plantation-grown rubber. Following the tradition of his mentor Louis Pasteur, who was well-versed in the agricultural sciences, Alexander Yersin, more famous for his research on plague, started work in 1898 on a batch of *Hévéa* seeds received from the Raoul shipment. Although these experiments continued until 1975, practically speaking, data gathered under the experimental conditions of sandy coastal soils with frequent exposure to high winds, which bent growing trees, yielded few insights into the gray and red soils elsewhere in Indochina. Furthermore, although seeds from the Raoul delivery were also sent to Ong Yêm, a new experimental station created in Cochinchina, experiments were often carried out apathetically, and a 1908 report from the Agriculture Service in Cochinchina mentioned problems of basic record keeping.[15]

[13] TTLTQG1/AFC 460, Letter, MDC to GGI, August 31, 1897. *Hévéa* seeds were imported sporadically into Indochina as part of a general movement to find agricultural products suitable for colonization. The beginning of a serious attempt to cultivate *hévéa* has often been traced to Raoul's 1897 shipment.

[14] TTLTQG2 IA.4/082 (6) Report, M. Carle, December 31, 1907. As in earlier periods, botanical gardens across the region continued to serve as nodes in the networks of knowledge transfer, see Grove (1995).

[15] TTLTQG2 IA.4/N4 (8) Report, Agricultural Service in Cochinchina, June 29, 1908 and Robequain (1944: 239). Thus, notwithstanding some interest expressed by the colonial government in the development of local research, with little actual financial support for these early experiments, French planters continued to have to send abroad for information.

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Despite the work of these government agents, the success of rubber production in Cochinchina ultimately depended upon the initiative of individual colons serving as trans-colonial actors. *Hévéa* was just one among many rubber-producing plants being considered for cultivation in Indochina, and botanical gardens helped colons to consider these alternatives. Over a year before Raoul sent his samples to Saigon, Josselme, a professor and powerful planter living in Cochinchina, wrote to the Governor General of Indochina (GGI) to request information and samples of *Céara* rubber, or *Manihot glazovii*. By the end of 1897, he had received his seeds and answers to his questionnaire from the head of the arboretum in Libreville, French Congo.[16]

It is the failure to establish plantation production of rubber in Tonkin and northern Annam that most clearly reveals the limitations of government support and the extent to which the industry depended on the initiative of individual planters. The first years of the twentieth century were still a time of exploration of the possibilities of rubber production, and in 1900, trade statistics from Marseilles listed Tonkin as exporting close to 89 tons of forest-harvested rubber (Marseilles Chamber of Commerce 1901: 158). From early on, government officials were involved and the Resident Superior of Tonkin (RST), for instance, sent out a letter to the provincial heads introducing a new method of extracting rubber from the skin of vines recommended by those at the colonial garden in Nogent-sur-Marne in France. In his missive, the RST also forwarded detailed instructions for the collection of all rubber-producing plants in the region, which he offered to subsidize using Tonkin's budget.[17] The prospects for the plantation growth of *Ficus* were particularly hopeful. Like *Hévéa*, *Ficus* is a tree and can be tapped in similar ways, with V incisions channeling the rubber into cups. Although not all government officials felt the same way, the head of the Service of Agriculture in Annam argued that these trees seemed to have good latex yield and economic potential.[18]

Government officials were only willing and able to fund the most general (i.e., theoretical) investigations into rubber, and it was left to private individuals and businesses to apply or create the specific (i.e., applied) knowledge necessary for a rubber industry in the north. Several colons expressed interest in importing *Ficus* from the Malaya peninsula, and in 1904–1905, one planter wrote a series of letters to Guillaume Capus, head of the Department of Agriculture, Forests, and Commerce (AFC), about the possibility of obtaining samples of *Ficus* from a well-known Chinese seller in Malacca. Capus agreed with the planter's request, and proposed to defray the costs of transport using a combination of funds from the general budget as well as the local budget of Tonkin. The RST refused, however, arguing that "despite

[16] Whether through official or private channels, the late-developing rubber plantations in Indochina "benefited continually from the experiments of the large neighboring producers in British Malaya and Netherlands Indies" and places further abroad (Robequain, 1944: 201).

[17] TTLTQG1/HD 3472, Circulaire 20, RST, March 22, 1900.

[18] TTLTQG1/AFC 456, Report, M. Mieville, November 1908. TTLTQG1/AFC 456, Notice, January 14, 1901. In this report on the distribution of FE in Annam, Jacquet mentioned one FE "giant that measured 16 meters in height," which had been growing in a Vietnamese court official's garden for about 20 years. See also TTLTQG1/AFC 456, Report, M. Jacques, nd, in which Jacques argued that "the Ficus in Annam is very productive," original: "*le ficus en Annam est très productif*."

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all of the interest that the introduction of a new culture presents for the colony, it is impossible for the local budget to contribute."[19]

Even though by 1905, early tests of *Ficus* had yielded few promising results, the metropolitan government continued to push for the development of rubber in the north. The minister of colonies, who wrote to the GGI late in the summer of 1906, acknowledged the "mediocre results" of *Ficus* tests reported in the *Bulletin Économique de l'Indochine* (BEI) but included in his letter further instructions for the propagation of the plant by cuttings. The head of the botanical garden in Hanoi mentioned in his comments on the minister of colonies' letter that the suggested methods were the same as those that had been employed in Indochina for years, with little to show as a result. Somewhat skeptically, one might imagine, the director suggested that these tests used *Ficus* from Indochina and later tests were on *Ficus* from Singapore, and the Buitenzorg research station on Java might give more promising indications. This suggestion was followed by continued requests from colons interested in *Ficus* and by analysis of samples, reports, and instructions on planting issuing from Nogent-Sur-Marne and elsewhere in the imperial circuits of knowledge. In spite of these efforts, plantation production did not yet rival the level of rubber collection achieved earlier.[20]

As with many other field sciences at the turn of the century, botany was moving indoors. Biological and chemical laboratories were becoming key sites of agricultural research as scientists measured soil samples and burned plant specimens to determine nutrient composition in carefully controlled, well-calibrated experiments (Kohler 2002). The growing emphasis on laboratory studies could easily have resulted in a shift to metropolitan control of knowledge generation about rubber. Yet, in the case of the rubber sciences, laboratories remained "in the field," located in Saigon and Nha Trang, not Paris. The fact that no one in Paris at the time carried out studies on the problems of rubber, however, did not mean that metropolitan scientists and administrators did not seek to become the hub for the rubber sciences. Those in France envisioned themselves as at the center of a classic Basallian model of center and periphery. In this relationship, the metropole would receive raw data, in the form of answers to questionnaires and plant samples preserved in alcohol and return processed knowledge contained in advances in growing and processing techniques (Basalla 1967, 1993). In this spirit, the MDC announced in 1910 the creation of a special office for the study of rubber.[21] The primary functions of this office were both to collect and store knowledge related to, and direct experiments analyzing, the growth of rubber plants, the harvesting of latex, and the industrial manufacture of products. In addition, this service was intended to be a focal point for relations with

[19] TTLTQG1/AFC 456, Letter, RST to AFC, April 6, 1905—Though see Carle mission that seemed to suggest otherwise. I do not have the response of the GGI. Original reads: "*malgré tout l'intérêt que présente pour la Colonie l'introduction d'une nouvelle culture, il est impossible au Budget local de contribuer*." The seller's name was Tan Chay Yan.

[20] TTLTQG1/AFC 456, Letter, MDC to GGI, August 30, 1906; Note, sd, on propagation of ficus by cuttings; Letter, Head of the Agricultural Service in Tonkin to AFC, September 14, 1906; Minute, AFC, October 23, 1906; Letter, Head of the Agricultural Service in Tonkin to AFC, October 26, 1906. For an understanding of agricultural concessions in Tonkin and northern Annam, see Tạ (1996, 2001).

[21] TTLTQG1/AFC 443, MDC to GGI, November 24, 1910.

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other countries involved in the rubber industry and a reference point for those in the French empire interested in cultivating latex-producing plants.

Along with the announcement of the new service, the MDC sent out specific instructions for the collection and preparation of agricultural samples related to rubber throughout the empire. These instructions were quite detailed, taking up five pages in length, and more closely resembled botanic collecting forms than political instructions. For example, in describing the method for preparing samples, the form instructed administrators that "a complete botanic sample should include: root fragments, stems, branches, leaves, flowers, fruit, and seeds" and that these "collected samples should be accompanied by a card indicating the scientific and indigenous name, if possible."[22] Local colonial administrators balked at the amount, and accuracy of information required by the minister. The head of the local Service of Agriculture and Commerce in Cambodia (SACLC), for example, stated that, due to a lack of funds, it was impossible to satisfy the Colonial Bureau's "very complicated" demands. In particular, the minister's request to collect samples from all latex-producing plants in the protectorate would have required "an agent sufficiently robust" to organize an "exploration mission" to areas in Cambodia that were still "unhealthy, almost deserted, and even dangerous to cross."[23]

What is interesting in this case is not so much the creation of this office, which had established models in London and Amsterdam, but the degree to which a centralized solution to rubber knowledge failed to serve the needs of empire. Clearly, the Colonial Bureau was attempting to take control of the rubber industry without, however, having the resources to do so. In other words, this example demonstrates a tension between a high-level tendency to centralize information and power and a ground-level reluctance to put such policies into practice, stemming from a lack of resources and, one might suppose, will—not all local administrators would be happy giving up their authority. Thus, information-generating activities remained in the colony and accessible even to those who had no connection to the metropole, and not until the 1930s did those in Paris take part in a significant way in knowledge production about rubber.

In 1910, the work of two French botanists on a species of rubber-producing tree of Tonkin and Annam was published in Paris. This publication coincides with another event, the founding of the Association of Rubber Planters of Cochinchina (APCC). The contrast between these two events is striking. While those interested in rubber production in the north were still at the stage of producing scientific volumes on species that had remained heretofore obscure, enough planters in the south had begun growing *Hévéa* to form an association dedicated to promoting their interests. My attention now shifts back down south to look at the further transformation of rubber and of rubber knowledge (Eberhardt and Dubard 1910).

[22] TTLTQG1/AFC 443, Supplement to Ministerial Circular 7.
[23] TTLTQG1/AFC 443, Letter, RSC to GGI, April 5, 1911 and Letter, SACLC to RSC, March 20, 1911.

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3 The Importance of Individual and Private Initiatives in the Formation of Rubber Science in Indochina, 1910 to Mid-1920s.[24]

The second phase of development in the rubber industry witnessed the formation of a rubber growers' association in Indochina and the consolidation and publication of knowledge in a specialized journal. In addition, a short-lived controversy over seed-importing regulations further highlighted the power of private individuals and businesses to influence government policy and typified in many ways the kinds of interactions that occurred between capital and government over the next 15 years.

The founding of the APCC, which later changed its geographic scope from Cochinchina to Indochina, so as to include Annam and Cambodia, marked an important milestone in the creation of a rubber industry in Indochina. By 1910, both individual colons and company-owned plantations were growing rubber; the first two such plantations were Suzannah, founded in 1904 and incorporated in 1907, with a capital of 150,000 piasters, and Xa-Trach, which was started as a joint-stock company in 1907. During the 1910s, rubber plantations, mostly but not completely European-owned, began to spread slowly out from Saigon, sometimes following, sometimes pushing roads and railways into the hinterland. Thus, until the mid-1920s, rubber production was the result of individual planter initiatives and the investment of capital from within the colony itself.[25]

The membership of the association included judges, lawyers, doctors, engineers, and others from high-level colonial society, and this organization often successfully influenced government policy. French, Vietnamese, and Chinese rubber-growing efforts at this point were not dissimilar. Yet, in practice, individual access to the association was based on social and political position within the colonial society. Thus, although this association was technically open to Vietnamese and Chinese planters, few joined. And, as a few French-owned companies gradually came to dominate the production of rubber, non-European contributions were eclipsed.[26]

The period lasting from 1910 to the mid-1920s was characterized by a balance of private and public generation of knowledge and offered many examples of discussions about how to put theoretical knowledge into practice in solving concrete problems. One place this balance can be seen is in scientific publications dealing with rubber. Although the government continued to fund agricultural scientists to carry out experiments on this substance, and to publish works of interest to the industry, privately funded books and journals began to carry crucial information. One such publication was the *Indochinese Rubber Planters' Journal* (APCI), the organ of the APCC, which ran from 1911 to the 1940s. This journal offered articles

[24] The involvement of amateurs in science is a very old phenomenon, one that predates the rise of professional science. See Sangwan (1998).

[25] TTLTQG1/AFC 446, Girard, Report of the Head of the Agricultural Service in Cochinchina on rubber plants. See also Đặng (2000: 41-44). M. Belland is credited by French planters as being the first to grow *hévéa* on a sizable level in Cochinchina. Even when prices rose as high as 30 francs/kilogram during the rubber "boom" of the early 1900s, double the average of 15 f/kilo of later times, French capital preferred to go into already established plantations, such as those in FMS. Unique among French colonies, Indochina possessed its own currency, the piaster, which was not pegged to the French franc until 1930. See Bassino and Nakagawa (2000).

[26] See APCC (1916) for a list of plantations. The majority of rubber growers were French, of course, and the non-French planters presumably saw few social or economic reasons to join the association.

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on a mélange of topics including science, law, economics, politics, and gossip as planters hashed out issues that mattered to the industry. In the early years, the *Annales*, like the colonial government, relied heavily on information gathered from neighboring rubber-producing countries. For example, in its first year of publication, the *Annales* reproduced the complete report of G. Vernet's government-sponsored mission to the Malaysian peninsula, as well as a study conducted by its own member, Octave Dupuy, a civil engineer, in the same region (APCC 1911: 57, 58). But the publishers of the *Annales* also recognized the need to develop a science of rubber specifically adapted to southern Indochina, as shown in an early issue:

> On the other hand, one can admit that in addition to general knowledge given by books and used in all lands, each region is liable to have information of practical interest limited to that region. The cultivation of rubber in Cochinchina and Annam, for example, will give rise, without doubt, to new theories, special studies, beneficial discoveries, especially for the colons, present and future, of this land. A body of work is thus set-up, that of the science of the cultivation of rubber in Indochina; this will be a communal work, offering the best returns, if each is prepared to supply, day after day, his contribution (APCC 1911: 11).[27]

According to the president of the Association of Rubber Planters of Indochina (APCI), knowledge was on the scale of the colony, and the study of rubber in Cochinchina and Annam should give rise to new, localized theories useful to the community of planters engaged in the business.

In contrast to the fate of the APCI, the fate of the *Agricultural Bulletin of the Indochinese Scientific Institute* (BAISI) hints at the overall lack of colonial government funding for agricultural research. Founded in 1919, the BAISI was designed to report the results of the newly formed Indochinese Scientific Institute (ISI), placed under the direction of the well-known botanist Auguste Chevalier, with research largely focused on agricultural activities. From the beginning of its existence, officials discussed whether or not to fold this ill-fated journal into the Economic Bulletin of Indochina (BEI), Indochina's premier economic publication. Vernet, the first editor of BAISI, argued that there were good reasons to keep the journal separate from the BEI. He stated, for example, that the BAISI served as a focal point for scientific contact with France and other countries. He also said that the planters of Cochinchina wanted a monthly publication printed in Saigon to keep up-to-date on scientific advances. And the BAISI, unlike the BEI, offered the space for "experimental sciences." These arguments were not enough, however, and the government decided to fold the specialized publication into the BEI in 1923.[28]

[27] Original reads: "*D'autre part, on peut admettre qu'en dehors des connaissances générales données par les ouvrages et utiles dans toutes les contrées, chaque région est susceptible d'enseignements d'un intérêt pratique limité à cette region. La culture du caoutchouc en Cochinchine et en Annam, par exemple, donnera lieu, sans doute, à des théories nouvelles, à des études spéciales, à des découvertes profitables surtout aux colons, actuels et futurs, de ces pays. Une œuvre est donc à constituer, celle de la science de la culture du caoutchouc en Indochine ; ce sera une œuvre commune, offrant les meilleures garanties, si chacun veut bien apporter ici, au jour le jour, sa contribution*."

[28] TTLTQG1/GGI 7774, Letter, ISI, October 29, 1919. TTLTQG1/GGI 7440, Letter, Director of ISI to Director of the SE, December 29, 1921.

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Returning to the planters, a brief but heated debate that occurred over a law regulating the importation of *Hévéa* seeds into Indochina revealed how scientific knowledge was both created and put into practice in response to specific questions concerning the development of the rubber industry in Indochina. This debate also highlighted, once again, the importance of regional links. Drawing from observation made during a scientific mission to rubber plantations in the region, Vernet, who worked as a chemist at the Pasteur Institute in Nha Trang before his BAISI duties, wrote a letter to the Chamber of Agriculture. In his letter, Vernet reported on the "maladies cryptogamiques" that threatened the *Hévéa* plantations of the British and Dutch colonies, identifying three diseases in particular, *Fomes semitostus*, *Diplodia rapax* (*Massee*), and *Corticium javanicum*, as posing special danger to rubber trees. Based on Vernet's letter and the recommendation of other planters, the president of the Chamber of Agriculture wrote a letter to the GGI in support of regulations concerning the importation of *Hévéa* seeds and trees. On June 7, 1910, the GGI issued an *arrêté*—something like a policy statement—that banned the importation of *Hévéa* plants and required *Hévéa* seeds to undergo the same disinfection procedures used for other seeds imported from abroad.[29]

The *arrêté* of June 7 was not simply the result of one person's report, representing instead the government's recognition of the need to regulate the rubber industry.[30] Around the turn of the century, most of the rubber-producing plants and seeds that had been imported into Indochina flowed through government channels. Yet, by the mid-1910s, with local sources still unable to meet the demand for seeds, and the government unwilling to do so, new planters needed to buy from private sellers abroad. The rather strict regulations on the importation of plants and seeds seemed necessary in the eyes of the GGI and the Resident Superiors in order to protect the fledgling rubber industry and retain control over its direction.

Many within the association almost immediately questioned the necessity and wisdom of the *arrêté*. Several planters viewed these regulations as a threat to their interests and the future of the rubber industry. At the constitutional meeting of the association, the President, André Crémazy, a defense lawyer by profession, thought the "measures taken were premature, the danger of disease propagation has not yet been sufficiently demonstrated" (APCC 1911: 5).[31] Disinfection killed the germinative faculty of *Hévéa* seeds, the planters claimed. Most of all, members were concerned that these restrictions would have the unfortunate consequence of allowing rubber seed venders to claim that the disinfection process freed them of any obligation to guarantee the germination of their seeds. This view was far from unanimous, however, and the association decided to wait to act until further information on the matter was available.

One important source of data needed to resolve this debate came from the planters themselves. With regards to this "delicate" matter, the committee reported in the minutes from the July 19 meeting that Auguste Belland, the revered pioneer of rubber growing

[29] APCC, *Annales* 1911. See also TTLTQG1/RST 78050, Order 1740, GGI, June 7, 1910 and TTLTQG1/AFC 460.

[30] TTLTQG1/AFC 460, Note 25, Consulting inspector of the Department of Agriculture and Commerce to the Director of the personnel agency, March 23, 1910.

[31] PV July 12, 1910 Original reads: "*la mesure prise est prématurée, le danger de propagation de la maladie n'ayant pas été suffisamment démontré.*"

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and former chief superintendent of the Saigon police, Bussy, a chemist at the analysis laboratory in Saigon, and Ledreux, a planter, had begun to conduct experiments on the ability of *Hévéa* seeds to germinate after undergoing the required disinfection process. When these initial tests, along with those conducted by P. Morange—Director of the Agricultural and Commercial Services of Cochinchina—at the botanical garden, were inconclusive, other planters jumped into the fray. Gaston Sipière, who eventually served as President of the association, France Filhol, and Jousset de Bellesme, all opponents of the law, reported germinations rates of around 2% after disinfection. Meanwhile, two other planters, Louis Jacque and Matard, reported almost no seed loss due to disinfection. With these conflicting reports, the committee changed its tone somewhat and argued that as a "result of these findings [it is clear] that the choice, the quality of the seeds, the method of packing, the length of transport, the time of disinfection, etc…, are, if not the only, at the least some of the most important causes of the loss of germinal faculty" (APCC 1911: 38).[32] In January 1911, François-René Hénaff, retired chief doctor of the military hospital in Saigon and former head of the Health Services, and the planter Saliège both achieved high germination rates, and by February of that year, N. le Coispellier, who was president of the association at the time, wrote that the experiments showed that the disinfection process did not affect germination. Despite these results, the committee maintained their position that the disinfection process, and the delay that it entailed, enabled devious seed sellers to renege on their guarantees, which threatened to hamper the growth of the industry.

As the various factions waited for the results of their experiments, they continued to gather data. For example, the committee asked le Coispellier to search for information at the international rubber exposition in Singapore, while individual members produced their own evidence. The committee also published the views of Ridley of Singapore, who thought that *Hévéa* plants, along with the soils and crates that they were packed in, could carry diseases but that the smooth *Hévéa* seeds were unlikely transporters of spores or mycelium.[33] With these divergent opinions in the colony, the GGI wrote away to his set of experts, including other government officials, as well as scientists in France.[34]

From the start, the GGI had taken the objections of the association seriously. For instance, he had issued an *arrêté* on September 15, 1910, which, following the suggestion of le Coispeiller, had clarified when and where the disinfection procedures would take place. This new *arrêté* ordered that seeds packed in sealed crates should be disinfected only when opened on the plantations and not at the ports. This law put the onus of informing the Department of Agriculture on the individual planter, and it meant that, during the seed-shipping season, the already understaffed agency would most likely be overwhelmed with work. The issue was far from settled, however, and in March 1911, the

[32] PV December 12, 1910 Original reads: "*résulter de ces faits que le choix, la qualité des graines, le mode d'emballage, la durée du transport, le moment de la désinfection, etc...., sont, sinon les seuls, du moins les plus importants facteurs de la perte de la faculté germinative*."

[33] Ibid. PV August 9, 1910.

[34] TTLTQG1/AFC 460, Report, French Consul in Singapore, August 22, 1910. He asked, for instance, the French consulates in American, Dutch, and British colonies of Southeast Asia to report on the local state of rubber and in particular on laws and regulations relating to the importation of rubber seeds and plants. The governments of the Straits Settlements and the FMS had taken "no special measures" reported Michel Trilles, head of the French consulate in Singapore, "regarding the importation of seeds or plants from abroad" on the Malaysian peninsula.

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President of the Chamber of Agriculture wrote to inform the association that the majority of the chamber continued to support the regulations, a view supported by the head of the Department of Agriculture and Commerce for Indochina.[35] And, as late as April 1911, the Governor of Cochinchina expressed reluctance to write to the GGI to ask to repel the *arrêté*.

On July 4, 1911, however, the GGI issued another *arrêté* that kept the ban on the importation of trees but lifted the required disinfection of seeds instituted over a year before. It seems likely that the GGI ultimately agreed with the stated position of the association that scientific studies showed no definite proof that seeds could spread infections. In this case, the costs and potential losses due to delays caused by disinfection procedures outweighed the possible risk of introducing diseases into Indochina.[36] The story of disagreeing experts and inconclusive evidence is not new, but in this case, the conclusion of the debate shows how some planters were able to use scientific ambiguity to overcome the compelling concerns of many scientists and other planters. In this case, the GGI refrained from arbitrating for over a year, and was willing to simply stand back and observe the dispute as the profits from rubber were not yet key to balancing the colonial budget.

By the early 1920s, the rubber industry in Indochina was at a critical juncture. Little metropolitan capital had been invested and limits on the ability of colonial capital to buy into rubber caused many to worry that the industry might stagnate without fruition. Yet, the Stevenson plan of 1922, which France did not take part in, and the second rubber "boom" beginning in 1925 signaled the coming of age of the industry in Indochina.

4 The Continuing Strength of Regional and Trans-colonial Links: Mid-1920s to 1938[37]

In an attempt to combat the danger of overproduction and low prices, the British government formed the Stevenson committee in 1922 to set restrictions on the production of rubber. As these restrictions, along with increasing demand, combined to drive the price of the agricultural product up, metropolitan investors flocked to Indochina's rubber sector. Although the influx of French capital into the Union may have created stronger links with the metropole, the particular sectors into which this money flowed, including rubber, were strongly influenced by the regional economic and political situation.[38]

This movement of capital accelerated the process of consolidation of rubber production, and by the end of the 1920s, a few large joint-stock companies controlled the majority of rubber-growing lands. In particular, the greatest expansion

[35] APCC (1911). PV March 6, 1911.

[36] TTLTQG1/AFC 460, Letter, N. Patouillard, President of the Mycological Society of France to GGI, May 29, 1911, 184. The tipping point may have been a letter from N. Patouillard, the president of the mycological society in France, that the GGI received in May. In this letter, Patouillard said that the seeds of *hévéa* had very little chance of carrying infection.

[37] It is this period that led Robequain to term rubber "the French planter's greatest success" (Robequain 1944: 201).

[38] For more on the Stevenson plan, see, for example, Dean (1987). Between 1924 and 1930, agriculture jumped to the leading position of metropolitan investment, thanks mostly to the surge of funds into rubber plantations, which received about two thirds of the capital provided for agriculture between 1925 and 1929. As a result, the lion's share of exported rubber came from large plantations. The examples of FMS, Java, Sumatra, and Borneo demonstrate, however, that the dominance of big rubber was not preordained (Robequain 1944: 161).

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of *Hévéa* plantations, which occurred between 1926 and 1929, coincided with a strong centralizing movement that saw the purchase of several plantations by companies with large reserves of capital.[39] In the mid-1920s, for instance, the Bank of Indochina created the Indochinese Company of Agricultural Trade and Finance (SICAF), which owned plantations at Bencui, Song Ray (later called Gallia), and Chamcar Andong in Cambodia. This trend continued into the 1930s, and in 1935, one of the most famous rubber companies, the Indochinese Company of *Hévéa* Plantations (SIPH), was formed. Composed of the plantations of SICAF and Far Eastern Company of Shipping and Trade (CCNEO), along with the later addition of smaller holdings, "this remarkable agro-industrial complex," held in combination with Donaï Rubber (*les Caoutchoucs du Donaï*), 23,000 hectares, which consisted of 17,000 hectares in Vietnam and 6,000 hectares in Cambodia (Vogüé 1993).[40] Despite the instability created in the rubber industry by the combination of the collapse of the Stevenson plan in 1928 and the 1929 market crash and subsequent economic crisis of the 1930s, revenue from taxes on rubber had made the product indispensable for the budget of the Union, leaving the government no choice but to accede to many of the loan requests made by rubber growers (Boucheret 2008).[41]

Although the centralizing trend was pushed by investment, this process had its beginning in government policy, including investment in scientific research and land-use decisions that allowed for the creation of large plantations. In particular, the period lasting from the so-called second rubber boom of the mid-1920s until World War Two witnessed a significant increase in the amount of scientific research on rubber (Boucheret 2008).[42] The growth in knowledge necessary to bring about the spread of plantations was the product of an evolving relationship between government and business. Throughout the 1920s, the government worked to reshape Indochina's scientific infrastructure, which included devoting more resources to the study of agricultural products such as rice and rubber. In 1925, for instance, the Indochinese Scientific Institute was refashioned into the Indochinese Institute for Agricultural Research (IRAI) and given the task of carrying out "research related to the protection of cultivation in the territories of southern Indochina (Cochinchina, Cambodia, and southern Annam) and to assist customs in the application of the regulations of the plant sanitation officers of the port of Saigon." Simultaneously, an improvement board (*conseil de perfectionnement*) was created, with scientific and technical matters ultimately resting under the control of the Museum of Natural History and the Ministry of Agriculture.[43]

[39] One can compare two directories from 1926 and 1931 for an idea of this growth and consolidation (SPCI 1926, 1931). See also UPCI (1936).

[40] Original reads: "*ce remarquable ensemble agro-industriel*." Cambodia began to produce appreciable amounts of rubber during the late 1920s.

[41] The loans may have totaled up to 100 million francs between 1930–35. (Robequain 1944: 164).

[42] See also Brocheux and Hémery (2001: 126) in which Hémery writes "after the crisis, the Indochinese plantations are the most modern in Asia and the most competitive in the world." Original reads: "*Passé la crise les plantations indochinoises sont les plus modernes d'Asie et les plus compétitives du monde*."

[43] CAOM/INDONF Carton 263, Dossier 2293, Note, Director of Political Affairs, May 18, 1934. Quote from pages four and five. Original reads: "*recherches relatives à la défense des cultures dans les territoires du Sud-Indochinois (Cochinchine, Cambodge, Sud-Annam) et d'assister le service des douanes dans l'application des règlements de police sanitaire des végétaux dans le port de Saigon*." Realizing that the needs of Tonkin, northern Annam, and Laos were not being met, the Institute for Agricultural Research was further divided 2 years later into a northern and southern section, with the southern section of the Institute created from the "laboratories of chemistry, entomology and mycology, genetics and the Giaray agricultural and plant quarantine station."

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In addition, the late 1920s witnessed continuing tensions in the relationship between government and private capital. Increasing struggles over the issue of labor, in particular, fueled antagonism between the two sides, as officials sought to enforce labor laws and introduce a small measure of labor protection. In a damning report, the labor inspector, E. Delamarre, accused the rubber industry of practices that resulted in gross mortality rates among rubber workers. Many critics of colonialism, both French and Vietnamese, subsequently based their critiques on reports such as Delamarre's and negative public opinion aroused by such exposés, along with the upsurge in Communist party organizing among rubber workers, caused officials to worry about social stability (Kalikiti 2000).[44]

The economic crisis of the 1930s presented a major challenge to rubber growers. One measure that growers took to defend their interests was to lobby for a 4-franc-per-kilogram tax on all rubber imported into France that did not come from the French colonies, which effectively meant Indochina. At that time, however, the rubber industry was under more intense scrutiny as high levels of Vietnamese unemployment exacerbated governmental fears of social unrest. Thus, one report arguing for the passage of the tax attempted to frame the importance of the industry to France in the following four terms. First, support of the industry was equated to support of the effort of many individual colons who grew *Hévéa* trees. Second, rubber was touted as a product essential to modern life. Third, a rhetoric of nationalism surrounded rubber as the supposed strategic importance of this raw material was emphasized. Finally, a high number of jobless former rubber workers was said to threaten the social and political stability of colony. Not only were the rubber planters deserving of aid because they had taken part in the arduous task of developing an "economically backwards" country but also because they were essential to continuing peace in the colony. "The role of government" was, therefore, "to assure capital, that has courageously undertaken a risk in a long-term project, a security as great as possible along with advantageous general conditions, seeing as how their effort benefits the entire nation."[45]

Although during the 1930s the locus of rubber knowledge production migrated from the public to the private sector, the reasons for this shift were more complicated than simply a lack of manpower and resources on the part of the government. Rice, for example, received its own office for scientific research in 1930. And with regards to private business, rubber was exceptional in the level of investment it received when compared with other crops such as coffee, tea, and maize. In fact, capital invested in

[44] For planters' reaction to this report see Vogüé (1993). Viollis (1935) brought plantation conditions to the attention of a wider French public. Thus, while I do not discuss the phenomenon here, much government-sponsored scientific research shifted to medical issues and a regulatory role, searching for ways to reduce the appalling rates of worker death on the rubber plantations. The push for improvement in social conditions continued into the 1930s and was especially evident after an investigative body, the Guernut commission, revealed what it called serious abuses on rubber plantations.

[45] TTLTQG2 N.5/55 "*Note justifiant la nécessite et l'urgence de l'institution d'un droit de 4 francs par kilogramme sur les caoutchoucs d'origine étrangère introduits en France*," UPCI, 1930. Quote from page 11. Original reads: "*La colonisation consiste essentiellement à provoquer l'essor du travail et la formation de la richesse dans les pays économiquement arriérés. Elle n'y peut parvenir que par des mises de fonds dans les grands travaux publics et dans les entreprises particulières, et le rôle des pouvoirs publics est d'assurer aux capitaux, qui s'aventurent ainsi courageusement dans une oeuvre de longue haleine, une sécurité aussi grande que possible et des conditions générales encourageantes, puisque leur effort bénéficie à la nation tout entière.*"

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rubber helped to gradually centralize a network of industrial laboratories and agricultural testing grounds that had already been established by the government and individual multinational agricultural corporations. According to one newspaper article, the efforts planters of Indochina were demonstrating "a nature more and more scientific [as] tropical agriculture, [achieving] success in the methods of grafting and selection, [and engaging in] fierce competition with the other [rubber] producing lands."[46]

Notwithstanding these optimistic accounts, however, planters in Indochina were still dependent on their neighbors in the region for news on the latest scientific developments, such as those taking place in tree selection and grafting. Gaston Van Pelt, a Belgian with long planting experience in Sumatra, was hired to lead the SICAF plantations in Indochina, which was technically illegal because of laws prohibiting non-French Europeans from becoming general directors of plantations. When he arrived in Saigon in 1930, Van Pelt pushed for the introduction of grafting, also called cloning, a technique being developed for *Hévéa* tree reproduction that resulted in higher latex yields. Partly because of Van Pelt's untimely death in 1932, however, the revolution in planting that was sweeping Java, Sumatra, and the Malaya peninsula, was slow to reach Indochina (Vogüé 1993: 89, 210).

An important year for the global rubber industry was 1934, as the major producers met in London in another attempt to buffer the large fluctuations in world prices. The terms of the resulting agreement, this time signed by all of the important producers, were very favorable to rubber planters in the French colonies thanks in part to the efforts of France's representative, Fernand Abraham "Colonel" Bernard. By the late 1930s, exports of rubber from Indochina had reached almost 60,000 tons per year, and in 1938, Indochina met a long-standing goal of French imperial self-sufficiency, namely, the Union produced as much rubber as industries in France consumed.[47]

The London agreement put a number of restrictions on rubber-producing countries, including caps on yield, area of land cleared and replanted, and percentage of grafted trees. In order to enforce these agreements, and assess fines, the signatories established the International Rubber Regulatory Committee (CIRC). Each country, in turn, was responsible for setting up a representative organization to communicate with the CIRC and ensure compliance with the terms of the agreement. In 1935, the Rubber Planters' Union in Indochina (UPCI), the metropolitan representative of Indochinese planters, founded the French Rubber Institute (IFC) to fulfill these obligations (IRCI 1942, 1944).[48] In addition to its role of ensuring treaty compliance, the IFC also contributed to the scientific work of the International Committee of Research (*Comité International de la Recherche*), the scientific arm of the CIRC. In fact, the laboratory set up by the IFC in 1938 signaled the first time that the systematic study of rubber was undertaken in France. Slated to be housed in the

[46] CAOM/INDONF Carton 263, Dossier 2293, *La Dépêche Coloniale et Maritime*, November 6 and 7, 1933, in "Le travail et l'effort français en Indochine," 2. Original reads: "le caractère de plus en plus scientifique des cultures tropicales, le succès des méthodes de greffe et de sélection, la concurrence acharnée des divers pays producteurs." By the late 1930 s, Indochina had dedicated the highest percentage of land to grafts, according to Robequain (1944: 209). The nature of the scientific questions, too, was evolving as researchers sought to further specify the science of plantations.

[47] Statistics show, however, that only about one third of the rubber exported from Indochina was sent to France.

[48] Enderlin (1945), gives the date of 1936. The counterpart organization in Indochina was the Union Indochinoise des Planteurs de Caoutchouc.

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organic chemistry section of the College de France, the IFC addressed industrial questions, such as properties of latex and the prevention of rubber degradation, during its first year of regular operation. The IFC also oversaw the formation of a center on rubber documentation, a long-time goal of many in the rubber industry.[49]

Even in Indochina, where agricultural problems had dominated research agendas, studies of industrial properties of rubber were taking on a leading role. The creation in 1941 of the Indochinese Rubber Research Institute (IRCI) under the aegis of the UPCI and the Indochinese Union of Rubber Planters (UIPC), based in Indochina, provided the means to carry out research on industrial processes.[50] Although a privately funded organization, the IRCI benefited from a legacy of government research on rubber, and many of the IRCI research sites, such as the Lai Khe agricultural research station (Fig. 2), were inherited from the government. New sites on both gray and red soils in Cochinchina and Cambodia, however, were envisioned during the early 1940s, with private business set to play a central role. The Red Earth Plantation Company (SPTR), for example, contributed its own machine to the IRCI's Office of Chemistry and Technology to study the properties of latex (IRCI 1942: 8, 9, 14; Enderlin 1945).

One author explained in early 1945 the increasing importance of private enterprise by noting the many demands placed on government institutions. "The first research was carried out in all of the [rubber] producing lands by governmental organizations….But the personnel of these institutions, sought out by all of the branches of agriculture, could not dedicate to rubber cultivation the time and the means that were necessary." This is why, he continued, "the planters, grouped into profession associations, were brought along to create the special institutes, or take control of the governmental institutes, to which they entrusted research related to their operations" (Enderlin 1945: 90-91).[51]

On the eve of World War Two, the rubber industry in Indochina seemed to be stronger than ever. A lack of money caused by wartime conditions, however, limited the ability to carry out most of the planned improvements, and the subsequent years of economic crisis "menaced even the existence of rubber production." In addition, the rubber industry had not completely eliminated the danger of overproduction, a condition exacerbated by improvements made in "synthetic" rubber (IRCI 1942: 3; 1944: 4).[52] Thus, while the decade before World War Two saw private enterprises

[49] CAOM/Agefom Carton 201, Dossier 143, Indochine Institut français du Caoutchouc (IFC), 1936–1939.

[50] The IRCI, one of the few agricultural research centers that was privately funded, was managed by representatives from the GGI, UPC, and UIPC along with a technical board selected from local experts and industrial leaders. As with earlier rubber work, the IRCI had models in Malaysia (RRI) and the Dutch East Indies (AVROS). Unlike its Southeast Asian counterparts, however, the IRCI focused from the beginning on the technical aspects of rubber production (Enderlin 1945: 170). Also see CAOM/SE 2250 Caoutchouc Nº 5458; IRCI (1942, 1944), du Pasquier (1950).

[51] Original reads: "Les premiers travaux de recherches furent effectués dans tous les pays producteurs par des organismes gouvernementaux....Mais le personnel de ces établissements, sollicité par toutes les branches de l'agriculture, ne peut consacrer à l'hévéaculture le temps et les moyens qui auraient été nécessaires....les planteurs, groupés en associations professionnelles, furent amenés à créer des instituts spéciaux ou à prendre en charge des instituts gouvernementaux, à qui ils confièrent les recherches relatives à leurs exploitations."

[52] While synthetic rubber, made from starting products such as isoprene, had been around for a long time, high costs had prohibited widespread use. But with rapid developments in production techniques, the price and quality of synthetic rubber had made it a strong challenger to the use of plantation produced rubber, and as R. Bouvier pointed out in his 1947 analysis, the potential combined level of "natural" and synthetic rubber could outstrip demand by one million metric tons in 1948.

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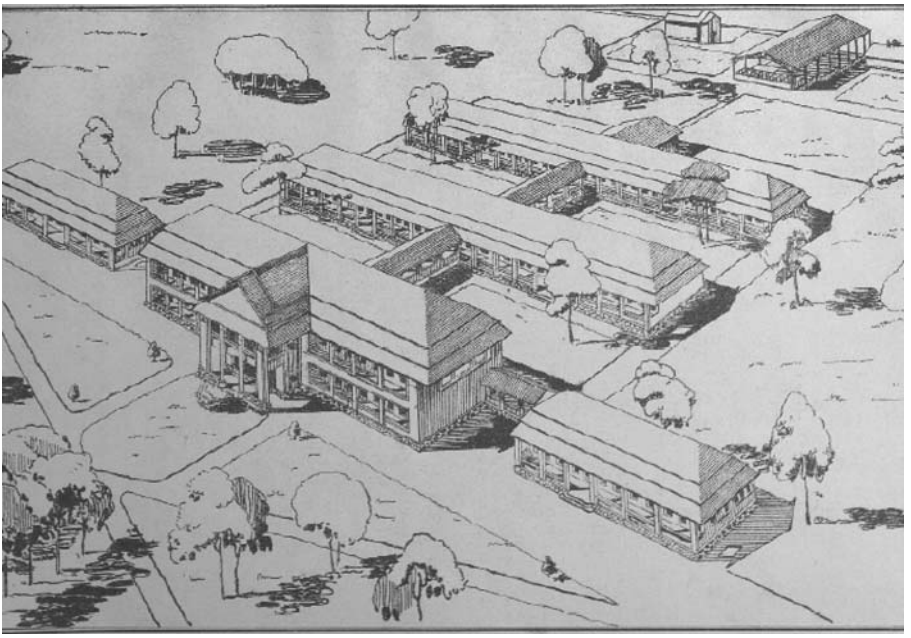

Fig. 2 Drawing of the future laboratory and offices of the Lai Khe research center. (*Source: IRCI* 1942)

beginning to shoulder most of the burden of refining knowledge about the material, government research and institutions continued to play a role.

5 Post-colonial Reflections on Rubber Production and Vietnamese Identity

In the summer of 1939, Charles Robequain, who had recently returned from Hanoi to assume the job of professor of geography at the Sorbonne, published the results of his study on the effects of over 50 years of French administration on the economy of Indochina.[53] Building on his doctoral thesis completed in 1929 and contemporaneous work at the French School of the Far East (EFEO), Robequain used the frame of tropical geography to address the question of agricultural colonization in Indochina. "It is generally recognized today," he wrote

> that the European cannot engage in the same kind of agricultural tasks as the Indo-Chinese without being degraded to the status of the 'poor white,' struggling vainly against the competition of the colored man and forced, in order to survive, to reduce his needs to a minimum, lowering his standard of living to the point of

[53] For a recent reassessment of the oeuvre of Robequain and fellow geographer Pierre Gourou, see the special issue of the *Singapore Journal of Tropical Geography*, 26 (3), 2005, in particular the articles by Michel Bruneau, Paul Claval, and John Kleinen. See also Bréelle (2002).

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> destitution...He does not engage in actual farm work, but instead manages and superintends the cultivation of a relatively large holding, whose yield is high in comparison with native plantations (Robequain 1944: 181-82).[54]

This statement clearly reveals that, for Robequain, there existed a hierarchy of access to knowledge within Indochina. From his point of view, it was the French who should be in control of the large agricultural estates that required the application of scientific knowledge to agricultural production. In fact, control of the rubber industry remained almost exclusively in the hands of Europeans throughout the colonial period.

The clear racial divide between European owners and managers and Vietnamese, Cambodian, Chinese, and Montagnard, or ethnic minority, workers was not, however, simply the result of racial prejudice and racist laws. The production of rubber was initially open to smallholder contributions and many colonial officials wanted to encourage native agricultural production. But by the late 1920s, the formidable intellectual challenges facing the new industry had worked to exclude those who did not have access to knowledge related to rubber growing and, more importantly, those who could not afford the costs of creating a plantation. The chronic budget shortages that plagued the colonial government meant that, until the late 1930s, individuals and businesses in all agricultural sectors were effectively left on their own to develop the best production methods. More than any other factor, this pressure on the political economy of Indochina, namely the growing emphasis on large, capital-intensive projects, helped shape who performed what function in rubber production.[55]

This situation of de facto restrictions on control in the rubber industry meant that, in the eyes of most Vietnamese, plantations were not part of a national economy during the colonial period. Until about 1950, for example, the Việt Minh approach to rubber, during its battles with the French military, was to sabotage the plantations. There exists, however, a fundamental disagreement about when rubber began to contribute to a "Vietnamese" economy. For those in the south who supported the Republic of Vietnam (RVN), the transfer of political power to a Saigon-based Vietnamese government in 1954 marked the point when Vietnamese effectively gained control of industrial and agricultural production. Lê Quang Hiền, who underwent advance training in government administration in Saigon, adopted this perspective. He was typical in arguing that, although the plantations contributed nothing to national development under French colonial rule, after 1954, rubber production was a key component of the South Vietnamese economy. The fact that Vietnamese began to hold key positions in the industry supported conclusions such as Lê's (Lê 1970).

[54] Robequain continued his analysis of European involvement in colonial enterprises by raising questions about the size of holdings, the proper balance between company-run estates and smaller plantations, the nature of the relationship between Europeans and natives "for the best legitimate interests of both", and the status of land held by Europeans.

[55] Certainly, some planters and officials feared Chinese and Vietnamese involvement in rubber planting, but the colonial government passed no laws specifically forbidding non-French natives of Indochina from entering the rubber business, and there were many instances in which individual officials considered promoting such growth, especially among the Vietnamese. See CAOM/SE 2239, for example.

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Yet, for the government of the Democratic Republic of Vietnam (DRV) based in Hanoi, rubber did not become part of a Vietnamese economy until after the unification of Vietnam under DRV rule in 1975. Writers in the north pointed out that French-controlled multinational companies such as Michelin continued to dominate rubber production during wartime. Starting in the 1980s, a number of works celebrating continuous worker resistance to capitalist exploitation began to appear. Despite theoretical critiques of capitalism and imperialism, however, the DRV and its southern collaborator, the National Liberation Front (NLF), recognized the strategic benefits, in terms of money and supplies, of holding rubber production hostage. In addition, the need to win the loyalty, or at least the non-interference, of the many local people deeply implicated in the rubber industry meant that, during the 1960s and early 1970s, a dynamic equilibrium developed in the region, one in which the RVN and private capital had official control while the NLF ruled at night.[56]

Finally, it is not surprising that the post-colonial rulers of both the RVN and the DRV attempted to gain legitimacy by connecting themselves with a cosmopolitan concept of modernity through access to scientific knowledge production. Gyan Prakash has shown how, in India, the nationalist leader Jawaharlal Nehru saw science and technology, as practiced by the West, as the path to an independent, modern nation-state (Prakash 1999).[57] Similarly, rubber production, which represented the coupling of scientific knowledge to agriculture, became a part of Vietnamese identity. Thus, Đặng Văn Vinh, a Vietnamese expert on rubber, concluded that the greatest limitation of French scientific work was the "failure" to train Vietnamese to do the job (Đặng 2000).

6 Conclusion

Anna Tsing has recently argued that the assimilation of global forms, such as science, biomedicine, and resistance, to specific places depends on friction in global connections. "Industrial rubber," she states, "is made possible by the savagery of European conquest, the competitive passions of colonial botany, the resistance strategies of peasants…and much more that would not be evident from a teleology of industrial progress" (Tsing 2005: 6). Viewing the cultivation of rubber in this way allows space to question the apparent naturalness of plantations in southern Indochina. Thus, in exploring the history of colonial rubber production, I have focused on three overlapping themes: (1) the relationship between private business and the government in the creation of the "rubber sciences," (2) the movement from the application of the general sciences of agriculture, botany, and climatology to the generation of specific information on the most suitable conditions for rubber production in Indochina, and (3) the related shift in research focus from agricultural to industrial and technical issues.

[56] Starting in the 1980 s, a number of histories of workers' movements on rubber plantations have come out in Vietnam. The claims of worker adherence to communism should be read carefully, however, as they may be motivated by many aims, including historical revisionism and current attempts to access state resources.
[57] See also Mrazek (2002).

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"Mirage...no, reality!" Source: *France Outre-mer*, Nº 246, March 1950. I would like to thank Caroline Herbelin for drawing my attention to this illustration.

I have examined the history of rubber, from its early years (i.e., from the 1890s until 1910) when colonial scientific infrastructure within Indochina was not yet prepared to conduct research on agricultural questions and those in Indochina turned to their neighbors in the region for models and answers, to just before World War Two. In examining this era, I have shown first that, although metropolitan scientists were not silent on the matter of rubber, metropolitan agricultural sciences, even of the tropical kind, provided at most a framework (and limited vocabulary) to be used in Indochina. The basic questions of what kinds of plants, where and how to grow them, how to fight plant diseases, all remained to be defined and answered in Indochina. Lacking systematic government programs until well into the 1920s, individual efforts, often in cooperation with the colonial government, played the biggest role during the initial period of rubber development. Yet, as the level of rubber production grew, funding for the rubber sciences slowly shifted to multinational companies, which eventually provided the most important human and financial resource for the development of this colonial science.

From the turn of the twentieth century until shortly before the Second World War, private business collaborated with the colonial government in Indochina in the formative development of tropical agricultural science. This article has focused on that development with a particular eye on how research was conducted and influenced by the changing political economy of French colonization, what was

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chosen as worthy of research, and how agricultural science projects were defined, structured, and funded. *Hévéa* trees grown on plantations in eastern Cochinchina have served as a lens through which to examine the ways in which government, private business, and science interacted to create the institutions and knowledge that existed in this region. Many government officials actively promoted rubber growing, but as with other colonial projects, they often lacked the means to carry through these projects. Yet, government institutions often served the needs of individual planters who were able to access the corridors of power. In this way, the government and enterprising individuals sponsored science in the early stages of the rubber industry. As the industry developed in Indochina, large joint-stock companies began to take control of knowledge and the means to produce rubber, benefiting from the previously constructed foundation.

The quickly elevating levels of rubber production on colonial plantations also gave rise to high-profile conflicts between labor and capital and inadvertently created a scaffolding for the revolutionary struggles that took place in the twentieth century in Vietnam. This incidental relationship is often the focus of critical observers of the rubber industry, who have most often adopted a Marxist framework to explain the growth and strength of opposition to French-owned plantations. These commentators have also looked at the ways that control over scientific knowledge enabling high yields and vast holdings, which gave French colons a competitive advantage over native labor and non-European holdings.[58]

As influential as this point of view has been, I argue that it has prevented discussion of other fundamental changes in Vietnamese society during the colonial era. In particular, we need to ask to what degree metropolitan science and technology came to be understood and accepted by those living in Vietnam as the legitimate basis of an agricultural order of things. Even before the debates over the so-called green revolution in the second half of the twentieth century, western science and technology were proposed as the standard by which agricultural activity in Vietnam should be judged. And if Chris Shepherd is correct in suggesting commonality between colonial and postcolonial development pathologies, then studies of colonial projects still have relevance for today's would-be development specialist (See Shepherd in this volume).

References

Abraham, I. (2006). The Contradictory Spaces of Postcolonial Techno-Science. *Economic and political weekly*, *41*(3).

Anderson, W. (2002). Introduction, Special Issue: Postcolonial Technoscience. *Social Studies of Science, 32*(5/6), 643–658.

Anderson, W. (2007). How far can East Asian STS go? A commentary. *EASTS Journal, 3*(2), 249–250.

APCC. (1911). *Les annales des planteurs de caoutchouc de l'Indochine*. Saigon: Imprimerie Commerciale.

APCC. (1916). *Les annales des planteurs de caoutchouc de l'Indochine*. Saigon: Imprimerie Commerciale.

Arnold, D., & Guha, R. (eds). (1995). Nature, Culture, Imperialism: Essays on the Environmental History of South Asia. Delhi: Oxford University Press.

Basalla, G. (1967). The Spread of Western Science. *Science, 156*(3775), 611–622.

[58] For rubber plantations in Southeast Asia, see among others Brocheux (1975); Murray (1980, 1992); Stoler (1995); and Khiun (2007).

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on 17 March 2018

Basalla, G. (1993). The spread of Western science revisited. In A. Lafuente, A. Elena & M. L. Ortega (Eds.), *Mundializacion De La Ciencia Y Cultura Nacional*. Madrid: Doce Calles.

Bassino, J.-P., & Nakagawa, H. (2000). Exchange rates and exchange rate policies in Vietnam under French rule, 1878–1945. In J.-P. Bassino, J.-D. Giacometti, K. Odaka & S. R. Clark (Eds.), *Quantitative economic history of Vietnam, 1900-1990: an international workshop* (pp. 343–364). Tokyo: Institute of Economic Research, Hitotsubashi University.

Bonneuil, C. (1991). *Des savants pour l'empire: la structuration des recherches scientifiques coloniales au temps de la mise en valeur des colonies Françaises, 1917–1945*. Paris: ORSTOM.

Bonneuil, C. (1997). *Mettre en ordre et discipliner les tropiques: les sciences du végétal dans l'empire française, 1870–1940*. Ph.D. Dissertation, Paris: Université de Paris VII.

Bonneuil, C. (2000). Science and state building in late colonial and postcolonial Africa, 1930–1970. In R. MacLeod (Ed.), *Nature and empire: science and the colonial enterprise*. Chicago: University of Chicago Press.

Boucheret, M. (2008). Les organisations de planteurs de caoutchouc Indochinois et l'état du début du XXe siecle a la veille de la seconde guerre mondiale. In H. Bonin, C. Hodeir & J.-F. Klein (Eds.), *L'esprit économique impérial (1830-1970). Groupes de pression et réseaux du patronat colonial en France et dans l'empire* (pp. 715–734). Paris: Société française d'histoire d'outre-mer.

Bouvier, R. (1947). *Le caoutchouc: brillante et dramatique histoire de l'hévéa*. Paris: Flammarion.

Bréelle, D. (2002). *The regional discourse of French geography in the context of Indochina*. Ph.D. Dissertation, Adelaide: Flinders University.

Brockway, L. (1979). *Science and colonial expansion: the role of the British royal botanic gardens in empire-building*. New York: Academic Press.

Brocheux, P. (1975). Le prolétariat des plantations d'hévéas au Vietnam méridional: aspects sociaux et politiques (1927–1937). *Le Mouvement Social, 90*, 55–86.

Brocheux, P., & Hémery, D. (2001). *Indochine la colonisation ambiguë, 1858–1954*. Paris: La Découverte.

Coates, A. (1987). *The commerce in rubber: the first 250 years*. New York: Oxford University Press.

Chambers, D. W., & Gillespie, R. (2000). Locality in the history of science: colonial science, technoscience, and indigenous knowledge. In R. M. MacLeod (Ed.), *Nature and empire: science and the colonial enterprise* (pp. 221–240). Chicago: University of Chicago Press.

Cooper, F., & Stoler, A. L. (eds). (1997). *Tensions of empire: colonial cultures in a Bourgeois world*. Berkeley: University of California Press.

Đặng, V. V. (2000). *100 Năm Cao Su Ở Việt Nam*. TP HCM: NXB Nông Nghiệp.

Dean, W. (1987). *Brazil and the struggle for rubber: a study in environmental history*. Cambridge: Cambridge University Press.

Drayton, R. H. (2000). *Nature's government: science, imperial Britain, and the 'improvement' of the world*. New Haven: Yale University Press.

du Pasquier, R. (1950). *Les problèmes d'utilisation des terres et leurs solutions en Indochine*. Saigon: IDEO.

Eberhardt, P., & Dubard, M. (1910). *L'arbre à caoutchouc du Tonkin et du Nord-Annam (Bleekrodea Tonkinensis)*. Paris: Augustin Challamel.

Enderlin. (1945). Industrie Indochinoise: institut des recherches sur le caoutchouc en Indochine. *Indochine Hebdomadaire Illustré, 231*, 168–172.

Grove, R. (1995). *Green imperialism: colonial expansion, tropical island Edens and the origins of environmentalism, 1600–1860*. Cambridge: Cambridge UP.

Headrick, D. R. (1981). *The tools of empire: technology and European imperialism in the nineteenth century*. New York: Oxford University Press.

IRCI. (1942). *Cahiers de l'institut des recherches sur le caoutchouc en Indochine*. Saigon: S.I.L.I.

IRCI. (1944). *Cahiers de l'institut des recherches sur le caoutchouc en Indochine*. Saigon: S.I.L.I.

Kalikiti, W. S. (2000). *Rubber plantations and labour in colonial Indochina: interests and conflicts, 1896–1942*. Ph.D. Dissertation, London: SOAS.

Khiun, L. K. (2007). *Specifying fevers: positioning Malaya's health lobbies (1876–1941)*. Ph.D. Dissertation, London: University College London.

Kohler, R. E. (2002). *Landscapes & labscapes*. Chicago: The University of Chicago Press.

Lê, Q. H. (1970). *Viễn Tượng Ngành Cao Su Việt Nam*. Master's thesis, Sài Gòn: Institute for Advanced Training in National Administration.

Marseilles Chamber of Commerce. (1901). *Compte rendu de la situation commerciale et industrielle de la circonscription de Marseille pendant l'année 1900*. Marseille: Imp. Marseillaise.

Mrazek, R. (2002). *Engineers of happy land: technology and nationalism in a colony*. Princeton: Princeton University Press.

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Murray, M. J. (1980). *The development of capitalism in colonial indochina (1870–1940)*. Berkeley: University of California Press.
Murray, M. J. (1992). 'White gold' or 'White blood'?: The rubber plantations of colonial indochina, 1910–40. In E. V. Daniel, H. Bernstein & T. Brass (Eds.), *Plantations, proletarians, and peasants in colonial asia* (pp. 41–67). London: Frank Cass.
Ong, A., & Collier, S. J. (eds). (2005). *Global assemblages: technology, politics, and ethics as anthropological problems*. Malden: Blackwell.
Osborne, M. A. (1994). *Nature, the exotic, and the science of French colonialism*. Bloomington: Indiana University Press.
Prakash, G. (1999). *Another reason: science and the imagination of modern India*. Princeton: Princeton University Press.
Redfield, P. (2000). *Space in the tropics: from convicts to rockets in French Guiana*. Berkeley: University of California Press.
Robequain, C. (1944). *The economic development of French Indo-China (I. A. Ward, J. R. Andrus and K. R. C. Greene, Trans.)*. London: Oxford University Press.
Sangwan, S. (1998). From gentlemen amateurs to professionals: reassessing the natural science tradition in colonial India, 1780–1840. In R. Grove, V. Damodaran & S. Sangwan (Eds.), *Nature and the orient: the environmental history of South and Southeast Asia*. New York: Oxford University Press.
Scott, J. (1998). *Seeing like a state: how certain schemes to improve the human condition have failed*. New Haven: Yale UP.
SPCI. (1926). *Annuaire du syndicat des planteurs de caoutchouc de l'Indochine*. Saigon: Maison Photo Nadal.
SPCI. (1931). *Annuaire du syndicat des planteurs de caoutchouc de l'Indochine*. Saigon: Maison Photo Nadal.
Stoler, A. L. (1995). *Capitalism and confrontation in sumatra's plantation belt, 1870–1979*. Ann Arbor: The University of Michigan Press.
Storey, W. K. (1997). *Science and power in colonial mauritius*. Rochester: University of Rochester Press.
Tạ, T. T. (1996). *Dồn Diền của Người Phap Bắc Ký, 1884–1918*. Hà Nội: Trung tâm khoa hộc xã hội và nhân văn quốc gia, viện sử học.
Tạ, T. T. (2001). *Việc Nhượng Dất, Khẩn Hoang Ở Bắc Ký từ 1919 dến 1945*. Hà Nội: Thế giới.
Tarling, N. (ed). (1999). *The cambridge history of Southeast Asia vol. 2 part 1*. Cambridge: Cambridge University Press.
Tsing, A. L. (2005). *Friction: an ethnography of global connection*. Princeton: Princeton University Press.
UPCI. (1936). *Annuaire*. Paris: La Librairie Technique et Économique.
Viollis, A. (1935). *Indochine S.O.S*. Paris: Gallimard.
Vogüé, A. D. (1993). *Ainsi vint au monde...la S.I.P.H. (1905-1939)*. Vicheres: Amicale des Anciens Planteurs d'Hévéa.

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