

UNIVERSITY OF CALIFORNIA

Los Angeles

Relocating Pastorian Medicine:

Accommodation and Acclimatization of Medical Practices at the Pasteur Institutes in China,

1899-1951

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy
in History

by

Chien-Ling Liu

2016

© Copyright by

Chien-Ling Liu

2016

ABSTRACT OF THE DISSERTATION

Relocating Pastorian Medicine:
Accommodation and Acclimatization of Medical Practices at the Pasteur Institutes in China,
1899-1951

by

Chien-Ling Liu

Doctor of Philosophy in History

University of California, Los Angeles, 2016

Professor Peter Baldwin, Chair

In contrast to the historical assessment of modern medicine as an emanation of hegemonic European domination operating exclusively under its auspices and presumably diffused to the rest of the world, this dissertation offers a new approach to discovering the collision, collaboration, and compromise between the local Chinese and the Pastorians in China, by focusing on medical practices in the network of knowledge circulation and influences of material culture and social beliefs on knowledge formation. Drawing upon evidence from archives both in China and in France and investigating how the practices had been shaped within environmental, political, and socio-cultural constraints, it argues that Pastorism in China functioned as a special style of practice, marked by its emphasis on localism that was unique to China. On the one hand, Pastorians in China validated traditional medical practices, which relied upon the Chinese textual tradition, by providing scientific explanations based on toxicology, immunology, and

pharmacology. Moreover, they learned and adapted on the ground, by incorporating local knowledge and accommodating local political circumstances and socio-cultural practices within their vaccination campaigns. On the other hand, they accounted for the acclimatization of local environmental specificities, pertaining to pathogens and animal species, in their vaccine production. These encounters and practices informed the colonial understanding of local meaning of public health, contagion, and immunity. Conversely, the ensuing knowledge reshaped the colonial medical practices and public health measures. The connections among the European Pastorians, Chinese practitioners of traditional medicine, and Chinese practitioners of Western medicine, as well as other colonial and international medical personnel and institutions, enabled multi-directional and transnational mobility that served as a fertile ground for mutual accommodation and created the contemporary medical landscape, which laid the foundation for modern integrative medicine and health care in the present day Chinese state.

This dissertation of Chien-Ling Liu is approved.

Theodore M. Porter

Andrea Sue Goldman

Hannah Louise Landecker

Peter Baldwin, Committee Chair

University of California, Los Angeles

2016

I dedicate this work to my parents,
Liu Jenho 劉仁和 and Lin Meilien 林美蓮.

TABLE OF CONTENTS

| | Page |
|---|------|
| DISSERTATION ABSTRACT | ii |
| ACKNOWLEDGEMENTS | viii |
| CURRICULUM VITAE | xi |
| INTRODUCTION | 1 |
| CHAPTER I: “Following ‘Science,’ Serving Fatherland”: Pastorian Culture in Republican China | 40 |
| CHAPTER II: A Tangled Transition from Variolation to Vaccination in Chengdu, China, 1908-1927 | 87 |
| CHAPTER III: Microbiological Studies of Rabies Virulence and Treatment at the Pasteur Institutes in Shanghai, 1899-1950 | 122 |
| CHAPTER IV: International Collaboration on Vaccination and Related Public Health Measures against Smallpox and Blindness in Tianjin, 1922-1942 | 158 |
| CONCLUSION: Pastorism and the Pastorian Legacy in China | 205 |
| APPENDICES: | |
| Appendix 1.1: Chinese Pastorians | 221 |
| Appendix 2.1: Map of Variolation and Vaccination Transmission Routes, Late Seventeenth Century - Early Nineteenth Century | 223 |
| Appendix 2.2: Map of Vaccination Cities and Routes in China, 1805-1900 | 224 |
| BIBLIOGRAPHY | 226 |

FIGURES AND TABLES

| | |
|---|-----|
| Figure 2.1: Vaccination Acupunctural Points | 99 |
| Figure 2.2: Heifer Vaccination at the Pasteur Institute of Chengdu | 112 |
| Figure 3.1: J. H. Jordan's Observation of the Time at Which Death Took Place in Fatal Cases Treated and Untreated | 142 |
| Figure 4.1: Foreign Concessions in Tianjin | 161 |
| Figure 4.2: Clinics Directed under the Collaborative Franco-Chinese Control | 173 |
| Table 4.1: Statistics of the Clinics for Blindness Prevention | 179 |
| Table 4.2: Statistics of the Visits to the Factories and Small Workshops | 187 |
| Table 4.3: Materials Sent to the Missionary Posts in the Interior China | 190 |

ACKNOWLEDGMENTS

The assistance that I have received to complete this dissertation is akin in its cross-cultural nature to the subject of the dissertation itself. I was most fortunate to study at UCLA, to conduct my research at multiple archives in China and in France, and to have constant support from many individuals and institutions both in the United States and abroad.

My dissertation chair, Peter Baldwin, was unstinting in his advices dispensed with exemplary patience at every stage of the project, from the commencement of my research to the completion of this dissertation. I am profoundly grateful for his encouragement and ongoing support. I sincerely thank my committee members, Ted Porter, Andrea Goldman, and Hannah Landecker. Much of the conceptual formation on history of medicine for this dissertation was shaped since the early stage of my doctoral work thanks to Ted, who has not only guided me intellectually, but also served as an inexhaustible wellspring of humor and encouragement. Andrea has consistently supported my interest and encouraged my curiosity on the subject of Sino-European contacts that became instrumental in my historiographical understanding. Hannah enabled me to explore unexpected archival materials and guided my development of analytical perspectives. I deeply appreciate their insightful suggestions for improving and revising each individual chapter and the entire dissertation.

The remarkable faculty and fellow students at the History Department of UCLA have inspired me and provided constant intellectual support. I thank Mary Terrall, Soraya de Chadarevian, Robert Frank Jr., Lynn Hunt, David Sabeian, Ben Madley, Bin Wong, Caroline Ford, Muriel McClenden, and Robin Kelley. I would like to extend a particular thanks to Kapil Raj at the *École des Hautes Études en Sciences Sociales* (EHESS). He has exerted a significant influence on this project that is felt throughout. Other scholars who have provided me with

valuable guidance along the way include Carlo Ginzburg, Sean Hsianglin Lei, Charlotte Furth, Fati Fan, Florence Bretelle-Establet, Ilana Löwy, Guillaume Lachenal, Karine Chemla, Catherine Jami, Angela Leung, Chiafeng Chang, and Bridie Andrews. I thank my peers at UCLA and EHES who have provided me with intellectual stimulation and dear friendship over the course of my doctoral study. I specially thank Hsiao-Chun Wu for going over all the footnotes.

My research was generously funded by grants from the University of California Pacific Rim Research Program, the Chateaubriand Fellowship, the Partner University Fund, as well as the History Department and International Institute of UCLA. I am also indebted to the UCLA Graduate Division for providing me with a Dissertation Year Fellowship.

Numerous people have helped me when I conducted research in different locations. I was fortunate to interview Li Shunyi 李順義 at The Second Hospital of Hebei Medical University in Shijiazhuang and learn about his experience of studying under Zhu Shiyong, a Chinese Pastorian at the Pasteur Laboratory of Tianjin. Many archivists have my sincere gratitude for making my research productive and pleasant. I thank Daniel Demellier, Dominique Dupenne, Dominique Mege, and Sandra Legout at the Archives de l'Institut Pasteur, Marc Gilbert at the Bibliothèque Municipale de Lyon, Xu Jinhua 徐錦華 at the Bibliotheca Zi-Ka-Wei of the Shanghai Municipal Library, and Wang Zongxin 王宗欣 at the Library of Peking Union Medical College Hospital.

I cannot express my gratitude enough for the support of my family. My parents, Liu Jenho 劉仁和 and Lin Meilien 林美蓮, raised me in a small city in Taiwan but encouraged me to explore the world beyond it with my full capacity. My sister, Liu Yihsiu 劉怡秀, has been my best companion during all the research trips, taking care of me in more ways that I can count. My brother, Liu Yenhung 劉彥宏, and my sister in law, Ts'ao Chunju 曹君茹, with their little boy Ray, have never failed to boost my morale and keep me going. Finally, without my husband,

Michael Zeleny, this accomplishment would have been impossible. He has taken up the role of my main editor throughout all these years, reading and editing my dissertation manuscript multiple times and offering me his insightful suggestions. Not only has he supported me intellectually, but he has also always had confidence in me, and for that I will always be grateful.

CURRICULUM VITAE

CHIEN-LING LIU

劉建伶

EDUCATION

| | | |
|---------------|---------------------|---|
| June 2012 | C. Phil. in History | University of California, Los Angeles |
| December 2011 | M. A. in History | University of California, Los Angeles |
| June 2001 | M. A. in History | National Taiwan University, Taiwan |
| June 1998 | B. A. in History | National Chung-Hsing University, Taiwan |

ACADEMIC HONORS AND AWARDS

| | |
|--------------|--|
| 2015-2016 | Dissertation Year Fellowship, UCLA |
| 2013-2014 | Pre-dissertation Fellowship, UCLA |
| 2013 | Chateaubriand Fellowship in Humanities and Social Sciences |
| 2012-2013 | University of California Pacific Rim Graduate Fellowship |
| 2012-2013 | International Institute Grant, UCLA |
| 2012-2013 | International Institute Fieldwork Fellowship (declined), UCLA |
| 2011 | Partner University Fund (PUF) summer research grant on the project of “21st Century Nutrition, Genetics and Cuisine in France and the United States” |
| 2010-2012 | Non-Resident-Tuition Waiver Fellowship, UCLA |
| 2009-2011 | Overseas-Student Scholarship, Ministry of Education, Taiwan |
| 2008-Present | Member of Alpha Mu Gamma Honor Society, honor in the language of French |
| 2000-2001 | Graduate Scholarship, Bureau of National Health Insurance, Taiwan |

CONFERENCE PRESENTATIONS

Invited Presentation

“Relocating Pasteurian Medicine: A Tangled Transition from Variolation to Vaccination in Chengdu, China, 1908-1927,” Colloquium in History of Science and Medicine, UCLA, 27 April 2015.

Conference Presentations

“History of Modern Medicine in Non-Western Countries,” International Workshop of the New Trend of Medical Development in Post-WWII Era, Academia Sinica, Taipei, 14 August 2014.

“Relocating Pasteurian Medicine in Chengdu, China: Vaccine Production and Public Health Work on Smallpox Prophylaxis, 1908-1927,” International Conference of Modern China in Global Context, 1600-Present, Academia Sinica, Taipei, 11-13 August, 2014.

“A Comparison of Poor Relief Policies between China (967-1127) and England (1601-1930),” Symposium of Charitable Services and Social Forces in History, Chinese University of Hong Kong, Hong Kong, 6-8 December, 1999.

TEACHING EXPERIENCE

| | |
|-----------|---|
| 2010-2011 | Teaching Assistant, Department of History, UCLA HIST 1C: Introduction to Western Civilization, circa 1715 to present HIST 1B: European History: The Carolingian to the Death of Louis XIV HIST 3D: History of Medicine |
|-----------|---|

ACADEMIC APPOINTMENTS

- 2014-2015 Conference Coordinator for Thinking Gender 2015, Center for the Study of Women, UCLA
2011-2012 Graduate Student Researcher to Dr. Hannah Landecker, UCLA Institute for Society and Genetics
2008-2009 French Tutor, Modern Language Tutoring Center, Santa Monica College
1999 Research Assistant to Dr. Chang Youngpei, National Taiwan University, Taiwan

PROFESSIONAL POSITIONS

- 2004-2006 Project Director, Ju Percussion Group Foundation, Taiwan
2002-2004 Executive Director, Shy Gong Art Studio, Taiwan
2001-2002 English Language Consultant, Columbia Language Consulting Company, Taiwan

INTRODUCTION

“I have tried everything to get closer to the truth.” So Aimé-François Legendre (1867-1951), French Pastorian and Physician Major of the first class in the French colonial troops, averred in the preface to his published travelogue to Sichuan, China, in 1905. He aimed “to show the Chinese as they are in life, not disguised, and not ‘adapted’ into a common ‘counterfeit’ that had been thoughtlessly fabricated from whole cloth without ever bothering to set foot on their territory.”¹ Thus Legendre disparaged his European predecessors and contemporaries who usually depicted the Chinese as “strange, stupid, incomprehensible,” while knowing little about them.² He admitted: “I harbored these prejudices, but they had to disappear as soon as I learned the language and was able to undertake an external and objective study through continual interrogation of the Chinese mindset (*l’âme chinoise*).”³ Legendre approached this endeavor “with all the rigor that ensues from the preparation for a routine scientific medical examination.”⁴ Here is where he drew the line for his French colonial physician colleagues: “we

¹ Aimé-François Legendre, “Préface,” in *Le Far-West Chinois: Deux Années au Setchouen* (Paris: Librairie Plon, 1905), 17. G. Eugène Simon was one of the implicit targets of Legendre’s polemics: “Thus the Chinese whom I have described are very different from those described by Eugène Simon, for example. [I think] that the physician, through ingrained habits, ought to mistrust the surface appearances to the highest degree and ruthlessly probe the internal organs. And having established his diagnosis after a thorough elimination of all the available erroneous alternatives, he must continue to observe and examine the subject anew and defer the definitive acceptance of his original conclusions until they have been ratified in the long term by the brutality of facts.” *Ibid.*, 17-18. Simon was an agricultural engineer, who undertook a four-year mission to China in the early 1860s. Legendre did not challenge Simon’s experience of actually having been in China but disagreed with his depiction of the Chinese people. I found no further evidence of what exactly Legendre questioned in Simon’s account. Judging from the above quote, it might have had something to do with how a physician ought to proceed in his work.

² *Ibid.*, 8.

³ *Ibid.*, 9.

⁴ *Ibid.*, 16.

enter the world of [Chinese] concepts whenever we come into actual contact with them, and once experiments on live subjects of lesser worth (*in anima vili*) become possible.”⁵

Legendre published this preface three years after leading the French Medical Mission, staffed by the physicians of the French Colonial Medical Service, into Chengdu in Sichuan to lay the groundwork for the establishment of a local Pasteur Institute. Accompanied by his wife, Legendre traversed approximately two thousand miles on the Yangtze River, from Shanghai westwards to Chengdu, where the first French-founded Pasteur Institute in China eventually opened in 1908.⁶ A crucial part of these Pastorian-trained colonial physicians’ duties was to investigate the bacteriological causes of diseases and implement their prophylaxes with vaccines, mainly against smallpox and rabies. Most importantly, in addition to mastering microscopic skills and microbiological knowledge in their colonial service, they pledged to discover the “other” human cultures in the places they served.⁷ Treating his Pastorian training as a method for approaching the truth, Legendre travelled to China, learned the Chinese language, made contacts with the local Chinese, and observed them “scientifically.”

With his observation and experience, Legendre came to appreciate China as a “beautiful civilization”, having “a vastness of land, a culture as old as the world, her swarm of people, her majestic rivers and mountains, the infinite plains, and also her fecundity and wealth of production.”⁸ She was “the great global arena, the wonderful field where any activity can unfold,

⁵ Ibid., 17.

⁶ Ibid., 15.

⁷ As stated below in Chapter I, Paul-Louis Simond, the French Pastorian and biologist best known for his discovery of the transmission of bubonic plague by rat fleas at his post at the Pasteur Institute in India, emphasized upon opening the first course of biology at the School of Colonial Medicine (the *Pharo*) in February 1907, that the students should aim not only at mastering microscopic skills and microbiological knowledge, but also at preparing to discover “other” human cultures. Louis-Armand Héraut, “La Médecine Militaire Coloniale Française. Une Aventure Médicale de Trois Quarts de Siècle, 1890-1968,” *Histoire des Sciences Médicales* 40. 4 (2006): 382.

⁸ Legendre, 7-8.

where every effort will be fruitful. Even her people, so different, so distant from ours to the superficial observer, quickly become interesting for those who want to take the trouble to study them, to understand them.”⁹ The Chinese people he learned showed “a civility, an exquisite politeness.”¹⁰ Out of mutual respect, “the Chinese do not hesitate to sincerely cooperate with you as long as you like and you will find them capable of friendship with any other races.”¹¹ Based on his observation, made in the contemporaneous context of growing international trade and communication, Legendre urged his public reader and his government to connect with China and her people, especially by exploring her rich resources and markets as an effective alternative to the ongoing colonial pursuits in Africa. Legendre saw this development as crucial for the destiny of France, because “the center of the world’s gravity no longer grounds in the Mediterranean and the Atlantic, but in the Yellow Sea. China becomes the center of attraction and the fascinating destination towards which all great nations are rushing feverishly.”¹² Connecting with China was a matter of “current necessities, both political and economic,” and it would help France become more competitive with other imperialistic powers.¹³ Many functionaries at the French Ministry of Foreign Affairs had agreed with Legendre’s view. Since 1901, the Committee of the French Asia

⁹ Ibid., 8.

¹⁰ Ibid., 16.

¹¹ Ibid., 17.

¹² Ibid., 13.

¹³ Ibid., 11. Here Legendre most likely alludes to the Boxer rebellion and the Eight-Nation Alliance in Beijing at the turn of the twentieth century. The Boxer Rebellion of 1900 was a violent uprising against the foreign and Christian presence in Northern China. In response, the Eight-Nation Alliance, an international coalition of Japan, Russia, Britain, France, the United States, Germany, Italy, and Austria-Hungary, launched a military intervention against Qing China. The alliance occupied Beijing and proceeded to loot and pillage the capital. The Qing government in the end signed the Boxer Protocol of 1901, which included reparations of 450 million *taels* of fine silver, equivalent to 333 million U.S. dollars at the time. The partial return of these monetary reparations played an important role in supporting Chinese students studying overseas, including in France. Jonathan Spence, *In Search of Modern China* (New York: W. W. Norton & Company, 1991), 230-235. Tael or tahl 兩 refers to a type of unit in Chinese currency system of sycees, silver ingots that officially remained in use until the end of the Qing Dynasty in 1911. In the second half of the nineteenth century, the East India Company reckoned 1 *tael* to be worth 6s. 8d. Samuel Wells Williams, “Moneys, Weights, etc., in China,” in *The Chinese Commercial Guide* (London: Shortrede, 1863), 268.

(*Comité de l'Asie Française*) had aimed to establish a vast French Asian Empire based in French Indochina, spreading west into Thailand and north into China.¹⁴ The specific region in China that Legendre had in mind was Sichuan, a province located in the Southwest of China, as it ensured “the best conditions [for] rapid and complete development of [the French] Indochinese colony.”¹⁵ Indeed, as a result of political and economic calculation, Sichuan had been designated a colonial strategic point at the Quai d’Orsay, the headquarters of the Ministry of Foreign Affairs in France.¹⁶

There remained one problem though: as Legendre observed, owing to their historical recollection of the European imperialistic expansion in China since the mid-nineteenth century, many common Chinese people regarded and treated the Europeans as barbarians. He often heard the Chinese complain that “the European rule is to attack, not to persuade.”¹⁷ He even agreed with them, pointing out that “the great mistake of the white race is thinking that its civilization, its creative power, and its machines impose themselves, dazzle the other races, open all vistas, and dispel all darkness. This is a serious delusion, all the more tenacious and dangerous because it flatters [the Europeans’] pride, which is as boundless as that of the Chinese.”¹⁸ In order to

¹⁴ L. Abrams and D. J. Miller, “Who were the French Colonialists? A Reassessment of the Parti Colonial, 1890-1914,” *Historical Journal* 19.3 (1976): 687.

¹⁵ Legendre, 14.

¹⁶ In the late 1890s, the French Ministry of Foreign Affairs aimed to compete with British influence in Sichuan and Paul Doumer, the Governor-General of French Indochina planned to expand the railway from Indochina to Yunnan, and even to Sichuan. The Kunming-Haiphong Railway was built after 1910, connecting Haiphong in Indochina with Kunming in the Yunnan province in China, but the connection to Sichuan never happened under French colonial rule. Hervé Barbier, “Les Canonnières du Yang-tsé, 1900-1941,” in *La France en Chine, 1843-1943*, ed. Jacques Weber (Nantes: Presse Académique de l’Ouest, 1997), 132-134.

¹⁷ Legendre, 10.

¹⁸ *Ibid.*, 11.

erase this ill impression on the Europeans, Legendre proposed to rely on “science.” Thus “scientific medicine” became his main objective in his “civilizing mission.”¹⁹

At the turn of the twentieth century, as considered by the practitioners of modern medicine, Western medicine had become “scientific,” insofar as it relied on more systematic anatomico-pathological observations and repeatable experiments, as well as evidence collected and performed in empirical tests and clinical practice. Its subjects of study and practice shifted to focus on the fundamental functions of organisms within a wide range of circulatory, metabolic, neurological, immune, and other systems, and their basic constituents such as organs, tissues, and cells. Biochemical studies deepened the scientific understanding of chemical structure and processes within living organisms and offered etiological and pathological explanations of some diseases. The germ theory of disease emerged under the rubric of scientific medicine, tracing the etiology of certain diseases to pathogenic microorganisms. Issues of public health, along with studies of infectious diseases and immunity — the ability to withstand or resist infection, disease, or other biological invasion — became the central focus of scientific pursuit in conjunction with European political and economic development and imperial expansion. This was where “Pastorian medicine” came in. Following the empirical guidelines of Louis Pasteur and his followers, it defined its mission of controlling, if not eradicating, infectious disease by administering the pathogen in an attenuated form and thus inducing immunity or resistance. From the 1880s on, Pastorian medicine had grown through support by the French government and international community, despite resistance from anti-vaccination and anti-vivisection movements. The French government supported the scientific expansion by Pasteur and the Pasteur Institute, first in Paris and later worldwide, in the hope of regaining France’s prestige lost through the Franco-Prussian War (1870-1871). As part of its political policy of secularism

¹⁹ Ibid., 10.

(*laïcité*), the Third Republic attempted to replace the traditional Catholic faith with the gospel of science, in particular with Pastorian medicine.²⁰ Since Pasteur's success of anti-rabies treatment in 1885, physicians from Western Europe, excepting Germany as France's scientific and national rival, travelled to Paris to study Pasteur's anti-rabies method and acquire rabbits inoculated for rabies treatment.²¹ Outside of Europe, foreign governments took the initiative at first. They included Brazil, Siam (nowadays Thailand), Russia, and the Ottoman Empire. Pasteur sent delegates to these countries to set up anti-rabies centers. Meanwhile, physician officials arrived from Mexico, Rio de Janeiro, and Constantinople to receive training in Paris.²² Since the establishment of the Pasteur Institute in Paris in 1888 and the inception of its course of microbiology in the following year, foreign physicians within Europe and elsewhere played a vital role in the dissemination of Pastorian medicine.²³ From 1891 on, Pastorian-trained French colonial physicians promulgated it in a form of "scientific imperialism" as part of their civilising mission, by conducting their work at overseas Pasteur Institutes in Asia, Africa, Americas, and

²⁰ Anne-Marie Moulin, "The Pasteur Institute's International Network: Scientific Innovations and French Tropisms," in *Transnational Intellectual Networks: Forms of Academic Knowledge and the Search for Cultural Identities*, ed. Christophe Charle et al (Frankfurt: Campus Verlag GmbH, 2004), 141.

²¹ "Monsieur Pasteur, convinced of the efficacy of his treatment, has done his best to facilitate the creation of new foci of anti-rabies inoculation. Physicians from London, Vienna, New York, and Odessa, have taken away rabbits inoculated in the laboratory under their very eyes..." Archives de l'Institut Pasteur (AIP), Minutes of the Administrative Council, 22/05/1886, 2; Moulin, 141.

²² "The Pasteur Institute," *British Veterinary Journal* 27 (1888): 422; Moulin, 152.

²³ European students came from Italy, Spain, Switzerland, Luxemburg, Belgium, Holland, Denmark, Sweden, Norway, Poland, Russia (the most represented group among the foreign students), Austria-Hungary, Serbia, Croatia, Greece, Romania, and Germany (the least represented group due to hostility and competition). The lack of exchange with the British is notable, resulting from the diplomatic tensions between France and Britain before the First World War. The foreign students also came from countries outside of Europe, including Africa: Tunisia, Algeria, Morocco, Transvaal (nowadays a province in the northeast of South Africa); Oceania: New Zealand; Americas: Canada, the United States, Mexico, Guatemala, Honduras, Salvador, Colombia, Peru, Brazil, Argentina, Haiti, Cuba; Asia: Ottoman Empire and later Turkey, Lebanon, Iran, India, Ceylon (nowadays Sri Lanka), Indonesia, Japan, and China. Marguerite Faure, "Cent Années d'Enseignement à l'Institut Pasteur," in *L'Institut Pasteur: Contributions à son Histoire*, ed. Michel Morange (Paris: La Découverte, 1991), 65.

Oceanic countries.²⁴ However, the actual practice of adopting the Pastorian principle varied widely in different locations, including China.

Legendre practiced “Pastorian medicine” with other Pastorian-trained colonial physicians in Sichuan, and later at the Pasteur Institute of Chengdu. The French colonial policy of “indirect imperialism” meant to spread French cultural, economic, and political influence as an alternative to military conquest.²⁵ This “science imperialism” manifested and attempted to impose itself through the Pastorian network.²⁶ Over the course of the first half of the twentieth century, physicians working at the four Pasteur Institutes in China (one in Chengdu, one in Tianjin, and two in Shanghai) were part of a cohort within the network. Having studied at the Pasteur Institute in Paris or the one in Saigon and then engaged in public health work in China, the Chinese Pastorians played a crucial role in connecting their European colleagues to local communities.²⁷

Beyond studying China’s customs and resources, Legendre and his fellow Pastorians sought to learn the “truth” of China and her people. Their impressionistic portrayals inspired the French government to realize the colonial value of China and send the Pastorians there under the auspices of a vague civilising mission: “to spread the French influence,” devoid of any clear and distinct advance agenda. Although the colonial office in Paris could not have anticipated all of the local conditions, it relied upon these physicians’ experiences to inform its understanding of local circumstances of infectious disease and public health for making decisions concerning the colonial policies, such as designating circulating routes for the supply of vaccines, coordinating with various French or international colonial posts to put in place for public health measures

²⁴ Anne-Marie Moulin, “Patriarchal Science: the Network of the Overseas Pasteur Institutes,” in *Science and Empire*, ed. Patrick Petitjean et al (London: Kluwer Academic Publishers, 1992), 307.

²⁵ Abrams, 687.

²⁶ Moulin, “Patriarchal Science,” 307.

²⁷ We will see the examples in Chapter I.

against epidemics, training local physicians in existing neighboring Pasteur Institutes, and so forth.²⁸ Legendre and his fellow Pastorians revealed the further “truth” of China and her people when they “entered the world of [Chinese] concepts,” and studied the subjects that had previously been considered of “lesser worth,” such as the lower animals and micro-organisms, if not the local people, as found and studied in their natural habitat.²⁹ In China, the Pastorians confronted a panoply of specificities in local environment, politics, religion, and social customs, as well as medical culture and its associated knowledge and practices. Thus they had to adapt and modify their Pastorian methods upon encountering these local conditions.

This dissertation aims to tell the story of how the European and Chinese Pastorians took into account and accommodated local specificities in their medical practices, undertaken in the context of microbiological studies and public health work related to immunity, especially on smallpox and rabies prophylaxes, at the Pasteur Institutes in China. These two diseases were the primary concerns of the Pastorians’ microbiological research and public health campaigns in China. Immunity provoked much contention in the context of the European-Chinese encounter. At the turn of the twentieth century, as they entered the era of scientific medicine, the Europeans were working on the epistemic basis of the recently formulated germ theory, humoral immunity and the discovery of phagocytosis.³⁰ In the course of competing with the German bacteriological

²⁸ We will see such examples of how these colonial physicians could better inform their colonial superiors with what they learned on the ground in the following chapters.

²⁹ Legendre, 17.

³⁰ In contrast to the Chinese humoral theory, which stresses the balance of *qi* in the body, the concept of humoral immunity that developed under German bacteriological research, led by Hans Buchner and Paul Ehrlich in the 1890s, is based on the analysis of antibacterial activity from alexins (protective substances) in the components of serum and other bodily fluids that are capable of killing microorganisms. Élie Metchnikoff, “Historical Sketch of Our Knowledge of Immunity,” in *Immunity in Infective Diseases*, translated by Francis G. Binnie (Cambridge: Cambridge University Press, 1905), 505-543. Phagocytosis is the cellular process of the cell membrane engulfing solid particles to form an internal phagosome by phagocytes and protists. It functions to remove pathogens and cell debris. Roy Porter, *The Greatest Benefit to Mankind: A Medical History of Humanity* (New York: W. W. Norton, 1997), 446-447.

research on humoral immunity, as he utilized serum to eliminate pathogens, Pastorian Élie Metchnikoff discovered phagocytes, which functioned as a primary internal defense against invading microorganisms. Whereas Western medicine employed immunization as a means of building a defense system against pathogenic microorganisms, Chinese medicine construed it as a process of inducing a certain *qi*, a vital physical force, and expelling through its circulation the toxin that was either inherited from birth (*tai du* 胎毒, fetal toxin) or acquired externally (e.g. via animal bites), thereby aiming to restore the balance of the human body.³¹ Traditional Chinese medicine was inherently prophylactic, focusing on preventing potential disease. Its concept of immunization exemplified the medical principle of treating patients who were “not yet ill” (*zhi wei bin* 治未病). Physicians who treated latent conditions not yet manifested as an illness were seen as superior to the ones who treated patients who already had become ill.³² In the matter of immunization against smallpox, traditional Chinese medicine since the sixteenth century employed variolation, a treatment that, according to the understanding of modern medicine, induced immunity against smallpox with the same agent acquired from human smallpox scabs. Since the late eighteenth century, Jennerian vaccination adapted the variolation principle but used a less-virulent agent obtained from retro-vaccinated animal lymph by inoculating animals

³¹ *Qi* (氣) is understood as a vital physical force, or the material principle inherent in all things. The concept of *qi* was laid down in the authoritative Chinese medical source, “Inner Canon of the Yellow Emperor,” (*Huang Di Nei Jing* 黃帝內經) which attributed disease to inharmonic vital force (*xie qi* 邪氣). The unimpeded circulation of *qi* and the balance of its negative (*yin* 陰) and positive (*yang* 陽) forms in the body are held by traditional Chinese medicine to be essential to good health. The paths through which *qi* proceeds, numbering twenty in total, are called meridians (*jinluo* 經絡). Each meridian corresponds to and nourishes each viscus and extends it to an extremity. The viscera in traditional Chinese medical understanding do not coincide with their anatomical counterparts but rather correspond to the interplay of functional systems with the body. The human body was thought to be a microcosm whose health was intimately connected with the harmony of nature, the macrocosm. If the external circumstances became disordered, they would affect the inner body system. Paul Unschuld, *Medicine in China: A History of Ideas* (Berkeley: University of California Press, 1985), 67-73; Nathan Sivin, “Prologue,” in Manfred Porkert, *The Theoretical Foundations of Chinese Medicine: Systems of Correspondence* (Cambridge: MIT Press, 1974), xiii-xiv.

³² In the Chinese medical tradition, this concept was often traced to its origin in the “Inner Canon of the Yellow Emperor: The Classic of Difficult Issues (*Nan jing* 難經), 77.” Paul Unschuld, *Nan-Ching: The Classic of Difficult Issues* (Berkeley: University of California Press, 1986), 630. It has been recorded in many ancient medical texts.

with human vaccine virus. This practice was transmitted to China in the beginning of the nineteenth century. From then on, Chinese vaccinators employed a technique similar to Jennerian vaccination but retained their explanation of smallpox etiology in fetal toxin. The French Pastorianians in China located their vaccination principle in the lineage of Chinese variolation and Jennerian vaccination. While practicing in China, the Pastorian-trained colonial physicians respected the Chinese ways of vaccination, as long as it was as effective at preventing smallpox as their customary practice.

This dissertation investigates the specifics of Pastorian practices in each different local context. Of particular concern is how the Pastorianians accounted for the acclimatization of animals and vaccine viruses, a process whereby a living organism adapts to gradual changes in the natural local environment. Beyond such environmental considerations, I examine the role of local social, cultural, political, and economic factors in the French Pastorianians' accommodating strategies, along with their explanations of the concept of "science" in various adaptations of their work. I also examine the connections of the Pastorianians working at the Pasteur Institutes in China with other physicians in China, including Western-trained doctors, practitioners of traditional Chinese medicine, and personnel at other colonial and international medical institutions. I further study both the French and the Chinese Pastorianians' resolution of the issues of commensurability between Western modern medicine and traditional Chinese medicine, especially in the fields of fermentation, neurology, toxicology, immunology, pharmacognosy (the study of medicinal drugs in their crude forms, derived from plants or other natural resources), and pharmacology (the study of how chemical substances, artificial or natural, interact with living organisms). Lastly, I address the definitions of Pastorianism, evolving in response to the Pastorianians' medical practices in China, and their roles in transitioning "accommodation" in

Pastorian practices into “integration” of Chinese and Western medicine in China during the Communist era.

“Pastorians,” “Pastorians in China,” and “Chinese Pastorians”

Maurice de Fleury, a French medical journalist, coined the term “Pastorian” (*Pastorien*), in 1895, to refer to the collaborators of Louis Pasteur in France during the two final decades of the nineteenth century.³³ Current scholarship on Pastorians identifies them as Pasteur’s immediate disciples and the following generations who completed the “*Cours de Microbiologie*” (Course of Microbiology), later (1922-1947) known as the “*Grand Cours*” (Grand Course), a program organized at the Pasteur Institute in 1889 by Émile Roux, a close collaborator of Pasteur and co-founder of the Pasteur Institute in Paris. These disciples included foreign nationals who studied in the same program, some of whom later worked in the Pasteur Institutes outside of France, either directly or indirectly linked with the Pasteur Institute of Paris.³⁴ Anne-Marie Moulin applies the term “Pastorians” more broadly, to “a community of men of all origins dedicated to a common goal: the investigation of the bacteriological cause of diseases and the invention of preventive and curative methods such as sera and vaccines to fight such diseases.”³⁵

³³ Maurice de Fleury, *Pasteur et les Pastoriens* (Paris: Rueff, 1895). The Pastorians included an active group of senior professors and young assistants in the medical sciences, such as the veterinarians Henri Bouley and Edmond Nocard, from École Vétérinaire de Maisons-Alford, and Louis Vaillard from the Military Hospital Val-de-Grâce, as well as the first cohort: Émile Duclaux, Jacques-Joseph Grancher, Charles Chamberland, Émile Roux, Élie Metchnikoff, Edmond Nocard, Nathan Straus, André Chantemesse, Louis Vaillard, Albert Calmette, Charles Nicolle, and Alexandre Yersin. Some scholars would also include Louis Thuillier, and Amédée Borrel. However, these two were not included in de Fleury’s list.

³⁴ Anne-Marie Moulin, “Bacteriological Research and Medical Practice in and out of the Pastorian School,” in *French Medical Culture in the Nineteenth Century*, ed. Ann La Berge and Mordechai Feingold (Amsterdam: Atlanta GA, 1994), 333.

³⁵ Moulin, “The Pasteur Institute’s International Network,” 137.

This dissertation studies the historical actors who worked towards this “common goal” within the educational and/or institutional network of Pasteur Institutes. They studied and/or worked at the Pasteur Institutes in France or abroad. Pastorians in China differed from others devoted to a similar endeavor elsewhere, such as in Anglo-American institutions like the Peking Union Medical School and Hospital in Beijing or the Henry Lester Institute of Medical Research in Shanghai. Without assuming that these groups were static, homogeneous or isolated, I divide the Pastorians in China during the period 1899-1951 into three categories. The first includes the French military physicians assigned by the French government to work in the three Pasteur Institutes in China.³⁶ They comprise the principal subjects of Chapters II and IV, and appear as supporting actors in Chapter III. The English physicians who worked at the Shanghai Pasteur Institute in the International Settlement of Shanghai constitute the second category, acting in part of Chapter III. The third category comprises the Chinese nationals trained in Pastorian sciences. Trained at the Pasteur Institute in Paris or the one in Saigon, they were employed in medical research or public health works in China, either at Pasteur Institutes or other medical institutions. As discussed above, I designate this group the “Chinese Pastorians,” numbering around twenty before WWII. They are the focus of the first chapter. In addition to studying the subjects that fall under Moulin’s definition of Pastorians, I examine the nature of their common and individual concerns, and ways whereby they carried out their “investigation of the bacteriological cause of diseases” and their “invention of preventive and curative methods” in China.³⁷

The remaining categories of medical professionals included in this study are “Western doctors,” “Chinese practitioners of Western medicine” (*xiyi* 西醫), and “Chinese practitioners of

³⁶ All French Pastorians in China had military ranks and served in the Colonial Medical Service (*Corps de Santé Colonial*). The military physicians, surgeons, and veterinarians, had to be trained at the Pasteur Institute of Paris before undertaking their missions in French colonies or concessions outside of France. The Pastorian training was meant to make them “fit for their future field practice.” Moulin, “Bacteriological Research,” 338.

³⁷ *Ibid.*

traditional Chinese medicine” (*zongyi* 中醫). Western doctors were the European physicians who practiced modern medicine, except for medical missionaries, whose practice was distinguishable as missionary medicine. “Chinese practitioners of Western medicine” were the Chinese nationals who received Western medical training in China or overseas (Japan, Western Europe, or the United States) since the 1880s. Just before the 1929 confrontation between Chinese and Western medicine, they numbered about two thousand.³⁸ As to the “Chinese practitioners of traditional medicine,” they were Chinese nationals who practiced traditional Chinese medicine and usually lacked formal medical training in modern biomedicine. Before the 1930s, these practitioners were not organized as a group and did not follow any common standards of medical education.³⁹

Medicine in Late Qing and Republican China, 1840-1949

When Legendre and his fellow Pastorians first arrived in China at the turn of the twentieth century, Western medicine there was transitioning from missionary medical practices to modern biomedicine. From the early 1920s until the late 1940s, the Pastorians in China worked in a medical culture that treated “scientific medicine” as one of the forces that facilitated Chinese modernity. Both terms, “Western medicine” (*xiyi* 西醫) and “Chinese medicine” (*zhongyi* 中醫), stood in contrast to each other after the former arrived in China in the early nineteenth century. Prior to that, “medicine” (*yi* 醫) in China comprised a wide range of practices, including “oracular therapy, demonic medicine, religious healing, pragmatic drug therapy, Buddhist

³⁸ K. Chimin Wong and Lienteh Wu, *History of Chinese Medicine: Being a Chronicle of Medical Happenings in China from Ancient Times to the Present Period* (New York: AMS Press, 1973), 770.

³⁹ Nathan Sivin, *Traditional Medicine in Contemporary China* (Ann Arbor: University of Michigan Press, 1987), 21.

medicine, and the medicine of systematic correspondence.”⁴⁰ From the early nineteenth century through the first two decades of the twentieth century, Western medicine was mainly practiced in China by missionary doctors, especially as they performed surgery and introduced anatomy in mapping the internal organs for illness.⁴¹ Ever since Peter Parker, the first Protestant medical missionary, opened his ophthalmologic hospital in Canton in 1834, medical missionaries had developed a reputation for their expertise in surgery, dispensed as Christian benevolence. Missionaries were the dominant organized providers of formal healthcare services in China. However, they did not actively promote public health, believing that curative treatment was more conducive to religious conversion. Also, they lacked the appropriate training in advanced preventive medicine and the government authority supporting its practice.⁴²

Medicine in the nineteenth century did not play a significant part in the late Qing reform of the Self-Strengthening Movement (*zhiqiang yundong* 自強運動, 1861-1895), a period of institutional reforms when Western military technology and armaments were adopted after a series of military defeats and concessions made to foreign powers. Instead of medicine, the late Qing reformers strove to adopt Western science, industry, weaponry, railways, and communication, all of which were regarded as constituents of the Western formula for wealth and power. Because the reformers considered Chinese medicine to be as effective as, if not superior to, its Western counterpart, they did not feel compelled to learn medicine from the West.

⁴⁰ Unschuld, *Medicine in China*, 4.

⁴¹ Since the early nineteenth century, foreign doctors and Chinese physicians had remarked on the limitations in each other’s medical theories and therapeutics, as they practiced their own institutional or private modes of caregiving traditions. Until anesthesiology was introduced in the early twentieth century and antibiotics discovered in the 1940s, the curative power of Western medicine, especially surgery that was mainly performed by medical missionaries in China, was deprecated in comparison to the traditional non-invasive pharmacopoeia of Chinese physicians. Benjamin A. Elman, *On Their Own Terms: Science in China, 1550-1900* (Cambridge: Harvard University Press, 2005), 406.

⁴² Sean Hsianglin Lei, *Neither Donkey Nor Horse: Medicine in the Struggle over China’s Modernity* (Chicago: University of Chicago Press, 2014), 46-48.

The Western medicine that the reformers identified at the time was missionary medicine, which was oriented toward religion and individual treatment and thus barely connected to “wealth and power.”⁴³ It was not until the Manchurian pneumonic plague of 1910-1911 that the Chinese started appreciating the power of Western modern medicine, especially as enforced by the state. After that, Western medicine in China started shifting its emphasis from missionary medicine and its curative approach to modern biomedicine, especially preventive practices applied through public health measures. This shift in practices paralleled the shift in medical leadership, from missionaries to Chinese practitioners of Western medicine. Thenceforth, Chinese medicine ceded ground to Western medicine, as its practitioners embraced public health as the key to Chinese modernity, gaining the support of the newly established Republic of China after the overthrow of the Qing Dynasty and the end of the imperial system in the Revolution of 1911.⁴⁴

The Manchurian plague epidemic of 1910-1911 was a turning point for the development of Pastorian medicine in China. It prompted the Chinese state authorities to control the etiological explanation of the plague, to construct the category of infectious diseases according to germ theory borne out by microscopic tests, and to promulgate serum therapy, vaccination, and related measures through public health initiatives. Charles Broquet, the French delegate to the International Plague Conference in Mukden (nowadays Shenyang 瀋陽, the capital of the

⁴³ Ibid., 48-49.

⁴⁴ Sean Hsianglin Lei, “Sovereignty and the Microscope: Constituting Notifiable Infectious Disease and Containing the Manchurian Plague (1910-1911),” in *Health and Hygiene in Chinese East Asia: Policies and Publics in the Long Twentieth Century*, ed. Angela Ki Che Leung and Charlotte Furth (Durham: Duke University Press, 2010), 73-106. The Revolution of 1911, on 10 October 1911, marked the end of a series of revolutionary activities led by Sun Yatsen since 1895. It overthrew China’s last imperial dynasty and established the Republic of China. The revolutionaries acted in response to the political decline of the Qing government, which they considered ineffective in its efforts to modernize China and to confront foreign aggression. The turmoil was exacerbated by ethnic resentment against the ruling Manchu minority. The Republican government sought to legitimize its polity in part by incorporating modern medicine and hygiene policies among other modernization strategies. The Republican government in Mainland China lasted from 1911 to 1949, when the Communist government took over. During 1927-1948, the Nationalist Party (*Kuomintang*) dominated the Chinese republican government, which was usually called the Nationalist government. The lineage of the Republican/Nationalist government continued to Taiwan after 1949. Michael Dillon, *China: A Modern History* (New York: I. B. Tauris, 2012), 145-187, 208-227, and 259-282.

Liaoning Province in northeastern China) at the end of the plague in April 1911, credited the Pastorian practices with the success of these measures.⁴⁵ Thanks to the plague, “China finally acknowledged the superiority of modern medicine over Chinese medicine.”⁴⁶ Using the modern microscopic examinations, physicians were able to identify the pathogen, trace the transmission route of the disease, and contain it accordingly. The response to the plague also enhanced the political power of the practitioners of modern medicine and connected China to an emerging international order of the global medical practice, in which many Pastorians participated. On quarantine, for example, China had to collaborate with other nations to form and maintain a unified international system of sanitary administration for its northern ports.⁴⁷

The details of the plague epidemic, which was to have a great effect on Chinese medicine, bear recalling. In early October 1910, a mysterious plague epidemic broke out in Manchuria, in northeastern China. From its origin in Manchuli at the border between China and Russia, the disease spread over more than three thousand miles within two months, traveling southeast by railways, roads, and boats, to threaten China’s capital Beijing and the treaty port Tianjin.⁴⁸ The three railway hubs of Harbin 哈爾濱, Changchun 長春, and Mukden, became the principal foci of the infection.⁴⁹ Through the following January, the plague claimed over two thousand lives, fifty thousand over the next year.⁵⁰ The unprecedented communicability of the disease sowed terror and panic. In the beginning, the Qing government made no medical attempts to contain the

⁴⁵ Musée Institut Pasteur, Charles Broquet, *La Conférence de la Peste à Moukden*, April 1911, 12.

⁴⁶ Carl Nathan, *Plague Prevention and Politics in Manchuria, 1910-1931* (Cambridge: Harvard University Asia Center, 1967), 50; Lei, “Sovereignty and the Microscope,” 88.

⁴⁷ Richard Strong et al, *Report of the International Plague Conference, Mukden, April 1911* (Manila: Bureau of Printing, 1922), 396.

⁴⁸ *Ibid.*, 410.

⁴⁹ “L’Épidémie avait fait son apparition le 13 octobre à Mandchouli.” Broquet, 2-3; Strong, 427.

⁵⁰ Strong, iii.

plague. Faced with previous epidemics, the government usually devolved medical issues to local gentry and Chinese physicians.⁵¹ At the most, it responded with “charitable relief, cleanup campaigns, appeals to the plague god, and participation in community ceremonies and processions.”⁵² The Qing state started taking action only when it realized that “Japan and Russia would use plague containment as an excuse to expand their influence in Manchuria.”⁵³ At the time, Russia controlled the Chinese Eastern Railway stretching through the north of Manchuria, while Japan dominated the South Manchuria Railway Company, which was taken over from Russia after the Russo-Japanese War in 1905. Both countries claimed that China was incapable of containing the epidemic in Manchuria, and demanded that the Qing government relegated to them its responsibility therefor. The only way to resolve this sovereignty crisis was to organize a national plague service that preserved China’s official control and was “as ‘Westernized’ as possible” in medical practice.⁵⁴ To accomplish this task, the Qing government called upon Wu Liande 伍連德 (1879-1960).

A Malayan-born Chinese physician, Wu was educated at University of Cambridge and the School of Tropical Medicine under Ronald Ross, the British physician who identified the Anopheles mosquitoes as the vector for the transmission of malaria. Only seven years before the Qing government summoned him to Manchuria, Wu was conducting his research on malaria and tetanus under Metchnikoff at the Pasteur Institute of Paris.⁵⁵ Before Wu reported to this task, he served as the vice-director at the School of Military Medicine in Tianjin. Upon arriving in Harbin

⁵¹ Elman, 406.

⁵² Carol Benedict, *Bubonic Plague in Nineteenth-Century China* (Stanford: Stanford University Press, 1996), 128; Lei, “Sovereignty and the Microscope,” 77.

⁵³ Nathan, 50.

⁵⁴ Lei, “Sovereignty and the Microscope,” 77-78.

⁵⁵ Yulin Wu, *Memories of Dr. Wu Lienteh: Plague Fighter* (Singapore: World Scientific Company, 1995), 28.

on 24 December 1910, he was immediately supplied with a compact, medium-sized British-made Beck microscope fitted with all necessities for bacteriological work.⁵⁶ Three days after his arrival, when a Japanese woman's corpse became available, he performed a postmortem. He determined that the plague bacilli were found exclusively in the victim's lungs, and identified this plague as an airborne disease transmitted directly from person to person, unlike the Hong Kong bubonic plague of 1894 that was transmitted through rat fleas. Consequently, the pneumonic plague was more virulent and more communicable than the bubonic plague. The microscope, used to detect the plague bacilli in the patients' sputum, became an indispensable diagnostic tool.⁵⁷

With no cure available, Wu formulated strategies for containing pneumonic plague and controlling the spread of the epidemic by rigorously and intrusively policing all human movement, especially railway traffic. He instituted strict quarantining, and mandated the wearing of gauze masks for blocking direct infection through the respiratory passages. To execute these measures, Wu recruited six hundred policemen in addition to twelve hundred soldiers at hand and trained them in anti-plague measures. These measures resulted in "the most brutal policies seen in four hundred years."⁵⁸ The majority of Chinese people in Manchuria, with no knowledge of the plague bacilli and no concern for sovereignty, were horrified to learn that no one taken into detention ever came back alive, and their dead family members were burned in a mass cremation without proper burial rites. In their eyes, Wu's measures seemed "arbitrary, despotic, and destructive."⁵⁹ The Chinese people saw the police restrict people's movements, interfere

⁵⁶ Wu, 1; Lei, "Sovereignty and the Microscope," 78.

⁵⁷ Lei, "Sovereignty and the Microscope," 78.

⁵⁸ *Ibid.*, 82.

⁵⁹ *Ibid.*, 84.

with their normal business, burn down their residence and property, and take away their family members, all without saving anyone. Rumors spread that the Japanese had poisoned wells and created the plague, and plague patients were being buried alive. Traditional Chinese medicine, it was often claimed, had succeeded in curing certain patients.⁶⁰ Wu and the anti-plague authorities were challenged on many fronts.⁶¹

Even modern-trained foreign physicians, including the Japanese, Russian, and French staff on Wu's anti-plague team, were skeptical. Many of them thought they had the most advanced epidemiological knowledge acquired since the Hong Kong plague. The received ideas regarding the bubonic plague obstructed the recognition of the radically different nature of the pneumonic plague. Alexandre Yersin, a French Pastorian, and Kitasato Shibasaburo, a Japanese scientist trained under Robert Koch (the German bacteriologist who identified the pathogens of tuberculosis, cholera, and anthrax) independently discovered the plague bacillus in 1894. Four years later, Paul-Louis Simond, another French Pastorian, identified rat fleas as the vector of plague transmission. Because insect-borne, the bubonic plague was not as contagious as other infectious diseases transmitted by direct contact. Many of these physicians considered this pneumonic plague as a derivative form of the bubonic plague. In the cases prior to the Manchurian plague of 1910-1911, pneumonic plague was thought to develop as a result of infection by a rat bite. In their perception, "instead of a bubo developing, the disease spread through the bloodstream to the lungs, causing pneumonia."⁶² The French colonial doctor G erald Mesny, a senior colleague on the Chinese anti-plague team and the head professor of the Imperial School of Medicine in Tianjin, resisted Wu's discovery and refused to wear a mask

⁶⁰ Broquet observed traditional Chinese practitioners attempting to treat plague patients with medicinal drugs. He explained the history of medicinal drugs in Chinese medicine in his report. Broquet, 11.

⁶¹ Lei, "Sovereignty and the Microscope," 84.

⁶² *Ibid.*, 79.

when attending to the terminally ill plague patients in close contact. On 2 January 1911, Mesny contracted the plague during a visit to the Russian epidemic hospital. This leading figure of the anti-plague team died ten days later.⁶³ Panic erupted when people realized the terrible nature of the plague, and soon “almost everyone in the street wore one form of mask or another.”⁶⁴

According to Wu, although no one was certain why the plague declined, the monthly death toll in Harbin dropped from 3,413 to zero in the thirty days after instituting the anti-plague measures.⁶⁵ This “pure pneumonic plague” was new to the international scientific community.⁶⁶ According to Fabian Hirst, “it was the great pneumonic epidemic of 1910-1911 in north Manchuria which first aroused universal interests in this unfamiliar type of plague.” Previous occurrences of pneumonic plague had been very rare throughout the world.⁶⁷ Soon after the plague subsided, the Chinese government invited ten other nations represented in Beijing to send specialists to the International Plague Conference in Mukden from April 3 to April 28.⁶⁸ This Conference aimed to clarify the nature of the disease and to offer advice on preventive methods.⁶⁹ It was the first international medical conference to be held in China. The Conference was conducted mainly in English, but German and French were also used during discussion

⁶³ Broquet, 5. In addition to Mesny, forty-two Europeans died. Thirty-one of them belonged to the medical service and died of the plague. AIP, Fonds Broquet, Cote BRQ (Charles Broquet), “La Peste Pneumonique – Étiologie. Prévention par les Masques,” communication faite à la Société de Pathologie Compare, dans sa Séance du 12 Décembre 1911.

⁶⁴ Lei, “Sovereignty and the Microscope,” 80.

⁶⁵ Wu, 25.

⁶⁶ Lei, “Sovereignty and the Microscope,” 98.

⁶⁷ Fabian Hirst, *The Conquest of Plague: A Study of the Evolution of Epidemiology* (Oxford: Clarendon Press of Oxford University, 1953), 221; Lei, “Sovereignty and the Microscope,” 79.

⁶⁸ Regarding the opening and closing dates of the Conference, please see Broquet, *La Conférence de la Peste à Moukden*, 6 and 20.

⁶⁹ Strong, iii.

sessions.⁷⁰ Because of Wu's pioneering role in advancing scientific knowledge about the nature of the plague, the Chinese Ministry of Foreign Affairs requested him, then only thirty-two years old, to serve as the conference chairman.⁷¹ Wu's discoveries "allowed China for the first time to face the world as a country performing cutting-edge scientific research. The new knowledge that was discovered with microscopes was crucial in resolving the sovereignty struggle over Manchuria."⁷² In addition to China, the participating nations included Austria-Hungary, Britain, Italy, Japan, Mexico, Russia, France, the United States, Germany, and Holland. The delegates representing the United States, Germany, and Holland respectively came from where they worked at the time: Manila in the Philippines, Qingdao in China, and Java in Indonesia.⁷³

Broquet attended as the French specialist, accompanied by his deputy, Joseph Chabaneix. Both of them were Pastorian-trained colonial physicians. Broquet had formerly served as Assistant Director of the Pasteur Institute in Saigon, whereas Chabaneix had taught as Professor at the Imperial School of Medicine in Tianjin and served at the Sanitary Department of the Province of Zhili 直隸, nowadays the Hebei 河北 Province in China. In addition, Arthur Stanley, British Pastorian working as the health officer of the Shanghai Municipal Council and Director of the Shanghai Pasteur Institute at Shanghai's International Settlement, served as one of China's delegates. During the conference, Broquet actively participated in the discussion of the use of

⁷⁰ Broquet, *La Conférence de la Peste à Moukden*, 9.

⁷¹ Wu's contribution to modern medicine in China went beyond his work during the Manchurian plague of 1910-1911. As a Western-trained physician, medical educator, and government official in public health, in 1915 he created the Chinese Medical Association with twenty other Chinese physicians of modern medicine. One of the important missions of the Association was to facilitate exchanges of medical knowledge within the medical community and promote it to the general public through the Chinese-English bilingual publication of *The National Medical Journal of China* (later changed to *Chinese Medical Journal* after merging with the *Chinese Medical Missionary Journal* in 1932). The Journal is an important source for studying history of medicine in China, as I have also benefited from it for my research. Min Shen et al, "China's Medical Periodicals: From Localization to Internationalization," *Learned Publishing* 23. 4 (2010): 303-311.

⁷² Lei, "Sovereignty and the Microscope," 99.

⁷³ Strong, iii-ix.

masks. His emphasis on wearing a proper mask as a preventive measure might have been inspired by his distress over Mesny's death.⁷⁴ His most notable contributions to the Conference took place in various discussions of plague prophylaxes, especially concerning vaccination and serum-therapy.⁷⁵ The participating nations were represented by expertise, not necessarily by nationality.

The Manchurian plague of 1910-1911 also lent weight to longstanding French efforts to encourage the Chinese government to create a Pasteur Institute in Northern China.⁷⁶ In addition to representing France at the Conference, Broquet brought along thousands of anti-plague vaccine doses for use at the French Corps of Occupation (*Corps Français d'Occupation*) in China. The Pasteur Institutes of Paris and Lille supplied the vaccine.⁷⁷ After learning of the death

⁷⁴ AIP, Fonds Broquet, Cote BRQ, "Discours Prononcé sur la Tombe du Docteur Gérald Mesny par le Docteur Broquet, Délégué du Gouvernement de la République Française à la Conférence Internationale de la Peste de Moukden, Kharbine, 23 Avril 1911"; "Discussion on Infectivity of the Breath," in Strong, 90-93.

⁷⁵ Dr. D. Zabolotny, Professor of Bacteriology, as one of the Russian delegates and the chief of Russian Commission for Plague Investigation in China, collaborated with Broquet to treat a patient in Mukden during the Manchurian plague of 1910-1911 with 400 cubic centimeters of anti-plague serum, 300 administered intravenously and 100 subcutaneously. The patient survived. The anti-plague serum had been obtained from animals injected with *Yersinia pestis* discovered during the bubonic plague in Hong Kong in 1894. French Pastors, Alexandre Yersin, Amedée Borrel, and Albert Calmette, developed the anti-plague serum in 1897. Zabolotny concluded that the anti-plague serum seemed more effective when injected in large doses intravenously and subcutaneously during the incubation period, which took place two to five days after contracting the disease. Strong, 103. Broquet also participated in the discussion of prophylactic inoculations. Please see "Discussion on Prophylactic Inoculations" and "Discussion on Vaccination" in Strong, 115 and 121. In the latter discussion, Broquet suggested experimenting with anti-plague vaccination in all countries on prisoners sentenced to death. In the discussion of the pathology of the pneumonic plague, Broquet suggested that if one could provoke mild infection with other microbes in plague patients, it would probably greatly hinder the development of the plague infection. This conjecture was based on Yersin's discovery that other microbes were unfavorable to the development of pest bacilli, and the pest bacillus could not be cultivated in proximity to other species of bacilli. If streptococci and staphylococci infected the plague patient, the plague bacillus could not penetrate the tissues. Ibid., 158. Other issues in which Broquet participated included the materials for culturing the plague bacteria and conservation of plague organs. Broquet noticed that the culture of the Harbin strain on agar-agar was more agglutinous than one of a bubonic strain from Saigon. Ibid., 42. In his paper in the Report: "A Method of Conservation of Plague Organs For Diagnosis," he offered the positive result of the conservation of plague materials in a solution of 20% glycerin with additional 2% of calcium carbonate in tropical countries. Ibid., 78-83 and 88-90.

⁷⁶ Archives du Ministère des Affaires Étrangères à Paris (MAEP), Nouvelle Série (NS), Chine, 652, Leon Mac-Auliffe, "Une Œuvre Médicale en Chine: Création d'un Institut Pasteur à Tientsin," 1911.

⁷⁷ AIP, CHN01, Charles Broquet, "Les Œuvres Médicales en Chine: Essai de Création d'un Institut Pasteur, 1907-1913," 1.

of Mesny, the French Ministry of War instructed Broquet to assist the French military personnel and residents in China. Minister of Foreign Affairs Philippe Berthelot also instructed Broquet to continue promoting the creation of a Pasteur Institute in Beijing.⁷⁸ Considering Tianjin, a coastal city, to be a better-connected location than Beijing, Broquet petitioned the viceroy of Zhili to create a Pasteur Institute there. He promised the viceroy to have all the necessary materials supplied from Beijing, with more to come from France.⁷⁹ The viceroy agreed.⁸⁰ After securing the Chinese imperial decree for the creation of a Pasteur Institute in Tianjin, Broquet prepared plans and budgets with the director of the Imperial School of Medicine in Tianjin before his return to Paris.⁸¹ Owing to revolutionary activities and the proclamation of the Republic of China, the Chinese Ministry of Foreign Affairs delayed Broquet's trip to Tianjin. The construction of the Pasteur Institute in Tianjin was adjourned and the contract with the Chinese government was invalidated. Broquet's attempt to resume the project with the new Republican government eventually failed.⁸² However, the subsequent establishment of the Pasteur Laboratory at the

⁷⁸ Ibid.

⁷⁹ AIP, Fonds Broquet, Cote BRQ, Charles Broquet, "Lettre au Ministre de la Guerre," 10/10/1911.

⁸⁰ In Qing China, under the imperial system, there were eight viceroys (*zongdu* 總督) in total. They were highest-ranking officials appointed by the Emperor to govern one or more provinces. In general, they oversaw military affairs and food production, managed waterways, and directed civil affairs. Royal members and military leaders occupied many of the positions. A viceroy usually played an important role in the Qing Court. He formulated plans of local affairs to which he was supposed to request approvals from the Emperor. The most important one was Viceroy of Zhili, since Zhili (literally meaning "directly ruled") encompassed the imperial capital, Beijing. William F. Meyers, *The Chinese Government: A Manual of Chinese Titles* (Shanghai: Kelly and Walsh, 1897), 34-35. In dealing with foreign powers, the Chinese Ministry of Foreign Affairs was usually in charge, as in the course of coordinating the national plague service during the Manchurian plague of 1910-1911, following Western practices, holding the International Plague Conference in Mukden and deciding whom to represent China, and negotiating for founding a Pasteur Institute. The Viceroy of Zhili played an important part in establishing a Pasteur Institute within his governing territory but the plan had to be approved by the Ministry of Foreign Affairs before the Emperor. The Emperor was supposedly the one who made the final decision. However, since the Emperor at this time was only three years old, the imperial power was held by his father, the Prince Regent, who delegated foreign policies and relations to the Ministry of Foreign Affairs.

⁸¹ Broquet, "Les Œuvres Médicales en Chine," 3-5 and 16-17.

⁸² Ibid., 15.

French Concession in Tianjin in 1922 followed most of Broquet's blueprints.⁸³ The Republican Chinese government at this time collaborated with the French and other colonial powers, attuning to Western medical practice.

To prevent future plague outbreaks in China, the International Plague Conference in Mukden in April 1911 passed forty-five resolutions suggesting measures for adoption by the Chinese government.⁸⁴ One was to institutionalize the notification and management of infectious diseases. Partially accepting this recommendation, the newly established Republican government created the North Manchurian Plague Prevention Service in 1912, with Wu as its director. Wu received subsequent appointments as the director of the Central Epidemic Prevention Bureau in 1919 and the Chinese Quarantine Service in 1930.⁸⁵ The Manchurian plague caused the Chinese government to promulgate in 1916 its first regulations for the prevention of notifiable infectious diseases, including cholera, dysentery, typhoid fever, smallpox, typhus exanthemata, scarlet fever, diphtheria, and plague. This set of eight infectious diseases was exactly the same as that of the diseases regulated by the Japanese government at the time. Except for smallpox, this legally-constructed set comprised diseases newly identified by microscopic tests and germ theory as infectious, but not previously associated with the concept of *chuanran* (傳染, spread by infection or contagion) in traditional Chinese medicine. The category of infectious disease did not exist in traditional Chinese medicine.⁸⁶ In Chinese medical understanding, *chuanran* referred to “an acute and widespread outbreak of epidemic *or* an infection spread through direct and intimate,

⁸³ Archives du Ministère des Affaires Étrangères à Nantes (MAEN), Tientsin 691PO/1/17, “Création à Tientsin d’un Laboratoire Bactériologique. Célébration du Centenaire de Pasteur,” 20/02/1923, 4.

⁸⁴ Strong, 390-397.

⁸⁵ Bridie Andrews, “In Republican China, Public Health by Whom, for Whom?” in *Science, Public Health and the State in Modern Asia*, ed. Liping Bu et al (New York: Routledge, 2012), 184-186.

⁸⁶ *Ibid.*, 93.

person-to-person contact.” (Emphasis added)⁸⁷ The Chinese perceived the different modes of transmission between contagion and infection with a dichotomous notion that “contagion is direct by [physical] contact [with the sick], and infection indirect, through the medium of water, air, or contaminated articles.”⁸⁸ These officially notifiable infectious diseases were now categorized by law through the power of the state, not by traditional Chinese medicine. The state was thenceforth committed to intrusive measures through public health work, employing practitioners of Western medicine as the core of its force.

From the 1910s on, supported by the state, the Chinese practitioners of modern medicine had been developing their critical stance toward traditional Chinese medicine while fostering their political power for the Chinese medical revolution. On 25 February 1929, shortly after the establishment of the Ministry of Health under the new Chinese Nationalist government in 1928, Yu Yan 余巖, a Western-trained physician, led sixteen others at the National Conference on Public Health in Shanghai to propose to the state their plan for abolishing traditional Chinese medicine. They argued that Chinese medical theories, including *ying-yang* 陰陽, the five *phases* 五行, the *qi*-transformation, the *jingluo* 經絡, known as meridian channels and associated circulation tracts, and so forth, had all proven to be wrong because they could not be tested by scientific experimentation and concluded that Chinese medicine could not be effective in treating diseases. Whereas its scientific methods sufficed to ratify Western medicine, they regarded traditional Chinese medicine as unscientific.⁸⁹ A few weeks later, on 17 March, the practitioners of traditional Chinese medicine mobilized a mass demonstration in Shanghai in order to

⁸⁷ Lei, “Sovereignty and the Microscope,” 88-89.

⁸⁸ Margaret Pelling, “The Meaning of Contagion: Reproduction, Medicine and Metaphor,” in *Contagion: Historical and Cultural Studies*, ed. Alison Bashford and Claire Hooker (London: Routledge, 2001), 15; Lei, “Sovereignty and the Microscope,” 90.

⁸⁹ Sean Hsianglin Lei, “How Did Chinese Medicine Become Experiential?” *Positions* 10.2 (2002): 337.

counteract this disparagement of their trade. This “National Medicine Movement” won the support of the general public and political elites, and succeeded in blocking the abolitionists’ proposal. In order to persuade the government that they were willing and able to comply with its program of modernizing China, the practitioners of Chinese medicine promised to conform to the empirical practice of scientific methods. Consequently, the Institute of National Medicine (*Guoyiguan* 國醫館) was established in 1931.⁹⁰ The first article of its constitution reads, “This institute has the objective of choosing scientific methods to put into order Chinese medicine and pharmacy, improve treatment of disease, and improve methods of manufacturing drugs.”⁹¹ Since the 1929 confrontation, the practitioners of Chinese medicine and Western medicine both aligned with the political modernity of the Nationalist state in striving for the scientific modernity of medicine. This led to epistemological and institutional changes in Chinese medicine.⁹² Early in the 1940s, following a series of reforms passed in the 1930s, Chinese medicine appeared at least from the political perspective to stand on equal footing with Western medicine as it gained support from the Nationalist government, even though these reforming efforts came to an abrupt end because of the political chaos and the start of the Sino-Japanese War in 1937.⁹³

From the early 1920s to the late 1940s, the Pastors at the Pasteur Institutes in China worked under the auspices and funding of the French government in collaboration with Chinese authorities, with an exception of the Shanghai Pasteur Institute at the International Settlement in

⁹⁰ Lei, *Neither Donkey Nor Horse*, 97-119.

⁹¹ Ralph Croizier, *Traditional Medicine in Modern China: Science, Nationalism, and the Tensions of Cultural Change* (Cambridge: Harvard University Press, 1968), 92.

⁹² Lei, *Neither Donkey Nor Horse*, 97-119.

⁹³ In 1935, the Chinese Nationalist Party Congress passed a resolution demanding equal treatment for Chinese and Western medicine, including establishing an official state organ to govern the affairs of Chinese medicine within a state-sanctioned license system autonomously by its practitioners and incorporating it into the national school system. In the following year, the government promulgated the “Regulations for Chinese medicine” to meet the foregoing demands. In 1939, the Ministry of Education passed the “Temporary Outline for the Curriculum of Schools of Chinese Medicine. *Ibid.*, 261-262 and 355 (note 6).

Shanghai, which had been founded under the British government. They all pursued their official agenda, namely conducting microbiological research on infectious diseases, producing vaccines, and providing services, such as vaccination and analysis of food and water, in the interests of public health. Founded respectively in 1899 and 1908, the Shanghai Pasteur Institute at the International Settlement and the Pasteur Institute of Chengdu were complemented by the Pasteur Laboratory of Tianjin in 1922 and the Pasteur Institute of Shanghai at the French Concession in 1938. While the Chengdu facility closed in 1944, foreign control in other three Pasteur Institutes continued until the Communist government took over Mainland China. The last one to have its foreign staff and funding move away was the Pasteur Laboratory in Tianjin in 1951. During the Republican era, these Pasteur Institutes provided the services that the Chinese Nationalist government, which maintained political control over much of China from 1927 to 1948, could not always deliver due to limited resources and political turbulence.⁹⁴ These services included treating rabies patients, developing and supplying vaccines against smallpox, cholera, tuberculosis, and other infectious diseases, and conducting public health campaigns. In the following chapters, we will see examples of the Chinese practitioners of Western medicine collaborating with Pastorianians in many ways, but sometimes their interests conflicted. Pastorianians also had to work with the Chinese practitioners of traditional medicine. We also note the presence of other foreign institutions that often competed but also collaborated with the local Pasteur Institutes. They include the American Rockefeller-founded Peking Union Medical School and Hospital in Beijing, the Henry Lester Institute of Medical Research in Shanghai, the

⁹⁴ The institutions that developed and produced biological products such as sera and vaccines under the Chinese Nationalist government included the National Epidemic Prevention Bureau (中央防疫處), Changchun Manufacturing Center of Biological Products (長春衛生技術廠), Dalian Institute of Health (大連衛生研究所), Northwest Epidemic Prevention Bureau (西北防疫處), and Serum and Vaccine Production Institute at China Military Medical School in Guizhou (中國軍醫校貴州血清疫苗製造研究所). Zhao Kai and Zhang Yihao, ed., *Zhongguo shengwu zhipin fazhan shi lue* 中國生物製品發展史略 (The Short History of the Development of Biological Products in China) (Beijing: Beijing shengwu zhipin yanjiusuo, 2003), 3-12.

Japanese Kwantung Army Medical Laboratory and Epidemic Prevention Center, and various public health departments located in foreign concessions in Tianjin and Shanghai.

When the Communists came to power in China in 1949, Mao Zedong 毛澤東 and his comrades considered science to be integral to the socialist revolution and had no objections to biomedicine.⁹⁵ However, their civil war experience in the 1940s and their experience of governing a vast rural population with minimal resources after 1949 motivated them to accommodate Chinese medicine, which was “home grown, culturally acceptable, and inexpensive.”⁹⁶ In the 1950s, the new Ministry of Health started implementing Mao’s series of directives, first organizing traditional physicians to be educated in biomedicine from 1950 to 1953, and then requiring biomedical doctors to learn Chinese medicine from 1954 to 1958. From 1956 onwards, Communist China officially established the policy of “integration of Chinese and Western medicines.” This policy required biomedical physicians to study Chinese medicine, and practitioners of Chinese medicine to study Western medicine. Some of the Chinese Pastors participated in these programs. We will discuss this in detail in the first and concluding chapters. This policy aimed to create “Traditional Chinese Medicine” (TCM), neither wholly Chinese nor wholly Western, which would integrate the best of the Chinese and Western medical cultures.⁹⁷ The policy and its implementation, in which the Communist government had provided the institutional basis and the standardization of knowledge, were all in place by 1963 and became the mainstay of Chinese medicine in China.⁹⁸ Since then, colleges and universities of Chinese medicine have flourished to compete with those of biomedicine. Since the 1980s, the

⁹⁵ Charlotte Furth, “Becoming Alternative? Modern Transformations of Chinese Medicine in China and in the US,” *Canadian Bulletin of Medical History* 28.1 (2011): 12.

⁹⁶ Ibid.

⁹⁷ Bridie Andrews, *The Making of Modern Chinese Medicine, 1850-1960* (Vancouver: UBC Press, 2014), 5.

⁹⁸ Kim Taylor, *Chinese Medicine in Early Communist China, 1945-63* (New York: Routledge Curzon, 2005), 153.

Ministry of Health in China has set a standard curriculum for students in colleges and universities of Chinese medicine with one third of their classes in biomedicine. The students at biomedical colleges devote less time in studying Chinese medicine than their peers at Chinese medical colleges. Nevertheless, the colleges of Chinese medicine and biomedical colleges award the same Bachelor of Medicine degree at the end of a four-year undergraduate program. The graduates are then qualified to practice both Chinese medicine and biomedicine.⁹⁹ This policy instituted the autonomy of Chinese medical education and practice within the framework of a single system of state supported socialized medicine.¹⁰⁰

The History of Pastorian Medicine in China

From a historiographical perspective, the study of Pastorian medicine in China belongs at the juncture of the history of Western modern medicine in China, the modern history of traditional Chinese medicine, and colonial knowledge studies. Conventionally, the scholarship of modern history of traditional Chinese medicine focuses on the perseverance of traditional knowledge, whereas its counterpart in the history of modern medicine in China usually formulates a grand narrative, wherein modern Western medicine appears as an emanation and operation exclusively under European hegemonic domination, resulting in a diffusion to China. Lei argues that neither of these two characteristics is historically true, and today's so-called Chinese medicine and medical health care in China is a product that coevolved between traditional Chinese medicine and biomedicine. In this revisionist account of the modern history of traditional Chinese medicine, Lei shows how traditional Chinese medicine changed through working within the

⁹⁹ Furth, 12.

¹⁰⁰ Ibid.

state's modernization project, by adapting scientific methods and strengthening itself through institutional efforts. Consequently, traditional Chinese medicine not only stands out as a unique case that not only survived the attack of science and modernity but also flourished and became accepted into state-sanctioned public knowledge.¹⁰¹ Scholars following this line of inquiry, including Marta Hanson, Angela Ki Che Leung, Bridie Andrews, Carol Benedict, Kim Taylor, and Xiaoping Fang, place the practitioners of Chinese medicine and sometimes the medical missionaries at the center of their work.¹⁰²

As regards the history of modern medicine in China, recent scholarship has paid more attention to the interactions and exchanges between colonial and local actors. Scholars such as Ruth Rogaski, Mary Brown Bullock, Shangjen Li, and Michael Shiyung Liu, focus on Anglo-American or Japanese colonial powers or medical institutions and personnel in China or Taiwan. These medical institutions, such as the Chinese Maritime Customs Medical Service, and the Rockefeller-founded Peking Union Medical School and Hospital in Beijing, had British or American sponsors.¹⁰³ Few studies have paid attention to other instances of European presence in

¹⁰¹ Lei, *Neither Donkey Nor Horse*, 6.

¹⁰² For the examples of their works, please see Lei, *Neither Donkey Nor Horse*; Marta Hanson, "Conceptual Blind Spots, Medical Blindfolds: Controlling 2003 SARS Risk in Taiwan," in *Health and Hygiene in Chinese East Asia: Policies and Publics in the Long Twentieth Century*, ed. Angela Ki Che Leung and Charlotte Furth (Durham: Duke University Press, 2010), 228-254; Angela Ki Che Leung, *Miandui jibing: chuantong Zhongguo shehui de yiliao guannian yu zuzhi* 面對疾病: 傳統中國社會的醫療觀念與組織 (In Face of Illness: Medical Concepts and Institutions in Traditional Chinese Society) (Beijing: Zhongguo remin daxue chubanshe, 2012). Leung included two of her English-published articles on vaccination in China in this book. These two articles were previously published as: "Variolation and Vaccination in Late Imperial China, ca. 1570-1911," in *Vaccinia, Vaccination and Vaccinology: Jenner, Pasteur and their Successors*, ed. S. Plotkin and B. Fantini (Paris: Elsevier, 1996), 65-71, and "The Business of Vaccination in Nineteenth Century Canton," *Late Imperial China* 29. 1 Supplement (2008): 7-39. Other examples include Andrews, *The Making of Modern Chinese Medicine, 1850-1960*; Benedict, *Bubonic Plague in Nineteenth-Century China*; Taylor, *Chinese Medicine in Early Communist China, 1945-63*, and Xiaoping Fang, *Barefoot Doctors and Western Medicine in China* (Rochester: University of Rochester Press, 2012).

¹⁰³ Their related works include Ruth Rogaski, *Hygienic Modernity: Meanings of Health in Treaty Port China* (Berkeley: University of California Press, 2004); Mary Brown Bullock, *An American Transplant: The Rockefeller Foundation and Peking Union Medical College* (Berkeley: University of California Press, 1980); Shengjen Li, "British Imperial Medicine in Late Nineteenth-Century China and the Early Career of Patrick Manson" (PhD Dissertation, University of London, 1999), and Michael Shiyung Liu, *Prescribing Colonization: the Role of Medical Practice and Policy in Japan-Ruled Taiwan* (Ann Arbor: AAS, 2009).

China, including the French in the South and the Southwest of China, the Germans in the Jiaozhou Bay in the Shangdong Province, or brief spells of European colonization by other nations such as Italy, Austria-Hungary, Belgium, and Russia.¹⁰⁴

Recent inquiries on colonial knowledge studies have gone beyond ideas and theories, focusing on scientific and medical practices to emphasize the circulatory constitution of scientific knowledge and practices and recognize an asymmetric relationships with a colonial power structure. This trend of scholarship methodologically focusing on scientific practices includes works by Kapil Raj, Deepak Kumar, Warwick Anderson, Margaret Lock, Patricia Kaufert, Hans-Jörg Rheinberger, Angela Creager, and Adrian Willson.¹⁰⁵ The scholarship related to colonial knowledge revises the conventional construal of the immutable nature of scientific knowledge, supposed to suffer no change through displacement and take no consideration of scientific practices in other cultures. It argues that it is the mutable nature of the materials, along with their transformation and reconfiguration in the course of their geographical or social displacement, constitutes the exchanges as the locus of formation of scientific knowledge and practices.

This dissertation builds on these lines of scholarship by focusing on a hitherto understudied community of Pastorian in China, including mainly French colonial physicians

¹⁰⁴ A study of the French presence in Southern China can be found in Florence Bretelle-Establet, *La Santé en Chine du Sud, 1898-1928* (Paris: CNRS Éditions, 2002).

¹⁰⁵ Their works include Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650-1900* (New York: Palgrave Macmillan, 2007); Deepak Kumar, "Unequal Contenders, Uneven Ground: Medical Encounters in British India, 1820-1920," in *Western Medicine as Contested Knowledge*, ed. Andrew Cunningham and Bridie Andrews (Manchester: Manchester University Press, 1997), 172-190; Warwick Anderson, *The Collectors of Lost Souls: Turning Kuru Scientists into Whitemen* (Baltimore: The Johns Hopkins University Press, 2008); Margaret Lock and Patricia Kaufert, "Menopause, Local Biologies, and Cultures of Aging," *American Journal of Human Biology* 13 (2001): 494-504; Hans-Jörg Rheinberger, "Patterns of the International and the National, the Global and the Local in the History of Molecular Biology," in *The Local Configuration of New Research Fields*, ed. Martina Merz and Phillippe Sormani (Cham, Switzerland: Springer International Publishing, 2016), 193-204; Angela Creager, *The Life of a Virus: Tobacco Mosaic Virus as an Experimental Model, 1930-1965* (Chicago: University of Chicago Press, 2001); Adrian Wilson, *Ideas and Practices in the History of Medicine, 1650-1820* (New York: Routledge, 2014).

and Chinese practitioners of Western medicine who were trained or worked in the system of the Pasteur Institutes. I argue that it was implausible for the Europeans simply to have imposed their medical practices in China. On the contrary, by looking at how practices had been shaped within environmental, political, and social constraints, I have found that in order to carry out their medical work, the Pastorian-trained colonial physicians had to accommodate local circumstances and make compromises with local communities. These Pastorian practices in China exemplified the content of Pastorism and the contrast between the French and Chinese understanding of science. This dissertation complements the current scholarship in finding that the Pastorians have displayed “intellectual mobility” since the late nineteenth century. It demonstrates that the contemporary Pastorians, both French and Chinese, conformed their research and public health work to local contexts and identified their practice with empiricism and applications, as opposed to theories and pure science.¹⁰⁶ However, current scholarship attests that “Pastorians had little consideration for indigenous cultures.”¹⁰⁷ One might regard “Pastorian medicine” as an instance of “modern Western medicine,” given that the latter adopted germ theory of disease and subsequently developed associated principles in vaccinology, immunology, and other fields. However, it becomes evident that owing to its emphasis on localism, and the accommodation of environmental and socio-cultural factors in its practices, the Pastorian approach has in fact differed from place to place, and from country to country. The Pastorians learned on the ground and incorporated local knowledge and conditions into their practices, especially regarding studies of immunity, infectious diseases, and preventive measures such as applications of vaccines or sera. Furthermore, the Chinese Pastorians were able to reconcile national patriotism with their

¹⁰⁶ Moulin, “Patriarchal Science,” 308.

¹⁰⁷ Anne-Marie Moulin, “The Pasteur Institutes between the Two World Wars. The Transformation of the International Sanitary Order,” in *International Health Organisations and Movements, 1918-1939* (Cambridge: Cambridge University Press, 1955), 257.

scientific training and used their scientific techniques to pursue their version of Chinese modernity. They saw no contradiction between learning what seemed useful from the colonial powers and pursuing a nationalist agenda of Chinese sovereignty.

Led by French scholars, the study of history of the overseas Pasteur Institutes has paid much attention to the interwoven relationship between scientific imperialism and colonial expansion from the late nineteenth century up to the end of the Second World War, extending to the post-colonial era in some regions. These Pasteur Institutes outside of France included both the ones directly connected with the French Ministry of Foreign Affairs and the Pasteur Institute of Paris, as well as those that, though not officially connected, followed the Pastorian methodology, mostly in rabies treatment and other microbiological studies and vaccine production. The thoroughly studied regions include Asia (French Indochina, Bangkok, Iran, and India), South and North America (Brazil and New York), and Africa (Ottoman Empire, Morocco, Tunisia, Cameroon, and Algeria).¹⁰⁸ This trend of scholarship has revised the diffusion view of imposition of Pastorian knowledge into these areas and contests the universality of Pastorian methods. It revised the diffusionist treatment of modern medicine, which was under the following assumptions: first, “Western medicine” was developed within Europe; secondly,

¹⁰⁸ The studies of the Pasteur Institutes in Asia include Annick Guénel, “The Creation of the First Overseas Pasteur Institute, or the Beginning of Albert Calmette's Pastorian Career,” *Medical History* 43.1 (1999): 1-25; Pratik Chakrabarti, *Bacteriology in British India* (Rochester: University of Rochester Press, 2012). Regarding the ones in South and North America: Ilana Löwy, “Yellow Fever in Rio de Janeiro and the Pasteur Institute Mission (1901–1905): The Transfer of Science to the Periphery,” *Medical History* 34.2 (1990): 144-163; Jessica Wang, “A Tale of Three Laboratories: Rabies Vaccination and the Pasteurization of New York City, 1885-1920” (paper presented in the History of Science Colloquium at UCLA, 1 April 2013). The works on the ones in Africa include Anne-Marie Moulin, *Le Dernier Langage de la Médecine: Histoire de l'Immunologie de Pasteur au SIDA* (Paris: Presse Universitaire de France, 1991); Maurice Peltier (Médecin-General, Dakar, French West Africa), “Yellow Fever Vaccination, Simple or Associated with Vaccination against Smallpox, of the Populations of French West Africa by the Method of the Pasteur Institute of Dakar,” *American Journal of Public Health* 37 (1947): 1026-1032; Kim Pelis, “Prophet for Profit in French North Africa: Charles Nicolle and the Pasteur Institute of Tunis, 1903-1936,” *Bulletin of the History of Medicine* 71.4 (1997): 583-622; Guillaume Lachenal, “The Intimate Rules of the French Cooperation: Morality, Race and the Postcolonial Division of Scientific Work at the Pasteur Institute of Cameroon,” in *Evidence, Ethos and Experiment: The Anthropology and History of Medical Research in Africa*, ed. Wenzel Geissler and Catherine Molyneux (New York: Berghahn Books, 2011), 373-400; Clifford Rosenberg, “The International Politics of Vaccine Testing in Interwar Algiers,” *American Historical Review* 117.3 (2012): 671-697; John Strachan, “The Pasteurization of Algeria?” *French History* 20.3 (2006): 260-275.

colonial medicine existed as a distinct phenomenon separate from modern medicine proper; thirdly, colonialism/imperialism produced certain features that were pathological distortions of “real” or “good” medicine; and lastly, “local knowledge” was disrupted or destroyed by colonialism/imperialism.¹⁰⁹

In this body of scholarship on Pastorian networks, the study of the Pasteur Institutes in China remains largely unexplored. The sole contribution here before the end of Second World War is made by French historian Marianne Bastid-Bruguière.¹¹⁰ Her research explores thoroughly the French sources and clearly lays out the political background of the establishment of the Pasteur Institutes in China. However, she maintains that the establishment and operation of the Pasteur Institutes in China before 1922 was a purely Parisian initiative, and that the transplantation of Pastorian knowledge to China in the following years was a “failure” in contrast to the success of scientific works elsewhere, particularly in French Indochina.¹¹¹ In writing the comparative history of the overseas Pasteur Institutes, Moulin and Jean-Pierre Dedet, follow Bastid-Bruguière’s study to portray the case in China. They agree with her assessment of the inefficiency of the Pastorian project in China and refer vaguely to the “local drive” and adaptation that complemented the French policy to extend its sphere of influence.¹¹² The diffusionist view, often derived from comparative studies, bears the Eurocentric position with empirical biases by evaluating the practices in non-Western countries from a Western analytical

¹⁰⁹ Helen Tilley, *Africa as a Living Laboratory: Empire, Development, and the Problem of Scientific Knowledge, 1870-1950* (Chicago: University of Chicago Press, 2011), 10-11.

¹¹⁰ Marianne Bastid-Bruguière, “Instituts et Laboratoires Pasteur en Chine avant 1949,” in *L’Institut Pasteur: Contributions à son Histoire*, ed. Michel Morange (Paris: La Découverte, 1991), 253-268.

¹¹¹ *Ibid.*, 254 and 265; Moulin, “The Pasteur Institutes between the Two World Wars,” 250.

¹¹² These works include Moulin, “Patriarchal Science”; Moulin, “Bacteriological Research”; Moulin, “The Pasteur Institute’s International Network”; Moulin, “The Pasteur Institutes between the Two World Wars”; Anne-Marie Moulin, Jerald Hage, and Jonathon More, “Transformational Organizations and Institutional Change: the Case of the Institut Pasteur and French Science,” *Socio-Economic Review* 6. 2 (2008): 313-336; Jean-Pierre Dedet, *Les Instituts Pasteur d’Outre-Mer: Cent Vingt Ans de Microbiologie Française dans le Monde* (Paris: L’Harmattan, 2000).

reference standpoint. This kind of methodological Eurocentricism is common in medical history as well as in other disciplines.¹¹³ With a similar emphasis on localism, my dissertation differs from the current scholarship by offering a broader and revisionist view of Pastorian practices in China.¹¹⁴ The body of knowledge within the Pastorian network was based on a commonality of empirical methods, which yielded scientific results. I argue that these results underwent many changes in China, challenging the understanding of science for the European Pastorians. Specific local social and cultural features modified various medical practices. The nature of Pastorianism, in this sense, was constantly reconstituted and reinvented in local contexts.¹¹⁵

Sources and Structure

The sources for this dissertation include evidence drawn from diplomatic and colonial archives located in Paris, Nantes, Lyon, and Aix-en-Provence in France, as well as archival materials, private collections, and personal interviews in Shijiazhuang 石家庄, Shanghai, and Beijing. The primary materials include interview records, personal correspondence and diaries, photographs and posters, historical maps, as well as hospital and laboratory reports. They also include memoirs and monographs by the French colonial physicians and Chinese practitioners, as well as Chinese government documents, foreign official accounts in China, and historical periodicals.

I start my narrative at the peak of Pastorian medicine in China, a stage that correlates with the chronological end of my inquiry. In the following chapters, we go back in time to the

¹¹³ See a synthesis of such methodological criticism in Taisu Zhang, “Beyond Methodological Eurocentricism: Comparing the Chinese and European Legal Traditions,” *American Journal of Legal History* 56 (2016): 195-207.

¹¹⁴ It accords with Michael Osborne’s work on the development of the French navy medicine, localizing concepts of diseases according to local conditions. Michael Osborne, *The Emergence of Tropical Medicine in France* (Chicago: University of Chicago Press, 2014).

¹¹⁵ Moulin, “The Pasteur Institute’s International Network,” 162.

earlier phases of Pastorian medicine to explore how it had developed through instances wherein Pastorians experienced collision, collaboration, and compromises with local actors in different parts of China. In the first chapter, I demonstrate the significance of the Chinese Pastorians' work as a scientific and cultural bridge between the international Pastorian circle and the medical community in China before the Communist government came to power in 1949. I trace the story of the Pastorians who followed the Chinese textual tradition and their accommodation of the Chinese dietary and medical culture. I argue that they appropriated Pastorian medical practices, concerns, and knowledge as crucial constituents in research and communication of medical disciplines, such as toxicology, immunology, and pharmacognosy, and so forth. These exchanges eventually manifested themselves in the integration of Chinese with Western medicine. The Pastorians' medical studies and practices served found its continuation into this integration that persisted into the Communist era.

Chapters II to IV analyze the ways whereby the Pastorians accommodated and negotiated their medical practices with local environmental and socio-cultural conditions. The second chapter focuses on vaccine production and public health work of smallpox prophylaxes during the prime years of the Pasteur Institute in Chengdu in 1908-1927. I examine the experiments of the Chengdu Pastorians on local heifers, chosen in addition to water buffaloes, choosing them as effective animal hosts for producing the lymph for Jennerian vaccine. Local Pastorians thus took advantage of the local heifers and water buffaloes that had adjusted to the local climate and environment better than their counterparts in French Indochina and elsewhere in the world. Climate also figured among the factors for vaccine production and preservation in Chengdu. I also examine the ways whereby the Chengdu Pastorians accommodated traditional Chinese inoculation practices against smallpox, and common Chinese people's seasonal preference for vaccination, in conjunction with the worship ritual of the Smallpox Goddess, in order to carry

out their vaccination campaigns and work with the local Chinese practitioners.

Continuing to account for acclimatization, I examine the microbiological studies of rabies virulence and treatment at the Pasteur Institutes in Shanghai from 1899 to 1946 in the third chapter. Focusing on the debate whether the naturally occurring rabies virus in Shanghai was more virulent than that in Europe, I trace the experiments conducted by the three groups of Pastorianians according to different doctrines, and compare their findings with the work at the Pasteur Institute of Paris. I find that only two out of these three groups obtained valid results, which pointed to the local specificity of the Shanghai rabies virus, showing its more intensive nature compared to that of Paris. However, the Pastorianians in Shanghai treated the more virulent strain of rabies with the inactivated vaccine, instead of a more potent live vaccine. When choosing a vaccine, its efficacy was less important considering local geography and climate than its transportability and durability.

The final chapter illustrates the international collaboration on vaccination and related public health measures against smallpox and blindness in Tianjin during 1922-1942. French Pastorianians and other international physicians affiliated with the International League for the Prevention of Blindness in China learned the causes and local incidence of blindness from experience in visiting factories and ateliers in the early 1920s. Their knowledge then translated into actual practices in the League's work on blindness prevention. The League's local fieldwork expanded the French and Western-trained Chinese physicians' experience by identifying the causes of blindness, such as local hygiene standards and reliance on the "native eye powder." It also helped them to identify the best locations to implement public health measures, especially in the poor quarters and areas close to factories. They found smallpox to be the biggest cause of blindness in China, and concluded that vaccination was the best method for preventing it. Through international collaboration extending from Tianjin to interior China, vaccination

combined with related measures to form a single crucial solution for two problems in public health.

The conclusion of this dissertation takes us forward in time to recent medical developments in China and the role of modern Pastorian in the international medical community in the postwar era and up to the present. Even though the local Pasteur Institutes had closed or merged into other medical institutions, and no longer remained under the European imperial control in the 1950s, the mode of Pastorian practices has continued. Some Pastorians continued to participate in the implementation of the policy with their previous experience of validating Chinese medicine with Western scientific methods. Is this in accordance with the idea that scientific imperialism [i.e. Pastorian medicine] survived without the political existence of Empire, as Moulin observed?¹¹⁶ In closing, I address the issues of the Pastorian legacy and its medical transformation in China.

Conventions

Hanyu pinyin 漢語拼音, developed in the People's Republic of China and currently established as the official system used for translating Chinese, is used in the main text to romanize Chinese names, including people, institutions, and provinces. Family names appear before given names for Chinese nationals. I preserve the ways in which the authors chose to spell their names and the order of their family and given names in their publications. I also retain the original designation of institutions, such as Peking in the name of Peiking Union Medical College and Academy of Peiping, as well as the names of the eye clinics and factories in Chapter IV. Chinese terms and the titles of Chinese classic texts are first translated into English according to established

¹¹⁶ Moulin, "Patriarchal Science," 318.

scholarly usage, and then noted in *hanyu pinyin* before Chinese characters. Chinese characters are quoted at the initial use. Translations from French and Chinese into English are my own unless noted otherwise. The format of dates is date/month/year.

CHAPTER I

“Following ‘Science,’ Serving Fatherland”:¹ Pastorian Culture in Republican China

On 30 September 1946, around eighty Chinese and French, many of them physicians, gathered at the Library of the Pasteur Institute in Shanghai to witness the decoration ceremony of Doctor Liu Yongchun 劉永純, a Pastorian-trained Chinese physician and the Vice-Director of the Pasteur Institute in Shanghai. As announced and presented by Baron Jacques Baeyens, French Consul-General in Shanghai, Liu received the Knight Cross of the Legion of Honor (*Croix de Chevalier de la Légion d'Honneur*) for his dedication and contribution to medicine, especially as regards the scientific and cultural exchanges and collaboration between China and France, aligned with Pastorian spirit and practices.²

This was a momentous event for several reasons. Established by Napoleon Bonaparte in 1802, the National Order of the Legion of Honor (*Ordre National de la Légion d'Honneur*), which the French government gives to both French and foreign nationals, has served as its highest decoration ever since. A recipient of such a decoration that Liu received must have served at least twenty-five years in his profession and demonstrated “eminent merits.”³ Though not the first Chinese national to receive such decoration, Liu was the first of them to qualify

¹“Yi kexue wei yi gui, yi zuguo wei duixiang” 以科學為依歸，以祖國為對象 (Following Science, Serving Fatherland) Liu Yongchun 劉永純, “Baside yanjiuyuan yu Zhongyao zhi guanxi” 巴斯德研究院與中藥之關係 (The Relationship between the Pasteur Institutes and Chinese Medicinal Drugs), *Zhonghua yixue zazhi* 中華醫學雜誌 (Chinese Medical Journal) 28. 9 (1942): 308.

²“Liu Yongchun boshi rongshou Faguo xunzhang jixiang” 劉永純博士榮受法國勳章記詳 (The Report on Dr. Liu Yongchun’s Reception of the Legion of Honor), *Yiyaoxue* 醫藥學 (Dr. Huang’s Medical Journal) 1.1 (1948): 42; “Chinese MD Gets Legion of Honor,” *North-China Daily News*, 01/10/1946.

³“Article R.128,” in *Légion d'Honneur, Médaille Militaire, Ordre National du Mérite: Législation et Réglementation* (Paris: Grande Chancellerie de la Légion d'Honneur, 2015), 37.

through his medical contribution. Furthermore, Liu was recognized as an exemplary cultural mediator between China and France. He transmitted and translated knowledge that contributed to mutual understanding of culture and science between China and France. Lastly, the event marked the importance of professional networks. Many of the attending Chinese guests had been educated in France, and some of them shared their educational lineage with Liu himself, from the medical school of the Aurora University in Shanghai to the Pasteur Institute of Paris. Liu was cultivated within this network as its outstanding member.

Starting with Liu, this chapter explores the significance of Chinese Pastorian, externally propagating through the international Pastorian circle and internally arising within the medical community of China. It considers them according to their Pastorian education and medical works, especially in relation to Chinese medicine and local Chinese environmental and socio-cultural factors. It seeks to identify the common traits among the Pastorians in China, especially among Chinese Pastorians. It aims to explain how Chinese Pastorians appropriated their medical practices, concerns, and knowledge as crucial constituents in research and communication of medical disciplines, such as toxicology, immunology, and pharmacology, and so forth. Specifically, it looks into the relevant Chinese cultural customs and scholarly textual tradition (i.e. learning from medical literature that integrated empirical cases into theoretical structures, in which its empirical practices involved combining uses of medicinal drugs in prescriptions, dosage, timing, and physical conditions) in comparison and contrast with laboratorial and evidential experimentation practiced by their Western counterparts. Finally, it seeks to evaluate the significance of Liu's reception of the French award with respect to the Pastorian culture in China and the general reception of the Pastorian medical practices.

Emphasis on Localism:

Pastorian Education Associated with the French Maritime Medical Tradition

Chinese Pastorians shared an education with their French counterparts at the Pasteur Institute of Paris. In addition to studying at individual laboratories, many of them attended or audited the Grand Course, a course of microbiology established at the Pasteur Institute of Paris since 1889 (until 1947). The Grand Course and the training at individual laboratories formed the core of the Pastorian education and played a considerable role in the making of future Pastorians.⁴

The Grand Course and the studies in individual laboratories at the Pasteur Institute of Paris contributed to the making of an apprentice-master relationship between teacher and pupil, reminiscent of the teaching of crafts within a guild.⁵ Led by Roux, the Grand Course attracted medical professionals and researchers within France and from abroad. Before being admitted, these pupils had already had a degree and were on the point of beginning employment. They included all levels of the medical professions, from young hospital interns to chiefs of medical institutions and professors at medical schools, as well as established pharmacists and veterinarians.⁶ The teaching at the Pasteur Institute of Paris did not prepare its disciples to obtain diplomas. At the end of the Course, the disciples received a certificate of “alumnus of the Pasteur Institute.” The certificate attested to their scientific and intellectual formation and conferred the prestige associated with the Pasteur Institute of Paris, but did not necessarily advance their

⁴ In his inauguration speech, Louis Pasteur announced that the Pasteur Institute of Paris was set to be a dispensary for rabies treatment, a research center for infectious diseases, and a center of teaching subjects relating to the microbes. However, during 1900-1939, the course of microbiology was not the only education offered at the Pasteur Institute of Paris. Émile Duclaux, Pastorian and professor of biochemistry at the Sorbonne, taught his course at his laboratory at the Pasteur Institute. Here Duclaux trained numerous biochemists before the course was integrated into the *Faculté des Sciences de Paris* (School of Sciences in Paris) in 1939. Faure, 62 and 69.

⁵ Moulin, “The Pasteur Institute’s International Network,” 144.

⁶ Faure, 64.

professional standing within their original institutions. The teaching sought to give them a practical training in the Pastorian disciplines.⁷

In addition to the knowledge of contemporary theoretical advances in germ theory of disease and immunity, training at the Pasteur Institute of Paris emphasized experimentation and clinical work, in contrast to the teaching style that stressed lecturing, as predominantly practiced by the faculty at contemporary French universities. It focused on microscopic techniques and microbiologic laboratory works to observe, culture, and process microbes into vaccine, as well as experiments on animals.⁸ Moreover, the curriculum focused on studying hygiene and sanitation measures for disease prevention and learning how to treat diseases in clinical practice.⁹ Most importantly, the teaching emphasized adapting equipment to changes in local conditions.¹⁰

Besides the Grand Course and studies at laboratories, Chinese Pastorians shared Pastorian training with all of the French military medical personnel who worked for the Colonial Medical Service (*Corps de Santé Colonial*, later the *Corps de Santé des Troupes Coloniales*), created in 1890. As defined in this dissertation, these colonial medical personnel count Pastorians because of their training at the Pasteur Institute of Paris and their accommodation of practices to different locales and cultures overseas. They included the French Pastorians at the Pasteur Institutes in China and French Indochina. Their Pastorian training followed maritime medical tradition, focusing on colonial medicine, particularly “exotic pathology,” noting “a special and distinctive sort of medicine in virtue of its content, practitioners, patients, diseases, and places of

⁷ Ibid., 74.

⁸ Faure, 62-74.

⁹ After WWII, the original course of microbiology was dismantled and replaced by several specialized ones in immunology, virology, and bacterial genetics, making further research a more likely aim for students than a career in public health. The School of Public Health opened in Saint Maurice, a Paris suburb, in 1980, which meant that the Pastorian monopoly in the field of public hygiene lasted a little less than a century. Moulin, “The Pasteur Institute’s International Network,” 151.

¹⁰ Moulin, “Patriarchal Science,” 311.

practice.”¹¹ Such training stood in contrast to the civilian medicine of Parisian hospitals and the Medical School of Paris (*Faculté de Médecine de Paris*) at the turn of the twentieth century. The teaching of clinical and civilian medicine remained theoretical, and prior to WWI microbiology was not part of the official curriculum, mainly because many fewer patients and fewer clinical materials of colonial diseases were found in the metropole, compared to naval medicine.¹² In the interests of political and scientific imperialism, the trained naval and colonial physicians, who later acquired clinical experience in the colonies treating the local people suffering from colonial diseases, formulated localized concepts of disease according to specific climatic and meteorological conditions, and accessed, diagnosed, and treated patients according to their ethnic and cultural origins.¹³ Since 1890, military medical personnel received their training at the Naval Medical School (*École de Santé Navale*, short for *École Principale du Service de Santé de la Marine*) in Bordeaux, the centralized institution in charge of all naval schools, including the ones in Rochefort, Brest, and Toulon.¹⁴ Later on, the training shifted to the School of Colonial Medicine (*École d’Application du Service de Santé Colonial*), in brief called the *Pharo* (*École du Pharo*, as it was located in the *Pharo*, a district of the seventh arrondissement in Marseille), which was founded in Marseille in 1905 and started accepting students in 1907.¹⁵

¹¹ Osborne, 3.

¹² “[T]he location and place of Paris as Assistance publique regulations prohibited patients with colonial diseases from receiving treatment in public hospitals.” *Ibid.*, 210.

¹³ *Ibid.*, 50.

¹⁴ The Naval Medical School in Bordeaux was created in 1890 and operated until 2011. The creation of the School in Bordeaux marked the centralization of naval medicine. *Ibid.*, 221. There was also a Colonial Department in operation at the *École de Santé Militaire* (Military Medical School) in Lyon from 1925 to 1956. *Ibid.*, 221-222.

¹⁵ Héraut, 381-392; Osborne, 182, 223. France had approximately 500-600 doctors active in 1910, who were trained in the *Pharo*, a number that rose to 667 in 1911. The *Pharo* was closed in 2013 and transferred from Marseille to Brétigny-sur-Orge in 2014.

These naval medical trainees studied tropical medicine and often had Pastorian professors, thanks to the close ties between the *Pharo* and the Pasteur Institute of Paris. For instance, Paul-Louis Simond, the biologist best known for his discovery of the transmission of bubonic plague by fleas at his post at the Pasteur Institute in India, was one of the instructors at the *Pharo*. Upon opening the first course of biology at the *Pharo* in February 1907, he emphasized that students should aim not only at mastering microscopic skills and microbiological knowledge, but also at preparing to discover the “other” human cultures.¹⁶ Before becoming colonial medical officers, these trainees also studied at the Pasteur Institute of Paris, specifically taking the course of microbiology.¹⁷

The French government sent many such French colonial physicians to China and French Indochina. Pastorian-trained French colonial physicians in China included Noël Bernard (1875-1971), who attended the Naval Medical School in Bordeaux and acquired his MD in 1900.¹⁸ He met Liu Yongchun in 1929, while serving as Director of Pasteur Institute in Saigon.¹⁹ The earlier colonial physicians in China at the turn of the twentieth century included Gustave Bouffard (1872-1957), who studied at the Naval Medical School in Bordeaux during 1892-1895 and attended the Grand Course in 1904. He was a colonial physician in China during 1897-1900, creating a hospital in Chengdu and studying Chinese medicine, such as herbal treatment and organotherapy (*organothérapie*) (therapeutics with ingestion or external application of extracts

¹⁶ Héraut, 382.

¹⁷ Deborah J. Neill, *Networks in Tropical Medicine: Internationalism, Colonialism, and the Rise of a Medical Specialty, 1890-1930* (Stanford: Stanford University Press, 2012), 51; Moulin, “Patriarchal Science,” 311.

¹⁸ Henri Jacotot, “Le Docteur Noël Bernard à la Direction des Instituts Pasteur d’Indochine,” *Bulletin de Liaison de l’Association des Anciens Élèves et Diplômés de l’Institut Pasteur* 53. 3 (1972): 38-42.

¹⁹ “Liu Yongchun boshi rongshou Faguo xunzhang jixiang,” 44.

or flesh from animal or human organs).²⁰ Another prominent actor was Aimé-François Legendre, who led the Scientific and Medical Mission to Chengdu, where he established the foundation of the local Pasteur Institute. He studied at the Naval Medical School in Bordeaux and under Roux at the Pasteur Institute of Paris.²¹ Furthermore, Émile Lossouarn, Chief of the Pasteur Institute in Tianjin during 1922-1928, Jean Henri Raynal (1897-1954), Director of the Pasteur Institute in Shanghai during 1937-1946, and the Director (1946-1951) succeeding Raynal, Jacque Fournier (1904-1978), were all part of the Bordeaux and *Pharo* cohort.²² Liu collaborated closely with Raynal and Fournier at the Pasteur Institute of Shanghai.²³ In the following chapters, I illustrate how these French colonial physicians' Pastorian training, emphasizing localism, translated into their medical practices at the Pasteur Institutes in China, as well as examine their connection with the Chinese medical community and the public in detail. Here I begin with the example of the ways in which Albert Calmette as the first French Pastorian carried out his work outside of France with an emphasis on localized Chinese concepts of diseases and consideration of Chinese culture.

Calmette was a pioneer establishing Pasteur Institutes outside of France, first in Saigon, and a strong advocate of following suit in China. He studied maritime medicine in Brest during

²⁰ At the turn of the twentieth century, Bouffard published some cases of organotherapy in traditional Chinese medicine that he gathered in Chengdu. These cases included the juice of macerated pig lungs for pulmonary ailment; pig bowels for dysentery, chronic diarrhea and other intestinal illness; infant urine for cleaning external lesions and for internal intake to stimulate circulation of blood; human placenta (*ziheche* 紫河車) for blood and vital deficiency; human sperm, as a kind of tonic, for illness like chlorosis (iron deficiency anemia in young women), and so forth. Bouffard observed that as the traditional Chinese practitioners were not familiar with the hypodermic method, these remedies were usually taken by ingestion. Gustave Bouffard, "Notes Médicales Recueillies à Tchentou," *Annales d'Hygiène et de Médecine Coloniales* 3 (1900): 175-176. Regarding Bouffard's colonial mission in Chengdu, see Gustave Bouffard, "Notes de Voyage au Se-Tch'Oan," *Annales de Géographie* 10. 50 (1901): 177-181. I will discuss the observation of organotherapies in treating rabies in Chinese medical practices in the later section of this chapter.

²¹ MAEP, NS, Chine, 656, "Lettre du Docteur A. Legendre au Consul Général à Tchentou," 21/09/1907, 4-5.

²² Victor Segalen (Émile Lossouarn's nephew) and Sophie Labatut, *René Leys*, 2 (Paris: Chatelain-Julien, 1999), 929; Georges Girard, "Jean Raynal (1897-1954)," *Bulletin de la Société de Pathologie Exotique* 47 (1954): 756-757.

²³ "Liu Yongchun boshi rongshou Faguo xunzhang jixiang," 44-45.

1881-1883 and attended the course of microbiology in 1890. Before he arrived in Saigon in 1891, the local Chinese held a monopoly on the production of rice alcohol. In order to stop the monopoly, Calmette was motivated to study rice fermentation in order to increase the colonial industrial profit and to collaborate with the *Régis*, a state administration in French Indochina that levied excise duties and oversaw state monopolies. In his 1894 paper, “Contribution to the study of ferments starch –Chinese yeast (*Contribution à l’étude des ferments de l’amidon – La levure chinoise*),” he points out that the Chinese prepared yeast with “a very complicated formula,” which he was fortunate to acquire from the text in Chinese.²⁴ He also visited the local manufacturer, from whom he learned about the old empirical process: mixing forty-six pulverized medicinal plants, such as ginger, pepper, cardamom, cinnamon, clove, with rice and water before paving the mixture on un-hulled rice, and then leaving it for forty-eight hours covered with straw, if possible in an airtight condition, at 30°C.²⁵ He observed that this yeast possessed both the properties of fermentation and saccharification (the process of breaking a complex carbohydrate, such as rice starch, into simple sugars, known as monosaccharides) and it was much more active with rice than the European processes used for producing alcohol from grains. However, he noted that the real active principle to saccharify the rice starch was identified neither in the Chinese text, nor by the manufacturer. He conjectured that this might be due to the Chinese not knowing, and not seeking to explain, the Pastorian mechanism of fermentation, which caused the growth of microorganisms.²⁶

Did the Chinese really not know how their yeast preparation worked? We find accounts of using un-hulled rice and the procedure for making rice liquor, as well as the medical function

²⁴ Albert Calmette, “Contribution à l’Étude des Ferments de l’Amidon – La Levure Chinoise,” *Annales de l’Institut Pasteur* 6. 9 (1892): 605.

²⁵ Liu, “Baside yanjiuyuan,” 304.

²⁶ Calmette, 606.

of different varieties of “Chinese yeast” (*qu* 麴) in several Chinese classics, including “Essential Techniques for the Welfare of the People” (*Qimin Yaoshu* 齊民要術) from sixth century and “Compendium of Materia Medica” (*Bencao Gangmu* 本草綱目) in the sixteenth century.²⁷

These texts attest to a standard procedure of manufacture and the associated medical use documented in records and realized in practices in China. The Chinese acquired the knowledge of fermentation from observation and experience, through historical texts and family tradition, but not from scientific experimentation as in Pastorian practices. Interestingly, we cannot find a single extant Chinese text illustrating the forty-six medicinal plants entering into the fermentation process that Calmette described in his paper. Since the tenth century in the Song period, the natural spiced rice liquor has been popular especially among ethnic groups in the southwest of China with close ties to Indochina.²⁸ It is plausible that the inclusion of these forty-six medicinal plants in the text and in local people’s practice resulted from continual local appropriation through a long period of time.

Calmette used this Chinese yeast, without knowing the specific mechanism of its fermentation, to isolate the species that seemed to have the best saccharifying properties. Calmette named it *Amylomyces rouxii* in honor of Emile Roux. He then found a way to produce and cultivate this yeast, and subsequently produced it in large quantities on un-hulled rice in the presence of beer wort (the sugary liquid extracted from the process of mixing grains with hot water and steeping during beer brewing). He combined it with another yeast obtained from the

²⁷ Jia Sixie 賈思勰, “Section 64 Zao shen qu bing” 造神麴餅第六十四 (Worshiping with Qu Doug), *Qimin yaoshu* 齊民要術 (Essential Techniques for the Welfare of the People), 7, in *Siku Quanshu*, Zi Bu 4, Nongjia Lei, 5-15, assessed 14/05/2016, <http://ia600205.us.archive.org/16/items/06049860.cn/06049860.cn.pdf>; Li Shizhen 李時珍, *Bencao Gangmu* 本草綱目 (Compendium of Materia Medica), 25, in *Siku Quanshu*, Zi Bu 5, Yijia Lei, 19-23, assessed 14/05/2016, <http://ctext.org/library.pl?if=gb&file=52839&page=101>

²⁸ Regarding the making of rice liquor by the ethnics in the southwest of China, see Li Xiaocen 李曉岑 and Zhu Xia 朱霞, *Kexue yu jiyi de lichen: Yunnan minzu keji* 科學與技藝的歷程: 雲南民族科技 (The Development of Science and Technology: Yunnan Ethnic Technology) (Kunming: Yunan jiaoyu chubanshe, 2000).

Pasteur Institute in Paris, and eliminated certain pathogenic species present in the Chinese yeast. The yield was greater than that obtained by the Chinese. His method yielded almost 45% of alcohol content, 15% more than the traditional Chinese method.²⁹ Having discovered the secret of Chinese yeast, Calmette could produce alcohol for local consumption with a lower production cost. He also transmitted the method to France, whereupon the French liquor industry employed it for fermentation. The paper on Chinese yeast was his first publication in the *Annales de l'Institut Pasteur*, eventually leading to his candidacy at the French Academy of Sciences.³⁰ However, the local market failed to respond positively to the scientific improvement in the composition of rice alcohol. For the local consumers in French Indochina, the taste of the liquor produced by Calmette's method that modified certain ingredients from the original recipe, had deteriorated in comparison to the traditional kind. The rice liquor became less flavorful. Many local consumers disliked this new liquor and continued to drink that to which they were accustomed, even though it had become illegal. About 60% of the local purchase of rice liquor consisted of the traditional-made product.³¹

With the same purpose of increasing colonial profit but encountering less resistance as in the case of rice alcohol, Calmette studied opium fermentation. He learnt from the Chinese that “a good chandoo” (a purified opium paste) was prepared after a series of complicated procedures that involved mixing hemp and ramie (a strong natural fiber) with crude opium and cooking it in a copper pot at low heat. After the mixing and cooking, the substance underwent multiple filtrations, steaming, and constant stirring until it became paste-like. The chandoo could be kept for a long time, about ten to twelve months. According to “Compendium of Materia Medica,” the

²⁹ Erica J. Peters, “Taste, Taxes, and Technologies: Industrializing Rice Alcohol in Northern Vietnam, 1902-1913,” *French Historical Studies* 27. 3 (2004): 580.

³⁰ Guénel, 20.

³¹ Peters, 583.

Chinese had practiced this method at least since the sixteenth century. However, the known record does not cover the selection and study of active fermentation agents. Calmette found that constant stirring was meant to spread the active agent within opium. He then isolated a single microorganism, *Aspergillus niger*, from some “very old opium, considered to be the best in the *Régis*,” and determined the best conditions for its cultivation and harvesting. It took him just one month to produce a completely fermented opium sample in the laboratory.³² The inspector from the *Régis* had the product tested by three “experts,” one Chinese, one Annamite (people who lived in the central region of nowadays Vietnam), and one French, all of whom returned a very favorable report. According to the Chinese expert, the experimental opium was comparable to the opium that his very rich compatriots stored in a box from five to twenty years.³³ Thus Calmette’s discovery of *Aspergillus niger* ensued from commingling local culture with Pastorian microbiological studies.

Calmette’s studies of rice and opium fermentation, *nuoc-mam* (fish fermentation),³⁴ and his discovery of the local water buffalo as an effective vaccinifer, which I examine below,³⁵ served as instances of adopting local circumstances and knowledge. His studies exemplify the application of French maritime and Pastorian training to local knowledge transmitted and acquired through ancient Chinese agricultural and medical texts, as well as through

³² Albert Calmette, “Le Fermente de l’Opium des Fumeurs et la Fermentation Artificielle des Chandoos,” *Archives de Médecine Navale et Coloniale* 57(1892): 136-137.

³³ Guénel, 18.

³⁴ Li Shizhen, “Yuzha” 魚鮓 (Fish Fermentation). *Bencao Gangmu* 44: 58-59, assessed 14/05/2016, <http://ctext.org/library.pl?if=gb&file=52862&page=226> It was a common practice along the east coast of the Fujian and Guangdong provinces, as well as in today’s Vietnam, to make a traditional food product by fish fermentation. In 1914, Calmette, at the time Director of the Pasteur Institute in Lille, took the initiative to begin studies on “*nuoc-mam*.” A food control service was set up in the Pasteur Institute in Saigon, allowing the colonial administration to regulate the sale of *nuoc-mam*. J. Guillerm, *L’Industrie du Nuoc-Mam en Indochine* (Saigon: Imprimerie A. Portail, 1931), 7.

³⁵ I illustrate this particular story in Chapter II.

communications with local people. His research was to become a model among Pastorians: learning the practice on the ground and incorporating local knowledge, environmental, and socio-cultural conditions in their work. We shall see some examples of this incorporation in the following sections.

Studying Science Overseas and Re-Discovering Things at Home

Current scholarship maintains that the Pasteur Institute of Paris served as an important institution of scientific and educational exchanges worldwide.³⁶ It provided “the education to the foreigners displaying an uninterrupted two-way flow of men and ideas.” As Moulin observes, in general, “[f]oreign students returned to their home countries and retained a link to their tutors,” whereupon they “played a crucial role in creating informal networks that increased the Pasteur Institute’s influence abroad.” The network of the Pasteur Institutes was made possible by this circulation.³⁷ My findings about the Chinese students within the Pastorian network complement this general depiction, since such connections have not yet been thoroughly explored in current scholarship. In this section, I demonstrate how some Chinese Pastorians’ political and socio-cultural roles complicated their connections and scientific work within the Pastorian circle and elsewhere in the Chinese society.

Li Yuying 李煜瀛 was the first Chinese national studying at the Pasteur Institute of Paris at the turn of the twentieth century. As the second son of the Grand Councilor, Li Hongzao 李鴻藻, at the Qing court, he was raised in a Confucian scholarly tradition in his youth. He first went to France in 1902 as an “embassy student,” accompanying the Chinese Ambassador Sun Baoqi

³⁶ Moulin, “Patriarchal Science,” 310; Moulin, “The Pasteur Institute’s International Network,” 146.

³⁷ Moulin, “Patriarchal Science,” 311; Moulin, “The Pasteur Institute’s International Network,” 146.

孫寶琦.³⁸ Having given up becoming a mandarin, he studied agronomy, focusing on the study of soybeans at the Agricultural School of Chesnoy (*École Pratique d'Agriculture du Chesnoy*) in Montargis, where he graduated in 1906, to continue the same study under Gabriel Bertrand (1867-1962), the first chief of the biochemistry department at the Pasteur Institute of Paris. Li complete his work, *Le Soja* (The Soy), in the following year. The book surveyed the chemical and nutritional components of soybeans and was the first scholarly work published by a Chinese national in France.

Li was not the only Chinese Pastorian interested in soybeans. In the 1930s, Hu Jiamo 胡嘉謨 studied the fermenting action of soybeans on lipids, also under the supervision of Bertrand.³⁹ Hu was born around 1900 in the Jilin 吉林 province in Manchuria. After his mother's early death at the age of thirty-two, his grandparents raised him and sent him to study in France for nine years. While in France, he was supported by the Franco-Chinese Society of Education (*Hua Fa jiaoyu hui* 華法教育會), of which Li Yuying was a founder. Hu studied at the Pasteur Institute of Paris during 1931-1933, supported by the scholarship offered by the Academy of Peiping (*Beiping yanjiuyuan* 北平研究院), in which Li served as the Rector.⁴⁰

I shall explain here how the studies of diet and nutrition in the field of biochemistry, initiated by Louis Pasteur's followers Émile Duclaux (1840-1904) and Gabriel Bertrand, became part of Pastorian medicine, which Li and Hu chose to study at the Pasteur Institute of Paris. Before working with Louis Pasteur, Duclaux had already worked in chemistry and agriculture.

³⁸ Paul Bailey, "Cultural Connections in a New Global Space: Li Shizheng and the Chinese Francophile Project in the Early Twentieth Century," in *Print, Profit, and Perception: Ideas, Information, and Knowledge in Chinese Societies, 1895-1949*, ed. Peiyin Lin and Weipin Tsai (Leiden: Brill, 2014), 19.

³⁹ Hu Jiamo, *Contribution à l'Étude de l'Action des Ferments de la Graine de Soja sur les Lipides* (Paris: Les Presses Modernes, 1933).

⁴⁰ *Ibid.*, 11-12.

After 1862, he worked as Pasteur's assistant to conduct on various studies, including the composition of milk, beer, and wine. After Pasteur died in 1895, he became the director of the Pasteur Institute and founded the department of biological chemistry (or biochemistry, *chimie biologique*) in 1900. Duclaux had already expressed his interest in founding this department by sending Bertrand, specialized in chemistry and biology, to study at various laboratories of chemistry in Germany in 1897. Bertrand became the first department chief in 1900, until his death in 1962, and contributed significantly in the field.⁴¹ In addition, since 1900, Duclaux, then a professor of biochemistry at the Sorbonne, taught his course in his laboratory at the Pasteur Institute of Paris. Duclaux had since established the practice of biochemistry by training numerous biochemists.⁴² The course of biochemistry, though on a smaller scale compared to the course of microbiology, was part of the education offered at the Pasteur Institute of Paris. The studies of biochemistry became institutionally incorporated into the Pastorian practice.

Both Li's and Hu's studies demonstrated that soybeans contained "trace elements," that Bertrand conceptualized as micro-nutrition in biochemical form that played an important enzymatic role and were needed for the proper growth and physiological development of living organisms, including animals and plants.⁴³ In the process of growth, these elements, plentiful in soybeans, were seen as capable of safeguarding humans from the illnesses caused by the

⁴¹ Gabriel Bertrand's main works included discovery of oxidases, trace elements (*infiniment petits chimiques*), the chemical role of laccase and manganese in nature, catalytic fertilizers, chemical composition of plant tissues, chloropicrin for destroying vermin, sorbose bacterium and its effect on sugar, venom amphibians and reptiles, and actions of diastases. Y. Raoul, "Gabriel Bertrand (1867-1962)," *Bulletin de la Société de Chimie Biologique* 44 (1962): 1051-1055.

⁴² Faure, 62 and 69.

⁴³ S. Ananda Prasad and Donald Oberleas, *Trace Elements in Human Health and Disease: Essential and Toxic Elements* (New York: Academic Press, 1976), 35.

deficiency of certain nutrients and minerals.⁴⁴ This line of research, attributing some diseases to nutritional deficiencies, had offered an alternative to germ theory in its etiological explanation. Taking another example, Casimir Funk, a Polish biochemist and also a student of Bertrand, in 1912 coined the term “vitamine” from *vital amine*. (The “e” at the end of “vitamine” was later removed when no nitrogen-containing amines were found in vitamins.) Funk used vitamins to describe the certain trace substances in food that had unique nutritional value and whose presence was necessary to ward off disease.⁴⁵

Why did Li and Hu choose soybeans to study? Concerned with the problem of malnutrition and related health issues in the Chinese population, Li was looking for an alternative diet that was nutritious, affordable, and familiar to the Chinese. While growing up in Manchuria, Hu witnessed numerous foreign invasions by the Russians and Japanese. He was particularly struck by the Japanese massacre in Mukden that took place on the first day of his study at the Pasteur Institute of Paris. Hu sought to find a solution for food shortages and associated diseases during political turbulence.⁴⁶ Moreover, the soy was adequate to the task because the Chinese had been familiar with it in their fields and diets for centuries. Therefore, it could be “studied as an oriental produce with Western science.”⁴⁷ For Li and Hu, studying soybeans was the “right” choice. Not only did it fulfill their scientific quest, but it also served

⁴⁴ Li Yuying and L. Grandvoinet, *Le Soja: Sa Culture, ses Usages, Alimentaires, Thérapeutiques et Industriels* (Paris: Augustin Challamel, 1912), 78-89; Deborah J. Neill, “Finding the ‘Ideal Diet’: Nutrition, Culture, and Dietary Practices in France and French Equatorial Africa, c. 1890s to 1920s,” *Food and Foodways* 17.1 (2009): 8.

⁴⁵ Neill, “Finding the ‘Ideal Diet,’” 4.

⁴⁶ *Ibid.*, 14.

⁴⁷ Li Yuying 李煜瀛, *Dado 大豆 (The Soy)* (Paris: Société Biologique de l’Extrême Orient, 1910), 1.

their patriotic purpose in demonstrating that the consumption of soybeans would be “highly beneficial to public health as well as to the budget of the poor.”⁴⁸

Li did not stop at the theoretical level of soy studies. He and his followers reintroduced and promoted soybeans based on their studies of the scientific and economic values of soy in France, as well as their understanding of soy in Chinese culture. According to Li, the Chinese have cultivated and consumed soybeans for over five millennia. This estimate was based on his reading of Chinese historical and texts on medicinal herbs.⁴⁹ Starting in the late eighteenth century, Jesuit missionaries transported soy plants from China to France, Britain, and other European countries. Although European agronomists and medical researchers took an interest in studying soy in the late nineteenth century, its consumption was not yet common in the West.⁵⁰ Before Li’s soyfood innovations, the cultivation of soybeans and *tofu* 豆腐 production was widespread in most of China, and also in Japan and in Southeast Asia. Traditionally, *tofu* was a kind of bean curd made by using magnesium chloride or gypsum liquid as a coagulant. In 1908, Li founded the first European commercial “*Caseo-Sojaine*” (*tofu*) factory, along with a Chinese vegetarian restaurant (*Zhonghua fandian* 中華飯店), located in Garenne-Colombes near Paris. The restaurant became an establishment where Li arranged numerous dinners for Bertrand and “important Chinese visitors.”⁵¹ He developed further the use of soybeans, based on his study into

⁴⁸ William Shurtleff and Akiko Aoyagi, ed., *History of Soybeans and Soyfoods in France, 1665-2015* (Lafayette, CA: Soyinfo Center, 2011), 1093; A. A. Horvath, *The Soybean as Human Food* (Shanghai: Bureau of Industrial and Commercial Information, 1927), 62.

⁴⁹ These texts included “Compendium of Materia Medica” and “Herbs Tasted by the Divine Farmer” in the *Writings of the Masters of Huainan*, (“Shennong chang baicao” in *Huainanzi ji* 淮南子記神農嘗百草, second century BCE), as well as in ancient dictionaries, such as “Broad Rimes” (*Guangyun* 廣韻, eleventh century) and “Explaining Graphs and Analyzing Characters” (*Shuowen Jiezi* 說文解字, second century CE). Li, *Dado*, 1. Archaeological evidences found in Northeast China confirm the date. Li Liu and Xingcan Chen, *The Archaeology of China: From the Late Paleolithic to the Early Bronze Age* (Cambridge: Cambridge University Press, 2012), 90.

⁵⁰ Li, *Dado*, 8.

⁵¹ AIP, Fonds Li Yuying, Li Yuying, “Lettres à Gabriel Bertrand,” 18/12/1912, 11/03/1914, et 06/06/1919.

the making of various soy products. They included powdered and canned soymilk, soy sauce, *jiang* (Chinese miso), soy coffee,⁵² and *tofu* that used pure salt as coagulant instead of the traditional ingredients. This kind of *tofu* was then called *caséo-sojaïne* or *fromage de soja*, represented as a soymilk-based cheese in Europe.⁵³ Li also made acidophilus soymilk, adapting Élie Metchnikoff and Henry Tissier's research on *Lactobacillus bulgaricus*, lactic-acid bacteria used for modifying the gut flora and replacing harmful microbes with their useful counterparts.⁵⁴ Other soy products included soy protein isolates used to make umbrella handles, pressing *tofu* sheets for use as army food, and soy sprouts used for replacing lettuce in salads.⁵⁵

His experiments and actual production at the *tofu* factory won international recognition. In December 1910, Li applied for two British and two French patents to protect his soyfood production. All were issued and granted during 1911-1912.⁵⁶ Among these patents, “soyoke” had the closest relationship with vaccine studies. It was extracted from soybeans as heated soy flour, in which the trypsin inhibitor was inactivated and was used as a culture broth for vaccine preparation, which was cheaper and more available than beef broth. It was subsequently

⁵² It was made by fermentation, processing soybeans instead of coffee beans, not by replacing milk with soymilk as done nowadays.

⁵³ Li, *Le Soja*, 101.

⁵⁴ Élie Metchnikoff, *The Prolongation of Life: Optimistic Studies*, translated by P. Chalmers Mitchell (New York: Springer Publishing Company, 2004), 116.

⁵⁵ Li, *Le Soja*, 91-135.

⁵⁶ In addition to “soyoke”, others include “sojabacille,” cheese rennet, registered as British Patent No. 30275, “Vegetable Milk and Its Derivatives.” This was the first use of either rennet or lactic acid cultures to ferment soymilk or produce a soymilk-based cheese, such as “kephir, yoghurt, koumiss, and the like.” Secondly, Li isolated a protein from soymilk, which he called “*caseine de soja*,” registered as British Patent No. 30351, “Sauce consisting chiefly of Soja grains,” and was meant to be used either in food products or to make a rock-hard substance that he called “sojalithe,” a counterpart of Galalith, made from milk protein. This was one of the earliest descriptions of soy protein isolation. Another French Patent No. 424124 covered mechanically extracted low-fat soy flour recommended for use in pasta, soups, bread, and cakes. This was one of the earliest known methods for making soybean flour patented anywhere. Indeed, soybean flour had never been previously developed in China. Lastly, another French Patent No. 424125, covered food products and condiments made from soybeans. In 1911, Li applied for three more French patents and one US patent related to soy. Shurtleff, 278, 307, and 1094.

developed at the Experimental Station of Richelieu (*Station Expérimentale de Richelieu*), an institution affiliated with the Pasteur Institute of Paris, during the Second World War and afterwards.⁵⁷ In addition to soy, the Station also developed poppy, sunflower, and pumpkin as alternative cultural media.⁵⁸

These ideas and the ensuing products were new to the Chinese and to the Europeans. In 1910, the Paris-based Biological Society of the Far East (*Société Biologique de l'Extrême Orient*, *Bali Yuandong shengwuxue yanjiu hui* 巴黎遠東生物學研究會) published the Chinese version of *Le Soja* in Beijing. It aimed to inform the Chinese about the various new ways of soy research and development in France, and encouraged them to consume more soyfood for its nutritious and economic values. Conversely, it asked the Chinese reader to participate in further research on soyfood processing and soybean farming. For instance, in order to broaden his collection of samples and to gather all categories of soybeans possible, Li invited the Chinese reader to search all kinds of soybeans that could be found locally in different regions in China and send them to the Beijing office operated by the Society. While sending the sample, the reader had to include a sheet, detailing the soybean type, the local name of the soybean, the place of growth, the name of the sender, the weight, and the price of the sent soybeans.⁵⁹ Since the information sent by the readers is not available, we are unable to learn if there was relationship between Li's continual studies of soybeans and the samples he thus gathered. Such connection deserves further investigation. However, we can see that materials, information, and ideas were circulating and facilitated Li's further soy studies.

⁵⁷ AIP, Fonds Brumpt, Cote BPT (Émile Brumpt), "Lettre à la Société Française des Produits du Soja Soyolk," 02/02/1946, Station Expérimentale Richelieu; AIP Fonds Cépède, CEP. (Casimir Cépède) B16, "Cahier de Casimir Cépède, 1939-1940," 23162, 23163, 23165, 23166, and 23341.

⁵⁸ AIP, Fonds Brumpt, Cote BPT. B7, "Lettres de R. Sigalas à E. Brumpt," 06/11/1942-06/11/1945.

⁵⁹ Li, *Dado*, 9-10 (the advertisement section).

Li continued his study of soybeans. In 1912, he collaborated with L. Grandvoininent in rewriting his book *Le Soja*, incorporating a thorough survey of all known research on soy nutrition and on the chemical and nutritional composition of soy. They discussed the place of soy in vegetarian diets, and were the first to observe that soyfood alkalizes the blood. Unlike meats, soybeans contain no metabolic waste materials such as uric acid, purine bodies, creatinine, and the like.⁶⁰ The ensuing study served as Li's theoretical base for advocating vegetarian diets.

It is interesting to note that in traditional Chinese medicine before the twentieth century, in addition to sleeping habits, sexual activity, body movements, and so forth, dietary regimens acted as part of the “nurturing life” (*yangsheng* 養生) practice that one could employ in order to guard life, improving individual health and fending off disease. These practices were designed to nurture the vital forces and ensure the proper flow of *qi* within the body.⁶¹ An unbalance of dietary regimen could result in blockage of *qi* and cause ailment. Li and Hu introduced a new concept of diet and nutrition to China using the insight of biochemistry and nutrition science in Pastorian practices. We can also observe such a connection between Pastorian sciences and diet elsewhere. Since the beginning of the twentieth century, Pastorian-trained French colonial physicians, especially in the tropics, recognized that dietary choices were not sufficient to cause infectious diseases (pathogens and microbes that invaded the body were the main culprits), but a poor diet could cause nutritional deficiencies, weaken the body (i.e. the innate immune system), and pave the way for bacterial invaders.⁶²

⁶⁰ Li, *Le Soja*, 78-89.

⁶¹ Rogaski, 25.

⁶² Neill, “Finding the ‘Ideal Diet’,” 8. For the details regarding the dietary practices in France and in French colonized Africa, see *ibid.*, 3-23. Regarding the scholarship on nutrition, colonialism, and dietary habits, see Alberto Capatti, *Le Goût du Nouveau: Origines de la Modernité Alimentaire* (Paris: Albin Michel, 1989); Jeremy Rich, *A Workman is Worthy of His Meat: Food and Colonialism in the Gabon Estuary* (Lincoln: University of Nebraska Press, 2007); James McCann, *Maize and Grace: Africa's Encounter with a New World Crop, 1500–2000* (Cambridge MA: Harvard University Press, 2005); Susanne Freidberg, “French Beans for the Masses: A Modern

Following Bertrand's research on micro-nutrition, which pioneered the Pastorian practice of biochemistry, Li and Hu were exemplary of the Chinese Pastorians, positioned within the contemporary circle of intellectuals in China, pursuing their scientific work within the agenda of modernity in order to strengthen China. According to the soy studies by Li and Hu, consuming soy products offered an opportunity for a healthier population with less economic burden. Such a population would then be fit to pursue the project of modernization. The main distinction between Chinese Pastorians, such as Li and Hu, and contemporary Chinese intellectuals, was their scientific training in biochemistry at the Pasteur Institute of Paris. In addition to their Pastorian practice in analyzing soybeans, the soy studies and development took into account the history of soy cultivation and consumption as recounted by ancient Chinese texts, the acclimatization of soy cultivation, and the cultural appropriation of soyfood for local consumption.⁶³ What distinguished Chinese Pastorians like Li also contributed to the circulation of funding, materials, and ideas, associated with soy studies and soyfood development, between China and France. The growth and consumption of the soy had long existed in China. The Catholic missionaries had introduced it to the West long before Li and Hu established the scientific ground for further understanding of soybeans and innovation of soyfood. It was left to Li to introduce and promote the "new" soy science and products in Europe and bring them back to China, creating a substantial impact on the food culture in both places.

Historical Geography of Food in Burkina Faso," *Journal of Historical Geography* 29. 3 (2003): 445–463; Erica J. Peters, "National Preferences and Colonial Cuisine: Seeking the Familiar in French Vietnam," *Proceedings of the Western Society for French History* 27 (1999): 150–159; Lauren Janes, "The Familiar and the Exotic: Colonial Foods in Interwar Paris" (PhD Dissertation, University of California Los Angeles, 2010). I learned of these works of scholarship from Neill, "Finding the 'Ideal Diet'," 23-24 (footnote 6).

⁶³ "L'Étude de l'air géographique du soja montre qu'il pousse sous des climats très différents et que par conséquent sa culture peut réussir en Europe, ce qui a d'ailleurs été prouvé par les essais faits dans les différents pays." Li, *Le Soja*, 139.

Discovering the “China Strain” of the Rabies Virus

Another thing that was discovered and transformed locally in China was a strain of rabies virus in Beijing. While working at the National Epidemic Prevention Bureau in Beijing, in 1931, Yuan Junchang, a Chinese Pastorian, isolated one strain of the local naturally occurring rabies virus from a street dog captured around the Bureau. He developed the strain in rabbit brains through thirty revaccinations. The strain turned into a fixed virus with a stable incubation period of six days. The Bureau called this strain of virus the “Beijing strain,” renaming it later on as the “China strain,” and adopted this strain of fixed virus for anti-rabies vaccine production until the 1980s.⁶⁴

Coming from a modern elite family, Yuan Junchang had experienced Western influence through his father, Yuan Changkun 袁長坤. His father was a pioneer of Chinese telegraph and communication, who had been included among the third group of young children, all around twelve years old, sent by the Qing government to study in the United States during 1874-1881 under the auspices of the Self-Strengthening Movement. Yuan Junchang was sent to the Nanyang Public School (*Nanyang gong xue* 南洋公學), established by the Qing government as part of its modernization plan after its defeat in the Sino-Japanese War in 1895.

After his study at the Nanyang Public School in the 1910s, Yuan received both a Pastorian and a maritime medical education, complementing his previous medical training at the Medical School at the University of Paris in the 1920s. He served as an intern at the *Hôpital Claude-Bernard*, and earned a diploma from the Institute of Colonial Medicine in Paris in 1927. He went on to work at the laboratory of René Legroux in the Pasteur Institute of Paris in 1929, while studying at the Sino-French University in Lyon, a branch of the Sino-French University

⁶⁴ Zhang Yihao, 81.

that had been established by Li Yuying and others in Beijing in 1920, with funding from the local authorities in Lyon. Yuan was certified as a maritime sanitary physician (*médecin sanitaire maritime*), serving as a preparer at the Experimental Biology Laboratory of the School of Advanced Studies (*Laboratoire de Biologie Expérimentale de L'École des Hautes Études*). Later on, he joined the Society of Biological Chemistry (*Société de Chimie Biologique*) and the Society of Medicine and Tropical Hygiene (*Société de Médecine et d'Hygiène Tropicales*).

Yuan completed his thesis on a comparative study of the strains of anti-smallpox vaccine. In identifying the condition wherein the anti-smallpox vaccine could avoid spontaneous decay and remain potent, he concluded that the glycerin heifer pulp specially developed and preserved in tropical countries would serve as the most effective vaccine against smallpox.⁶⁵ Prior to the use of glycerin heifer pulp, the common and inconvenient practice was to use fresh lymph from calves or horses. Even though the use of heifer lymph instead of arm-to-arm application of human lymph had been proposed but seldom employed in the nineteenth century, Yuan's method yielded a more effective glycerin heifer vaccine, which solved the logistic and preservation issues.⁶⁶ His finding comported with the use of heifers as an effective animal source to acquire vaccine at the Pasteur Institute of Chengdu, which I will illustrate in more detail in Chapter II. The League of Nations subsequently promoted such usage of the heifer pulp.⁶⁷

The nature of Yuan's practices, taking account of environmental factors in his scientific work, was shared among other Pastorians in China. We can find an example in the microbiological studies of the more intensive nature of rabies virulence and the localized treatments done by both French and Chinese Pastorians at the Pasteur Institute of Shanghai. I

⁶⁵ Yuan Singtsong, *Étude Comparative des Souches de Vaccine Antivariolique* (Paris: Librairie M. LAC, 1929), 54.

⁶⁶ *Ibid.*, 14 and 18.

⁶⁷ *Ibid.*, 54.

illustrate this discovery of acclimatization and associated adoption of the rabies treatment in Shanghai in more detail in Chapter III.

In addition to his contribution in developing the “China strain” of the rabies virus, Yuan devoted himself to advocating Pastorian medicine, aiming to counter the predominant American influence. In a letter of September 1930, he asked Calmette, who had served as one of his thesis advisors at the Pasteur Institute of Paris, to write to Li Yuying. This letter was meant to solicit Li’s support for Yuan’s repeated requests to conduct further research at the Pasteur Institute of Paris, after his initial request had been turned down by his director at the National Epidemic Prevention Bureau, the central research and public health authority under the Nationalist government in China at the time. Yuan explained that the refusal was due to the American influence dominating the works in the Bureau, and marginalizing him as the only staff member who had studied in France.⁶⁸

Since the late Qing through the early Republican period, Japan, and later on the United States, were the major destinations for Chinese students who studied medicine overseas. Upon their return to China, they filled many of the positions related to public health work in the universities, hospitals, and government. Even though more than 1,500 Chinese students were studying in France during the Work-Study Movement in the 1910s and 1920s, the program of studying in French institutions of higher education gained government support only in the early 1920s. With funding from the Lyon Academy, Li Yuying collaborated with Edouard Hériot, the mayor of Lyon, in creating the Sino-French University in Lyon. This time around, the students in the Work-Study Movement were not considered for admission. Instead, the Sino-French University in Lyon recruited students with a certain level of independent income and prior

⁶⁸ “J’ai demandé immédiatement au Directeur de ce Bureau la permission d’aller travailler pendant quelque temps à l’Institut Pasteur à Paris mais il m’a refusé même pour quelque semaines. Ici, c’est l’influence américaine qui prédomine et je lutte isolément, car je suis le seul qui ai fait de études en France et je ne pas rien faire.” AIP, Fonds Calmette, CAL. (Albert Calmette) B6, Yuan Junchang, “Lettre à Albert Calmette,” 28/03/1930.

knowledge of French all over China, based on competitive examinations. The school was designated for advanced studies of the elites and had nothing to do with Work-Study students. This policy triggered an angry response from the Work-Study students and caused a rupture between them and their mentors.⁶⁹ Accordingly, the majority of Chinese students studying in France from the 1920s on, in particular at the Pasteur Institute of Paris, had been selected mainly from elite institutions such as the Aurora University in Shanghai and the Sino-French University in Lyon. Liu Yongchun, Song Guobin, Hu Tingfu, and Yuan Junchang were among the students attending the Pasteur Institute of Paris.⁷⁰

Liu Yongchun was the most accomplished Chinese Pastorian in terms of his scientific works and his role at the Pasteur Institute of Shanghai. In next section, we will explore Liu Yongchun's encounters with Chinese medical practices. As an authoritative Chinese Pastorian, did he recognize the efficacy of Chinese medicine? How did he evaluate Chinese medicine? How did he deal with the issues of conflict and compatibility between Chinese and Western medicine? How did his attitudes towards Chinese medicine play out within the contemporaneous medical profession?

Validating Chinese Medicine with Toxicology, Immunology, and Pharmacology at the Pasteur Institutes in China and Worldwide

During the 1930s and 1940s, while most Chinese Pastorians were actively practicing medicine in China, the Chinese medical community underwent a confrontation and reconciliation between

⁶⁹ Paul Bailey, "The Chinese Work-Study Movement in France," *The China Quarterly* 115 (1988): 458.

⁷⁰ Some of them were family related. Liu Yongchun was a cousin of Song Guobin's wife. "Yangzhouren shouchuang Kajiemiao fang lao" 揚州人首創卡介苗防癆 (First Yangzhou People Introduced BCG against Tuberculosis), *Yangzhou Wangbao* (Yangzhou Evening Post), 26/05/2012, assessed 14/05/2016, <http://wenhua.yzwb.com/system/2012/05/26/010564950.shtml>

Chinese and Western medicine. On 25 February 1929, the practitioners of Western medicine launched the “Chinese medical revolution” and proposed to the state their plan of abolishing Chinese medicine. In order to counter this revolution, on 17 March the practitioners of Chinese medicine mobilized the “National Medicine Movement” in Shanghai, and eventually acquired political support to block the abolitionists’ proposal and established the Institute of National Medicine in 1931. After the 1929 confrontation, the practitioners of Chinese medicine and Western medicine both strove for the scientific modernity of their fields, aligning with the political modernity of the Nationalist state.⁷¹ As mentioned in the Introduction, in the beginning of the 1940s, after a series of reforms passed in the 1930s, Chinese medicine appeared to stand on equal footing with Western medicine, at least from the political perspective. It was in this period that practitioners of Chinese medicine formed professional societies, set up schools, wrote textbooks, published journals, established and practiced in hospitals – all attempts to amend their outdated image and dispel the public image of Chinese medicine as a relic of the past.⁷² It was in this political context that Liu Yongchuan, a well-established practitioner of Western medicine at the Pasteur Institute of Shanghai, addressed the public concerning his encounters with Chinese medicine, especially as regards its medicinal usage and acupuncture.

Liu’s medical work was closely associated with his contacts formed during his education and collaboration with the French Pastors of Paris and in French Indochina. Born in Yangzhou in 1897, Liu had studied Western medicine at the French-established Aurora University in Shanghai during the 1910s. While studying at the University of Strasbourg in France during 1922-1928, Liu attended the Grand Course at the Paris Pasteur Institute in 1923 and audited the course there again in 1928, learning from both Roux and Calmette. Liu also

⁷¹ Lei, *Neither Donkey Nor Horse*, 97-119.

⁷² Taylor, 7.

studied microbiology with two French Pastorian in Paris, Amédée Borrel and Louis Boëz. Upon moving to Strasbourg, Liu worked with Jean Alexandre Barré, a French neurologist, with whom he was jointly credited for the discovery of Barré-Lieou Syndrome.⁷³ Although some scholars claim that Barré and Liu discovered the syndrome independently, according to Liu it was a collaborative effort, with Barré providing clinical materials and mentoring him for the study.⁷⁴ This collaboration with Barré established Liu's reputation in neurology, closely connecting with his subsequent work on rabies treatment. As Liu was leaving Strasbourg in 1928, Barré gave him a biography of Louis Pasteur as a parting gift. Liu credited this gift with reminding him of Pasteur's scientific spirit in his subsequent work at various Pasteur Institutes.⁷⁵

In September 1929, the French government hired Liu as the chief of the Pasteur Institute Laboratory at the Pasteur Institute in Saigon, Indochina. He remained there for six years until 1935, specializing in anti-rabies vaccine, as well as in BCG vaccine against tuberculosis. Liu recalled that during his stay in Saigon, he learned much from Joseph Mesnard, Director of Pasteur Institute in Hanoi, Henri Morin, Director of the Pasteur Institutes in Saigon, and Alexandre Yersin, Director of the Pasteur Institute in Nha Trang and later Inspector General the Pasteur Institutes in Indochina.⁷⁶ Most importantly, he maintained a mentor-disciple relationship

⁷³ Barré-Lieou Syndrome describes a wide range of symptoms thought to be due to a dysfunction of the group of nerves called the posterior cervical sympathetic nervous system, located near the vertebrae in the neck. J. M. S. Pearce, "Barré-Liéou 'syndrome'," *Journal of Neurology Neurosurgery and Psychiatry* 75 (2004): 317-319.

⁷⁴ "Liu Yongchun boshi rongshou Faguo xunzhang jixiang," 44.

⁷⁵ Ibid.

⁷⁶ Liu emphasized that Alexandre Yersin had deep influence on him. He met Yersin in Saigon. During his directorship at the Pasteur Institute in Nha Trang (created in 1895), Yersin visited other Pasteur Institutes in Saigon and Hanoi, two or three times a year. When the Shanghai Incident broke up in 1932, Yersin asked Liu about the situation in Shanghai and showed much sympathy. Wu Liande - pioneer of public health and medical education in China, and then chief of the National Epidemic Prevention Bureau in China - once visited Saigon and requested Liu to ask Yersin about his discovery of the pathogen causing bubonic plague as some believed the pathogen was discovered by Kitasato Shibasaburo, a German-trained Japanese bacteriologist. Yersin answered with a smile without saying anything. Before Liu returned to Shanghai, he visited Yersin in Nha Trang. Yersin signed in Liu's diary as a souvenir. Liu cherished it dearly. Ibid.

with Noël Bernard, then Director of the Pasteur Institutes in Indochina and later Director of Overseas Pasteur Institutes. Liu followed Bernard's direction in regard of the "scientific principles" and the "practicality of administrative tasks."⁷⁷ In 1935, Liu returned to China and served as the chief of the Municipal Laboratory in the French Municipal Council in Shanghai. Upon the creation of the Pasteur Institute of Shanghai in 1938, he became the chief of the vaccine service pursuant to Bernard's recommendation. From then on, he worked with Jean Raynal at the Pasteur Institute of Shanghai until 1946. They achieved much progress at the Institute, and as Liu recalled, came to treat each other as family.⁷⁸

Considering Liu's Pastorian training, his achievement in Pastorian medicine, and his well-established connections within the Pastorian circle and the medical community in China, particularly in Shanghai, how did he evaluate traditional Chinese medicine? He discussed it in public on at least two occasions. The fact that Liu was invited to speak on these occasions reflected a subtle political relationship between the practitioners of Western and Chinese medicine. The first speech took place at the opening of the Exposition of Chinese Medicine in Shanghai's Aurora Museum on 25 April 1942. And in November 1949, Liu gave another speech on the Chinese acupunctural practices in France at Chinese Medical History Association (*Zhonghua yishi xuehui* 中華醫史學會), an institution dedicated to the study of the history of medicine. The setup of these events exemplified the striving for the co-existence of Chinese and Western medicine. In the first case, a respectful practitioner of Western medicine was invited to an important event, possibly organized in a collaboration of practitioners of Chinese and Western medicine, meant to introduce Chinese medicinal materials and their functions in a venue that had been established by a French Jesuit priest almost seventy years earlier as a museum of natural

⁷⁷ Ibid.

⁷⁸ Ibid. I illustrate their collaborative work on rabies vaccine production and treatment in Chapter III.

history and had been operated since 1930 by a French-established university for modern sciences. As Liu stood at the podium, he likely felt subjected to conflicting expectations by the practitioners of Chinese and Western medicine. The former were probably hoping that he would say something positive about Chinese medicine, while the latter expected scientific insights from a practitioner of Western medicine. In the event, Liu managed to please both parties somewhat, even as he posed more questions for future generations to ponder.

The title of his talk that day was “The Relationship between the Pasteur Institutes and Chinese Medicinal Drugs.” (*Baside yanjiuyuan yu Zhongyao zhi guanxi* 巴斯德研究院與中藥之關係) Liu gave two sets of examples to prove the tight relationship between the Pasteur Institutes and Chinese medicinal drugs. The first was the Chinese invention of variolation that indirectly influenced the vaccination principle, which was adopted by Louis Pasteur and subsequently applied in Pastorian medicine.⁷⁹ This is also the story that I will trace in more detail in the next chapter.

The second set of examples was Liu’s studies of fermentation and the efficacy of certain Chinese medicinal drugs. He used Calmette’s fermentation studies on opium, rice liquor, and *nuoc-mam*, which I previously mentioned, to argue that the knowledge Calmette obtained from local people and ancient texts and practices peculiar to the Chinese inspired his discoveries of particular fermentative agents and their mechanisms.⁸⁰

As for the Chinese medicinal drugs, Liu cited two cases by the Pasteur Institutes in Saigon and Tangier respectively. One worked, while the other one failed, according to the Pastorians who tested them. The first one was the chaulmoogra seed (*da feng zi* 大風子). Louis Boëz, Director of the Pasteur Institute in Saigon, learned from the Chinese about its medicinal

⁷⁹ Liu, “Baside yanjiuyuan,” 305-306.

⁸⁰ *Ibid.*, 304-305.

capacity in treating leprosy. The Chinese had known of this remedy since the thirteenth century. The concurrent growth of trade between China and Southeast Asia explains the increasing availability of this tropical plant commonly grown in South and Southeast Asia, including French Indochina.⁸¹ As recorded in various Chinese medical texts, including “Compendium of Materia Medica,” the Chinese were cautious about its toxic nature and the quantity in treatment. If using it too much, “the heat produced by its nature (*xin* 性) could damage the blood (*xue* 血) and cause blindness.”⁸² During 1927-1928, Boëz gathered its seeds from locations situated in present-day Cambodia, and tested them on rabbits and guinea pigs. Boëz found out that the pill made of chaulmoogra seed oil and fatty acid with the ratio of 2:1 could palliate the symptoms by 30% and even cure leprosy. For treating leprosy, the patient should take four pills after meals per day and increasing to 12-20 pills every day for six to eight months.⁸³

The other medicine was a Chinese recipe containing a mixture of Chinese herbs for curing rabies. In the early 1930s, Roux at the Pasteur Institute of Paris received a gift package from *Tongteh Tang* 同德堂, a renowned medicinal dispensary in China, containing unknown ingredients similar to cinnamon. In 1933, Roux forwarded the package to Paul Remlinger, Director of the Pasteur Institute in Tangier, Morocco, and asked him to verify its claimed efficacy: a 100% cure rate after taking a package with water per day for two days. It was claimed to be effective for both humans and animals that suffer from rabies. Remlinger’s results were not as rosy. The dogs administered the medicine in his experimental and the control groups all died

⁸¹ Angela Ki Che Leung, *Leprosy in China: A History* (New York: Columbia University Press, 2009), 56.

⁸² Li Shizhen, *Bencao Gangmu* 35. 2: 53-54, <http://ia802703.us.archive.org/2/items/06048809.cn/06048809.cn.pdf>

⁸³ Liu, “Baside yanjiuyuan,” 308. Boëz treated rabbits with 3 or 4 ml of the extracted chaulmoogra oil by injecting it into the stomach. After twelve hours, all rabbits died of poison. Upon being injected subcutaneously, the rabbits could resist about 8 ml. The same dosage injected under the skin in guinea pigs also worked, but they died after being fed with 2 ml of the oil. Boëz made the pill out of the soap containing chaulmoogra seed oil and fatty acid with the said ratio. Each pill weighed 30mg.

of rabies. The rabbits all died, too, but from ingestion of the medicine. Remlinger concluded that there was no curative value in this package and the Pastorian rabies vaccination was still the most effective method available.⁸⁴

Before I present Liu's conclusion of the speech, let us note his continual research on Chinese medicinal drugs for the treatment of rabies and two other Pastorian-trained French colonial physicians' observation of Chinese organotherapies in treating rabies. Liu studied Chinese remedies from classical texts, and compared them to his own experiments and the studies done by other Pastorians. He learned that "The Handbook of Prescriptions for Emergencies" (*Zhouhou beijifang* 肘後備急方), written by Ge Hong 葛洪 (284-363 CE), a Chinese physician active in the fourth century, recommended that "killing the mad dog that bit the patient and then placing its brain on the bite [where the foul blood had been removed and acupuncture had been administered] would result in no recurrence [of the poison]."⁸⁵ He commented that Ge Hong's anti-rabies treatment did not contradict Pastorian principles.⁸⁶ He inferred that Chinese physicians knew that certain anti-rabies substance existed in the brain of a rabid dog long before Louis Pasteur and his followers hypothesized its existence and developed the treatment of rabies systematically, when the pathogen of the disease was still unknown.

In addition to the use of a rabid dog's brain, Liu noted that Chinese practitioners since the fourth century had also used poison from snakes and toads to treat rabies according to the

⁸⁴ Ibid., 306.

⁸⁵ Ge Hong 葛洪, "Zhi zu wei quan suo yao du fang" 治卒為犬所咬毒方 (Treatment of Mad-Dog Bites), *Zhouhou beijifang* 肘後備急方 (The Handbook of Prescriptions for Emergencies), 7. 54, assessed 14/05/2016, <http://alturl.com/e5uuz> "Xian suo que e xue, jiu chuang zhong shi zhuang." 先啣卻惡血，灸瘡中十壯。(First remove the foul blood, and then perform acupuncture on the bite spot ten times.); "Sha suo yao quan, qu nao fu zhi, hou bu fu fa." 殺所咬犬，取腦敷之，後不復發。(Killing the mad dog that bit the patient and then placing its brain on the bite spot would result in no recurrence [of the poison].)

⁸⁶ Liu Yongchun 劉永純, "Qigoubin zhi shiguan jiqi zhenzhifa de chubu tantao" 癩狗病之史觀及其診治法的初步探討 (History of Rabies and the Preliminary Studies of Its Therapeutics), *Yishi zazhi* 醫史雜誌 (Chinese Journal of Medical History) 1. 2 (1947): 2.

remedies described in classical texts, such as “The Handbook of Prescriptions for Emergencies” and “Valuable Therapies for Emergency” (*Beiji qianjin yaofang* 備急千金藥方). Liu associated such remedies with Calmette’s and Césaire Phisalix’s (1852-1906) experiments with similar treatments.⁸⁷ In line with serum-therapy, Calmette conducted experiments in the 1890s by using the serum extracted from a dog or rabbit that had been injected with the rabies virus and gained immunity and mixing the serum with cobra poison.⁸⁸ The snake poison was thereupon neutralized. Conversely, when injecting the rabies virus between the eyes of a rabbit that had immunity against snake poison, the rabbit did not contract rabies.⁸⁹ In the same period, Césaire Phisalix and Gabriel Bertrand used a secretion containing bufotenin drawn from the skin of a red toad (*Bufo vulgaris*), either alone or mixing it with snake poison (*Vipera aspis*), and injected a non-fatal dose into the vein of a rabbit. The rabbit thus gained two months’ immunity against rabies.⁹⁰ Following her husband’s work, Marie Phisalix went on to mix snake venom and the rabies virus and discovered that the rabies virus was neutralized by the snake venom and could be used as a vaccine against rabies. Upon increasing the volume of the snake venom in the mixture, short of making it fatal, it could be used to induce immunity against snake poison.⁹¹

⁸⁷ Liu “Qigoubin,” 4.

⁸⁸ *Bulletin of the Johns Hopkins Hospital*, 1899, 226. “This belief in the non-specificity of toxins and antitoxins of snake-venom is shared by other [than Calmette’s] investigation on the same subject....dogs immunised to a high degree against rabies are capable of great resistance to snake-poison; while Calmette and others have shown that rabbits vaccinated against snake-venom, became resistant to poisoning by abrine, while those vaccinated against abrine may in turn acquire a certain degree of immunity against snake-venom, diphtheria, ricine or even sometimes against anthrax, and animals vaccinated against erysipelas or rabies may posses a serum that may even be preventive against snake-venom.”

⁸⁹ Albert Calmette, “Contribution à l’Étude du Venin des Serpents. Immunisation des Animaux et Traitement de l’Envenimation,” *Annales de l’Institut Pasteur* 8 (1894): 275-291.

⁹⁰ Césaire Phisalix and Gabriel Bertrand, “Recherches sur la Toxicité du Sang de Crapaud Commun,” *Archives de Physiologie Norm, et Pathology* 5 (1893): 511-517.

⁹¹ Marie Phisalix, “Vaccination contre la Rage Expérimentale par la Sécrétion Cutanée Muqueuse des Batraciens, puis par le Venin de Vipère Aspic,” *Comptes Rendus de l’Académie des Sciences* 158 (1914): 111-113.

Putting together the Chinese medicinal usage of snake and toad poison for rabies treatment and the studies of Calmette and the Phisalixes, Liu corroborated and verified the Chinese medical concept of “tackling poison with poison” (*yi du gong du* 以毒攻毒) in the case of anti-rabies treatment with snake venom. Liu immunized three rabbits with cobra’s venom. He then injected the rabies virus into them. Two of them remained free from rabies. However, in his experiment, the rabbits immunized from rabies were not immune to snake poison.⁹² A plausible explanation of the different results in Calmette’s and Liu’s experiments attributed it to different methods, *in vitro* vs. *in vivo*. In a more controllable setting, Calmette mixed the rabies-immunized dog or rabbit’s serum with the cobra’s venom in a petri dish, whereas Liu injected the venom directly into his rabbits. In addition, in the Chinese medical texts, the treatment is usually said to be certain when using snake venom to treat rabies, but not the other way round.⁹³

In addition to the medicinal usage of snake and toad poison for rabies treatment, Chinese organotherapies in Chinese medicine were adopted by two Pastorian-trained French colonial physicians in the early twentieth century. Jules Regnault, a French colonial physician posted in Tonkin of French Indochina, where medical practice mainly drew upon Chinese medicine, observed the local practice of feeding the liver of the rabid dog to the victim.⁹⁴ In contrast to many colonial physicians’ ridicule of local medical practices as superstitious and “useless,” he sought to understand the ideas behind them before passing judgment on the efficacy. However, he did not blindly admire local culture; nor was he naïve about his colonial civilizing mission

⁹² Liu “Qigoubin,” 4.

⁹³ *Ibid.*, 4-5.

⁹⁴ David Marr, “Vietnamese Attitudes Regarding Illness and Healing,” in *Death and Disease in Southeast Asia*, ed. Norman Owen (Oxford: Oxford University Press, 1987), 162-186; Jules Regnault, “Médecine Européenne et Médecine Indigène en Extrême-Orient,” *Archives de Médecine Navale* 78 (1902): 272.

and surroundings.⁹⁵ In his opinion, it was important for a European physician to win the local patients' trust by attending to them with local methods.⁹⁶ For the sake of their patients, in addition to practicing Western medicine, European physicians "must learn the general theories of Chinese anatomy, physiology, pathology, and have some knowledge of local therapies," especially relating to Chinese pharmacopoeia. In the case of rabies treatment, notwithstanding his training in microbiology, Regnault entertained the notion of Chinese organotherapy that the liver contained an antitoxin that might aid healing. He admitted that the medical efficacy of this practice remained to be verified, but in his opinion, the practice seemed more medically justified than the practice then common in France, of having the patients touch a sculpture of Saint-Hubert's coat with their foreheads. More importantly, the Chinese practice implied an explanation of rabies etiology alternative to germ theory, which seemed restrictive in its insistence on a single pathogen, especially given that the rabies pathogen had not yet been discovered.⁹⁷ In addition to rabies, Regnault also studied the Chinese practices of prescribing the spinal cord and brain of a deer for certain nerve disorders, as well as utilizing animal liver, kidney, and lung for other diseases.⁹⁸ Another French colonial physician, Gustave Bouffard, serving in Sichuan during 1897-1900, regarded Chinese medicine as favorably as Regnault. In his opinion, European physicians should study Chinese pharmacopoeia, whose rich store of medicinal substances and related treatment ensued from thousands of years' experience, before

⁹⁵ Evelyn Bernette Ackerman, "The Intellectual Odyssey of a French Physician: Jules Regnault and Far Eastern Medicine," *French Historical Studies* 19. 4 (1996): 1084.

⁹⁶ Jules Regnault, "Création d'une Faculté de Médecine Française en Chine," *Revue Politique et Parlementaire* 38. 112 (1903): 102-103.

⁹⁷ Regnault, "Médecine Européenne et Médecine Indigène en Extrême-Orient," 272.

⁹⁸ *Ibid.*; Jules Regnault, "L'Opothérapie en Chine et en Indochine," *Revue de Médecine* 10 (1900):1028-1030.

deciding what was more effective for their Chinese patients.⁹⁹ He also studied the Chinese organotherapies, using animal lungs, brains, and even human urine and placenta for treatment.¹⁰⁰

Liu concluded his speech by distinguishing the epistemological differences between Pastorian and Chinese medicine. One was based on scientific experiments, and the other, on “*benneng jingyan*” (instinct and experiences). In the wake of the 1929 confrontation, medical practitioners at that time in China would agree with this epistemological division, experimental vs. experiential, though the two traditions were not seen as so clearly divided prior to that.¹⁰¹ Before the 1920s, a traditional Chinese physician differentiated two kinds of medical qualifications, scholarly learning (*xueshu* 學術) and experience (*jingyan* 經驗), but the latter was subordinate to the former, as a contemporaneous doctor asserted that “[i]n Chinese as well as Western medicine, the excellent doctors must be those who had abundant scholarly learning and experience. Nevertheless, to comprehend the [medical] principles and the concept of *qi*, Chinese doctors must be the ones who were good at studying books.”¹⁰² At the time, traditional Chinese medicine was not considered as the learning based only on experience. Only after the 1929 confrontation did Chinese practitioners of Western medicine decoupled traditional practitioners from scholarly learning and condemned their experience-based practices as unscientific.¹⁰³

For Liu, the instinct and experiences that underwrote Chinese medicine specifically manifested themselves in therapeutics and medicinal drugs. He recognized their curative and

⁹⁹ Regnault, “Médecine Européenne et Médecine Indigène en Extrême-Orient,” 272.

¹⁰⁰ Bouffard, “Notes Médicales Recueillies à Tchentou,” 172-183.

¹⁰¹ Lei, “How did Chinese Medicine Become Experiential?” 333-364.

¹⁰² *Ibid.*, 335.

¹⁰³ *Ibid.*

preventive efficacy as long as they had been verified by scientific methods, and encouraged further scientific studies of potentially effective Chinese treatments and drugs.

The emphasis on therapeutic efficacy in treating neurological symptoms appeared even more pronounced in Liu's speech on Chinese acupunctural practices in France at the Shanghai Chinese Medical History Association in 1949. As a practitioner of Western medicine, he candidly announced his interest in acupuncture, acquired in the course of his studies of neurology in Strasbourg in the 1920s. He observed that no therapeutic methods available at that time could effectively treat patients who suffered from neurological diseases. Coming from Chinese society, which originated the acupunctural practice that seemed effective for many people, Liu conjectured that it might be useful in neurological treatment, complementing the clinical and pathological understanding of the diseases.¹⁰⁴ For Liu, neurology was the connection between acupuncture and Pastorian practices.¹⁰⁵ However, when Liu first attempted to learn acupuncture in 1928, his expert instructor stressed the importance of *qi* in the practice. This required learning to “move *qi*” (*yunqi*) and not everyone could succeed at it. The traditional Chinese practitioners used the theory of *qi*-transformation and the associated Chinese medical doctrines to explain how acupuncture worked with no reference to neurology. This traditional theory discouraged Liu from learning it.

¹⁰⁴ In fact, acupuncture “had become marginalized in Chinese medicine as the Chinese increasingly abhorred the idea of intrusive intervention during the Late Imperial period.” “It was only as a result of Japan’s inspirational influence that traditional practitioners began to view acupuncture in a very different light in Republican China.” The Institute of National Medicine “incorporated the once marginal practice of acupuncture into its modernized version of Chinese medicine as a core representative and unique invention” of Chinese medicine vis-à-vis the world of global medicine.” Lei, *Neither Donkey nor Horse*, 158-159.

¹⁰⁵ Liu Yongchun, “Zhongguo jinzhen zhiliaofa zai Faguo de gaikuang” 中國金針治療法在法國的概況 (The Overview of the Chinese Acupunctural Treatment in France), *Zhonghua yixue zazhi* 中華醫學雜誌 (Chinese Medical Journal) 35. 11 and 12 (1949): 455. Interestingly, earlier in the 1930s, a traditional Chinese practitioner Chen Dan’an 承淡安 (1899-1957), influenced by the Japanese acupunctural studies, used Western anatomy, namely the mapping of the nervous system, to redefine the location of the acupunctural needle entry points. Elman, 408; Lei, *Neither Donkey nor Horse*, 159-160.

Liu rediscovered the value of acupuncture as he represented the Pasteur Institute of Shanghai while attending the first international conference of BCG vaccine against tuberculosis in Paris in 1948. In learning the BCG from the West, Liu regarded acupuncture as one of the Chinese practices that could provide a reciprocal value to the West.¹⁰⁶ Liu was aware that Jean-Baptiste du Halde, a Jesuit priest, had demonstrated the practice in France in the seventeenth century. However, acupuncture did not become prominent there until 1929, when Georges Soulié de Morant, a French diplomat in China, introduced both its theory and technique to a domestic public by conducting research and education in France. Liu met with Soulié de Morant, who encountered acupuncture during a cholera epidemic while serving as a diplomat in Beijing in 1900. According to Soulié de Morant, the successful treatment outcomes at the Western hospitals were only around 10%. Only a temporary hospital in a Catholic Church outside of the embassy district enjoyed an 80% rate of success in treating cholera patients with acupuncture. Soulié de Morant visited this hospital and met with its acupunctural practitioner, who taught him the application. Ever since then, Soulié de Morant had devoted himself to the study and practice of acupuncture. Liu was able to witness in Paris Soulié de Morant's successful acupunctural treatment of insomnia, asthma, enuresis, arthritis, and diabetes.¹⁰⁷

Liu was aware that acupuncture had no scientific basis in anatomy, as one could not observe particular physiological structures at any acupunctural point or the meridian channels.¹⁰⁸ However, he told the audience that he would temporarily accept the physiological and endocrinological explanation of why acupuncture worked, since it was the best scientific explanation available. He was encouraged by the power of acupuncture to diminish the

¹⁰⁶ Liu, "Zhongguo jinzhen," 455.

¹⁰⁷ *Ibid.*, 455-456.

¹⁰⁸ *Ibid.*, 457.

symptoms caused by functional disorders, often associated with neurological reflexes. As Liu learned, the French acupunctural researchers and practitioners in the 1930s and 1940s initiated a great deal of discussion regarding the physiological functionality of acupuncture without involving any Chinese medical theories. Some sought to prove that the practice could stimulate nerves, which connected to the inner organs that functioned abnormally. They showed that the skin could sense pain when the peripheral nerves responded to the insertion of acupunctural needles. Others associated acupuncture with endocrinology. They claimed that acupuncture could generate parathyroid hormones and regulate calcium in the blood. According to Liu, contemporary French physicians, such as Pierre Abrami (1879-1945), Marcel Lavergne, Charles Flandin, Paul Ferreyrolles, and A. Macé de Lépinay, clinically proved that acupunctural practices caused the disappearance of the symptoms of functional disorders, such as facial paralysis and arthritis. Abrami concluded that symptoms due to functional disorders, relating to abnormal neurological reflexes, could be corrected by acupuncture.¹⁰⁹

Liu encouraged the medical community in China to study acupuncture further by applying established scientific methods. He thought that contemporary medicine could learn from the Chinese therapeutic practice. In his words, “although acupuncture was in no way a panacea, neither should it be dismissed as quackery.” Also, “although contemporary Chinese physicians considered acupuncture as an ‘old’ knowledge, the Parisian medical community saw it as it ‘new’ and found it to be useful.”¹¹⁰ Liu lamented that the enthusiasm it elicited in France stood in contrast to its disregard among the practitioners of Western medicine in the Chinese medical community. A French physician who studied acupuncture wrote to Liu to ask some questions about acupuncture, hoping that the Chinese could help him, since China was the origin

¹⁰⁹ Pierre Abrami, “Les Troubles Fonctionnels en Pathologie (Leçon d’Ouverture du Cours de Pathologie Médicale),” *Presse médicale* (1936): 2081.

¹¹⁰ Liu, “Zhongguo jinzhen,” 455.

of the practice. Liu thought that the Chinese should study this “Chinese inherent and unique knowledge” with “scientific methods” to secure for it a justified position in medicine.¹¹¹

As a well-respected and authoritative Pastorian with a humble temperament, Liu lauded the Chinese practices of fermentation of opium, rice liquor, and *nuoc-mam*, all of which inspired Calmette’s discoveries of effective fermentative agents and their mechanisms. He took pride in the Chinese variolation practice of smallpox prophylaxis playing an important role as the preamble of the vaccination principle in history of medicine. He recognized the therapeutic efficacy of the traditional medicinal drugs, such as chaulmoogra seeds for leprosy and snake venom for rabies. He noted the therapeutic efficacy of acupuncture. He went so far as to suggest that Chinese medical practices could serve as an inspiration for Western medicine. However, Liu rarely mentioned the validity of Chinese medical theories, such as *ying-yang*, the five *phases*, the *qi*-transformation, the twelve *jing-mai*, known as meridian channels and associated circulation tracts, and so forth.

As far as I can determine, Liu only commented on Chinese medical theories in two cases. First, he thought that it is wrong that the ancient Chinese believed that snake poison and rabies “toxin” had the same origin. For Liu, the truth lay in the scientific discoveries: snake poison is a kind of zootoxin and the cause of rabies is a particular virus. As the Chinese story goes, after every “awakening of insects” (*jingzhe* 驚蟄),¹¹² the earth *qi* emerges, whereupon all the insects and snakes come out of their burrows. When “frost descent” (*shuangjiang* 霜降)¹¹³ occurs, the earth *qi* fades, and all the insects and snakes become dormant. During this period, they breathe

¹¹¹ Ibid.

¹¹² It is the third of the twenty-four solar terms in the traditional East Asian calendars, usually occurring during March 5-20 in the Gregorian calendar, when the weather becomes warmer.

¹¹³ It is the eighteenth of the twenty-four solar terms, usually occurring in the period between October 23 and November 7 in the Gregorian calendar.

out the poison *qi* and expel it outside of their burrows. As dogs are sensitive to smell, they sniff around the burrows and breathe in the poison *qi*. This is how they become sick and crazy.¹¹⁴ Liu could claim in confidence that the Chinese theory was wrong, because it was incompatible with germ theory, borne out by the established scientific knowledge of the rabies virus, which has been proven as the cause of rabies.

The second case, claiming the association of acupuncture with *qi*, was not as clear-cut for Liu. In the traditional medical theory, when an acupuncturist used needles to stimulate specific points along the meridian channels, he or she believed that the stimulation helps to improve the flow and restore the balance of *qi*, enabling all parts of the body to work together in harmony as intended. This achievement of harmony allowed the body to repair itself and maintain health. Liu was mystified by the theory of *qi* and did not continue his study. He did not openly deny the traditional theory of acupuncture, but sought a scientific explanation of its effectiveness.

Under the rubric of Western science in the fields of immunology, pharmacognosy, and toxicology, Liu accepted the efficacy of some Chinese medical practices that had been verified by the scientists in the Pasteur Institutes worldwide. However, he remained skeptical about the related Chinese medical theories. He thought that the Chinese did not know the pathogenic causes of rabies, leprosy, and smallpox, or even those of many other infectious diseases, which could only be validated by germ theory. He did not understand the Chinese theory of acupuncture. He could only provisionally accept the “scientific” theories offered in France and encourage further scientific studies of the practice. Like many contemporary reform-minded practitioners of Chinese and Western medicine, Liu strove to validate the former, and its medicinal drugs and therapeutics in particular, with the scientific methods of the latter, and refute some Chinese medical theories that contradicted the scientifically-proven etiologies of infectious

¹¹⁴ Liu, “Qigoubin,” 1.

diseases. Interestingly, emphasizing the therapeutic efficacy of Chinese medical practices, with or without coming to terms with the tenets of germ theory, was precisely the strategy some practitioners of Chinese medicine employed to justify the practicality of their trade. Some practitioners of Chinese medicine in the 1930s had even chosen to refrain from arguing for the incommensurability of germ theory with Chinese medical theories. Instead, they embraced germ theory for identifying the cause of disease, but at the same time insisted that Chinese medical practices could offer effective and valuable treatments, even though it did not address the etiology of a disease. Lei argued that this contemporaneous view could be seen as the “prehistory” of “pattern differentiation and treatment determination” (*bianzheng lunzhi* 辨證論治), a phrase that explained the direct link between the diagnosis of symptoms, patterns, and therapy in Chinese medicine after the 1950s.¹¹⁵ It depicted a clinical practice with two integrated processes, pattern differentiation and treatment determination. In the first stage, pattern differentiation, physicians identified symptoms and signs elicited by four traditional examinations in Chinese medicine (facial observation, auscultation and olfaction, review of medical history and routine habits, and pulse palpation) into distinctive clinical pathological patterns found in the classic medical texts. In the second stage, treatment determination, physicians responded to the patterns of disorder with appropriate treatments designed to balance or control the disordered process.¹¹⁶ In next section, I offer an example of Gao Jinglang 高鏡朗 (1892-1983), a practitioner of Western medicine who had studied at the Pasteur Institute of Paris. He worked outside of this zero-sum framework positing mutual incompatibility of Chinese and Western medicine, and became one of the predecessors of integrative medicine in China in the beginning of the 1950s.

¹¹⁵ Lei, *Neither Donkey nor Horse*, *op. cit.*, 185-190.

¹¹⁶ Volker Scheid and Sean Hsianglin Lei, “The Institutionalization of Chinese Medicine,” in *Medical Transitions in Twentieth-Century China*, ed. Bridie Andrews and Mary Brown Bullock (Bloomington and Indianapolis: Indiana University Press, 2014), 256.

Transition to the “Integration of Chinese and Western Medicine” (*Zhongxiyi jiehe* 中西醫結合)

“In the autumn of 1954, the Chinese Medical Association urgently needed teaching materials for the practitioners of Western medicine to learn Chinese medicine.” Gao Jinglang wrote this in the preface of *New Interpretation of Ancient Pediatric Diseases* (*Gudai erke jibing xin lun* 古代兒科疾病新論). He continued: “Professor Zhu Futang 諸福棠 at the National Pediatric Association wrote to request that I put together some ancient pediatric materials. Therefore, I hastily compiled this book.”¹¹⁷ The first edition of the book was eventually published in 1956, just in time for the program of “doctors of Western medicine studying Chinese medicine” (*xiyi xuexi zhongyi* 西醫學習中醫). This book was one among many other textbooks chosen for the program, which was part of initial steps for Mao Zedong’s directives towards the “integration of Chinese and Western medicines” (*zhongxiyi jiehe* 中西醫結合).

Mao and his Communist comrades considered science as integral to the socialist revolution and had no objections to biomedicine but their civil war experience in the 1940s and governing a vast rural population with minimal resources after 1949 pushed them to accommodate Chinese medicine that was characterized as home grown, culturally acceptable, and inexpensive.¹¹⁸ In the 1950s, the new Ministry of Health started implementing Mao’s directives: traditional physicians studying biomedicine from 1950 to 1953, and then, from 1954 to 1958, requiring biomedical doctors to learn Chinese medicine. Officially from 1956 on, Communist China established the policy of “integration of Chinese and Western medicines.” It

¹¹⁷ Gao Jinglang 高鏡朗, “Preface,” in *Gudai erke jibing xin lun* 古代兒科疾病新論 (New Interpretation of Ancient Pediatric Diseases) (Shanghai: Shanghai kexue jishu chubanshe, 1983), 1.

¹¹⁸ Furth, 12.

required biomedical physicians to study Chinese medicine and practitioners of Chinese medicine to study Western medicine. It aimed to create a new medicine, “neither wholly Chinese nor wholly Western,” that integrated the best of Chinese and Western medical cultures.¹¹⁹

Following Mao’s directive requiring practitioners of Western medicine to learn Chinese medicine, Gao’s treatise was meant to be a textbook for teaching Chinese medicine to biomedical physicians. However, why was Gao, a practitioner of Western medicine, and other colleagues with similar training, considered authoritative and asked to compile a book about ancient Chinese pediatric diseases? Once again, it was Mao’s idea. In a speech given in July 1954, Mao placed the responsibility of reorganizing, developing, and promoting Chinese medicine with the practitioners of Western medicine, not Chinese medical practitioners:

Henceforth the most important thing is to ask practitioners of Western medicine to study Chinese medicine, and not for practitioners of Chinese medicine to study Western medicine. Firstly we must transfer one to two hundred graduates of medical institutes or colleges, handing them over to some well-known doctors of Chinese medicine so that they can study their clinical experience. Furthermore, they should assume an attitude of great modesty in their studies. The study of Chinese medicine by practitioners of Western medicine is honourable. This is because through the studying and improving of [Chinese medicine], the demarcation lines between Chinese and Western medicine can be discarded, to form one Unified Medicine of China, as a contribution to the whole world.¹²⁰

¹¹⁹ Andrews, *The Making of Modern Chinese Medicine, 1850-1960*, 5.

¹²⁰ Taylor, 72.

The Chinese Medical Association (*Zhonghua yixue hui* 中華醫學會) that was responsible for providing the teaching materials for the program at first approached Zhu Futang, a renowned practitioner of Western medicine specializing in pediatrics at the Peking Union Medical School and Hospital. Zhu recommended Gao for the task. Born in Zhejiang in 1892, Gao acquired his medical degree at Hunan's Xiangya School of Medicine in 1921. In 1927, along with Yen Fuqing 顏福慶 and other practitioners of Western medicine, he founded the Medical School at Zhongshan University in Shanghai, later to become the Shanghai Medical College. After brief training in pediatrics and tuberculosis in the United States, he studied at the Pasteur Institute of Paris and visited several hospitals in Germany, Austria, and Switzerland. After his return to China in 1930, he established the first children's hospital in Shanghai. At the time when he was asked to compile the book, he was a well-respected pediatric expert working at Guangzi Hospital 廣慈醫院 in Shanghai.

The textbook offers a good opportunity to examine Gao's integration of the Chinese and Western medicine. Of particular relevance is the entry on "smallpox." That is a part of the chapter on "virus," categorized under "infectious diseases." Most of the categories are etiologically defined according to the causes of diseases, as established by biomedicine. Other categories in the book include "diseases of the newborn," "children's growth and nurture," "diseases related to nutritional deficiencies and chronicle indigestion," and "diseases of systems' (*xitong bin* 系統病): diseases related to respiratory, laryngological, gastrointestinal, neurological, endocrinological, dermatological, and urological systems."¹²¹

The format of each entry is as follows. Gao gives the biomedically-defined name of the disease as the title. The first section of the entry includes the traditional names found in the

¹²¹ Gao, 2-4.

ancient medical texts and the names of the disease that remain in use. For instance, there are twenty-seven old names listed for smallpox, and two names that are commonly used. From the second section onwards, up to but excluding the conclusion, the content is all based on ancient Chinese medical texts. In the entry for smallpox, Gao cites medical texts from the fourth to the nineteenth century. The second section usually treats the cause of the disease. In the case of smallpox, the traditional physicians claimed in various texts that fetal toxin was its cause. The third section covers the symptoms or patterns of the disease as found in medical texts. The fourth section usually recounts the diagnosis and treatment, followed by the history. For smallpox, identifying the source from each individual text, Gao covers detailed descriptions of the colors, shapes, numbers, and the volume of the smallpox pustules along with their distribution on the body as an indication of the severity of the disease and their changes over its course. Gao comments that traditional physicians' diagnosis of the disease was usually quite precise due to their learning of ancient medical texts and their keen observation. In this entry, Gao specially adds the sections of "possible complication," "epidemic seasons" "immunity," "death rate," and "prevention," all according to ancient medical texts. The concluding section is usually the correction according to a modern biomedical understanding of the diseases. For smallpox, Gao recognizes the value of variolation and smallpox treatment, but rules out fetal toxin as its cause.¹²²

The way Gao integrated Chinese and Western medicine was based on the Chinese textual tradition, the differentiation of symptoms and patterns by Chinese medicine, the efficacy of the Chinese therapeutics, and biomedical verification. As a practitioner of Western medicine, he followed the Chinese scholarly tradition in learning Chinese medicine through medical texts. Through these texts, he absorbed the knowledge of various Chinese medical practices. However,

¹²² Ibid., 105-116.

the efficacy of certain Chinese medical practices could be verified only by scientific methods. In the case of an infectious disease such as smallpox, Gao identified the cause as a virus, not the fetal toxin. On the other hand, he recognized the efficacy of variolation in preventing smallpox and in administering treatment according to the diagnosis based on the patterns of pustules. Gao thus integrated Chinese and Western medicine in a manner similar to Liu Yongchun's. He accepted the etiologies of diseases that have been identified by germ theory. When judging which kind of treatment should be in use, Chinese or Western, he chose the one that was most effective. If effective, he would even choose Chinese medical practices as long as they were effective, with their efficacy verified by scientific methods.¹²³ In addition to smallpox, Gao also applied this integrative strategy to describing other infectious diseases, such as typhoid fever, measles, chickenpox, malaria, parotitis (inflammation of one or both parotid gland), ascariasis (caused by parasitic roundworm *Ascaris lumbricoides*), and fasciolopsiasis (infection from a kind of parasitic flatworms, trematode *fasciolopsis buski*). This method of integrating Chinese and Western medicine, as exemplified in Gao's book, served as a preamble of integrative medicine starting in the late 1950s.

Conclusion: “Following ‘Science,’ Serving Fatherland”

In addition to their various degree of educational and institutional involvement with the Pasteur Institutes in Paris, Saigon, Chengdu, Tianjin, or Shanghai, these practitioners of Western medicine were counted as Chinese Pastorians because they followed “science” to facilitate Chinese modernization and strengthen their own country. This “science” was “Pastorian” in nature. Owing to its emphasis on localism, considering the environmental, and socio-cultural

¹²³ Gao, 80-145.

factors in its application, this Pastorian culture differed from place to place, and from country to country. Pastorians learned on the ground and incorporated local knowledge and conditions into their practices, which were associated most with studies of immunity, infectious diseases, and preventive measures such as the application of vaccines or sera.

When encountering Chinese local knowledge and practices, the first thing we notice is that the Pastorians, both European and Chinese, followed the Chinese textual tradition and cultural customs. Chinese medical and agricultural texts inspired Calmette's fermentative studies of opium, rice liquor, and *nuoc-mam*. He also observed the local people, regarding their manufacturing methods. Along the way, he understood that these products represented a certain shaping of social activities and material cultures in the local society. Li Yuying's understanding of Chinese soy culture and his subsequent studies of soybeans had its basis in the Chinese historical and pharmacognostical texts. Louis Boëz indirectly learned of the medical capacity of chaulmoogra seeds to treat leprosy based on Chinese textual knowledge. Liu Yongchun referenced his studies of rabies and snake venom in several Chinese medical texts. Gao Jinglang consulted a massive corpus of Chinese medical texts in the course of compiling a textbook for a project of integration of Chinese and Western medicine. These Pastorians read, interpreted, and appropriated medical classics and historical texts, and incorporated them into their practices. This textual tradition has bonded with medical practices in China. In consulting this tradition Pastorians in China distinguished themselves from those of elsewhere.

Secondly, Pastorians served their country by their overseas scientific learning that transformed the knowledge of the things at home. We see Li Yuying and Hu Jiamo reintroducing soybeans to the Chinese pursuant to a new scientific understanding and in different varieties of products. They hoped that soyfoods could make the Chinese population healthier while reducing its economic burden, further strengthening the country. We see Yuan Junchang making his

contribution by developing the “China Strain” of the rabies virus that provided for vaccine production for almost fifty years. His practices involving acclimatization align with the Pastorian trait of localism. In addition, Li Yuying, Liu Yongchun, and Yuan Jungchang strove to establish a Pasteur Institute in China and eventually created one in Shanghai, in the hope that the scientific research and public health work conducted there would benefit the public.

Lastly, “Pastorian medicine” had to be “scientific.” That is to say, the efficacy of every medical practice, Chinese or Western, had to be validated by scientific experiments. Therefore, we see that Liu Yongchun offered examples where Chinese medicine was validated through findings in immunology, pharmacognosy, and toxicology at the Pasteur Institutes in China and elsewhere. These examples include the testing of chaulmoogra seeds and a supposed anti-rabies package with unspecified herbal ingredients. Liu also verified the Chinese theory of the effectiveness of snake venom against the rabies virus. He recognized the efficacy of acupuncture, while explaining its use based on physiological and endocrinological factors, not on *qi*-transformation in the meridian channels. Gao Jinglang took a further step in aligning the contemporaneous political policy of integrating Chinese and Western medicine with the same principle. Historian Kim Taylor argues that medical education and policies in the “integration of Chinese and Western medicines” in China resulted from an active political control and support by the Chinese Communist government, especially from Mao in the early years of the communist era.¹²⁴ As we have seen, however, the “scientific” orientation of integrative medicine was rooted already in the 1930s and early 1940s.

¹²⁴ Taylor, 1.

CHAPTER II

A Tangled Transition from Variolation to Vaccination in Chengdu, China, 1908-1927

Starting in the 1910s, many local practitioners of traditional medicine in Chengdu collected the scabs that resulted from vaccination with the Jennerian vaccine produced at the local Pasteur Institute.¹ They preserved the dry scabs, mixed them with breast milk or water, soaked a cotton ball in the mixture, and then placed it either into the nostril or into three incisions, corresponding to acupunctural points, on each arm of a child ready to be “vaccinated.” They prescribed herbal medicine to facilitate eruption of pustules and issued dietary restrictions. After the patient recovered, the Chinese practitioner collected the scabs for future vaccination. These practitioners called such a procedure “the new method,” or “the European way.”²

Upon a closer look, this procedure was neither new, nor European. It did not completely duplicate the vaccination as practiced in Britain or France, but was instead similar to variolation as the Chinese had practiced it to prevent smallpox since the sixteenth century, well before the emergence of germ theory of disease in the late nineteenth century.³ Modern medicine interprets

¹ The terminology used to describe the prevention of smallpox can cause confusion. “Inoculation” and “variolation” referred solely to inducing immunity against smallpox with human smallpox virus and were not interchangeable with “vaccination.” The term “vaccination” was first used in late eighteenth century after Edward Jenner developed a smallpox vaccine derived from cowpox. From the nineteenth century on, the term “variolation” in English was used to avoid confusion with vaccination. In the late nineteenth century, Louis Pasteur honored Jenner by expanding the meaning of “vaccination,” referring to the artificial induction of immunity against any infectious disease. “Inoculation” is also used as an equivalence of “injection” in connection with the use of vaccines but usually relating to laboratory works.

² H. Jouveau-Dubreuil, “La Variolisation au Setchouen,” *Bulletin de la Société de Pathologie Exotique* 14 (1921): 95.

³ According to historians Fan Xingzhun 范行準, Angela Ki Che Leung 梁其姿, and Chiafeng Chang 張嘉鳳, even though there is no solid evidence to pinpoint the beginning of variolation, the most likely time of its initial adoption is no later than the sixteenth century. Fan Xingzhun, *Zhongguo yufang yixue sixiangshi* 中國預防醫學思想史 (Chinese Preventive Medical History) (Beijing: Renmin weisheng chubanshe, 1953), 114-116; Chiafeng Chang, “Aspects of Smallpox and Its Significance in Chinese History” (Ph.D. Dissertation, University of London School of Oriental and African Studies, 1996), 131; Leung, “Variolation and Vaccination in Late Imperial China,” 65.

variolation as a method of inducing immunity against smallpox by inducing a mild protective infection with the same pathogen that caused smallpox, usually *Variola major*, taken from a patient who either suffered from naturally occurring smallpox or had just been inoculated, in the hope of inducing a mild protective infection. In contrast, Jennerian vaccination used a less-virulent agent, usually acquired from animal lymph gathered through retro-vaccination (inoculating animals with human vaccine virus) or from human lymph obtained through the arm-to-arm method (extracting pustule lymph from a vaccinated person and transmitting it to another who was about to be vaccinated). According to Jules Regnault (1873-1962), a French colonial physician in Tonkin (nowadays Northern Vietnam) of French Indochina at the turn of the twentieth century, the Chinese who practiced variolation since the sixteenth century were “the precursors of the Pastorian school.”⁴

This chapter tells the story of how this “neither new, nor European” practice emerged and its subsequent reception by the medical community and the general public in China. First off, I briefly summarize the history of variolation in China and its transmission elsewhere before the introduction of vaccination to China in the early nineteenth century. Next, I investigate the relation between this transformation of practice and its effect on the interaction between the Pastorian-trained French colonial physicians at the Pasteur Institute of Chengdu and local Chinese practitioners in the context of French imperialism in China during the early twentieth century. Lastly, to illustrate the nature of knowledge exchange in the relationship between the French and Chinese, I examine the reasons why the practices of French Pastorians in China on Jennerian vaccine production and public health work were likewise “neither new, nor European,” and how they accommodated the local political situation, environmental circumstances, and medical culture.

⁴ Jules Regnault, “Précurseurs de Pasteur et ... de beaucoup d'autres inventeurs,” *Côte d'Azur Médicale* 4.8 (1923): 8.

Chinese Variolation: A System of Medical and Social Practices

The Chinese had suffered from smallpox since the fourth century.⁵ Variolation in China had emerged as a prophylactic measure against the disease no later than the sixteenth century.

Archival sources suggest that variolation existed throughout China, but varied from place to place. Here I specifically account for the practice as performed in Sichuan and some areas in the southwest of China, the region where the Pasteur Institute of Chengdu later extended its services in the early twentieth century.

Chinese medicine attributed smallpox to the effect of a combination of fetal toxin (*tai du* 胎毒) and seasonal vapor (*shi qi* 時氣). A child inherited fetal toxin from its parents, as a result of physical desires, emotional instability, or unbalanced diet.⁶ This fetal toxin was stored in five viscera (*wuzang* 五臟), corresponding to the functional systems related to lung, heart, spleen, liver, and kidney.⁷ A disturbing seasonal vapor, a cold *qi*, or poisonous damp heat, would trigger the fetal toxin in the child's body and cause smallpox.⁸ The Chinese believed that smallpox was not a disease, but an expulsion of impurities that had accumulated in the fetus. Once the patient recovered, he or she would never suffer from it again.⁹ Variolation was a method to expel such

⁵ The earliest available medical text that refers to an identifiable smallpox outbreak in China is Ge Hong, "Shanghan Shiqi Wenbing" 傷寒時氣溫病 (Illness Relating to Cold Damage and Seasonal Epidemics) *Zhouhou beijifang*, 2. 13, <http://alturl.com/9o8fa>

⁶ Zeng Ding 曾鼎, *Douzhen huitong* 痘疹會通 (Understanding of Pox), 1, 1786 (Beijing: Huaxia chubanshe, 1999), 11.

⁷ As mentioned in the Introduction (footnote 31), The viscera in traditional Chinese medical understanding do not refer directly to their anatomical counterparts, but rather correspond to the interplay of functional systems with the body.

⁸ Unknown author, *Youke zhongdou xinfa yaozhi* 幼科種痘心法要旨 (The Key Aspects of Pediatric Variolation), 1742, in "Neke" 內科 (Internal Medicine), *Yizong Jinjian* 醫宗金鑒 (Golden Mirror of the Medical Tradition), 2. 5 (Taipei: Da Zhongguo tushu gongsi, 1971), 169.

⁹ Charles A. Gordon, *An Epitome of the Reports of the Medical Officers to the China Imperial Maritime Customs Service, 1871-1882* (London: Baillière, 1884), 298.

impurities, and it had to take place as early in life as possible. In China, the variolator inserted *miao* 苗, a substance meant to release fetal toxin from the “gate of life” (*mingmen* 命門) to induce a mild case of smallpox.

The understanding of the etiology of smallpox in England and France underwent a significant shift during the eighteenth century, largely as a result of accruing experience with variolation.¹⁰ Up to the late eighteenth century, physicians such as Phillipus de Violante, following Thomas Willis, had a similar belief that “the suprarenal capsules are the seat of the smallpox germ, which is possessed by every individual, and which, no matter how long unfruitful, must sooner or later declare itself, if life be sufficiently prolonged.”¹¹ Such a belief seemed enforced by imperial experiences. When David Rennie served as surgeon to the British army in Tianjin, China, dealing with smallpox among British soldiers in 1861, he concluded that “a latent material in the blood,” acting upon by the influences, such as “atmospheric changes, electrical states, or currents in the air,” caused smallpox; therefore, the effective cure was to “guide” the elimination of such morbid material “to its most innocuous site.”¹²

Chinese variolators usually had experience as religious healers or physicians with a family tradition of treating smallpox.¹³ These practitioners played an important role not only in the practice of variolation, but also in vaccination after its introduction to China. Some of them

¹⁰ Genevieve Miller, *The Adoption of Inoculation for Smallpox in England and France* (Philadelphia: University of Pennsylvania Press, 1957), 241-266.

¹¹ Armand Trousseau, *Lectures on Clinical Medicine: Delivered at the Hôtel-Dieu, Paris*, 2, translated by John Rose Cormack (London: The New Sydenham Society, 1869), 146.

¹² Rogaski, 89.

¹³ Huang Tingjian, “Preface,” in Unknown authors, *Zhongdou zhizhang* 種痘指掌 (Instruction of Variolation), 1806, cited in Chang, 101 and 152; Wang Quan 萬全, *Jiachuan douzhen xinfa* 家傳痘疹心法 (Variolation Guidelines from the Family Tradition), 1549, in *Gujin Tushu Jicheng* 古今圖書集成, *Yibu quanlu* 醫部全錄 497: 870, cited in Chang, 102; Zhang Yan 張琰, “Preface,” in *Zhongdou xinshu* 種痘新書 (New Book of Variolation), 1741, in *Siku Quanshu*, Zi Bu 5, Yijia Lei, 2-14, assessed 14/05/2016, <http://ia600302.us.archive.org/34/items/02093464.cn/02093464.cn.pdf>

learned and disseminated vaccination, while others opposed vaccination due to its conflict with their trade as variolators. Some variolators, called *douyi* 痘醫 (variolation doctor) were traditional physicians who learned the practice through the family tradition in their medical trade.¹⁴ Many others were religious healers, called *doushi* 痘師 (variolation master), *fangshi* 方士, or *shushi* 術士, the latter two both meaning “skilled healer.” The variolators, especially the religious healers, usually transmitted their practice of variolation in secret, as an oral tradition. Given their reach into rural areas where no physicians were available, this otherwise marginal group was the most influential promoter of variolation. Even though many of these healers were illiterate and lacked any other medical training, they were able to attract their clients by claiming a secret tradition passed down from ancient authorities and reciting legends in support of their ritual treatment of smallpox.¹⁵

The variolators conducted their trade with an elaborate preamble. The practitioner first had to ensure the good health of the child who was about to be variolated, before choosing an auspicious day, preferably in the spring.¹⁶ The entire procedure took place at an altar of the Smallpox Goddess, set up in the patient’s home.¹⁷ Praying preceded the variolation and

¹⁴ According to the local Sichuan gazetteers, the physicians who practiced variolation in Sichuan and the areas in the Southwest of China included Wang Wenxuan 王文選, Ye Ruxi 葉如璽, Qi Binghui 齊秉慧, Wu Zhengfang 吳正芳, Hu Zhaoyu 胡肇虞, Gao Shijie 高士杰, and Fu Zhonghan 傅宗瀚. Chen Xianfu 陳先賦, ed., *Sichuan yilin renwu* 四川醫林人物 (Chinese Practitioners in Sichuan) (Chengdu: Sichuan renmin chubanshe, 1981), 83, 131, 138, 220, 320, 342, and 417. Unfortunately, the materials of these physicians that I have at hand only mention their specialties and medical publications and do not have detail information on how they practiced variolation.

¹⁵ Zhang Yan, 2.

¹⁶ Jules Regnault, *Médecine et Pharmacie chez les Chinois et chez les Annamites* (Paris: A. Challamel, 1901), 58.

¹⁷ In Sichuan, in addition to *Tienlao Niangniang* 天姥娘娘, the goddess who took care of the variolation is also called *Sanxian Shengmu* 三仙聖母, *Sanxiao Shengmu* 三霄聖母 or *Sanpo Niangniang* 三婆娘娘, it was specially worshipped by *Hakka* people, a subgroup of the Han Chinese that originated in Northern China and migrated to Southern China after the third century BCE. In other places in China, the Smallpox Goddess was also called *Douzhen Niangniang* 痘疹娘娘 in the North, *Tianhua Shengmu* 天花聖母 in the Jiangxi province, and *Zhongdou Furen* 種痘夫人 in the Fujian province. Chang, 176-179.

continued until the total recovery of the variolated child.¹⁸ As of the seventeenth century, the Smallpox Goddess was believed to have come from *Emei* Mountain 峨眉山 in Sichuan during the tenth century, transforming herself into a human to blow pulverized smallpox scabs into the nostril of the Prime Minister's son, and variolating him.¹⁹ Her worship continued into the early twentieth century.²⁰ After the preparation, the variolator administered raw human smallpox lymph or pulverized smallpox scabs as the variolation substance *miao*— either dry or mixed with water, alcohol, or breast milk – by blowing or placing it into one nostril of the patient (boy in his left nostril and girl right), usually a child.²¹

These practices differed from their European counterparts. According to an early account of variolation in England in the 1720s, the child underwent a preparation stage designed to “weaken” its constitution through purging, bleeding, and restriction to a light diet for several weeks, in contrast to the Chinese doctrine of variolating a robust and healthy child.²² After placing the child in a warm room, the English variolator made several short but deep incisions with a three-edged surgeon's needle or a lancet turned sideways to rip up the skin slightly, prior to planting therein the pus, acquired from another child on the twelfth or thirteenth day after his variolation and mixed with blood. The sites of incisions were then covered with a half of a walnut shell for several hours. The incisions could be made on any parts of the body, but the

¹⁸ Leung, *Miandui jibing*, 53.

¹⁹ *Ibid.*, 50; Zhu Chungu 朱純嘏, *Douzhen Dinglun* 痘疹定論 (The Final Argument on Smallpox), 2, 1713, 26-27, assessed 14/05/2016, <http://ia600301.us.archive.org/11/items/02093461.cn/02093461.cn.pdf>

²⁰ Qiu Zhonglin 邱仲麟, “Ming Qing de ren dou fa: diyu liubu, zhishi chuanbo yu yimiao shengchan” 明清的人痘法—地域流佈、知識傳播與疫苗生產 (Smallpox Inoculation in Ming-Qing China: Regional spread, Knowledge Dissemination, and Vaccine Production), *Zhongyang yanjiuyuan lishi yuyan yanjiusuo jikan* 中央研究院歷史語言研究所集刊 (Journal of Institute of History and Philology, Academia Sinica) 77.3 (2006): 460.

²¹ Jouveau-Dubreuil, “La Variolisation au Setchouen,” 94.

²² F. Fenner, *Smallpox and Its Eradication* (Geneva: World Health Organization, 1988), 255; Similar procedures were practiced in France in the second half of the eighteenth century. See M. le Camus, “Maladies Qui Ont Régné à Paris pendant le Mois de Septembre,” *Journal Economique* (Octobre 1755): 121-129.

upper arm and forearm were preferable. From the 1760s on, Robert Sutton, a surgeon and one of the forerunners of variolation in England, performed and advocated a simpler of implementing a much shallower incision without any dressing.²³ The variolation practice in Europe was not restricted to any particular season, unlike the Chinese emphasis on spring variolation.²⁴

In Sichuan, the variolator visited the patient every day for twenty to thirty days after variolation, until his fully recovery. He prescribed medicines to facilitate the eruption of pustules and responded to occasional development of severe smallpox.²⁵ The practitioner also prescribed a strict diet, requiring the variolated child to abstain from beef and cherries for three months and from mustard and certain spices for three years. The food restriction was meant to improve the internal *qi* and ensure a successful variolation.²⁶ Upon achieving success, the practitioner sought to collect scabs from the patient and preserve them in a porcelain vial in order to secure a supply of good *miao*. The quality of *miao* was critical to a successful variolation. These rigorous tasks made variolation toilsome and costly and ensured the renown of successful variolators.²⁷

²³ Ibid.

²⁴ Miller, 61-62.

²⁵ Chang, 148-149. Unknown author, “Shui miao zhong fa” 水苗種法 (The Wet Scab Method), in *Youke zhongdou xinfu yaozhi* 幼科種痘心法要旨 (The Key Aspects of Pediatric Variolation), 173-174; Zhang Yan, 5-6; Unknown author, “Zhong dou yaozhi” 種痘要旨 (The Key Aspects of Variolation), in *Youke zhongdou xinfu yaozhi*, 170; Zhu Yiliang 朱奕梁, *Zhong dou xin fa* 種痘心法 (The Method of Variolation), 1808, in *Zhongyi Dianji Baoku* 中醫典籍寶庫, 23 (Beijing: Xianzhang shuju, 2006), 12-19; Unknown author, “Han miao zhong fa” 旱苗種法 (The Dry Scab Method), in *Youke zhongdou xinfu yaozhi*, 174; Zhu Chungu, 27-29; Unknown author, “Dou jiang zhong fa” 痘漿種法 (Pustule Matter Method), in *Youke zhongdou xinfu yaozhi*, 175; Jouveau-Dubreuil, “La Variolisation au Setchouen,” 94.

²⁶ Jouveau-Dubreuil, “La Variolisation au Setchouen,” 94.

²⁷ Ibid. During the Yongzheng 雍正 period (1723-35), a client requested a high-end *miao*, which cost him “three gold pieces.” Ma Boying 馬伯英, *Zhongguo yixue wenhuashi* 中國醫學文化史 (History of Chinese Medical Culture) (Shanghai: Shanghai remin chubanshe, 1994), 823; Even until the 1930s, the customary charge of variolation amounted to a two-day wage of a common laborer. Hugh L. Robinson, “A County-Wide Vaccination Campaign in Lintsing, Shantung,” *Chinese Medical Journal* 44.9 (1930): 1060.

During the recovery period, the patient's parents had to comply with moral precepts, in particular abstaining from sex. The family had to maintain an appropriate environment by sheltering the child from all external disturbances, maintaining clean air and comfortable temperature, and eradicating foul smells and loud noise.²⁸ In addition, the family needed to announce a variolation in progress by posting a piece of red paper on the front gate of their house. Their neighbors were required to maintain certain social norms, in particular avoiding the production of foul smells from painting or burning. Excrement carriers refrained from passing near the house.²⁹

The practice of variolation in China involved social aspects in addition to medical techniques. First of all, the Chinese regarded the preparation for variolation by the variolator and family as crucial for securing the success of variolation. This preparation included ensuring the physical wellness of the patient, cleansing his house, informing the community, and worshipping the Smallpox Goddess. Second, the variolator was constantly present in the household during the entire practice and usually received a bonus when the variolation was successful. Third, in the course of the practice, the family and the neighboring community complied with certain social rules. Thus, variolation comprised a holistic system of medical and social practices insofar as it reflected the rules, manners, and conventions that constrained the local Chinese community, whereby its members recognized and understood certain customs and fulfilled certain duties.

²⁸ One of the measures for cleansing the air was to spray the bed and the body with a warm mixture of rice liquor and pulverized dry parsley seeds. The patient's family also fumigated the doorway by burning powder mixed with *atractylis lancea* roots, lemongrass, flowers of oregano, mugwort leaves, parsley seeds, incense, and myrrh. When the patient's pustules were completely dry, the spraying was repeated by mixing arak or the broth of a fat hen, with a bark decoction, a concentrated infusion of bark boiled in water. The variolator deposited the mixture both on the variolated child and on its clothes, either by dripping it from his hand, or by spattering it with his mouth. Fumigation was also repeated. Additionally, the variolator advised the patient's family to burn everything that had been contaminated. Regnault, *Médecine et Pharmacie chez les Chinois et chez les Annamites*, 64-65.

²⁹ Miu Junde 繆俊德, *Dou kexue* 痘科學 (Science of Smallpox) (Rugao: Yan ling yi she, 1935), 57-58. These practices were also described in *Honglouloumeng* 紅樓夢 (Dream of the Red Chamber). Cao Xueqin 曹雪芹 (1717-1763), *Honglouloumeng*, 21 (Shanghai: Shanghai cishu chubanshe, 2000), 188 and 190.

This smallpox etiology and the principle and techniques of variolation were transmitted to neighboring countries, such as Japan, Korea, Vietnam, and Russia, largely in the course of travels by Chinese physicians through diplomatic relations.³⁰ In 1688, Russian diplomats learned the practice at the Qing Kangxi court (1661-1722) in Beijing, and charged their physicians with transmitting it back to Russia. From Russia, variolation was transmitted into the Ottoman Empire by Circassian traders by 1700 and thence to England in 1721, as introduced by Lady Mary Wortley Montagu, wife of the English ambassador to the Ottoman Empire. It was there practiced in the early eighteenth century by Sir Hans Sloane, the King's physician and President of the Royal Society.³¹ Before discovering the efficacy of the cowpox vaccine in 1798, Edward Jenner started out as a variolator. The British used variolation as their main weapon against smallpox until the mid-nineteenth century. From England, variolation was introduced to France, Sweden,

³⁰ Regarding variolation transmitting to Japan, as early as the eighteenth century, a Hangzhou physician, Wu Xuekong 吳學孔, who had renamed himself in Japan as Li Renshan 李仁山, practicing variolation for several decades, travelled to Nagasaki, Japan, in 1744, and practiced variolation under a local magistrate's request. Li later authored a detailed manual for variolation in which he emphasized the critical role of the local *miao*. He stressed that, since Japan was located in a different geographical zone where it was influenced by different climate, it would be ideal to employ local *miao*, which was coherent with the local *qi*. The local physicians, Yanagi Takashimoto 柳隆元, Mano Shunan 真野駿菴, Horie Dogen 堀江道元, and Nararin Eizo 榎林榮藏, learned from Li. They also translated his book and published it locally. Later on, in 1753, the Chinese completion of medical works, "Golden Mirror of the Medical Tradition" (*Yizong jinjian* 醫宗金鑒), including "The Key Aspects of Pediatric Variolation" (*Youke zhongdou xinfa yaozhi* 幼科種痘心法要旨) was circulated in Japan. Ogata Shunsaku 緒方春朔, a Japanese physician, studied the text of Chinese variolation and modified the method slightly, stressing the need to ensure the fine grain of the smallpox powder before blowing it into the patient's nose during his sleep. By applying this method during the smallpox epidemic in 1790, he succeeded at variolating several children. From 1795 onwards, his disciples and his publication *Shutō hitsujun ben* 種痘必順辨 (The Need for Inoculation) played important roles in disseminating variolation in Japan. Saburo Miyashita 宮下三郎, "「李仁山種痘書」について (About Li Renshan's Book of Variolation)," *Sekko to Nihon* (浙江と日本), ed. Masumi Fujiyoshi 藤善真澄 (Suita-shi: Kansai Daigaku Shuppanbu, 1997), 129 and 120-121; Qiu Zhonglin, 461. Hidehisa Tomita 富田英壽, *Ogata Shunsaku: Shutō no so* (Fukuoka: Nishinihon Shinbunsha, 2005); Ann Jannetta, *The Vaccinators, Smallpox, Medical Knowledge, and the "Opening" of Japan* (Stanford: Stanford University Press, 2012), 22-24. In 1790, another Qing's tributary state, Joseon (nowadays Korea), sent ambassadors to Beijing, where they acquired the same "Golden Mirror of the Medical Tradition." Upon their return, variolation met with success in local trials. C. H. Chun, "The History of Smallpox Prevention in Korea," *Uisahak* 2.2 (1993): 123. As to Vietnam, Chinese physicians practiced variolation, competing with the local doctors, at the border in the eighteenth century. The local population preferred being variolated by the Chinese physicians. Regnault, *Médecine et Pharmacie chez les Chinois et chez les Annamites*, 5.

³¹ Fenner, 254; Miller, 70-99.

and South America in the eighteenth century.³² In the early nineteenth century, Jennerian vaccination became accepted in Europe and spread around the world. It was as effective as variolation in preventing smallpox and involved a greatly lowered risk of disease and contagion. In the course of state policies and public health measures, Britain banned variolation in 1840 and made vaccination compulsory in 1853. France followed suit much later. It did not enact compulsory vaccination until 1902.³³

Sinicized Vaccination

The inception of vaccination in China in the early nineteenth century took place in Canton (nowadays Guangzhou 廣州), a port city located in the southeast of China and the capital of the Guangdong 廣東 province. It subsequently was disseminated nationwide, including the Sichuan province as early as in 1840, more than half of a century before the arrival of the French medical mission in 1902 and the founding of the Pasteur Institute in Chengdu in 1908.³⁴

³² From England, variolation was introduced to France by the *philosophes*. Although the French academic physicians at first opposed its practice, the campaign conducted in the mid-eighteenth century by the mathematician and geographer Charles de La Condamine and the death of the King Louis XV from smallpox bolstered the adoption of variolation from 1774 onwards. Miller, 228 and 237. David von Schultzenheim introduced the variolation practice in Sweden in the mid-eighteenth century. Horatio R. Storer, “The Medals, Jetons, and Tokens Illustrative of Sanitation,” *The Sanitarian* 22. 231 (1889): 144; Miller, 228. Across the Atlantic Ocean, Roman Catholic missionaries transmitted variolation to South America in the second half of the eighteenth century. Fenner, 256.

³³ Fenner, 261 and 270. Infant vaccination was made compulsory in Bavaria (1807), Denmark (1810), Norway (1811), Bohemia and Russia (1812), Sweden (1816), and Hanover (1821) Jenner’s arm-to-arm vaccination was banned in Britain in 1898. For the comparison of different attitudes towards smallpox vaccination as a public health measure among European countries, see Peter Baldwin, *Contagion and the State in Europe, 1830-1930* (Cambridge: Cambridge University Press, 2005), 244-354; Allan Mitchell, “Bourgeois Liberalism and Public Health: A Franco-German Comparison,” in *Bourgeois Society in Nineteenth-Century Europe*, ed. Jürgen Kocka and Allan Mitchell (Oxford: Berg, 1993), 346-364.

³⁴ In 1837, Chen Xu 陳煦, who then resided in Yangzhou, learned about vaccination and asked his brother Chen Beiya 陳北崖 to spread the practice to the Sichuan province. Chen Beiya learned vaccination and practiced it in Sichuan starting in 1840. Chen Yuan 陳垣, “Niudou ru Zhongguo kao lue” 牛痘入中國考略 (The Brief History of Vaccination Dissemination in China), in *Chen Yuanan xiansheng quanji* 陳援菴先生全集 (Collection of Mr. Chen Yuanan), 16 (Taipei: Xin wen feng chuban gongsi, 1993), 780-781; Chang Chiafeng 張嘉鳳, “Shijiu shiji chu

In the spring of 1805, Alexander Pearson, a surgeon at the East India Company in Canton, introduced Jennerian vaccination into China.³⁵ This vaccine was delivered to Macao by a ship from Manila, employing children on board as live carriers of lymph for the purpose of keeping up the supply by the arm-to-arm practice.³⁶ Assisted by Cantonese *Hong* merchants, Pearson started practicing vaccination in a vaccination dispensary (*zhong niudou suo* 牛痘所). He also published a pamphlet on its technique that was translated into Chinese by George Staunton under the title, “The Extraordinary Book of a New English Method of Vaccination.” (*Yingjiliguoxinchu zhongdou qishu* 英咭喇國新出種痘奇書) Pearson’s first Chinese apprentice, Qiu Xi (邱熿), a trader with no medical background at the *Hui Long* Trading Company 會隆商行 in Macao, emerged as the first local authoritative vaccinator.³⁷ Qiu’s publication “The Introduction of Inducing Smallpox by Cowpox Vaccine” (*Yin dou lue* 引痘略) enhanced his renown and authority. This book was based on Pearson’s pamphlet and Qiu’s reconfiguration of vaccination

niudou de zaidi hua” 十九世紀初牛痘的在地化 (Localization of Vaccination in the Nineteenth Century), *Zhongyang yanjiuyuan lishi yuyan yanjiusuo jikan* 78.4 (2007): 774-775. Also, Wang Zuyuan 王祖源, a magistrate in Longan (龍安), Sichuan, founded a Children protection depot (*Baochi ju* 保赤局) and offered free vaccination starting in 1874. Liao Yuqun 廖育群, *Qihuang yi dao* 岐黃醫道 (Chinese Traditional Medicine) (Shenyang: Liaoning jiaoyu chubanshe, 1991), 235-236. In 1907, Zhao Erfeng 趙爾豐 (1845-1911), the Sichuan viceroy and the official in charge of the frontier in the southwest of China, set up an official medical dispensary, sending out local Chinese practitioners to vaccinate subjects at the frontier in Tibet and Xikang until 1911. Zhao Er-Feng 趙爾豐, “She yiyao ju shi zhen shi yaopian” 設醫藥局施診施藥片 (Establishing a Medicinal Dispensary for Medical Practice and Distribution of Drugs), in *Zhao Er-feng Chuan bian zoudu* 趙爾豐川邊奏牘 (Zhao Er-Feng’s Reports of the Frontier to the Emperor), ed. Wu Fengpei 吳豐培 (Chengdu: Sichuan minzu chubanshe, 1984), 105; Sichuansheng minzu yanjiusuo 四川省民族研究所, ed., *Qingmo Chuan Dian bianwu dang’an shiliao* 清末川滇邊務檔案史料 (The Archival Documents of the Southwestern Frontier in the Late Qing Dynasty) (Beijing: Zhonghua shuju, 1989), 201, 225, 269, 293-295, 306, 840-841, and 851.

³⁵ K. C. Wong, Railway Medical Officer in Hankow, observed that Chinese seemed to have had an idea of using cow fleas for the prevention of smallpox. K. Chimin Wong, “Smallpox in China,” *Chinese Medical Journal* 33 (1919): 55.

³⁶ Gordon, 299.

³⁷ Wang Zhenzhong 王振忠, “Huizhou wenshu suo jian zhongdou ji xiangguan xisu” 徽州文書所見種痘及相關習俗 (The Relating Customs of Vaccination in Huizhou Documents), *Minsu yanjiu* 民俗研究 (Folklore Studies) 1 (2000): 26; Chang, “Shijiu shiji chu niudou de zaidi hua,” 759 and 764.

by incorporating Chinese medical and social practices of variolation. Qiu expanded the practice outside of Canton by serving political elites and training as his successors not only his sons and nephews, but also disciples recruited both locally and elsewhere.³⁸

The specification of the acupunctural points as the scarifying points of vaccination first appeared in Qiu Xi's publication. He implemented the principles of meridian points and designated two to three corresponding acupunctural points on each arm as the location of incisions.³⁹ In his instruction, the practitioner made two small incisions at two acupunctural points on each arm, *xiao shuo* 消爍 and *qing leng yuan* 清冷淵, sometimes adding an extra incision between these two if there was more post-natal toxin.⁴⁰ These spots were regarded as reflexive points corresponding to the *sanjiao jing* 三焦經 – triple burners, a meridian (a path through which *qi* flowed) of the body controlling all the viscera. (Figure 2.1) This application was expected to simulate the fetal toxin directly out of the visceral system.⁴¹ In Sichuan, the Chinese practitioners chose to make three incisions on each arm, instead of two.⁴²

³⁸ Leung, "The Business of Vaccination in Nineteenth-Century Canton," 8-15. The vaccination practice spread from Canton to other towns in the Guangdong province. It first expanded northwards to the Hunan 湖南 and Hubei 湖北 provinces and up to the Beijing area. Later on it proceeded eastwards to the coast of China, such as the Fujian 福建 province and the Jiangnan 江南 area that encompassed the southern parts of the low reaches of the Yangzi River, including locales presently known as the Shanghai municipality, the southern Jiangsu 江蘇 province, the southern Anhui 安徽 province, the northern Jiangxi 江西 province, and the northern Zhejiang 浙江 province. Later yet, vaccination expanded to the southwest of China, including the Guangxi 廣西, Guizhou, Sichuan, and Yunnan provinces, and the Southwestern frontier in Tibet and Xikang 西康. Chen Yuan, 780.

³⁹ Qiu Xi 邱熿, *Ying dou lue* 引痘略 (Introduction of Inducing Smallpox by Cowpox Vaccine), 1817, 1, in *Xuxiu Siku quanshu*, Zi Bu 5, Yijia Lei, 1012 (Shanghai: Shanghai guji chubanshe, 2002), 404 and 406.

⁴⁰ The Chinese vaccinator located the first spot at the length of the child's middle finger away from the elbow, and the other spot, at the length of its palm up on the arm away from the first one. Ibid.

⁴¹ Qiu Xi, 404 and 406.

⁴² H. Jouveau-Dubreuil, "Service de la Vaccine à l'Institut Pasteur de Tchen-Tou," *Annales de Médecine et de Pharmacie Coloniales* (1920): 75; In the north of China (Beijing) and southeast of China (Fuzhou), vaccination was also performed in three places on each arm. Gordon, 78 and 300.



Figure 2. 1: Vaccination Acupunctural Points⁴³

Opposition to vaccination, especially from variolators, traditional practitioners who treated smallpox, and medicinal dispensaries, stemmed from conflicts of interest and a concern whether vaccination was effective. Since its introduction, vaccination was usually free of charge since it was supported by local philanthropists, including merchants, local officials, and missionaries, and later by the public health administration of foreign settlements. In many places, it was even rewarded when the patient returned to have vaccine lymph collected.⁴⁴ In contrast, variolation was usually costly and the patient's family usually paid the variolator a bonus in addition. These practitioners could no longer make a living when variolation was no longer needed.

⁴³ Qiu Xi, 404.

⁴⁴ Chang, "Aspects of Smallpox and Its Significance in Chinese History," 161-163.

Such Chinese practitioners opposed vaccination also because they believed that it was not as effective as variolation. First of all, the variolators thought that cow and human possessed different *qi*; therefore the human body could not tolerate cowpox vaccine. Secondly, they believed that only the nasal method could induce the smallpox toxin out of all viscera thoroughly.⁴⁵ By contrast, vaccination did not direct *miao qi* through these five viscera; therefore, the smallpox toxin might remain in the body. This led to the third reason to oppose vaccination, namely that it did not guarantee permanent protection from smallpox while a patient had to undergo variolation only once in a lifetime to develop permanent immunity.⁴⁶ A vaccinated patient still had a chance of contracting smallpox again because the purification was not complete.⁴⁷

Although contemporary debate on the relative efficacy of variolation and vaccination among Chinese practitioners continued unabated, both claimed legitimacy within the Chinese understanding of smallpox, attributing the origin of the disease to seasonal vapors triggering the fetal toxin that had been inherited from the parents and accumulated in the fetus. The merits of these two practices were determined by their efficacy at expelling the impurities from the body. The Chinese practitioners in Chengdu using the “neither new, nor European” way of vaccination

⁴⁵ According to the variolators, once the *miao* was placed in the nose, its *qi* moved to the lung (where was believed to affect the skin and hair), then to the heart (related to blood), and then to the spleen (related to the muscles), and following to the liver (related to the tendons), and finally to the kidney (related to the bones). The smallpox toxin was then relieved in these five viscera in an reversed order: first out of the bones (cleansing the toxin out of the kidney), then out of the tendons (cleansing the liver), and then out of the muscles (cleansing the spleen), and following that out of blood (cleansing the heart), and finally out of the skin and hair (cleansing the lung). Qiu Xi, 405.

⁴⁶ Xiong Yiran 熊乙燃, “Preface,” in *Yinzhong bao ying niudou fang shu* 引種保嬰牛痘方書 (The Method for Childrens’ Vaccination), cited in Liao, 241.

⁴⁷ Gu Wenling 顧文林, “Preface,” in *Zengbu niudou san yao* 增補牛痘三要 (Three Key Additional Points for Vaccination), cited in Liao, 241.

most likely concerned themselves with traditional Chinese medical explanation of fetal toxin and seasonal vapors, not the virus that caused smallpox.⁴⁸

Vaccination was usually implemented in Western European countries at this time by scarification, not by nasal application. There is no evidence of the European vaccination ever prescribing the exact location for its application on the body. Nor did the post-vaccination care include any specific medicine or dietary restrictions. The European vaccinators' concern was limited to ensuring hygiene around the incisions.

It is difficult to identify the content and efficacy of vaccine used by the Europeans in the nineteenth and early twentieth century. Vaccine harvested from animal vaccination, mostly using calves, was introduced in Western Europe at the turn of the nineteenth century.⁴⁹ Such vaccine did not involve any human scabs harvested from vaccination. However, prior to employing animal vaccination, the European vaccinators practiced the arm-to-arm method of vaccination and continued to do so through the late nineteenth and early twentieth century. In China, the earlier local vaccinators as well as foreign missionaries and physicians also employed this practice, especially in areas where transportation and climate did not allow vaccine to maintain its potency over time. The arm-to-arm vaccination method utilized the lymph acquired from a recently vaccinated child who developed pustules after vaccination. The vaccinator placed the fresh pustule lymph into the incisions on the arms of another child. The contemporary vaccinators, European and Chinese, considered animal vaccine to be equal in efficiency to the freshly harvested human pustule lymph used in the arm-to-arm practice.⁵⁰ Only later, as the arm-

⁴⁸ The variola virus of smallpox was identified in 1947. Donald Hopkins, *Princes and Peasants: Smallpox in History* (Chicago: University of Chicago Press, 1983), 13.

⁴⁹ Fenner, 247.

⁵⁰ The contemporary critics of vaccination and Jenner's use of cowpox believed that the material used for vaccination was not derived from cowpox, but was an attenuated strain of variola virus, and thus vaccination was really an extension of variolation. *Ibid.*, 264.

to-arm method was found liable to cause infections and transmission also of other diseases such as syphilis, was its practice discouraged. The origin of the “vaccine” in the “neither new, nor European” method was not attributed to European practice, but was rather seen as a variation of the pustule lymph in the arm-to-arm practice, adopted in order to overcome logistical and environmental constraints.

“Indirect Imperialism”: the French Pastorians in the Southwest of China

At the turn of the twentieth century, the Committee of French Asia (*Comité de l'Asie Française*) within the French Ministry of Foreign Affairs aimed at establishing a French Empire in Southeast Asia centered in French Indochina (conquered in 1887).⁵¹ The Committee increasingly advocated a policy of “indirect imperialism,” attempting to spread French cultural, economic, and political influence in the southwest of China where the French did not have formal colonial control. Marked as the beginning of a new colonial policy with the aim of scientific expansion, medical work was regarded as one of the most effective strategies.⁵² The French chose Chengdu, the capital of the Sichuan Province, appreciating advantage of its location and resources and they sought to counter other colonial influences, including Britain, the United States, Canada, and Japan.

In reality the French “civilizing mission” was negotiated in nature. Prior to the establishment of the Pasteur Institute in Chengdu in 1908, the French Medical Mission in

⁵¹ Abrams, 687.

⁵² French physicians and their medical work were documented in the following areas: the territories of Guangzhou Wan 廣州灣 (French spelling then: Kouang-Tchéou-Wan) (1898-1946) and Xiamen Dao 廈門島 (French spelling then: Shamian) (1859-1949) as the only two official French colonies in China in this era. The sphere of French influence officially recognized by China on the provinces of Yunnan, Guangxi, Hainan, Guangdong. Moreover, the French had three concessions, in Shanghai (1849-1946), Tianjin (1860-1946), and Hankou (1898-1946).

Chengdu since 1902 was not directly in charge of local French-associated medical institutions. These institutions - namely the Chinese Medical School (*École de Médecine Chinoise*), the School of Arts and Crafts (*École des Arts et Métiers*), and the Catholic Missionary Hospital (*Hôpital de la Mission Catholique*) - operated through collaboration between the Chinese authorities and the French government. The French Medical Mission employed five members (three physicians and two nurses), all with military rank, led by Aimé-François Legendre, the French colonial physician who arrived in Chengdu from Phulang-Thuong in Tonkin, French Indochina, after studying at the Pasteur Institute in Paris.⁵³ The Medical Mission was meant to reinforce vaccination dissemination through training the Chinese students at the two affiliated schools, as well as through dispensing medical services at the hospital. However, the French physicians had to defer to the Chinese authorities in these two schools, while being constrained by the Catholic Mission in the hospital.

The position of the French colonial physicians in these institutions was far from secure, as their contracts were often allowed to expire without renewal if not breached beforehand. The authority of the Catholic Missionary Hospital did not adequately serve the goals of these French physicians. From the physicians' point of view, their medical work was meant to treat patients regardless of the nature of their illness. Pointing out that the Catholic Mission preferred to dedicate its limited resources to religious conversion of the local population, the French physicians accused the Catholic missionaries of being reluctant to treat patients suffering from acute illnesses.⁵⁴ Also, they observed that Chinese elites rarely used the medical services offered

⁵³ MAEP, NS, Chine, 656, "Lettre du Docteur A. Legendre au Consul Général à Tchentou - Annexe à la lettre no. 43, en date du 23 Septembre 1907, du Consulat Général de France à Tchentou à la Direction Politique," 21/09/1907, 4-5.

⁵⁴ MAEP, NS, Chine, 651, "Rapport du Dr. Legendre au Sujet de l'Hôpital Catholique de Tchen-tou, du Docteur Aime-François Legendre au Ministre des Affaires Etrangères," 26/05/1908, 5.

by the Catholic Hospital because they were averse to Christian religious institutions.⁵⁵ Under these circumstances, the French physicians repeatedly petitioned the French Council and the French Ministry of Foreign Affairs to secure their positions and autonomy.

In addition to the political difficulties, the French colonial physicians also had to face medical challenges. First was the conception of contagion. Judging by the standards of the germ theory of disease, Jouveau-Dubreuil concluded that the Chinese were unaware that smallpox was contagious. He observed patients continuing to live with their family and sometimes even having physical contact with the neighbors. No one protested these arrangements or attempted to quarantine inoculated children, who traversed the city on the way to the hospital in hired sedan chairs, which did not undergo any disinfection.⁵⁶ By contrast, Regnault observed that the Chinese understood contagion differently. They believed that smallpox was transmitted through the “wind,” (*qi*) with the pustule matter and smallpox scabs, sometimes accompanied by an evil spirit.⁵⁷ His interpretation was based on the Chinese practice of spraying and fumigating the house to get rid of foul air, and burning contaminated objects to prevent the spread of smallpox. The fumigation was often performed in conjunction with magical rituals meant to ward off evil spirits. During an epidemic, the Chinese practitioners advised people to take the decoction (extraction from a mixture of herbs) of preventive medicine before exposing themselves to the pathological *qi* (*xie qi* 邪氣).⁵⁸

⁵⁵ Concerning the missionaries considering prevention less demonstrative of good will than the cure, see Andrews, “In Republican China, Public Health by Whom, for Whom?” 179; Henrietta Harrison, *The Missionary’s Curse and Other Tales from a Chinese Catholic Village* (Berkeley: University of California Press, 2013); Henrietta Harrison, “Rethinking Missionaries and Medicine in China: The Miracles of Assunta Pallota, 1905-2005,” *Journal of Asian Studies* 71. 1 (2012): 127-148. The French physicians observed that the Chinese elites abstained from going to both Catholic and Protestant hospitals. The Protestant hospitals also treated mostly the lower classes.

⁵⁶ Jouveau-Dubreuil, “La Variolisation au Setchouen,” 96.

⁵⁷ Regnault, *Médecine et Pharmacie chez les Chinois et chez les Annamites*, 64.

⁵⁸ *Ibid.*

The second medical challenge that the French physicians confronted was the failure of vaccination due to the low potency of vaccine that was procured elsewhere and degraded owing to lengthy transportation and inadequate preservation. During 1908-1910, the success rates of vaccination averaged only 20% among adults and 50% among newborns.⁵⁹ At this rate it could not compete with the repute of the Chinese variolation practice, as the Chinese believed that the success rate of variolation could reach as high as 99%.⁶⁰ The low potency aggravated the failure of Jennerian vaccine to guarantee permanent immunity due to its attenuated virulence. The French colonial physicians considered revaccination every three years to be necessary in order to renew immunity. However, the local patients were reluctant to revaccinate, even after they underwent initial vaccination.⁶¹ The medical culture of variolation appeared so deeply ingrained that it affected the local concept of revaccination. Chinese physicians believed that once the fetal impurity was expelled, the body became purified and contained no more toxins in need of expulsion. Therefore, they rarely revaccinated their patients. In consequence, the French physicians' insistence on revaccination had little effect.⁶²

Not only did the Chinese physicians prevent smallpox better, but they also possessed extensive and accurate experience of early smallpox prognosis. Foreign physicians were often confounded by their local counterparts' superiority in smallpox diagnoses and treatment. Traditional Chinese medicine posited three different kinds of development after contracting the disease. One was called "flowing," (*shun* 順) where patient's pustules appeared full and pink,

⁵⁹ MAEP, NS, Chine, 656, Jean Paul Esserteau, "Rapport pour l'Année 1909 par Dr. Esserteau," 01/03/1910, 51. The success rate is questionable. It was difficult to check the results of vaccination. The French physicians could not obtain the results from the local vaccinated people, as the turnout of the returning patients was low. MAEP, NS, Chine, 656, Jean Paul Esserteau, "Rapport pour l'Année 1910 par Dr. Esserteau," 23.

⁶⁰ Wong and Wu, 276.

⁶¹ Jouveau-Dubreuil, "Service de la Vaccine à l'Institut Pasteur de Tchen-Tou," 65-66.

⁶² Jouveau-Dubreuil, "La Variolisation au Setchouen," 96.

distributed evenly on the body, while the body temperature remained normal, with no acrid taste found in urine and excrement. This was seen as extremely favorable and the patient was expected to recover without drugs. The second was called “dangerous,” (*hsien* 險) where the pustules were flat, dry, and pale. These were the symptoms of blood and *qi* deficiency that could be regulated by drugs, although the patient was at risk of dying from neglect or bad treatment. In the last and most acute course of disease, called “opposing,” (*ni* 逆) the pustules appeared dark and broken, and the patient suffered from high fever, stomach ache, coughing fits, and even loss of consciousness. Such cases were invariably fatal, but the symptoms could be eased by drugs.⁶³

Under these complex circumstances of political and medical struggle, these French physicians found it necessary to ensure vaccine quality by producing it locally and in other ways also demonstrate their competence in preventing the disease. Advocated by Albert Calmette, the project of establishing the Pasteur Institute of Chengdu was finally launched in 1908. Its establishment depended upon the political maneuvering undertaken in France by the Consul of Chengdu Pierre Bons d’Anty and Philippe Berthelot, Deputy Director of Asia and later the Minister of Foreign Affairs, as well as the funding provided by Robert Lebaudy, a French sugar industrialist. However, even though the Pasteur Institute of Chengdu operated under the French direction, it had to collaborate and negotiate with the Chinese authorities. Before the fall of the Qing dynasty in 1911, the Pasteur Institute of Chengdu depended on maintaining good *guanxi* 關係 between the French Consulate and the viceroys of Sichuan and that of other surrounding provinces.⁶⁴ The political situation became even more complicated after 1911, in the course of

⁶³ Gordon, 298; Fei Puquan 費溥泉, “Dou zheng you sun ni xian san zhong ji zhi fa zhi dalüe” 痘症有順逆險三種及治法之大略 (Smallpox of Three Kinds, Flowing, Opposing, and Dangerous, and Their Treatments), *Zhongyi zazhi* 中醫雜誌 (Journal of Chinese Medicine) 19 (1926): 12-13.

⁶⁴ *Guanxi* 關係 is an untranslatable Chinese concept, describing a dynamic in personalized networks of relationships or connections that an individual cultivates with others. The term largely originated from Confucianism, which

armed conflicts among the Chinese warlords of Sichuan and those in the neighboring provinces, especially Yunnan 雲南 and Guizhou 貴州.⁶⁵ Consequently, political concerns informed the decisions of the French Consul and the Pasteur Institute's medical services in Chengdu.⁶⁶ In other words, the Pasteur Institute in Chengdu could attain only partial political independence, as it still had to rely on collaboration with local Chinese authorities.

Upon the establishment of the Pasteur Institute of Chengdu, the Pastorians in France authorized it to perform local microbiological studies and produce anti-rabies and Jennerian vaccines.⁶⁷ The Institute partially lived up to these expectations until 1927, when it was forced to

stresses the importance of associating oneself with others in an order of social relations, with an emphasis on implicit mutual obligations, reciprocity, and trust, in order to maintain the social and economic order of a society. Thomas Gold, ed., *Social Connections in China: Institutions, Culture, and the Changing Nature of Guanxi* (Cambridge: Cambridge University Press, 2002), 6 and 63.

⁶⁵ For detailed accounts of warlords and their politics and military conflicts, James E. Sheridan, *China in Disintegration* (New York: Free Press, 1977); David Bonavia, *China's Warlords* (Oxford: Oxford University Press, 1995); Cun cui xueshe 存萃學社, ed., *Minguo yila Sichuan dongluan shilao huiji* 民國以來四川動亂史料彙輯 (Collection of Historical Materials on Sichuan Political Turbulence in Republican Era) (Hong Kong: Dadong tushu gongsi, 1977); Kuang Sanji 匡珊吉, *Sichuan junfa shi* 四川軍閥史 (History of Sichuan Warlords) (Chengdu: Sichuan renmin chubanshe, 1991); Sichuansheng wenshi yanjiu guan 四川省文史研究館 (Sichuan Research Institute of Culture and History), ed. *Minguo Sichuan junfa shilu* 民國四川軍閥實錄 (History of Sichuan Warlords in Republican Era) (Chengdu: Sichuan renmin chubanshe, 2011).

⁶⁶ See Lucien Bodard, *Monsieur le Consul* (Paris: B. Grasset, 1999). This autobiographical fiction by the son of the French Consul, Albert Bodard, describes a complex relationship among the French consulate of Chengdu, the warlords in Sichuan, Yunnan, and Guizhou, and the governor general of French Indochina, between 1917 and 1921. The French tried to maintain a mutually beneficial connection with warlords in Yunnan and Guizhou, aiming to extend the railroad from Yunnanfou (nowadays Kunming 昆明) to Chengdu, and to oppose the English and their allied warlords in Sichuan. However, the French constantly had to deal with uncertainty and negotiate and compromise. Also see Albert Gervaise, *Medicine Man in China*, translated by Vincent Sheean (New York: Frederick A. Stokes Company, 1934). Serving as a military physician sent by the French government, Albert Gervaise practiced and taught medicine in Sichuan from 1911 to the 1920s. In this autobiographical work, he focused on his experiences along the Yangtze River. It includes several accounts of his exchange with the local warlord regarding the prevention or treatment of diseases, such as cholera.

⁶⁷ MAEP, NS, Chine, 300, 77-79, "Devis et Lettre de P. Lequeux, Paris," 25/09/1907; AIP, CHN01, 004, "Projet d'Installation d'un Institut Pasteur à Tchen-tou"; MAEP, NS, Chine, 651, "Organisation d'un Institut Pasteur à Tchentou," 9.

close.⁶⁸ Even though the French government reorganized and reopened the Institute in 1929, it could not continue its mission for long and the Institute was permanently closed in 1944.

Local production of Jennerian and anti-rabies vaccines was meant to solve the problem of their questionable quality as experienced earlier when they were shipped from elsewhere, with degradation due to uncontrollable temperature and long transportation. For instance, shipping the Jennerian vaccine from Saigon to Chengdu via Hong Kong usually took thirty to forty days, causing it to suffer a considerable loss of virulence.⁶⁹ Manufacturing the vaccines locally in temperate seasons would avoid this obstacle.⁷⁰

During this period, the Pasteur Institute of Chengdu was the only institution producing Jennerian vaccine in Western China, and its geographical location was convenient to supply the surrounding provinces, including Guizhou, Yunnan, Shaanxi 陝西, and Gansu 甘肅. Vaccine production increased sharply each year, from 4,000 doses in 1910, to about 100,000 doses in 1918-1919 and 378,900 in 1926.⁷¹ The success rate reached 98% in children in 1919, and 100% in 1926.⁷² The increasing amount of pulp delivery sufficed to serve Sichuan, even after its population reached 100 million in 1919.⁷³ From the late 1910s until 1927, the Pasteur Institute of Chengdu supplied Jennerian vaccine to most of the European and American medical services in

⁶⁸ The anti-rabies vaccine could not be made locally in the Pasteur Institute of Chengdu until 1926. Between 1926 and 1927, the number of rabies treatments was limited to seven cases. The Chengdu Pastorians attributed that to rabies having been supposedly uncommon in Sichuan. MAEP, Série E, Asie, Chine, 175-176, "Rapport du Dr. Jouvelet," 22/02/1927.

⁶⁹ Jouveau-Dubreuil, "Service de la Vaccine à l'Institut Pasteur de Tchen-Tou," 64.

⁷⁰ "Organisation d'un Institut Pasteur à Tchentou," 9.

⁷¹ Jouveau-Dubreuil, "Service de la Vaccine à l'Institut Pasteur de Tchen-Tou," 75; MAEP, Série E, Asie, Chine, 174, "Rapport sur le Fonctionnement de l'Institut Bactériologique de Tchentou pendant l'Année 1926."

⁷² Jouveau-Dubreuil, "Service de la Vaccine à l'Institut Pasteur de Tchen-Tou," 75.

⁷³ *Ibid.*, 76.

Sichuan, including French, English, Canadian, and American hospitals, which previously received their vaccine from Shanghai, Hong Kong, or Japan.⁷⁴

Regarding the public health services in China at the time, the Pasteur Institute of Chengdu presented itself as one of rare institutions to play a crucial part in such a needed task. Chinese public health institutions before WWII, including the North Manchuria Plague Prevention Service from 1910, the Central Epidemic Prevention Bureau from 1919, and the Chinese Quarantine Service in the 1930s, were all funded and controlled by the Chinese Customs Service led by the British, and also funded by agencies from the United States, such as the Rockefeller Foundation. The rural public health initiatives by the Chinese Nationalist government were still very much in the initial stages by the time of the Japanese invasion in 1937. Also, a survey on modern rural public health practice, carried out by the Chinese Medical Association Council on Public Health in 1934, found only seventeen rural public health centers, all of which were located on the east coast of China.⁷⁵ The Pasteur Institute in Chengdu in the southwest of China therefore stood out as a non-Anglo-American Western institution, leading public health work against smallpox in this part of rural China.

Making Local Vaccine against Smallpox: Circulation and Acclimation

Vaccine strains coming from France and French Indochina were optimal for producing the local vaccine against smallpox in Chengdu, which was far removed from any other vaccinogen centers. The first vaccine strain came to the Pasteur Institute of Chengdu from the Vaccinogen Institute of Thai-Ha-Ap in Tonkin, French Indochina in March 1911. The vaccine retained its potency for

⁷⁴ Ibid., 67-68; “Rapport sur le Fonctionnement de l’Institut Bactériologique de Tchentou pendant l’Année 1926,” 174.

⁷⁵ Andrews, 189-190.

two years. In 1913, owing to the lack of refrigeration, the vaccine lost its virulence after being stored at room temperature throughout the summer. Its replacement came from the same institution and the supply continued until 1920.⁷⁶ In 1917, Jouveau-Dubreuil traveled back to Chengdu from Paris after acquiring ten tubes of dry vaccine, equal to five hundred doses, prepared by the Institute of Animal Vaccine (*Institut de Vaccine Animale*), founded in Paris in 1864 as the first organization to produce cowpox vaccine in France. The Director Lucien Camus at the Institute of Vaccine (*Institut Supérieur de Vaccine*) in Paris also sent him another batch of desiccated vaccine in 1919. Speculating about the efficiency of desiccated vaccine in comparison with the glycerin one, Jouveau-Dubreuil tested them on local children and water buffalos. The results exceeded his expectations. The two strains produced equally good results, measured in terms of the dimensions and confluence of the pustules. He then mixed the two strains and used this mixture from the late 1910s and throughout the 1920s.⁷⁷ The vaccine strains could be circulated, and even mixed locally to produce new strains within the imperial network spanning Paris (France), Tonkin (French Indochina), and Chengdu (China). Thus the Pasteur Institute of Chengdu became an important vaccinogen center in the southwest of China.

In contrast to the foreign provenance of the vaccine strains that were eventually adapted locally, the local species of vaccinifers – the animals used for producing vaccine – performed better in local applications than those delivered from afar. Based on his practice in French Indochina, Calmette successfully adapted the Paris cowpox strain to the local water buffalos and concluded that these animals were preferable to heifers as vaccine producers.⁷⁸ Subsequently, all

⁷⁶ Jouveau-Dubreuil, “Service de la Vaccine à l’Institut Pasteur de Tchen-Tou,” 73-74.

⁷⁷ Institut de Vaccine Animale, *Institut de Vaccine Animale: 8 Rue Ballu, Paris* (Paris: S. N., 1895), 1.

⁷⁸ Albert Calmette and G. Lepinay, “Mémoire sur l’Organisation et le Fonctionnement du Service de la Vaccine en Cochinchine de 1867 à 1890,” in *Rapport Général Présenté par l’Académie de Médecine sur les Vaccinations et Revaccinations pendant l’Année 1892* (Paris: Masson, 1908).

of the vaccinogen institutions in the Far East relied upon water buffalos. However, the Pasteur Institute of Chengdu found that the Sichuan water buffalo resisted infections much better than in French Indochina. Jouveau-Dubreuil attributed this to the buffalo's origins in China. More interestingly, the local breed of heifers in Sichuan could substitute for water buffalos as a good vaccinifer whenever the latter were in a short supply. The adoption of local heifers in Chengdu proved the efficacy of local acclimatization once again. Jouveau-Dubreuil found that although the heifers in French Indochina tended to be small and feeble, their counterparts in Sichuan, where local farmers bred them to rival the European ones in size, were much stronger.⁷⁹ Moreover, the Sichuan heifers reacted to vaccination much better than those in French Indochina. In 1908, Marie-Joseph Mouillac, one of French colonial physicians in Chengdu, tested and inoculated a heifer before students in the Chinese Medical School. The heifer developed a few pustules, whereupon Mouillac vaccinated four soldiers with its pus dissolved in glycerin. One of these vaccinations succeeded, whereas the other three produced no reaction. Mouillac attributed the failure to the patients having been variolated before, not to the potency of the vaccine.⁸⁰ In 1911, Jouveau-Dubreuil vaccinated fourteen heifers with the vaccine strain from Tonkin. The average harvest was satisfactory. He concluded that the Sichuan heifers would become useful whenever there was a shortage of water buffalo, as happened in 1918 and 1919.⁸¹ (Figure 2.2)

⁷⁹ Jouveau-Dubreuil, "Service de la Vaccine à l'Institut Pasteur de Tchen-Tou," 73.

⁸⁰ Marie Joseph Mouillac, "Le Poste Medical de Tchentou," *Annales d'Hygiène et de Médecine Coloniales* 11 (1908): 18.

⁸¹ Jouveau-Dubreuil, "Service de la Vaccine à l'Institut Pasteur de Tchen-Tou," 73.



Figure 2.2: Heifer Vaccination at the Pasteur Institute of Chengdu⁸²

At first, the Pasteur Institute of Chengdu met with trouble in procuring local water buffalos. In negotiations with local Muslim farmers, the French Pastors had to take into account their assessment of the intrinsic value of these animals, as well as their price, selection, and availability. In his 1910 report, Jean-Paul Esserteau, Director of the Pasteur Institute in Chengdu during 1908-191, recounted the reluctance of the local farmers to lend cattle to him. They were concerned that the animal would lose its value after vaccination and no longer realize a good price in trade. Esserteau asked the missionaries to help him. For example, a missionary who lived a four days walk away in a village southwest of Chengdu did not receive a favorable response from the local Muslim butchers, who demanded a too high price or did not want to sell

⁸² MAEP, NS, Chine, 656. “Rapport pour l’Année 1910 par Dr. Esserteau,” 81.

at all. He also requested three more missionaries in other villages to find out if they could get a better deal.⁸³ The archival document does not show the final response of these three. From these exchanges we can have a sense that cross-cultural factors should be also taken into account in the process of acquiring the animals. It was not a pure economic transaction.

According to Jouveau-Dubreuil, the temperate nature of local climate aided the transportation and preservation of the glycerin vaccine. During most of the spring and autumn, and throughout the winter, the outdoor temperature remained below 15°C. Even though the temperature could reach as high as 30°C in summer, given adequate insulation and reliable postal service, the vaccine did not lose its potency in shipment.⁸⁴ For preservation in summer, it was kept in a large thermos with a wide opening, surrounded by ice, maintaining a temperature a few degrees below zero. The Institute utilized an effective cooling device, “the Refrigerant.” It was maintenance-free and required no chemical supplies for its operation. During winter, the Institute stored the vaccine at room temperature of the laboratory. The favorable climate helped to maintain the potency of the glycerin vaccine.⁸⁵

Acting upon their knowledge of microbiology in making the local vaccine, the Chengdu Pastorians adapted to the local environmental circumstances in their actual practices of vaccine production, especially in accounting for the local specificity of animals and climate. This adaptation included vaccine production drawing upon various foreign vaccine strains for local use, adopting local animals such as heifers and water buffalos as better sources of vaccine, and taking advantage of the local mild climate in preserving the glycerin vaccine.

⁸³ ANOM (Archives Nationales d’Outre Mer), INDO GGI (Fonds du Gouvernement général de l’Indochine) 32823, “Au sujet de la cession de certains produits à titre gratuit au poste médical de Tchentoufou,” 29/01/1910, 3.

⁸⁴ Jouveau-Dubreuil, “Service de la Vaccine à l’Institut Pasteur de Tchen-Tou,” 75.

⁸⁵ *Ibid.*, 73.

Disseminating Jennerian Vaccine: Compromises and Collaboration

When Jouveau-Dubreuil took over the Pasteur Institute of Chengdu as its director in 1911, he realized that it was best not to compete, but to collaborate with Chinese practitioners. He invited them to the laboratory at the Pasteur Institute and demonstrated the manufacture of the vaccine, as well as explained its properties and application. He particularly emphasized the quality of the vaccine. Local Chinese practitioners at a time of political turmoil found it hard to acquire and preserve the substance of inoculation. Jouveau-Dubreuil expected to attract them with the advantages of a readily available and swiftly replenishable active vaccine.⁸⁶ He did succeed partially. As early as the beginning of 1913, about a dozen local Chinese practitioners applied regularly for their supply of vaccine, and in 1914 about forty of them numbered among the Institute's customers.⁸⁷ These Chinese practitioners, most of who used to be variolators and now became vaccinators, played an important role in reaching the areas where no local physicians were available.

However, the composition and production of vaccine constituted only part of the vaccination practice. Just about everything else diverged from the "European" norm. Local Chinese practitioners did not recognize a clear-cut division between variolation and vaccination. They used the vaccine purchased from the Pasteur Institute but still applied the theory and techniques of variolation. The local Chinese practitioners, upon whom the French Pastorians relied in disseminating vaccination, demonstrated medical diversity and a pragmatic approach,

⁸⁶ *Ibid.*, 66.

⁸⁷ *Ibid.*, 67.

incorporating various local medical and social practices.⁸⁸ These practices neglected germ theory of disease, while incorporating Chinese medical theories such as the environmental influence on the timing of vaccination, configuration of *qi*, individual bodily constitution, diet, and worship rituals of the Smallpox Goddess.

As recounted above, the Chinese vaccinators in Sichuan revised the vaccine content by using two kinds of substance as vaccine. For the first, they collected the smallpox scabs of vaccinated children, dried them, and mixed them with breast milk or water. For the second, they used the glycerin lymph emulsion produced in the Pasteur Institute of Chengdu, which the Chinese vaccinators claimed to ensure the “purity” of the vaccine. These two kinds of mixtures were both called “nious-too” (contemporary spelling) 牛痘, cow vaccine, without distinguishing the original sources of the pathological agent, either from the locally collected smallpox scabs or the glycerin lymph emulsion supplied by the Pasteur Institute of Chengdu.⁸⁹

Local practitioners also reconfigured the application of the vaccine. They administered vaccination through the nose, by soaking a cotton ball in the cow vaccine, not human smallpox virus, and placing it into one nostril.⁹⁰ The nasal application imitated the technique in Chinese variolation. Moreover, normally the Pasteur Institute of Chengdu produced three centigrams of glycerin pulp per package, which might suffice for two people in France. Since Chinese

⁸⁸ Similarly, in regard to the discussion of Chinese medical diversity, see Rogaski’s *Hygiene Modernity on weisheng* 衛生 (Hygiene Modernity). She observed that medical diversity allowed Chinese to adopt, alter, or reject the content of Western medicine in Tianjin.

⁸⁹ C. W. Freeman, “Report on the Health of Chungking for the Year Ending 30th September, 1909,” *Chinese Medical Journal* 24.2 (1910): 216. Similar practices took place in the southwest of China and in Tonkin, where variolation was practiced as well. Jouveau-Dubreuil, “Service de la Vaccine à l’Institut Pasteur de Tchen-Tou,” 75; R. L. Sircar, “Report on the Health of Tengyueh for the Two Years Ended the 31st March, 1911,” *Chinese Medical Journal* 26.1 (1912): 318-319. Dr. Sircar observed that a vaccinator’s work was unpopular among the people on account of many children suffering from blood poisoning or going blind after vaccination. He suspected that either the lymph or the scales might have been infected with septic matter, or the lancet must have been dirty. He admitted that these cases had brought discredit on vaccination and prejudiced people’s minds.

⁹⁰ Jouveau-Dubreuil, “Service de la Vaccine à l’Institut Pasteur de Tchen-Tou,” 75

practitioners usually vaccinated three places by making small incisions along the meridian channel on each arm, they needed more vaccine and the Institute accommodated such practices by increasing the vaccine supply.⁹¹

The Pastorians worked with local people by incorporating social practices originating from variolation. The most notable example was the crucial choice of timing for vaccination, to coincide with that favored for variolation. The Chinese variolated in the spring, because the temperature was mild and nature was growing. They believed that under these conditions the inoculation substance would be more effective at expelling the fetal toxin. This concern for timing was deeply ingrained. In the laboratory at the Pasteur Institute of Chengdu, there was a Chinese calendar, which the French physicians consulted to determine when local people were most willing to be vaccinated, and conducted their services and stocked their vaccine accordingly.⁹²

The Chinese had worshipped smallpox deities since the sixteenth century as a crucial ritual to prevent smallpox. The local people in Sichuan worshipped the Smallpox Goddess when they had their children variolated and continued the ritual for vaccination. Ordinary people went to the temple to pray for a good vaccination, whereas a wealthy family set up an altar at home and worshipped the Smallpox Goddess until the vaccinated child had recovered.

Many representations of these deities were employed as protectors of the afflicted, the variolated, and the vaccinated patients into the twentieth century. Specifically in Sichuan, there existed three accounts of smallpox deities. One was the aforementioned Smallpox Goddess (*Dou Shen Niangniang* 痘神娘娘) from *Emei* Mountain in Sichuan in the tenth century. Another account by Yue Jun in 1792 involved three fairy sisters (*Ma Niangniang* 麻娘娘), also from

⁹¹ Ibid.

⁹² Jouveau-Dubreuil, "La Variolisation au Setchouen," 96.

Emei Mountain in Sichuan.⁹³ The rituals and religious regimes revealed in historical sources claim these three fairies to be related to the Smallpox Goddess. During the course of smallpox, the family had to follow the worship ritual and a strict regimen, as well as the cleanliness of dress, polite manner of speaking, and pious attitude. According to Yue Jun, these deities acted as supervisors of these rules and further facilitated the recovery of the patient.⁹⁴

The third account of smallpox deities came from the worship of the *Hakka* people, a subgroup of the Han Chinese that originated in Northern China and migrated to Southern China in the third century BCE. In the nineteenth and early twentieth century, the Smallpox Goddess (called *Tienlao Niangniang* 天姥娘娘, *Sanxiao shengmu* 三霄聖母, or *Sanpo niangniang* 三婆娘娘) was worshipped during group variolation, especially in response to smallpox epidemics. The local people called this procedure “relieving smallpox.” (*fang tianhua* 放天花) It usually took place once every three years, in lunar January or February. The variolator coordinated his practice with the leaders in the surrounding villages who generated a roster of children in need of variolation (*hui zhong sheng* 匯種生), including their names, birthdays, and names of their parents. They added up the number of children about to be variolated, designated as “smallpox children.” (*huatong* 花童) Following the survey, they assembled the children’s parents at the ancestral temple, electing or appointing official worshippers to attend and share expenses of the whole procedure.⁹⁵

The local people in Sichuan also worshipped the Smallpox Goddess during vaccination. The Smallpox Goddess’s birthday, also called “All Flowers’ Day,” was commonly celebrated on

⁹³ Chang, “Aspects of Smallpox and Its Significance in Chinese History,” 106-121.

⁹⁴ *Ibid.*, 116-117.

⁹⁵ Lin Xiaoping 林曉平, *Kejia minjian xinyang yu minsu wenhua* 客家民間信仰與民俗文化 (Hakka folk beliefs and culture) (Beijing: Zhongguo shehui kexue chubanshe, 2012), 64-66.

22 March, during spring according to the Chinese lunar calendar. In the same way as the flower bud opens on the auspicious day, so it was believed that vaccination done on that day was bound to take or “open” smallpox, which was called “*tianhua*” 天花, literally meaning “heaven’s flowers” with an auspicious connotation. Many local people chose to have themselves or their children vaccinated on this day. The belief in the Smallpox Goddess and the Chinese idea of the nature of spring inspired the local people’s propensity to get vaccinated in spring. The Pastorians in Chengdu accommodated this preference in order to disseminate vaccination.⁹⁶

Conclusion

Although the Chengdu Pastorians faced numerous obstacles, their success in producing vaccine and disseminating vaccination complemented the French desire to extend its sphere of influence in the southwest of China. It conformed to the French colonial policy of “indirect imperialism,” meant to spread French cultural influence to benefit local population without imposing direct colonial rule. The key to their comparative success was threefold. First, the Chengdu Pastorians did not impose their Parisian methods in a straightforward fashion, but adapted to the local environmental circumstances for vaccine production, especially pertaining to animals and climate.

Secondly, on the one hand, the Pastorians in Chengdu accommodated the local social conditions in the dissemination of vaccination and collaborated with local Chinese practitioners by incorporating local medical and social practices. On the other, Chinese practitioners did not disseminate vaccination in a straightforward adoption of the vaccine produced by the Pasteur Institute of Chengdu. Instead, they revised the content of the vaccine and reconfigured the

⁹⁶ Jouveau-Dubreuil, “La Variolisation au Setchouen,” 96.

vaccination method to incorporate Chinese medical theories and variolation techniques. The Chengdu Pastorians also accommodated Chinese social customs in their vaccination practices, including the alignment of vaccination with the timing of variolation practices in spring and ritual worship of the Smallpox Goddess. Thus the nature of the Pastorian works in Chengdu exemplifies a mutual compromise and collaboration between the French and the Chinese at the level of actual practices.

Lastly, this French culturally imperialist project enabled and promoted the mobility of colonial physicians and laboratory materials such as vaccine strains and scientific equipment, moving from Europe to China, often through French Indochina. Mutual adaptation, compromise, and collaboration occurred in reliance on such mobility.

Did local acceptance of vaccination and the increasing prevalence vaccination, by employing an artificial vaccine to prevent smallpox through organized efforts by the Pasteur Institute of Chengdu and its collaborators, realize the Pastorian idea of public health care in accordance with germ theory? Not entirely. There remained three differences between Pastorian and Chinese medical theories and practices – in the understanding of immunity against smallpox, in the perception of contagion, and in the very practice of vaccination on the local Chinese population.

In spite of their encounter with the Pastorians in Chengdu, in this era, most Chinese medical practitioners and the majority of the population still believed that immunity against smallpox could be achieved only through a material change in substance, namely the expulsion of impurities from the body, whereas the Pastorians stressed a dynamic change in function, namely the increased ability of the organism to resist the smallpox pathogen. Their disagreement in how they viewed immunity against smallpox derived from disparate views of smallpox etiology. When Chinese practitioners vaccinated their patients, they believed that they were

releasing the fetal toxin through crucial acupunctural points by the *qi* of the vaccine. Once vaccinated, revaccination was considered unnecessary, since the impurity had been purged. By contrast, the Pastorians insisted that revaccination was necessary for the persistence of immunity against smallpox. Since vaccination used a less virulent agent in the vaccine, it needed to be done periodically in order to renew immunity. In this period, it is plausible that except at the Chinese Medical School in Chengdu, the Chengdu Pastorians did not force the Chinese to accept their view of smallpox etiology, even as they accepted the Chinese vaccination practices, based on the Chinese understanding of smallpox etiology. Persuading their local patients to get revaccinated became one of their ensuing and enduring challenges.

The French physicians encountered a different understanding of contagion in Chengdu, derived from divergent ideas of smallpox transmission. The Pastorians believed that smallpox was transmitted by direct contact, whereas the Chinese believed that smallpox was transmitted by the “wind” (*qi*) with the pustule matter and smallpox scabs. However, of other colonial physicians, only few like Regnault, understood the Chinese idea of smallpox transmission by observing Chinese vaccination practices.

The public health efforts relating to smallpox prevention in the southwest of China during this period were based on the network established among the French medical mission in Chengdu, Chinese practitioners and other foreign medical service providers, along with a passive participation of the local Chinese government. The dissemination of vaccination did not depend on government initiative. The Pastorian contribution mainly consisted in the production and supply of Jennerian vaccine. However, the technical capacity for vaccine production did not guarantee a wide dissemination of vaccination. Aside from the French physicians and the students from the Chinese Medical School practicing vaccination in the French Catholic Missionary Hospital, the French Clinic (*maison de santé*), and the Pasteur Institute of Chengdu,

most of vaccination dissemination depended on the missionaries, other European and American hospitals, and Chinese practitioners, not only in Sichuan, but also in the surrounding provinces.⁹⁷ Even though we can count the growing number of administered vaccine doses to measure the increase of its production and distribution, we can only infer that the scope of vaccination correlated with this increase, especially as performed in rural areas by the Chinese practitioners. The actual practices of vaccination involved revising the Jennerian vaccine, along with reconfiguring vaccination to conform to the existing social practices of variolation. These practices differed from their European prototypes. The mutual compromises between Pastorians and Chinese practitioners were the keys to their acceptance by the local society.

⁹⁷ MAEP, Série E, Asie, Chine, 499, 171-173, “Rapport sur la Clinique Médicale Française de Tchentou pour 1925 par Dr. A. Gervais,” 06/03/1925, 6-8.

CHAPTER III

Microbiological Studies of Rabies Virulence and Treatment at the Pasteur Institutes in Shanghai, 1899-1950

Arthur Stanley, Health Officer of the Shanghai Municipal Council and Director of the British-founded Shanghai Pasteur Institute at the International Settlement in Shanghai from 1898 to 1921, emphasized multiple times in his Annual Reports: “The virus of rabies in Shanghai dogs is an exceptionally intense character, the period of incubation being shorter than the rabies met with in dogs in Europe.”¹ However, his conclusion of higher rabies virulence did not remain unchallenged. Stanley’s successor J. H. Jordan was skeptical of the rabies virus’ greater intensity. The debate continued after the French-founded Pasteur Institute of Shanghai at the French Concession was established in 1938.² The Pastorians in the latter establishment concurred with Stanley’s finding on the nature of local rabies.

The local specificity of rabies virulence demonstrated the variability of its pathogens.³ Accordingly, the local health officials had to make a choice, either following or modifying the

¹ Shanghai Municipal Archives (SMA), U1-16-4650~4653, “Annual Reports of the Health Department of Shanghai Municipal Council,” 1875-1925.

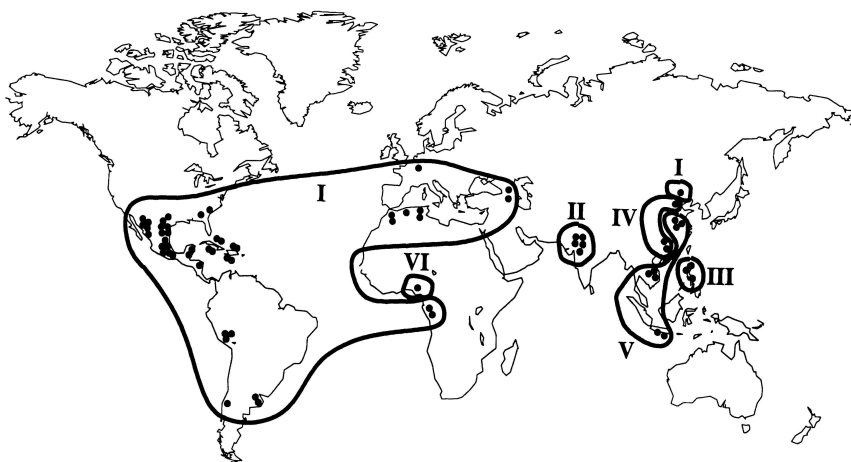
² During this period, there existed two Pasteur Institutes in Shanghai, established respectively by Britain and France. Britain named her institute after Pasteur because it was originally set up for rabies research and treatment, an integral part of Pastorian practices. The administrative board at the Pasteur Institute of Paris welcomed local initiatives of establishing and naming a Pasteur Institute. The policy changed only after WWI. The administrative board in Paris stipulated that any so-called “Pasteur Institute” must satisfy two conditions: self-funding and submitting the names of the chosen directors to Paris. Moulin, “The Pasteur Institute’s International Network,” 154.

³ Nowadays, studies have confirmed that rabies viruses are genetically variable and the evolutions of different groups can be inferred by their geographical locations. Sheng-Li Meng et al, “Molecular Epidemiology and Sequencing of the G-L intergenic Region of Rabies Viruses Isolated in China,” *Virologica Sinica* 22. 1 (2007): 33. However, in a vast country like China, “[p]lacement of the vaccine and laboratory strains within a given cluster, however, did not always correspond to geographic origin.” In China, there are three types of strains, manifesting difference genetic sequences, found in Beijing (Group IB2), in the Guanxi and Shandong provinces (Group IV) and in the Anhui province (Group VB). The genetic sequence of the Shanghai strain is in the same group with the ones in former French Indochina and different from the ones in Europe. Jean S. Smith et al, “Epidemiologic and

original treatment. Treating rabies involved choosing among different vaccines, their dosage, the interval allowed between the bite and the treatment, the methods of injection, and the duration of the treatment. The physicians at the Pasteur Institutes propagated the rabies treatment in order to mitigate the mortality of the disease and forestall the “failures” of its treatment. It was commonly considered a “failure” of rabies treatment when death occurred after the complete period of treatment, normally from fifteen to twenty-one days, depending on severity and the location of body parts where the infection occurred. Deaths of patients occurring within this period were not thought of as failure of treatment, but attributed to the want of time for establishing immunity.

Given the doctors’ similar Pastorian training, we cannot help wondering why opinions diverged over assessing local rabies virulence, as well as applying different vaccines and treatments at different institutes in the interest of public health within the metropole. How did these physicians in two Pasteur Institutes distinguish between the virulence of the local rabies viruses? How did their findings contribute to knowledge of the disease and its treatment? Why did the Pasteur Institute at the French Concession still use the phenolized vaccine (vaccine attenuated by carbolic acid), a weaker vaccine, even though they found the natural-occurring

Historical Relationships among 87 Rabies Virus Isolated as Determined by Limited Sequence Analysis,” *Journal of Infectious Diseases* 166. 2 (1992): 296-307. The map below of the world distribution of unique genetic groups of rabies virus is from Smith, 7.



rabies was more virulent in Shanghai? And how did the Pastorian study and treatment of rabies intersect with the Chinese medical knowledge of rabies?

With materials drawn from contemporary scientific articles, institutional annual reports, and personal correspondence, this chapter is arranged as follows. Following a brief introduction of the rabies treatment in China before the emergence of the Pastorian rabies treatment in the late nineteenth century, I identify the methods applied by Stanley and Jordan in the Shanghai Pasteur Institute at the International Settlement, and the Pastorians at the Pasteur Institute of Shanghai in the French Concession, led by French Pastorian Jean Raynal and Chinese Pastorian Liu Yongchun, and determine why their results differed. I then explore the connection between their findings of the incubation period and the rabies treatment that they administered.

Chinese Medical Knowledge of Rabies and Its Treatments Related to Pastorian Principles

Before going into the detail of Pastorian development of rabies treatment derived from the germ theory of disease developed since the late nineteenth century, let us see what the Chinese had understood the illness and how they treated it before Pastorians propagated the Pasteur method in China. Before the first European historical record of rabies made in 100 CE by the physician Celsus, the study of rabies in China started as early as the fifth century BCE.⁴ Recorded in *Zuo Zhuan*'s 左傳 passages, "...the people were pursuing a mad dog..." and "...when there is a mad dog in the city, it bites everyone."⁵ The Chinese at the time called such dogs with an abnormal

⁴ Alan C. Jackson, *Rabies: Scientific Basis of the Disease and its Management* (New York: Elsevier, 2013), 1.

⁵ Zhu Qiuming 左丘明 (556-451 BCE), "Xiang 17" 襄公十七年, *Zuo Zhuan* 左傳 (Changsha: Yuelu shushe, 1988), 209. "Guo ren zhu qi gou" 國人逐瘕狗 (The people were chasing a mad dog away.); Zhu, "Ai 12" 哀公十二年, 406. "Guo gou zhi qi, wu bu hi ye" 國狗之瘕, 無不噬也。 (The mad dog in the city bites everyone.)

behavior of biting people without reasons “mad” (*qi 癡*) and observed them becoming paralyzed before death.

It was not until the fourth century CE that Ge Hong, a Chinese physician living in today’s Jiangsu area where Shanghai is located, recommended treating patients bitten by such a dog by killing it and placing its brain on the bite spot where the foul blood had been removed and acupuncture had been administered.⁶ Ge Hong seemed to acknowledge that the “poison” (*du 毒*) came from the dog’s bites. He attributed the symptom of paralysis after being bitten to the “poison” that was transmitted through bites. In order expel that “poison” from the patient’s body, he employed the principle of “tackling poison with poison” (*yi du gong du 以毒攻毒*), using the original “poison” of the dog that bit the patient, especially drawing upon its brain where the “poison” concentrated.⁷

The Pastroians encountered Chinese medical understanding of rabies that the cause of rabies as “poisoning” by mad dog bites and Chinese remedies for the illness when they started propagating Pasteur’s method in treating the disease in China. In 1926, a rabies patient sent a package of “Chinese rabies vaccine” to the Shanghai Pasteur Institute at the International Settlement in Shanghai. The Institute then analyzed its chemical component and found it to match the substance, *strychnos nux-vomica*, from strychnine trees.⁸ In modern days, the properties of *strychnos nux-vomica* are those of alkaloid strychnine, with applications for

⁶ Ge Hong, *Zhouhou beijifang* 7. 54, <http://alturl.com/e5uuz>

⁷ It is nit clear whether Ge Hong knew exactly how the “poison” was transmitted. He knew that rabies was contracted through a mad dog’s bite. In Europe, not until 1804 was Georg Gottfried Zinke (1771-1813) able to prove that the infective agent of rabies was transmitted in infected saliva. Jackson, 2.

⁸ SMA, U1-16-4653, ‘Anti-rabic Treatment of Pasteur,’ in “Annual Reports of the Health Department of Shanghai Municipal Council,” 1926, 34.

allergic conditions and as a stimulant of the central nervous system.⁹ That package actually contained seeds of *strychnos nux-vomica* (strychnine).¹⁰ The Chinese had used this herb therapeutically at least since the sixteenth century, when Li Shizhen 李時珍 compiled the “Compendium of Materia Medica.” Credited with a “bitter, cold, poisonous” nature, the herb was believed to cleanse the meridian system and to relieve pain, inflammation, and paralytic symptoms, especially in the limbs.¹¹ Unfortunately, we cannot find any evidence that the Shanghai Pasteur Institute made any further comments on this herb used to treat rabies.

The Shanghai Pasteur Institute also encountered another account of a Chinese remedy for rabies. A rabies patient was treated at home with a combination of “strychnos beans, and a powerful vesicant, probably cantharides.” The Institute sent the sample of this combination to the museum of the London School of Hygiene and Tropical Medicine.¹² The usage of the “poisonous” *strychnos* is in evidence again. However, we do not know what happened to that sample and whether any analysis took place.

The speculations of Chinese medicine on rabies within the Pastorian circle traversed national borders. I have recounted the story of a Chinese recipe containing a mixture of Chinese herbs claiming for curing rabies in Chapter I. The recipe was tested by Paul Remlinger at the Pasteur Institute in Tangier, Morocco, but led to no “scientific” success.¹³ We are not able to

⁹ Govinda Rao Duddukuri et al, “Suppressive Effect of *Strychnos Nux-Vomica* on Induction of Ovalbumin-Specific IgE Antibody Response in Mice,” *Indian Journal of Biochemistry and Biophysics* 45. 5 (2008): 341-344; I. Setnikar et al, “Amino-Methylchromones, Brain Stem Stimulants and Pentobarbital Antagonists,” *Journal of Pharmacology and Experimental Therapeutics* 128 (1960): 176-181.

¹⁰ The Chinese call it “ma qian zi” 馬錢子. Li Shi-Zhen called it “Fan mu bie” 番木鱉. Li Shizhen, *Bencao Gangmu*, 18.1:18-19, <http://ctext.org/library.pl?if=gb&file=52833&page=47>

¹¹ Ibid.

¹² SMA, U1-16-4655, ‘Anti-rabic Work,’ in “Annual Reports of the Health Department of Shanghai Municipal Council,” 1930, 33.

¹³ See the detail in the section of “Validating Chinese Medicine with Toxicology, Immunology, and Pharmacology at the Pasteur Institutes in China and Worldwide” in Chapter I.

know the reasons for the curative powers that the Chinese claimed for the medicine. However, even though Remlinger found this Chinese remedy useless at the time, the fact that Pastorians' attempted to test this alternative treatment reflected their search of knowledge that was not previously available to the Europeans.

As mentioned in Chapter I, Liu Yongchun, Chinese Pastorian working at the Pasteur Institute of Shanghai at the French Concession, commented that this concept of tackling poison with poison appeared compatible with Pastorian principles, hypothesizing that certain anti-rabies substance existed in the brain of a rabid dog. He verified further such a concept in the case of anti-rabies treatment with snake venom.

Inventing the Pastorian Rabies Treatment

Today we single out the rabies virus, RABV, the rhabdovirus with its RNA-based genome covered by a glycoprotein membrane, to understand rabies as an acute inflammation of the brain (encephalitis), caused by this pathogen entering the peripheral nervous system, travelling along the afferent nerves, and eventually infecting the central nervous system.¹⁴ Warm-blooded animals, such as dogs, cats, monkeys, and cattle, can be infected by the virus and thereupon transmit the disease to humans.¹⁵ As to the canine symptoms, an infected dog first becomes

¹⁴ Monique Lafon, "Rabies virus receptors," *BMC (BioMed Central) Proceedings* 2. Supplement 1 (2008): S26. During this phase between entering of the rabies virus and reaching the central nervous system (incubation period), the virus cannot be easily detected within the host and vaccination may still confer cell-mediated immunity to forestall the development of symptomatic rabies. Once the virus reaches the brain, it rapidly causes encephalitis, constituting the prodromal phase and triggers the first symptoms of rabies. An animal bitten by a rabid animal during its incubation period does not carry a risk of rabies because the virus is not yet found in the saliva. Only after the virus has reached the brain and multiplied there to cause encephalitis does it move from the brain to the salivary glands and infect the saliva. After the virus has multiplied in the brain almost all infected animals begin to show the first signs of rabies. Jackson, 299.

¹⁵ Besides these common animals, there are other animals in some specific parts of the world, such as jackals in India, coyotes in America, and wolves in certain countries in Europe. SMA, U1-16-212, J. H. Jordan, "Rabies: Notes of Lecture to the Public Health Club, Shanghai," 1934, 47. Transmission between humans is rare, with only a few

sluggish, seeking to isolate itself, but appearing restless and fidgety. It gradually turns violent, attacking any animal in its way, before a paralysis of its lower jaw sets in, and then spreading to the whole body. Meanwhile, constriction of its throat impedes swallowing. In addition to an itching sensation at the site of bite, the first symptoms of rabies in humans are similar to those of influenza, including fever, headache, and fatigue, progressing within days to cerebral dysfunction, confusion, anxiety, and agitation to the point of delirium, aggressive behavior, and insomnia.¹⁶

Since the early nineteenth century, European physicians have located the rabies pathogen in the saliva of a symptomatic rabid animal.¹⁷ In 1879, Pierre-Victor Galtier (1846-1908), a professor at a veterinary school in Lyon, France, noted the paralytic feature of rabies in laboratory rabbits.¹⁸ Three years later in 1881, Pasteur adopted Galtier's experimental model in rabbits and published his first paper on rabies, confirming that in addition to saliva the rabies virus was also present in the nervous system.¹⁹ Contemporaries understood that the rabies infection usually began with a bite.²⁰ The mortality of rabies was very high. Once the patient became symptomatic, rabies treatment was hardly ever effective, with mortality exceeding 99%. This understanding of rabies transmission holds to the present day. In 1903, while directing the

cases documented through transplant surgery. In 2004, four recipients of kidneys, a liver and an arterial segment from a common organ donor died of encephalitis caused from rabies virus. A. Srinivasan et al, "Transmission of Rabies Virus from an Organ Donor to Four Transplant Recipients," *New England Journal of Medicine*, 352. 11 (2005): 1103-1011. Four cases of human transmission of rabies through corneal transplants are described by Gerald L. Geison in *The Private Science of Louis Pasteur* (Princeton: Princeton University Press, 1995), 202.

¹⁶ George M. Baer, *The Natural History of Rabies* (Boca Raton, Florida: CRC Press, 1991), 538.

¹⁷ In 1804, Zinke found that the infective agent of rabies was transmitted in infected saliva. In 1821, the French neurophysiologist François Magendie (1783-1855) reported rabies transmission to a dog by inoculation of saliva from a human case of rabies. Jackson, 2-3.

¹⁸ Galtier found that using rabbits in experiments was technically much less difficult and less dangerous than using dogs and cats. *Ibid.*, 3.

¹⁹ *Ibid.*

²⁰ Mark H. Beers, ed., *The Merck Manual of Medical Information* (Whitehouse Station, NJ: Merck, 2003), 484.

Imperial Anti-rabies Institute in Constantinople, Paul Remlinger, French biologist and Pastorian who specialized in rabies, identified an ultrafilterable nature of the virus.²¹ With the introduction of the ultracentrifuge in 1926, ultrafiltration in 1928, and electron microscopes in the 1930s, the knowledge of filterable viruses gradually improved.²² In 1931, Joseph Lennox Pawan, a Trinidadian bacteriologist, discovered that vampire bats were capable of transmitting rabies virus.²³ The understanding of its morphology, chemical composition, antigenic properties, and possibilities for cultivation progressed dramatically in the 1960s.²⁴ Only in the 1980s was the rabies understood as an RNA core contained in a typically bullet-shaped envelope responsible for its infectivity.²⁵

Since no cure was available once symptoms appeared, the hope of a successful treatment after exposure depended wholly on prophylaxis during the incubation period, the interval between the exposure and the initial manifestation of symptoms. Thus, even though the treatment is implemented after infection, it is considered prophylactic rather than curative, as per Pasteur's vaccination principles.

Owing to the ignorance of the actual pathogen, as we know it today, the debate on the virulence of rabies in the early twentieth century centered on the length of the incubation period.

²¹ P. A. Remlinger, "Le Passage du Virus Rabique à Travers les Filtres," *Annales de l'Institut Pasteur* 17.12 (1903): 834-849.

²² Lise Wilkinson, "History," in *Rabies*, ed. Alan C. Jackson and William H. Wunner (New York: Academic Press, 2002), 20.

²³ Jeffrey N. Sfakianos and Alan Hecht, *West Nile Virus* (New York: Chelsea House Publications, 2009), 13.

²⁴ Pratik Chakrabarti, *Bacteriology in British India: Laboratory Medicine and the Tropics* (Rochester, NY: University of Rochester Press, 2012), 167.

²⁵ Wilkinson, 20. Even before the 1950s, there were already attempts to cultivate the fixed rabies virus *in vivo* (within the living organism, as opposed to *in vitro*, "in glass," referring to conducting experiments outside of the living organism). For instance, in 1948 China, Chen-Jen Chen and Samuel H. Zia, from the National Vaccine and Serum Institute at the National Epidemic Prevention Bureau in Beijing, successfully cultivated a fixed rabies virus in the developing fetal brain of the guinea pig *in utero* ("in the womb"). Chen-Jen Chen and Samuel H. Zia, "Study of Fixed Rabies Virus Propagated in the Brain of Guinea Pig Fetus," *Journal of Immunology* 60 (1948): 17-21.

Led by Pasteur, the contemporary Pastorians believed that a specific microbe caused rabies, even though – bereft of microscopic technology – they could not yet identify it. Thus they strove to develop the vaccine for rabies without relying on the identification and cultivation of its pathogen. During the late nineteenth century, studies in France, particularly by Galtier and Pasteur, discerned that the rabies incubation period in people bitten by rabid animals varied with the time it took for the “virus” to reach the central nervous system.²⁶ Here the “virus” was construed on the conceptual level, referring to the poisonous substance embodied by a microbe causing rabies, as opposed to the actual pathogen.²⁷ Pasteur discovered that the incubation period of the natural-occurring rabies virus (“street virus”) in rabbits was long, varying from seventeen to thirty days,²⁸ but in repeated passage from one rabbit to another, the incubation period became shortened and finally “fixed.”²⁹ Since the 1880s, Pasteur and his disciple and colleague, Émile Roux, inoculated the street virus directly under the *dura mater* of dogs, a thick membrane that is the outermost of the three layers of the meninges that surround the brain and spinal cord, and then serially passed it through rabbits via an intracranial injection, until securing the fixed virus with an incubation period of six to seven days.³⁰ Pasteur then applied the fixed virus to induce immunity against the street virus. The conventional Pastorian line of immunization was to induce immunity with the attenuated form of same microbes that caused the disease. Whether the fixed

²⁶ Jackson, 3.

²⁷ When the early-twentieth-century contemporaries mentioned “virus,” it generally meant the poisonous and usually infectious substance produced within the body by a disease, as the term was used since the fifteenth century in Europe. (Similar to the Chinese usage of *du* 毒) Only after 1900, “virus” could also specifically mean filterable virus – an infectious, often pathogenic agent or biological entity, typically smaller than a bacterium and functional only within the living cells of an organism. See “virus,” *Oxford English Dictionary*, <http://www.oed.com/view/Entry/223861>

²⁸ Pierre Lépine, “On the Evolution of Fixed Strains of Rabies Virus,” *Journal of Hygiene* 38. 2 (1938): 180.

²⁹ Lawrence K. Altman, “The Pasteurian Club,” in *Who Goes First? The Story of Self-Experimentation in Medicine* (Berkeley: University of California Press, 1986), 110.

³⁰ Lépine, 180; Wilkinson, 17.

virus was weaker or more intensive than the street virus would depend on what kind of animal was used for passages. The serial passages of rabies virus through rabbits increased its virulence, whereas that through monkeys decreased it.³¹

The early-twentieth-century physicians believed that the incubation period was usually associated with three parameters: the virulence of natural-occurring rabies, as well as the variety of animals and modes of inoculation during the transmissions repeated before acquiring the fixed virus. The virulence of rabies and the variety of available laboratory animals could be influenced by local conditions, such as climate and animal breeds. The Pastorians in Shanghai had already understood that the incubation period was usually long because the progressive saturation of nerves was slow, but the period would be shortened and the central nervous system would become infected sooner if the street virus became more intensive.³² In other words, the shorter the incubation period, the more virulent the street virus must be. Hence, the incubation period served as an important indication of relative virulence of the street rabies virus in Shanghai and in Paris.

As regards laboratory animals, the contemporary physicians believed that all warm-blooded animals were more or less susceptible to rabies, but different species varied in their rate of susceptibility. Some resisted better, and some worse. They inoculated different laboratory animals and found that mice and guinea pigs were the most susceptible and yielded the shortest incubation period. Rabbits, dogs, chickens, and monkeys came in ascending order of their ability to resist infection. The researchers concluded that susceptibility correlated with the size or

³¹ Geison, 185 and 212-213.

³² MAEN, Shanghai 635/PO/A/25, J. H. Raynal and Y. Palud, "Les Mesures de Défense contre la Rage et Leur Application sur le Territoire de la Concession Française de Chang-hai," *Bulletin Médical de l'Université l'Aurore*, 23/05/1940.

weight of the animals.³³ Smaller animals, such as mice or guinea pigs, usually had shorter nerves connecting the peripheral to the central nervous system.³⁴ Pasteur mainly used rabbits for his experiments. For a reasonable comparison of the results in Paris and in Shanghai, we should take note of the laboratory animals used by the Pastorianians in Shanghai, along with other specifics of local conditions.

The early Pastorianians also noted that modes of inoculation, such as the choice of location injected with rabies-infected matter, might interfere with the incubation period. They found that different modes led to different incubation durations. There were four modes of injection. In the order of prolonging the effect on the central nervous system, the first one was intracranial or subdural injection, injecting under the *dura mater*. The second was intraocular injection in the anterior chamber of the eyeball. The third was intramuscular injection, and the fourth was subcutaneous injection into the layer of fat between skin and muscle in the abdomen. The rule was that inoculating on the spot farther from the central nervous system prolonged the incubation period. Injecting the rabies-infected matter directly into the central nervous system, as happened with intracranial injection, yielded the shortest incubation period.³⁵ Pasteur tested the incubation period on laboratory rabbits with intracranial injection. Again, we must bear in mind the modes of inoculation employed by the Pastorianians in Shanghai in order to compare them with Pasteur's own inoculating technique.

³³ The Guinea pigs in the French Pasteur Institute of Shanghai weighed 250-330 grams, while the rabbits weighed between 1,300 and 1,500 grams. MAEN, Shanghai 635/PO/A/25, J. H. Raynal and Y. Ch. Lieou, "Valeur Expérimentale des Vaccins Antirabiques (Vaccin Formole et Vaccin Phéniqué)," *Bulletin Médical de l'Université l'Aurore* 6. 6 (1941) : 3.

³⁴ J. Genevray and J. Dodero (Pasteur Institute of Hanoi, Indochina), "Le Virus Rabique Fixe de l'Institut Pasteur de Hanoi," *Annales de l'Institut Pasteur* 57. 6 (1936): 639-642.

³⁵ *Ibid.*, 639-642.

After identifying the length of the street virus's incubation period, to achieve a successful treatment it was important to acquire the fixed virus and find out how much time might be allowed to elapse between the bite and the beginning of the treatment. Pasteur identified the incubation period of the street virus tested in rabbits in Paris as from seventeen to thirty days. In order to treat street rabies, he first had to produce the fixed virus as the base of the vaccine. He intracranially infected the first rabbit with the spinal marrow of an ordinary rabid dog from the street, and then repeated passages through rabbits to produce a fixed rabies virus of maximum virulence and minimum incubation period.³⁶ Pasteur believed that the technique could alter the physiological and pathological properties of the microbe and change its virulence.³⁷ His experiments showed that the period of fixation demanded twenty-one passages. The incubation period was then reduced from over twenty days to eight days. At the 90th passage, he used the virus for the first successful human vaccination of Joseph Meister on 6 July 1885.³⁸ At this time the virus appeared completely fixed. The incubation period in rabbits, which was eight days after the 21st passage, fell to seven days after the 90th, and to six days after the 270th passage in 1891. Since then, the incubation period in Paris remained the same six days, after 1558 passages up to June 1936.³⁹

In the case of Joseph Meister, the interval between the bite and the beginning of the treatment had been only two days. However, Pasteur observed that in most cases, it should be longer than that.⁴⁰ His complete course of the ordinary treatment lasted for fifteen days. The

³⁶ Geison, 185 and 212-213.

³⁷ *Ibid.*, 185.

³⁸ *Ibid.*, 208. See the details regarding controversy of human trials, M. Girard and Julie-Antoinette Poughon, before the successful case of Joseph Meister in *ibid.*, 195-205.

³⁹ Lépine, 181; Geison, 213.

⁴⁰ Geison, 216.

rabies street virus incubation period, as tested by Pasteur, varied from seventeen to thirty days. Thus, it allowed for two to fifteen days before the treatment started. Pasteur and Roux usually allowed four to six days before starting treatment.⁴¹ However, if the incubation period of the street virus was shorter, the interval had to be adjusted accordingly. In most cases, the treatment had to be started as soon as possible after the bite.

After acquiring the fixed virus with seven-day incubation period, Pasteur inoculated rabbits with it intracranially in order to obtain the vaccine. After the rabbits died, he extracted their spinal cords, cut them into strips several centimeters long, and suspended them from a thread inside a flask with two holes at the top and bottom plugged with cotton. Pasteur then placed caustic potash inside each flask to extract moisture from the filtered air and ensure its purity. The treated spinal strips gradually lost their virulence at a rate that varied according to their thickness, and especially according to the ambient temperature. Usually, it took two weeks to render the suspended strips harmless to dogs.⁴² In human treatment, the abdominal subcutaneous vaccination started with grounded spinal strip that had been suspended longer, and proceeded with inoculation by strips of shorter suspension. In other words, it began with a weaker form of the virus and gradually increased the virulence of the vaccine.⁴³

Depending on where the infection occurred, the types of animal bite, and the degree of severity, the course of the human treatment originally adopted in the Pasteur Institute of Paris varied according to the severity of the case. From 1890 onwards, Albert Calmette, the founder of the Pasteur Institute in Saigon, applied the technique of preserving dried spinal cords in glycerin,

⁴¹ Ibid.; SMA, U1-16-2639, "Letter from Noël Davis, the Commissioner of Public Health of the Shanghai Municipal Council, to Thorgoir Sigveland, Acting Consul General for Norway in Shanghai," 01/08/1925.

⁴² Geison, 213.

⁴³ See the details of the Pasteur treatment in A. C. Marie, "Methods of Vaccinating Human Beings Who Have Been Bitten: Various Modifications of the Pasteur Treatment," *Reports to the International Rabies Conference at the Pasteur Institute of Paris in 1927* (C. H. 531) (Geneva: League of Nations, 1927), 36-44.

which slowly attenuated the virulence of the virus and required no modification if they remained in glycerin for up to eight to ten days.⁴⁴ This method became standard for common use in France in the early twentieth century, and was in turn adopted throughout Europe and in the United States, as well as in China.⁴⁵

The Shanghai Pasteur Institute at the International Settlement, 1899-1922

The first Pasteur Institute in China was established under the auspices Shanghai Municipal Council under British control at the Shanghai International Settlement in 1899.⁴⁶ Given the prevalence of stray dogs and incidence of rabies in the settlement since the 1870s, Edward Henderson, appointed part-time as the first Municipal Surgeon and Health Officer (1871-1898), recommended the establishment of a Pasteur laboratory in 1890, bearing the name of “Pasteur” and using Pastorian techniques in treating rabies. His recommendation was inspired by Pasteur’s success in reducing rabies mortality, as per the information provided by his colleague W.J. Milles at Pasteur Institute of Paris.⁴⁷ The Council did not carry out this recommendation due to

⁴⁴ Émile Roux discovered that fixed virus retained its virulence when placed in glycerin and Calmette put the discovery into practice to preserve the spinal cords used in the classical Pasteur method so that they remained virulent. Émile Roux, “Note sur un Moyen de Conserver les Moelles Rabiques avec Leur Virulence,” *Annales de l’Institut Pasteur* 1. 2 (1887): 87; Albert Calmette, “Notes sur la Rage en Indochine et sur les Vaccinations Antirabiques Pratiquées à Saigon du 15 Avril au 1 Août 1891,” *Annales de l’Institut Pasteur* 5. 10 (1891): 633-641; James McIlvaine Phillips, “Prophylactic Treatment for Rabies by Means of Standardized Glycerinated Virus,” *Journal of Immunology* 7. 5 (1922): 409-421.

⁴⁵ Marie, 39.

⁴⁶ Even though the Shanghai Municipal Council was a British-American joint entity, in reality the British headed all the municipal departments and held the majority of seats on the council, as voted by ratepayers at the International Settlement. The British consul served as the *de jure* authority in the settlement. No Chinese residing in the settlement was permitted to join the council until 1928. Andrew Porter, ed., *The Oxford History of the British Empire, 3: the Nineteenth Century* (Oxford: Oxford University Press, 1999), 151.

⁴⁷ SMA, U1-16-4697, “Historical Data Relating to Public Health Matters, Public Health and Medical Report,” 27.

budget concerns. Only in March 1899, thanks to sufficient funding proved by the Municipal Council, Stanley established the “Shanghai Pasteur Institute” for anti-rabies treatment.⁴⁸

Born in 1868 in Suffolk, England, and educated at the Royal College of Science, Stanley obtained his MD and diploma of public health in 1897. He served as a pathologist and medical officer in several medical institutions in England before his post as the Health Officer at the International Settlement in Shanghai during 1898-1921. At the outset, the Municipal Laboratory was already established, aiming at microbiological research, prevention of infectious diseases, and analysis of food and water in the interest of public health.⁴⁹ Under the Municipal Laboratory, the Shanghai Pasteur Institute, established in 1899, became the first Pasteur Institute in the world under British control, preceding the 1900 establishment of the Kasauli Pasteur Institute in India.⁵⁰

As a result of his experimental subdural inoculation of laboratory rabbits with brain matter of street rabid dogs, Stanley observed that the incubation period of rabies in Shanghai seldom lasted much over a month in humans and over two weeks in rabbits. The latter incubation

⁴⁸ *Gong bu ju dongshihui huiyi lu* 工部局董事會會議錄 (The Minute of Shanghai Municipal Council), 13, 01/06/1898 (Shanghai: Shanghai guji chubanshe, 2001), 581; *Gong bu ju dongshihui huiyi lu*, 14, 15/03/1899, 477.

⁴⁹ Arnold Wright, *Twentieth Century Impressions of Hong-Kong, Shanghai, and other Treaty Ports of China* (London: Lloyd's Greater Britain Pub. Co, 1908), 436; SMA, U1-16-212, J. H. Jordan, “Some Aspects of Public Health Work in Shanghai,” 1935, 4, in the collection of “Dr. Jordan’s Speech Materials,” 1928-1937, 59. A few accounts of discoveries at the Shanghai Municipal Laboratory: “The Laboratory, it is true, was only fully established in 1898, but previously to [its establishment] bacteriological work had been performed in a sporadic fashion as and when it was considered that knowledge could not be obtained without the aid of bacteriological research. In 1885 Drs. [Neil] Macleod and [W.J.] Milles investigated the Cholera vibrio in this Town and took their cultures to Professor Koch’s own Laboratory in Berlin, thus showing that even at that time Shanghai was distinctly alive to the necessity for accurate scientific information. In addition, at a far earlier date [in 1872] the disease of cattle, known as Rinderpest (or in those days Steppe Murrain) had been thoroughly verified by sending specimens back to England where they were investigated by Professor John Gamgee and Dr. Duguid, with the result that Rinderpest (hitherto unsuspected in China) was for the first time verified.” “Dr. Jordan’s Speech Materials,” 59-60; J. H. Jordan, “Notes on Lecture for Staff Circle,” 01/04/1936, 3, in the collection of “Dr. Jordan’s Speech Materials,” 78; “Dr. Edward Henderson’s Memorandum on Steppe Murrain in Shanghai,” *Customs Gazette* 3 (Oct. 1871-March 1872 March): 66-75.

⁵⁰ The Shanghai Pasteur Institute was part of the Municipal Laboratory at the International Settlement, whereas the Pasteur Institute of Shanghai at the French Concession, starting in 1938, replaced the Municipal Laboratory in the Concession.

period varied from nine to sixteen days, averaging twelve days. By contrast, the incubation period for laboratory rabbits with intracranial inoculation in Paris varied from seventeen to thirty days, averaging eighteen days, whereas the incubation period of human rabies in Paris was between two and three months.⁵¹

Stanley's experimental results are credible insofar as his method is compatible with Pasteur's, especially in the choice of laboratory animals and inoculation methods. Both physicians used white albino rabbits in their experiments.⁵² Both of them injected the street virus directly into the central nervous system as practiced in the Pasteur Institute of Paris.⁵³ His experimental results concluded that the street virus of Shanghai rabies was more virulent than that of Paris.

Stanley learned the technique of Pasteur's rabies treatment in 1898 at the Kitasato Laboratory in Tokyo, Japan.⁵⁴ He procured the brain of a rabbit that died of rabies, and preserved it in glycerin according to the Calmette method. After returning to Shanghai, he commenced the preparation of rabies vaccine. He began by inoculating two local rabbits subdurally with the fourteen-day-old brain substance acquired from Japan. This inoculation failed and even after several trials the brain substance proved ineffective. Stanley conjectured that the glycerin used for preserving the brain may have been impure or the different breed of rabbits used may have affected its potency. The animals used by Kitasato were a larger breed with curly hair, whereas

⁵¹ Arthur Stanley, "The Shanghai Pasteur Institute," *Journal of Hygiene* 1. 2 (1901): 260; "Historical Data Relating to Public Health Matters, Public Health and Medical Report," 1902, 118, 119, and 121; "Historical Data Relating to Public Health Matters, Public Health and Medical Report," 1903, 121; SMA, U1-16-4652, "Annual Reports of the Health Department of Shanghai Municipal Council," 1914-1921; Geison, 184.

⁵² Robert H. Dunlop and David J Williams, *Veterinary Medicine: An Illustrated History* (St. Louis: Mosby, 1996), 377; Wilkinson, 15.

⁵³ Stanley, 266.

⁵⁴ *Gong bu ju dongshihui huiyi lu*, 13, 24/08/1899, 594.

the Shanghai rabbits were mostly small albinos bred in the laboratory, aged about three months and seldom weighing more than one kilogram.

Stanley then sought another source of virus. In February 1899, Paul-Louis Simond, then the Director of the Saigon Pasteur Institute, sent him the brain of a rabbit that had seven days of the incubation period before the symptoms occurred and was dead for sixteen days. The brain was preserved in a sealed tube filled with glycerin. In the meantime, Stanley also received from the Kitasato Laboratory a rabies-infected rabbit brain, with an incubation period of seven days and death on the tenth day. Using both strains of viruses he successfully undertook 379 passages through rabbits. The virus for inoculation of the rabbits was prepared by taking a fragment of the medulla oblongata of a rabbit that died of intensive rabies, grinding it into cream in a small porcelain mortar, sterilizing it by boiling it in water, and adding saline to create an emulsion of a consistency that could be administered with a hypodermic syringe.⁵⁵ After these passages, Stanley first produced a fixed virus with six to eight days of incubation period, and then lengthened it to nine days.⁵⁶

It is interesting to note how Stanley lengthened the incubation period from seven to nine days. We know that since Pasteur, scientists and physicians knew that passages of rabies virus through rabbits would only render it more virulent and shorten the incubation period, whereas its passage through monkeys rendered it less virulent and lengthened the incubation period. Stanley did not specify how he lengthened the incubation period of the fixed virus from rabbit passages. However, according to contemporary practices, we can speculate that Stanley might have been one of the first practitioners to apply antiseptic, heat or other agents to dilute the fixed virus and reduce its virulence when repeating the passages through rabbits. This drew upon the British

⁵⁵ The medulla oblongata is the lower half of the brainstem in connection with the spinal cord. The bulb is an archaic term for the medulla oblongata.

⁵⁶ Stanley, 261.

legacy of Listerian antiseptics.⁵⁷ He then used the fixed virus at the Shanghai Pasteur Institute in the first Pastorian rabies treatment in China.

Because he did not receive many cases seeking treatment, Stanley modified Pasteur's method for keeping the vaccine potent in the Shanghai Pasteur Institute. This scarcity was probably not due to the diminishing number of rabies cases. Rather, it may have been caused because Chinese patients were skeptical and did not know of the treatment's availability.⁵⁸ In order to keep the vaccine potent while also effectively using as few laboratory animals as possible, he found out that if one rabbit developed rabies every other day, it would suffice to produce a descending series of dried spinal cords beginning on any given day.⁵⁹ He dried the cords for the requisite number of days to form the series and then preserved them in sealed tubes filled with glycerin. These tubes were then sent to different medical posts, allowing treatment outside the Shanghai Pasteur Institute.⁶⁰ Since the incubation period of the Shanghai street virus appeared short, more intensive treatment was required with more frequent injections on the first few days of treatment, compared to the Pasteur treatment.⁶¹

Stanley's methods of testing the street virus, preparing and preserving dried spinal cords, and treatment, broadly followed the Pastorian procedures from Paris, but with special modifications inspired by experimental results and cultural factors. Stanley discovered that the street rabies virus in Shanghai appeared more virulent than that of Paris. Its short incubation

⁵⁷ Diluting the rabies virus in phenolized salt solution, for instance. Phillips, 416; "The incubation periods are often lengthened when putrefied material is used in the experiments." 'Review of H. Koenigsfeld's *The Diagnosis of Rabies* (1913),' in "Experiment Station Records of July-December 1914," 31 (Washington: Office of Experiment Stations of the United States, 1915), 580; Michael Worboys, *Spreading Germs: Disease Theories and Medical Practice in Britain, 1865-1900* (Cambridge: Cambridge University Press, 2000), 81.

⁵⁸ Stanley, 263.

⁵⁹ *Ibid.*, 263-264.

⁶⁰ *Ibid.*, 266.

⁶¹ *Ibid.*, 264-265.

period did not leave room for any delay of treatment, which had to commence right after the bite. Stanley modified the treatment with more frequent injections administered each day over the first few days. He also had to accommodate certain cultural considerations. He complained that the “comparative fewness of cases receiving the Pasteur treatment in Shanghai is explained by the prejudice of the Chinese against Western Medicine.”⁶² Setting aside his reasoning, the fact that few people were willing to receive the treatment despite the prevalence of rabies made him adjust his method by using fewer laboratory animals and manipulating them to speed up the course of disease in order to sustain a sufficient quantity of potent vaccines.

The Shanghai Pasteur Institute at the International Settlement, 1922-1942

Following Stanley’s departure, three changes of rabies research and treatment took place. First, there was a change in the view of the virulent nature of the Shanghai street rabies. J. H. Jordan, who had studied medicine at Cambridge University (M.B.), acquired his Master of Surgery (M.Ch.) credentials, and became the Vice-director of the Health Department at the International Settlement in 1922-1930 and the director of the same department in 1930-1942, questioned the more intensive quality of Shanghai rabies street virus. Secondly, given that the original fixed strain of rabies, used since 1899, had gradually lost its virulence, the Shanghai Pasteur Institute started using a London strain in producing its vaccine from early 1935 onwards. Thirdly, in rabies treatment, the Institute replaced the Pasteur technique with the Semple method.⁶³

⁶² Ibid., 263.

⁶³ Marie, 47; Chakrabarti, 148.

Jordan was skeptical of the claim that the Shanghai street rabies was more virulent than its counterparts in Europe.⁶⁴ Nevertheless, we cannot conclude otherwise from his prognostic study of Shanghai rabies and his studies on Negri bodies. In his prognostic study, the data of human rabies includes the duration between bites by rabid animals and patients' death. In the treated cases, death occurs no later than the 65th day after the bite, and most often before the 50th, but the peak of death rate appears on the 30th day. In the untreated cases, a peak of death rate also appears on the 30th day, but there is a second peak on the 60th day, which is higher than the first one.⁶⁵ (Figure 3.1) These numbers for treated cases are similar to the cases between 1899 and 1921, where death most often occurred around the 30th day after the bite, as recounted by Stanley.⁶⁶

⁶⁴ “[It] was at one time claimed that the Shanghai rabies virus was more virulent than in other countries, but it is not really necessary to bring such a solution. I think the principal reason for the higher mortality in Shanghai is the time that is allowed to elapse before patients present themselves for treatment.” J. H. Jordan, “Prognosis in Rabies,” *The Lancet* 234. 6060 (1939): 885. “[According to the study on Negri bodies, there] is no reason to suppose that rabies in China differs in this respect, or in any other respect, from rabies elsewhere.” SMA, U1-16-4653, ‘Anti-rabic Treatment of Pasteur,’ in “Annual Reports of the Health Department of Shanghai Municipal Council,” 1922, 23-24. “In certain other Institutes a tendency has been noted to attribute any [rabies treatment] failures that may occur to a special virulent strain of the infecting agent. This seems to be looking at the problem from the wrong viewpoint since it is precisely on these cases that the treatment stands or falls. 4 failures were reported from this Institute last year but no claim was made that they were due to an unusually virulent infection. Instead it was realized that possibly owing to the multiplicity of the patients’ wounds and their site, or to some other factors associated with either the patients or the treatment – and not necessarily with the virus – the methods in use cannot control the disease in every instance. As a result it has been decided that in cases where severe bites have been inflicted treatment will be extended to 18 doses as against the usual 15.” SMA, U1-16-4655, “Annual Reports of the Health Department of Shanghai Municipal Council,” 1931, 36-37.

⁶⁵ Jordan, “Prognosis in Rabies,” 884-885.

⁶⁶ SMA, U1-16-4650~4653, “Annual Reports of the Health Department of Shanghai Municipal Council,” 1875-1925.

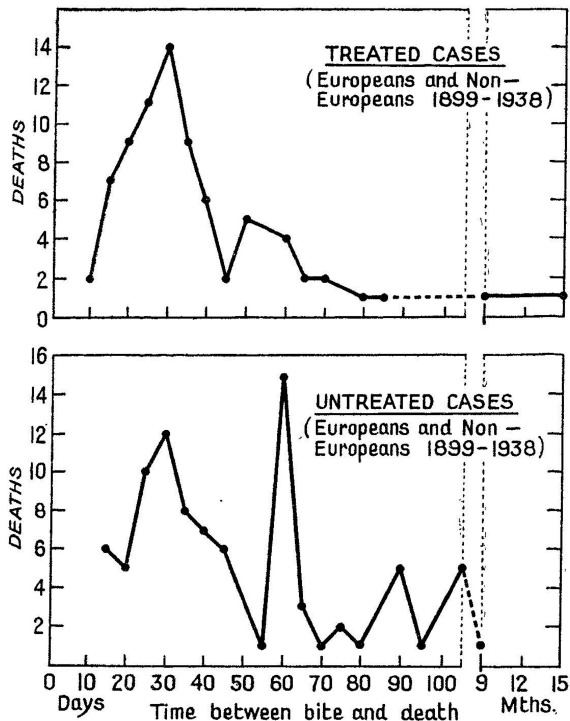


Figure 3.1: Jordan’s Observation of the Time at Which Death Took Place in Fatal Cases Treated and Untreated⁶⁷

The incubation period – the elapsed time between the initial exposure to the rabies virus through a bite by an infected animal and the occurrence of rabies symptoms – had to be evaluated in comparison to that of other countries. However, Jordan’s measure of the elapsed time was between the exposure and death, not between the exposure and the occurrence of symptoms. Jordan did not provide any data of the incubation period in the referenced study, his public health department at the Shanghai Municipal Council was well advanced in its statistical collections, to the point of equaling the standards of the medical services at the Chinese Maritime Customs Medical Services, the China Medical Missionary Association, the Henry Lester

⁶⁷ Jordan, “Prognosis in Rabies,” 885.

Institute of Medical Research, and the Hong Kong Government.⁶⁸ Therefore, his statistical evidence did not support his argument on the nature of rabies virulence in Shanghai.

The second argument that Jordan provided relied on the relatively low rate of appearance of Negri bodies in dogs that died of rabies. In the 1920s, his contemporaries mistook the Negri body for the pathogen of rabies. In Jordan's view, if Negri bodies appeared less often in the cases of Shanghai street rabies, the virulence of rabies in Shanghai could not be more intensive than in other places. Not until the 1930s was the Negri body recognized as a larger pathognomonic cellular inclusion of a rabies infection, but not as its pathogen.⁶⁹ It was useful as a diagnostic sign but its absence did not guarantee freedom from rabies. Jordan would not have known any better in the 1920s but we do not find any evidence that he corrected himself in this respect later.

Between 1922 and 1935, the Shanghai Pasteur Institute detected Negri bodies in 53-77% of the cases of animals that died of rabies, with the rate of error reaching in excess of 30%.⁷⁰ Jordan did admit that impurities in the reagents might cause a difficulty in detecting Negri bodies in his experiments. In 1926, he examined twenty-nine animals, with nineteen testing positive and proven rabid later on by an animal incubation test. However, the remaining ten animals were also proven rabid by re-inoculation test, even though no Negri bodies were detected in them in the first place. In other words, the rate of error was quite high, amounting to 35% in this case. From 1926 on, Jordan described the staining technique as improved and it should have been easier to detect Negri bodies. This might correlate with the higher percentage of detecting Negri bodies in the later years. Up to the 1960s, studies indicated that Negri bodies were found in about 75% of

⁶⁸ H. S. Gear, "The Study of Disease Prevalence in China," *Transactions of the Royal Society of Tropical Medicine and Hygiene* 29. 6 (1936): 679-683.

⁶⁹ Baer, 213.

⁷⁰ SMA, U1-16-4653~4656, "Annual Reports of the Health Department of Shanghai Municipal Council," 1922-1935.

naturally occurring cases of rabies.⁷¹ There was still nearly a 25% possibility that an infected case would not yield any Negri bodies detected. The technical difficulties that Jordan experienced denied him the capacity to distinguish the comparative virulence of Shanghai street rabies, based on his study of Negri bodies. Neither Jordan's prognostic study nor his study on Negri bodies could controvert the results of other physicians' microbiological experiments, in which Shanghai rabies appeared more virulent than that of Paris.

Moreover, it seems that some test results of incubation periods recorded between 1922 and 1928 contradicted Jordan's assertion. Throughout these years, the Shanghai Pasteur Institute examined suspicious local animals for rabies. In testing the street rabies virus from rabid animals in laboratory rabbits, the incubation period ranged from 12.9 to 14.3 days.⁷² This result was not very different from Stanley's test results from 1914 to 1921. The incubation period of Shanghai street rabies in the 1920s and 1930s still appeared shorter than that originally tested in Paris.

Jordan and Stanley did both agree that rabies treatment should begin as soon as possible after the bite, but Jordan emphasized that the delay of treatment was the main reason for high mortality of rabies in Shanghai, not necessarily owed to the virulence of the local rabies virus.⁷³

The original rabies strain at the Shanghai Pasteur Institute was an offshoot of the Saigon strain originated from the Paris virus, acquired by Stanley in 1899. By the late 1930s, in his experiments, Jordan observed that this fixed virus had lost its subcutaneous infecting power to a large extent. It would also fail to infect laboratory animals with any degree of regularity either by intraocular infection or by injection into the neck muscles, but remained effective in intracranial

⁷¹ Baer, 170.

⁷² SMA, U1-16-4653~4654, "Annual Reports of the Health Department of Shanghai Municipal Council," 1922-1928.

⁷³ Jordan, "Prognosis in Rabies," 885; SMA, U1-16-4653, 'Anti-rabic treatment of Pasteur,' in "Annual Reports of the Health Department of Shanghai Municipal Council," 1921, 22; SMA, U1-16-4653, 'Anti-rabic work,' in "Annual Reports of the Health Department of Shanghai Municipal Council," 1931, 36-37.

inoculation or by injection into the mucous layer of the tongue directly contacting the nerve endings.⁷⁴ Since early 1935, the Institute had started using a newly found London strain as its fixed virus and for producing the rabies vaccine.⁷⁵

Starting in 1922, the Shanghai Pasteur Institute gradually replaced the Pasteur treatment with the Semple vaccination. David Semple, a military physician of British Army in India, developed the Semple vaccine at the Kasauli Pasteur Institute in 1911. He modified the Fermi vaccine by adding 1/100 of carbolic acid to sterilize 8% (instead of 5% in the Fermi method) of the fixed virus for 24 hours at 37°C and adding the same volume of water for dilution. The patient received only half as much virus as did Fermi's patients.⁷⁶ Requests for anti-rabies vaccine from the outskirts of Shanghai motivated the Institute to find a proper method for transporting and preserving the vaccine. However, the Shanghai Pasteur Institute did not use the Semple vaccine right away when requests arose. It first experimented on laboratory animals using the Hoegy's vaccine. A. Hoegy developed this in Budapest, Hungary, where he replaced dried spinal cords with a diluted fixed virus before desiccating the vaccine. The desiccation did not alter the quality of the virus but only its quantity.⁷⁷ The dry vaccine seemed more convenient for transportation. However, after researchers at the Shanghai Pasteur Institute experimented with the Hoegy's and the Semple vaccine, they found that the former was not suitable "to [the] conditions [in Shanghai]."⁷⁸ Their reasons were not stated explicitly, but we can

⁷⁴ J. H. Jordan et al, "Bites of Rabies Animals Treated by Experimental Cautery with Ultra Violet Rays and Eosin," *Transactions of the Royal Society of Tropical Medicine and Hygiene* 29. 2 (1939) 233-234; Y. Manouélian and J. Viala, "D'Où Vient la Virulence de la Bave chez les Animaux Rabiques?" *Comptes Rendus de l'Académie des Sciences* 183 (1926): 1357-1359.

⁷⁵ Jordan et al., "Bites of Rabies Animals," 236.

⁷⁶ Marie, 47.

⁷⁷ *Ibid.*, 41.

⁷⁸ SMA, U1-16-4653, 'Anti-rabic Treatment of Pasteur,' in "Annual Reports of the Health Department of Shanghai Municipal Council," 1922, 23-24.

speculate that the vaccine did not have enough virulence to induce immunity against rabies, which seemed more virulent in Shanghai than in Budapest.

Even though the use of the Semple vaccine began in 1921, Jordan had his doubts for the first few years. In late 1921, the Institute prepared the Semple vaccine to use on patients who could not reach Shanghai for the Pasteur treatment within twenty-four hours after the bite.⁷⁹ However, Jordan's Annual Report of 1922 raised suspicions: "Our experiments on the protective power of this [Semple] vaccine, and on the possibility of protecting animals from rabies by a single injection have given inconclusive results; but they have given us an insight into the subject, and very clearly demonstrated the difficulty of reaching any trustworthy conclusions. We have, at present, no evidence that a single dose of dead carbolised vaccine confer any protection on rabbits."⁸⁰

Following his attendance at the First International Rabies Conference in Paris in 1927, Jordan saw his confidence in the Semple vaccine bolstered by the reports of its low rate of paralysis occurring after rabies treatment, in addition to its superior transportability and longevity.⁸¹ Even after Jordan confronted several cases of post-vaccinal paralysis in Shanghai, his confidence in the Semple vaccine remained grounded in the information he had acquired at the Conference and A. G. McKendrick's collections of statistical materials published in the *Analytical Review of Reports from Pasteur Institutes on the Results of Anti-rabies Treatment* from 1930 to 1941.⁸² Before the 1940s, the post-vaccinal paralysis, known as "laboratory rabies,"

⁷⁹ SMA, U1-16-4653 'Vaccines,' in "Annual Reports of the Health Department of Shanghai Municipal Council," 1921, 26.

⁸⁰ "Annual Reports of the Health Department of Shanghai Municipal Council," 1922, 23-24.

⁸¹ SMA, U1-16-2639, "Letter from J. H. Jordan to J. E. Murray," 31/01/1931. Regarding the discussion of post-vaccinal paralysis, see Chakrabarti, 142-178.

⁸² Marie, *Reports to the International Rabies Conference at the Pasteur Institute of Paris in 1927* (Geneva: League of Nations, 1927); A. G. McKendrick, "Analytical Review of Reports from Pasteur Institutes on the Results of Anti-

was usually associated with the Pasteur rabies vaccine. Only in the late 1940s did the World Health Organization find that the paralytic cases were actually a reaction of nervous tissue to the vaccine and not an effect of the rabies virus. Thus “laboratory rabies” was not true rabies but a different disease, known as encephalomyelitis, a kind of inflammation of the brain or the spinal cord.⁸³ Moreover, reliance on the Semple vaccine could not exclude the possibility of its causing such inflammation, since the vaccine also used nervous tissue. Throughout the years, there were several cases of post-vaccinal paralysis that followed the Semple vaccination.⁸⁴

Between 1922 and 1942, the Shanghai Pasteur Institute reexamined the virulent nature of Shanghai rabies in light of Jordan’s studies on prognosis in rabies and Negri bodies. The conclusions of these studies contradicted the previous experimental findings by Stanley by claiming that the Shanghai rabies virulence was no more intensive than that of its counterparts elsewhere. In addition to the variability of rabies virulence, the diminishing power of the Paris strain after nearly four decades and the need to replace it with a more potent London strain demonstrate another type of variability that local physicians had to take into account in order to treat rabies effectively. Moreover, replacing the Pasteur vaccination with the Semple treatment fulfilled the local requirements, such as long-distance transportation. Responding to requests from remote places, Jordan and his colleagues decided to produce a vaccine that could cope with the difficulties of transportation and preservation. Through various experiments with the Hoegyès, Fermi, and Semple vaccines, they chose the Semple vaccine as the one best suited to the local conditions.

rabies Treatment,” 1930-1941, *Quarterly Bulletin of the Health Organization*, 1-9 (Geneva: League of Nations, 1930-1941).

⁸³ Chakrabarti, 175.

⁸⁴ *Ibid.*, 177.

The Pasteur Institute of Shanghai at the French Concession, 1938-1949

In July 1921, a French diplomat in Shanghai died after being injected with a rabies vaccine produced by the Shanghai Pasteur Institute at the International Settlement with contaminated spinal cords. His death inspired general discontent at the French Concession.⁸⁵ The French Municipal Administrative Council (*Conseil d'Administration Municipale*), the governing body of the French Concession, donated 600 *taels* in 1900 and 1,000 *taels* in 1907 to the Shanghai Pasteur Institute as a consideration for treating its rabies patients in lieu of spending far greater amounts on building their own medical institution.⁸⁶ After this incident, the public opinion at the French Concession called for an institution of its own for rabies treatment. Under the auspices of E. L. Tartois, who had studied rabies treatment and practiced medicine at various hospitals in Paris and also served as the former Shanghai Municipal Counselor, the “Anti-Rabies Institute” was inaugurated on 27 December 1922, the date of Pasteur’s centennial celebration, as a laboratory affiliated with the French-Catholic-founded Ste. Marie Hospital.⁸⁷

René Porak was appointed in charge of this Anti-Rabies Institute. Porak had rabies research experience at the Pasteur Institute of Paris and was a member of the medical faculty of the University of Paris.⁸⁸ At the time of his appointment, he was working and teaching at the Ste. Marie Hospital and Aurora University in Shanghai. The Kitasato Institute in Japan sent a package of fixed virus, containing fifty doses of vaccine, to this new Anti-Rabies Institute in

⁸⁵ MAEN, Shanghai 635/PO/A/129, René Porak, “Les Débuts de l’Institut Antirabique Français de Shanghai,” *Journal de Pékin*, 12/01/1923.

⁸⁶ *Gong bu ju dongshihui huiyi lu*, 14, 04/01/1900, 528. In the second half of the nineteenth century, the East India Company reckoned 1 *tael* at 6s. 8d. Therefore, the amount of 1,000 *taels* was equal to 333£ 6s. 8d. Williams, 268; Porak, “Les débuts de l’Institut Antirabique français de Shanghai.”

⁸⁷ “New Anti-Rabies Clinic Planned,” *North China Herald and Supreme Court & Consular Gazette*, 1870-1941, 26/11/1921, retrieved from ProQuest, *Historical Newspapers: Chinese Newspapers Collection*, 1832-1953, 579.

⁸⁸ *Ibid.*

Shanghai.⁸⁹ Before Porak's departure in 1924, he directed the rabies vaccination and vaccine production at the Institute according to Pasteur's methods, using the initial fixed virus sent from Japan. He took the more intensive rabies virulence in the Far East into account by recommending increased doses and accelerated adaptation for immunizing against a virus that was more life threatening than in Europe.⁹⁰

Unfortunately, rabies research ceased after Porak's departure from Shanghai.⁹¹ The laboratory then turned into a clinical training space for the medical students at the Aurora University under the direction of Hu Tingfu 胡廷黻, a Chinese national who had just returned from his study at the Pasteur Institute of Paris. Hu died in 1926 and his successor continued to use this laboratory for teaching and training but not specifically for work on rabies. In 1934, the laboratory was incorporated into the Municipal Laboratory of the French Municipal Administrative Council at the French Concession in Shanghai.⁹²

At the end of 1928, Li Yuying and Zhu Minyi 褚民誼, a French-educated Chinese physician and politician in China, led the Chinese delegation to the Sino-Belgian Commission of the Returned Boxer Indemnity in Brussels. They proposed to fund the creation of a Pasteur Institute in Shanghai with the return of the Boxer indemnity.⁹³ They hoped that its creation could

⁸⁹ MAEN, Shanghai 635/PO/A/129, "Letter from Auguste Wilden, Consul of France in Shanghai to Paul Claudel, Ambassador of France in Japan," 06/01/1922.

⁹⁰ Porak, "Les Débuts de l'Institut Antirabique Français de Shanghai."

⁹¹ MAEN, Shanghai 635/PO/A/25, "L'Institut Pasteur de Changhai, Quatorzième Filiale de l'Institut Pasteur de Paris," Changhai, 1938, 7.

⁹² MAEN, Shanghai 635/PO/A/25, J. H. Raynal, "L'Institut Pasteur de Changhai," *Bulletin Medical de l'Université l'Aurore* 20 (1938): 6.; Yang Wei 楊威 and Li Zhiping 李志平, "Shanghai Baside yanjiuyuan de yanjiu gongzuo" 上海巴斯德研究院的研究工作 (The Research at the Shanghai Pasteur Institute), *Zhonghua yishi zazhi* 38. 2 (2008): 93.

⁹³ In the late 1910s and the 1920s, Li Yuying had already attempted to create a Pasteur Institute in Beijing. For this project, Li requested Bertrand's help to arrange a meeting with Émile Roux, then the Director of the Pasteur Institute of Paris. Along with the letter of recommendation, he included a lacquered plate dating from Qianlong period in the

replace the Franco-Chinese Technical Institute (*Institut Technique Franco-Chinois*) in Shanghai, an institution originally funded by the German reparation to the Treaty of Versailles.⁹⁴ The Pasteur Institute of Paris supported the proposal. Louis Boëz, Director of the Pasteur Institute of Saigon, arrived in Shanghai and participated in organizing the creation of the Pasteur Institute there.⁹⁵ However, the project also ended in failure because of insufficient funds, not to mention that the faculty of both Franco-Chinese Technical Institute and the Aurora University resisted because of their fear of losing their positions and intellectual prestige.⁹⁶

Anti-rabies research and treatment resumed at the French Concession in 1938 with the establishment of the new Pasteur Institute of Shanghai, the outcome of an initiative by the French government. Overseen by the French Ministry of Foreign Affairs, this new institute, incorporating the Municipal Laboratory at the French Concession, functioned as a joint effort among the Department of Public Hygiene and Assistance (*Service d'Hygiène et d'Assistance Publique*) in the French Municipal Council, the Association of the Public-Interest Works of the French Concession (*Caisse des Oeuvres d'Intérêt Public de la Concession Française*) in Shanghai, and the Pasteur Institute of Paris. All three sponsors shared the expenses, and additionally the Pasteur Institute of Paris provided administrative and technical assistance to the

eighteenth century as a gift meant to express his gratitude and emphasize the importance of the matter. The project eventually failed. AIP, Fonds Li Yuying, Li Yuying, "Lettre à Gabriel Bertrand," 06/06/1919.

⁹⁴ MAEP, Série E, Asie, Chine, 501, 138-144, "Institut Technique Franco-Chinois de Shanghai; Le Dr. Tsu et la Commission Sino-Belge de l'Indemnité Boxer," 14/05/1929; Bastid-Bruguière, 264.

⁹⁵ MAEP, Série E, Asie, Chine, 501, 191, "Création d'un Institut Pasteur à Changhai," 14/08/1929; Bastid-Bruguière, 264.

⁹⁶ MAEP, Série E, Asie, Chine, 501, 140-144. "Institut Technique Franco-Chinois de Shanghai." These initial failures did not undermine the professional network that Li Yuying had cultivated in close collaboration with Chinese political elites and their French connections, especially in the course of establishing the Pasteur Institute of Shanghai in the late 1930s and founding two Sino-French Universities, one in Beijing and another in Lyon.

new Institute, established as its local branch.⁹⁷ The Pasteur Institute of Saigon also offered its assistance in establishing this Shanghai Institute. In addition to supplying materials and equipment, it also trained Chinese vaccine preparers, such as Chen Hengxin 陳恆鑫 and Huang Rong 黃榮, who later worked at the Pasteur Institute of Shanghai.⁹⁸ The Pasteur Institute of Shanghai, replacing the Municipal Laboratory, conducted microbiological and serological research, chemical tests, and vaccine production and services, with special focus on vaccines for rabies, tuberculosis, and other infectious diseases, such as cholera and typhoid.⁹⁹ The purpose of these activities was announced as “[adaptation] to the infectious ‘climate’ of Shanghai and to the technical problems of microbiology found in the local practices.”¹⁰⁰

Between 1938 and 1949, Jean Henri Raynal and Liu Yongchun contributed heavily to rabies research and treatment in Shanghai.¹⁰¹ Raynal, a French physician of the Colonial Troops, transferred from the Pasteur Institute of Hanoi in French Indochina where he had worked as the director of the laboratory of microbiology and serology since 1933, to become the first director of this new Institute, officially designated as the Pasteur Institute of Shanghai (*Institut Pasteur de Changhai*).

Raynal and Liu found that rabies in Shanghai was marked by local particularities, especially in its short incubation period. By inoculating laboratory rabbits intracranially with the

⁹⁷ SMA, Q2-1-60-17, “The Contract of the Establishment of the Pasteur Institute in Shanghai,” signed by Jacques Meyrier (Consul-General and the director of the Association of the Public-Interest Works of the French Concession) and Louis Martin (Director of the Pasteur Institute in Paris, 1934-1940); “L’Institut Pasteur de Changhai,” 1.

⁹⁸ MAEN, Shanghai 635PO/A/39, “Lettre du Directeur Administratif des Services Municipaux Secrétaire au Conseil au Consul Général de France à Changhai, 06/11/1934.

⁹⁹ “L’Institut Pasteur de Changhai,” 13-18.

¹⁰⁰ J. H. Raynal, *Rapport sur le Fonctionnement Technique de l’Institut Pasteur de Changhai en 1938* (Shanghai: Tou Se We, 1939), 1.

¹⁰¹ MAEN, Shanghai 635/PO/A/25, “Propositions de Promotions ou Nominations – Institute Pasteur, 1944-1946,” 13/01/1946.

street virus in Shanghai in 1939, they measured the incubation period as twelve to thirteen days,¹⁰² consistent with Stanley's observation of twelve days on average and almost one week shorter than that of Paris. In 1947, their experiments showed the incubation period as ten days, even shorter than the result obtained ten years earlier.¹⁰³ They found that in Shanghai the human rabies incubation period ranged from twenty-nine days to one month, as opposed to lasting two to three months in Paris, likewise agreeing with Stanley's observations.¹⁰⁴

Raynal noted in 1939 that the rabies virus was acclimated to its geographical region. The degree of virulence in the street virus varied according to the climate where it was isolated, as reflected in the change of incubation period.¹⁰⁵ Moreover, even a fixed virus of the same origin was likely to behave differently depending on its location. This observation attested to a perception of street and fixed viruses different from that in Pasteur's days. Pasteur believed that the incubation period of the street virus could vary between different individual humans but variability in different geographical regions and climates was unknown until its demonstration by Raynal, Liu and, other rabies experts in other parts of the world outside of France. Moreover, they found the fixed virus to belie its designation by changing according to the climate.¹⁰⁶ In the changes of geographical locations, from Paris to Saigon, and thence to Shanghai, the incubation period of the fixed virus varied from seven to eight days in Paris (as tested in 1891), to six days

¹⁰² J. H. Raynal, *Rapport sur le Fonctionnement Technique de l'Institut Pasteur de Changhai en 1939* (Shanghai: Tou Se We, 1940), 36.

¹⁰³ Y. Ch. Lieou and C. C. Kouo, "Premier Virus Rabique 'Renforcé' Isolé à Changhai," *Annales de l'Institut Pasteur* 79 (1950): 108.

¹⁰⁴ Raynal and Palud, 5; J. H. Raynal, *Rapport sur la Fonctionnement Technique de l'Institut Pasteur de Changhai en 1939*, 36.

¹⁰⁵ Raynal and Lieou, 1.

¹⁰⁶ Liu Yongchun 劉永純, "Shanghai qi du yanjiu zhi yi de" 上海瘰毒研究之一得 (Learning from the Shanghai Rabies Research), *Zhonghua yixue zazhi* 32. 102 (1945): 59; Lépine, 181. The examples could also be found in Tangier and Hanoi.

in Saigon (1895), to four days in Hanoi (1935), and to 4-4.5 days in Shanghai (1936).¹⁰⁷ The fixed virus used at the French Pasteur Institute of Shanghai was the strain isolated by Pasteur on 19 November 1882 from a street virus. This Paris strain of fixed virus served as a starting point for most of the fixed strains used throughout the world for anti-rabies vaccination.¹⁰⁸

Upon founding the Saigon Pasteur Institute in 1891, Calmette brought there the fixed strain of the rabies virus at its 275th passage and repeated its passages through rabbits.¹⁰⁹ In September 1936, the ensuing strain, comprising rabbit brain matter suspended in glycerin, then already in its 2113th passage, was sent to the French Pasteur Institute of Shanghai. The Pastorianians there performed intracranial inoculation into rabbits with a quarter cc of the emulsion made of one portion of the ground rabbit brain sent from Saigon and fifty portions of saline solution. This vaccine paralyzed the rabbits after 4-4.5 days. The incubation period of this fixed virus was almost half of the duration tested in Paris. Raynal attributed its shortening to the adaptation of the virus to the local climate.¹¹⁰

The test results were similar to that of Hanoi. The Pastorianians there also observed that the biological properties of the fixed virus in Hanoi differed from its original strain discovered by Pasteur. They considered an accommodation to these properties as essential for effective treatment.¹¹¹

After acknowledging the short incubation period of the fixed virus, from 1938 to 1949, the Pasteur Institute of Shanghai employed a phenolized vaccine for rabies treatment. But why

¹⁰⁷ Raynal and Lieou, 1; Liu, "Shanghai qi du," 59.

¹⁰⁸ Lépine, 181.

¹⁰⁹ Genevray and Doderro, 629.

¹¹⁰ Raynal, *Rapport sur le Fonctionnement Technique de l'Institut Pasteur de Changhai en 1938*, 49.

¹¹¹ Genevray and Doderro, 651.

did they employ a supposedly weaker vaccine, instead of a stronger live vaccine acquired through the Pasteur method, for the more virulent local rabies virus?

In the course of establishing the Pasteur Institute of Shanghai in 1937, the Pastorians prepared dried spinal cords of rabid rabbits for anti-rabies treatment and planned to employ a live vaccine, as was done in Pasteur's days. However, urgent requests from the outskirts of Shanghai required a transportable and longer-lasting vaccine. The urgency only increased with laboratory animal shortages, due to the Sino-Japanese war starting in July 1937. In order to cope with such problems, in August 1937, all rabies vaccine production and treatment, both for the Institute and for remote areas, relied on the production of a phenolized vaccine by the Fermi method, which required only half of the amount of the nervous substance from laboratory animals.¹¹² The maintenance of the fewest number of laboratory animals required for producing a phenolized vaccine allowed the Institute to continue its work despite great difficulties in a troubled time.¹¹³

For more than a decade, the Pastorians at the Pasteur Institute of Shanghai sought other effective methods to prepare rabies vaccine, mindful of planning backup options for a turbulent era. In 1938, H. Jacotot experimented with a formalin rabies vaccine and found it to work against the rabies street virus in Nhatrang, French Indochina, better than a phenolized vaccine.¹¹⁴ This vaccine was then transmitted to Shanghai. The Pastorians in Shanghai reproduced and distributed the formalin vaccine to local veterinarians for anti-rabies campaigns for vaccinating dogs.¹¹⁵

¹¹² In 1908, C. Fermi "used Sassari's fixed virus, which is regularly virulent on subcutaneous injection. The addition of 1/100 of carbolic acid appears to sterilize 5% emulsions of this virus; 5 to 6 c.cm doses are injected for a period of 21 days. In other series of vaccinations, Fermi combines the use of the vaccine and that of an anti-rabies serum, with an excess of rabies virus." Marie, 45.

¹¹³ MAEN, Shanghai 635PO/A/25, Y. Ch. Lieou, "L'Institut Antirabique de la Concession Française de Changhai au Cours des Années 1937, 1938, 1939," *Bulletin Médical de l'Université l'Aurore* 5. 2 (1940): 84.

¹¹⁴ Henri Jacotot et al, "Contribution à l'Étude Expérimentale de la Vaccination Antirabique," *Annales de l'Institut Pasteur* 61. 1 (1938): 92-103.

¹¹⁵ MAEN, Shanghai 635PO/A/25, "Lettre du Docteur Royal, Directeur de l'Institut Pasteur de Changhai au Directeur des Services d'Hygiène et d'Assistance," 01/04/1938, 1-4.

However, the use of the formalin vaccine did not go without challenges. The Pastorians in Shanghai tested Jacotot's formalin vaccine and compared it with the existing Fermi phenolized vaccine.¹¹⁶ The experiment concluded that in preventive and curative vaccination alike, the phenolized vaccine performed better than the formalin vaccine. However, even though the former was more effective, it was not completely harmless, because it was found to cause rabies in one guinea pig and its successive injections caused shock in rabbits.¹¹⁷ In the end, the Fermi phenolized vaccine won the Shanghai Pastorians' favor, despite the preference for the formalin vaccine in French Indochina. The test showed that different types of vaccine might work differently in different geographical locations, even with similar grades of rabies virulence. The Pastorians produced this vaccine and used it for rabies treatment until 1949, the year before the Pasteur Institute in Shanghai closed in 1950.¹¹⁸

Led by Raynal and Liu, during the late 1930s and early 1940s the Pastorians at the Pasteur Institute of Shanghai at the French Concession discovered that the incubation period of the Shanghai street rabies was shorter compared to that of Paris. Their discovery conformed to the earlier observation by Stanley at the Shanghai Pasteur Institute in the International Settlement before 1922. With the advantage of a Pastorian network, the knowledge of the variability of the local rabies virus, be it a naturally occurring virus or a fixed virus, and its propensity for acclimation according to different geographical locations, widely circulated through scholarly publications, especially in the *Annales de l'Institut Pasteur* and *Bulletin de la Société de Pathologie Exotique*. Additionally, the more intensive Shanghai rabies virulence did not cause

¹¹⁶ Raynal and Lieou, 1-4.

¹¹⁷ Ibid.

¹¹⁸ In 1948, the Pasteur Institute of Shanghai started using a new strain of the rabies virus, isolated for the first time from a local street virus, as the original virus for repeating passages to acquire a fixed virus vaccine. The incubation period of this street virus was 10 days; through intracranial passages it reduced to 6 days, through intraocular passages, to 7-11 days, and through subcutaneous passages, to 7-12 days. Lieou and Kouo, 108-109.

the Pastorians to revert to the Pasteur treatment with a live vaccine. Instead, they chose to administer one that was relatively weaker. The choice of the Fermi vaccine at the French Concession agreed with the particular local conditions. Responding to the needs for supplying far-removed locations and accommodating animal shortages, the Institute used the phenolized vaccine. Not only was it easier to transport and preserve, it could also cut in half the consumption of laboratory animals in vaccine production, compared to both the Pasteur and the formalin vaccine preparation. In choosing the phenolized over the formalin vaccine, it was made clear that rabies vaccine had to fit the local condition, and could not be used universally.

Conclusion

The diverging opinions whether the Shanghai rabies virus was more intensive than that of Paris were settled by convincing evidence collected by Stanley at the Shanghai Pasteur Institute in the International Settlement from 1899 to 1921 and by the Pastorians at the Pasteur Institute of Shanghai in the French Concession from 1938 to 1949. Applying the same experimental principles as were used at the Pasteur Institute of Paris, they found the natural-occurring rabies virus in Shanghai to be more intensive.¹¹⁹ Jordan's studies on prognosis in rabies and Negri bodies did not alter this conclusion.

The more intensive nature of local rabies did not necessarily lead to treatment with a more virulent live vaccine, such as was used in the Pasteur treatment. Adaptions to local social and political circumstances are demonstrated in the choice of rabies vaccine. Both Jordan and the Pastorians at the French Concession weighed their decision to use phenolized vaccine against the

¹¹⁹ Similarly, the researchers and physicians in the Peking Union Medical College Hospital in the 1940s also concluded that "the possibility that the virus of hydrophobia in North China is more virulent than in Western Europe and Africa." Isidore Snapper, *Chinese Lessons to Western Medicine* (New York: Grune and Stratton, 1965), 141.

concerns for transportability and preservation, rather than efficacy. Since they had to deliver the vaccine over long distances, they needed it to be portable and longer lasting. For the Pastorians, given the difficulty of acquiring laboratory animals during wartime, they had to produce a vaccine economically with a minimal animal consumption.

The need for adaptation, both scientific and socio-political, motivated multiple directions of research on rabies. Beginning with Pasteur's experiments manipulating the incubation period of a fixed virus for vaccine production, adaptation had to take place with the actual pathogen then unknown. European physicians also had to deal with or adapt to the variability of the rabies street virus and the fixed virus in different geographical locations. They tested the virulence of the local street virus and observed the particularity of local animals and the propensity of virus acclimation in different parts of the world. Thus Jordan had to adopt a new London strain for making the fixed virus once the immune power of the original Paris strain had diminished. The Pastorians at the French Concession chose the phenolized over the formalin vaccine, based on the result of their scientific experiments, showing that the former worked better locally in Shanghai, even though the latter had proven to be better in French Indochina. These local European physicians gained their knowledge about Shanghai rabies and its treatment through adaptation in their studies and experiments.

CHAPTER IV

International Collaboration on Vaccination and Related Public Health Measures against Smallpox and Blindness in Tianjin, 1922-1942

On 11 October 1924, around forty physicians of various nationalities gathered at Peiyang Naval Medical School (*École de Médecine Navale du Peiyang*) in Tianjin to form the International League for the Prevention of Blindness in China (*Ligue Internationale pour la Prévention de la Cécité, Zhongguo hua yang fang mang hui* 中國華洋防盲會). Emile Lossouarn, Director of the Pasteur Laboratory and Chief Physician of the French Municipal Public Health Service at the French Concession (*Service de Santé de la Concession Française*), initiated this meeting. Upon its opening, Lossouarn pointed out the severity of blindness in China, affecting two million, approximately 4 in 1,000 at the time.¹ He stressed the necessity of an international institution collaborating to suppress diseases that affected the eyes. In particular, the League would pursue vaccination by all means in its power, as smallpox was the biggest cause of blindness in China.² The Chinese who had lost their sight from smallpox were estimated to constitute 35% of the total number of the blind in China.³ Vaccination against smallpox served to bring down the

¹ MAEN, Tientsin 691PO/1/114, "Projet d'une Ligue Internationale de Prévention de la Cécité en Chine," 1; MAEN, Tientsin 691PO/1/114, "Lettre du Dr. Lossouarn aux Missionnaires," 1923. The contemporaries had similar estimate of the blind population in China. For example, H. J. Howard, an ophthalmologist with many years' experience in China, wrote: "There are probably not less than one-half million of people in China today who are blind in both eyes; probably five million more who are blind in one eye, and at least fifteen million who are nearly blind, many of whom will be totally blind within a few years." Harvey J. Howard, *Trachoma in China* (Beijing: Peking Medical College, 1925), cited in The League of Red Cross Societies, *The Prevention of Blindness - Minutes of the Constitutive Assembly of the International Association for the Prevention of Blindness* (Paris: The League of Red Cross Societies, 1929), 35.

² MAEN, Tientsin 691PO/1/114, 'Travail dans les Provinces,' in "Rapport General, La Ligue Internationale pour la Prévention de la Cécité en Chine," 1933, 5.

³ "The International Association for the Prevention of Blindness," *British Journal of Ophthalmology* 15.4 (1931): 248.

number of patients in this era of smallpox epidemics. It also acted as an important institutional tactic for blindness prevention.

In a global perspective, founding of the League and its focus on smallpox for blindness prevention was a pioneering move that preceded other international cooperation to prevent blindness. The League of Red Cross Societies started its mission of blindness prevention in 1926 and the Second Pan-American Conference of the Red Cross at Washington, D.C. in the United States then followed. During the Constitutive Assembly of the International Association for the Prevention of Blindness on 16 March 1928, the participants agreed that smallpox had been the greatest single cause of blindness. Reports for the first half of the nineteenth century show that one-half to two-thirds of the blind owed their handicap to this disease in the world. As the problem gradually mitigated in Western Europe, it still remained as a serious problem for many regions elsewhere, including China.⁴ The work by the League of Red Cross Societies, with the device “Educate and Care,” (*Instruire et Soigner*) stood out among blindness prevention campaigns even among countries where smallpox was also a leading cause of blindness.⁵ For colonial physicians and local practitioners of Western medicine in general, an urgent concern was coping with diseases such as smallpox and prevalent eye diseases like trachoma and conjunctivitis that were no longer major medical problems in Western Europe where physicians often knew of such diseases only theoretically.

⁴ The League of Red Cross Societies, 24.

⁵ *Ibid.*, 36. In comparison of the situation in India, “[s]mallpox, as is well-known, plays havoc with the eyes of many children. A simple treatment will save the eye in these cases. Field workers are taught to apply this. The village officers are requested to send immediate reports of cases of smallpox and the sub-assistant surgeon of the Saluta or the Touring Medical Officer, if there is one, is expected to visit the village as soon as possible. But with smallpox breaking out sporadically in widely scattered villages, these medical officers, though they can do much, cannot do everything, and there the [Blind Relief] Association field-workers can render help, for they are on the spot. They have continually to visit cases of smallpox in their villages and keep the eyes clean and apply the simple treatment mentioned. In this way many eyes can be saved, and were it not for this system, many children in the villages would be left to go blind.” *Ibid.*, 24.

This chapter deals with the colonial context of Tianjin where multi-national imperial actors were located in up to nine foreign settlements during different periods (Figure 4.1). I investigate how the colonial physicians and local practitioners of Western medicine dealt with such urgent concerns by evaluating experiences based on local specificities and then translating these into organized public health efforts. I trace these experiences in tracking the origins of the Chinese “native eye drugs,” learning where they were used and experimenting with them. The empirical work was not confined to laboratories but more importantly extended to fieldwork, aiding the League in determining where physicians should implement smallpox vaccination and other campaigns for blindness prevention.⁶

Furthermore, I evaluate if these tactics worked and what the obstacles the physicians encountered, in consideration of local and international collaboration and compromises with the local Chinese physicians and medical officers in other foreign concessions. Against the backdrop of the 1939 flood, the most severe in Tianjin during the first half of the twentieth century, I evaluate whether the public health measures prevented smallpox epidemics and mitigated the medical problems during and after this inundation.⁷

⁶ “To obtain more experience, ...” MAEN, Tientsin 691PO/1/114, E. Lossouarn, “Report of Dr. Lossouarn: Preparatory Meeting of the International League for Prevention of Blindness in China,” 11/10/1924, 4. There were other contemporary organizations and movements. “At the instigation of the China Continuation Committee, the Mandarin Braille Literature Committee was reconstituted as a Committee for the Promotion of Work for the Blind, and now includes in its programme a study of causes of blindness and educational propaganda; the Police Public Health Demonstration, Peking, conducts school and industrial surveys and has a definite programme of medical care and education; the Council of Health Education includes prevention of blindness work among its activities... and in 1927 a committee for the prevention of blindness was formed which, according to Mr. George B. Fryer, Superintendent of the Institute for the Chinese Blind, will take up work on a small scale, beginning with the schools.” The League of Red Cross Societies, 36.

⁷ Lo Chengzheng 駱承政 and Le Jiexiang 樂嘉祥, *Zhongguo da hongshui* 中國大洪水 (Floods in China) (Beijing: Zhongguo Shudian, 1996), 120-27 and 387-434 (list of floods in China during 1840-1992).

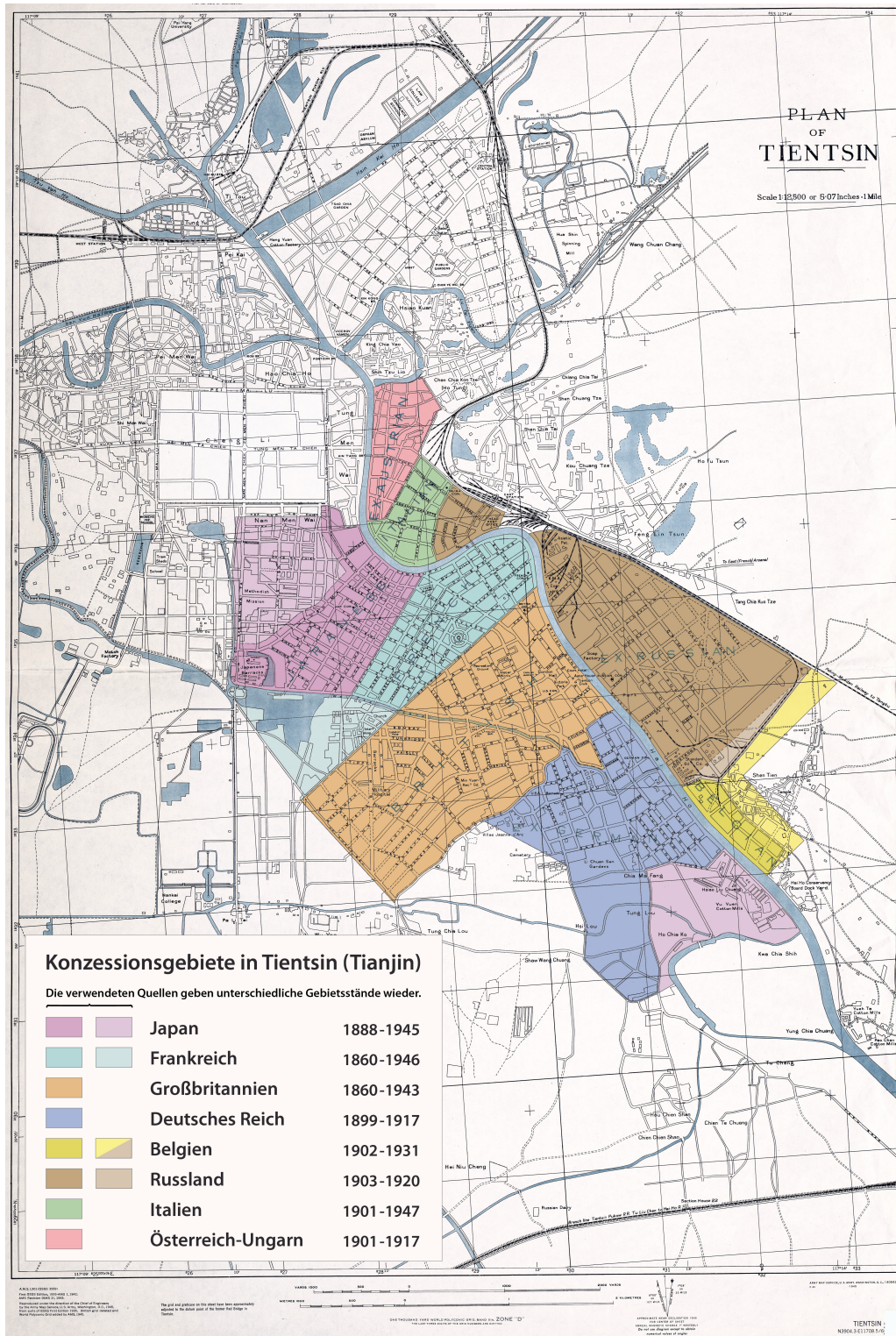


Figure 4.1: Foreign Concessions in Tianjin⁸

⁸ The author of this map is Maximilian Dörbbecker. The sources of making this map include 1902 Map of Tianjin, 1912 Tien-chin – The Settlements Map, 1941 Peiyang Map, and 1942 British War Office/US Army Map Service Map. See the link: <http://alturl.com/imond>

In current medical history on such topics, Ruth Rogaski's work stands out.⁹ She illustrates the emergence of "hygiene modernity," which was applied to public health projects for sanitary reform and disease control, manifesting the exercise of modern state power and its bureaucratic institutions in Tianjin from the late nineteenth through the twentieth century. However, Rogaski and other scholars working on modern public health measures in Tianjin concentrate mostly on work undertaken by the Japanese and the British and pay less attention to other colonial powers.¹⁰ This chapter includes the other colonial actors, such as the French and the Italian, presenting a more comprehensive picture of such colonial activities and their similarities with, and differences from, their British and Japanese counterparts.

Relying on French, British, and Japanese diplomatic and colonial documents, as well as the local Chinese governmental materials and newspapers and private physicians' accounts, I observe that the foreigners were neither as separated from, nor as opposed to, the Chinese as the current scholarship portrays.¹¹ Rogaski's study emphasizes the foreign dominance and colonial coercion of public health measures. She concludes that the Chinese elites "were quite willing to embrace a foreign-defined modernity – particularly its aspects related to public health and hygiene – at the very height of imperialist violence and coercion and to extend that embrace once the violence ended".¹² Her conclusion derives largely from the Japanese implementation of public health policies and its influence on the Chinese elites. Complementing her work, I find that coercion was only one of the colonial tactics. Thus I examine the diverse interactions among

⁹ Rogaski, *Hygienic Modernity*.

¹⁰ In addition to Rogaski's work, see Zhang Chang and Liu Yue, "International Concessions and the Modernization of Tianjin," in *Harbin to Hanoi: The Colonial Built Environment in Asia, 1840 to 1940*, ed. Laura Victoir and Victor Zatspine (Honk Kong: Hong Kong University Press, 2013), 83-102.

¹¹ "In Tianjin, the majority of foreigners and Chinese lived separate lives. The vast majority of Chinese lived more than a mile away from the white settlements. The British and French concessions operated on small budgets and tidied up their few square blocks, thankful that the 'squalid' Chinese city was out of sight." Rogaski, 132.

¹² *Ibid.*, 13.

different concessional authorities and between colonial authorities and local Chinese people – whether they were collaboration, “silent opposition,” or negotiation – which tends to complicate our understanding of public health measures and medical practices then.

Discovering Blindness Causes and Localities from Local Observation

Lossouarn and a group of Chinese and international physicians, including the doctors from French, Belgian, British, and Italian concessions, founded the International League for the Prevention of Blindness in China. Many of them also occupied teaching positions at Peiyang Naval Medical School in the French concession. The Chinese Ministry of Navy founded the School in 1902 and hired French military physicians as professors to train Chinese students, many of whom later collaborated with the French colonial physicians in public health work at the French concession. Many of the professors at Peiyang Naval Medical School also served at the Pasteur Laboratory of Tianjin, established in 1922 inside the school. The Pasteur Laboratory functioned as the only institution in northern China to treat rabies. It also offered bacteriological and chemical examinations, as well as serological work, to hospitals, local physicians, and public health services, including inspecting the sanitation condition of local brothels, in various concessions until 1945.¹³ In addition to Lossouarn, the colonial physicians who participated in the League included E. Robin (French, professor at the school and physician at the French Municipal Public Health Service), A. Lespinasse (French, professor at the school and Pharmacist-Major of the French Colonial Troops at the French Municipal Public Health Service),

¹³ MAEN Tientsin, 691PO/1/118, “Note sur le Laboratoire Pasteur de la Municipalité Française de Tientsin.”

Charles Kaisin (Belgian, assistant to Lossouarn's eye treatment service),¹⁴ J. O'Malley Irwin (British, Chief of the Health Department at the British concession), and M. de Giovanni (Italian, Chief of the Health Department at the Italian concession). The French Consul-General, E. Saussine was also one of the foreign attendees.¹⁵

The attending Chinese physicians were renowned in both political and medical circles in Tianjin at the time. Many of them were also associated with Peiyang Naval Medical School, including W. T. Watt 屈永秋 (former director of the school), Jing Ziqing 經子青 (also known as H. Y. King, director of the school), Zhang Zixiang 張子翔 (also known as T. H. Chang, vice-director of the school), and Xu Weihua 徐維華 (also known as W. H. Hsu, Professor at the school). Others had their private practices or worked at nearby foreign medical institutions, such as the French General Hospital and the Mackenzie Memorial Hospital under the London Missionary Society at the British concession. They included Shen Hongxiang 沈鴻翔 (also known as H. H. Shen, physician at the French General Hospital), Liang Baochang 梁寶暢 (also known as P. K. Liang, visiting surgeon at the Mackenzie Memorial Hospital), Zhang Zixiu 張子修 (also known as F. T. Chang, local physician), and Wang Zuxiang 王祖祥 (also known as T. H. Wang, local physician).¹⁶

The League aimed at both medical studies and public health work. It studied the causes of blindness in China, particularly those that were restricted to China, as well as how to treat and

¹⁴ Regarding Dr. Kaisin's activities in China, see Koen de Ridder, ed., *Footsteps in Deserted Valleys: Missionary Cases, Strategies and Practice in Qing China* (Leuven: Leuven University Press, 2000), 41-43.

¹⁵ MAEN Tientsin, 691PO/1/114, "Tientsin Medical Body Forms League for Prevention of Blindness among Chinese: Medical Profession Turns out en Masse at Peiyang Naval Medical College to Form International League – Meeting Held under Chairmanship of French Consul-General – over Forty Persons Join Organization," *North China Star*, 12/10/1924.

¹⁶ "Projet d'une Ligue Internationale de Prévention de la Cécité en Chine," 1.

prevent it.¹⁷ Lossouarn and his colleagues had dedicated themselves to research blindness among the Chinese. They determined that the causes of eye diseases and blindness in China included diseases such as smallpox and syphilis, also gonorrheal ophthalmia, phlyctenular keratitis and xerophthalmia.¹⁸ In addition, unhygienic practices, climatic conditions, the use of “native eye drugs,” lack of prophylaxis at birth and general medical care, as well as insufficient smallpox vaccination were among the culprits.¹⁹ From the 1920s until the 1940s, public health measures against smallpox and blindness were informed by their observations, research methods, and medical practices as they visited and collected data from various local sites, mainly factories and small workshops. The lessons these physicians derived formed the base of their measures for preventing blindness, including smallpox vaccination. This method of gathering knowledge went beyond animal experiments or other laboratory work necessary to determine the pathogens.

As to hygiene, Lossouarn observed that local Chinese medical practice usually utilized unsterilized hands, blades, towels, handkerchiefs, and even pins to treat the affected parts of the eyes. Superficial wounds on the cornea often ensued, opening it up to morbid matter from the nostrils and tear ducts. For instance, wet-nurses and mothers used their own handkerchiefs to clean their babies’ eyes. In a Chinese barbershop, including those in the foreign concessions, after the shave, the barber usually moved down the customer’s eyelid and used the razor’s tail

¹⁷ Ibid.

¹⁸ At the time, other illnesses, such as hypertonia, nephritis, tuberculosis, diabetics, scrofula, and anemia were observed and treated by the collaboration of clinicians and ophthalmologists because they were liable to cause blindness. MAEN Tientsin, 691PO/1/114, ‘Clinique pour Malades Speciales,’ in “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1937, 12. During 1939-1942, Dr. Zhou Jingrong 卓景榕 at the Hospital for Blindness Prevention had been in charge of treating syphilis and other general diseases, partly for the prevention of blindness. “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1939, 22; “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1940, 3. Scrofula, and anemia were observed from The League of Red Cross Societies, 36.

¹⁹ The League of Red Cross Societies, 36.

end to give a few massage strokes on the customers' conjunctives. The razor, which was probably never disinfected, then became the means of transmitting germs.²⁰

Lossouarn considered the use of "native eye drugs" one of the causes of blindness unique to China. Starting in 1921, physicians at the Hospital of Peiyang Naval Medical School examined their patients' eye lesions and determined the causal diagnosis. When they could not determine a known cause, they questioned the patients and in most cases learned that the patients had used "native eye drugs."²¹

Lossouarn and other physicians at Peiyang Hospital collected these drugs in their various forms, lotion, ointment, medicine-stick, pill, or white or colored powder, and placed them in glass tubes or in small paper bags. Lossouarn sent these drugs to be analyzed by A. Lespinasse, professor of pharmacology at Peiyang Naval Medical School. Even though these drugs were presented as different makes or under different labels, when analyzed, they almost always had the same "unpleasant odour with no definite smell, like a mixture of camphor, menthol, or musk." The principal elements of these drugs were "porphyried calc-carbonate, unrefined menthol and sodium chloride."²² Lossouarn then tested these drugs on rabbits and himself. In both cases, he found that the powder remained concentrated in the conjunctiva. For him, he first felt a "sensation of freshness," and then after a few hours he had to remove it by continual movements of his eyelids and rubbing his eyes.²³ Having obtained this result, he abstained from further self-experimentation: "I did not dare to continue these experiments on myself any longer."²⁴ The

²⁰ Lossouarn, 1.

²¹ *Ibid.*, 2.

²² *Ibid.*

²³ *Ibid.*

²⁴ *Ibid.*

experiments remained incomplete, but with evidence from himself and other patients, he found that the “native eye powders” directly related to severe ocular lesions and blindness.

Lossouarn found that most of his patients were factory workers. At the time, factories in this region employed children as a large part of the work force. In 1924, Lossouarn and Kaisin received three patients, working in the same factory, and found that they had “some abscess in the cornea with buff colored inferior conjunctiva.” These patients were in generally good health and lived apart. All three of them asked the factory foreman to give them the eye powder when they developed eye problems for two or three weeks.²⁵ In May 1924, Joseph Wang, a local Western-trained eye doctor informed Lossouarn that five hundred children, who worked in the factory of S.E. Wang Ke Ming, had eye infections. Lossouarn, Kaisin, and Wang examined the children and found that most had serious ocular lesions. They attributed the infections to the use of “native eye powders.”²⁶

Lossouarn found these powders in use at other factories. Through an introduction by the comprador of the Bank of Indochina, Lossouarn and other physicians were allowed to visit the cotton mill of the Peiyang merchants. Some of the children who worked in the mill had the same lesions in Wang’s factory. The local Chinese physician showed Lossouarn his medicine and the instruments with which he applied the powders.²⁷ The director of Messrs. Anderson, Meyer & Co. assisted Lossouarn and other physicians in their visit of another factory at the Pao Cheng Cotton Mill. On that occasion, they found 79 infections whose sufferers admitted having used local drugs. Lossouarn met the Chinese man who was in charge of the working children’s health. He was young, about thirty years of age, who claimed to have served as a nurse in hospitals

²⁵ Ibid.

²⁶ Ibid., 3.

²⁷ Ibid.

under the direction of physicians who used “occidental methods.” For eye treatments, he used boric acid and a light solution of cocaine that were normally accepted as antiseptic and pain relief at that time. The children at the mill may have obtained these powders from elsewhere.²⁸ Upon another visit to the Yu Yun factory, the physicians found that child workers were able to consult either a traditional Chinese or a foreign trained physician at will. They went from one to another and sometimes received both kinds of treatments. On occasion, they procured outside treatments as well. Based on these factory visits, Lossouarn observed that the use of local powders was prevalent and whenever the local powders were applied, they frequently caused peculiar and severe ocular lesions that resulted in total loss of eyesight.²⁹

It is curious that the usage of “native eye powders” was widespread despite their failure to work, as observed by Lossouarn and his colleagues. I could not find any contemporary Chinese account of the specific ailment against which such eye drugs were thought to be effective. Lossouarn was well aware that the Chinese who applied local eye powder for eye inflammation usually did so in an unsanitary manner, for example, by touching the eye with an unclean hand or an unsterilized instrument. We might ask if the lesions could be caused by other pathogens transmitted through unsanitary procedures and not by the chemical composition of the powder itself. On the other hand, did these drugs really fail to work? Since Lossouarn did not specify the names of the eye powder, I cannot identify the drugs with certainty. However, I did find some Chinese and foreign accounts attesting to the usefulness of a certain contemporary eye powder, called “Ma Yinglong eye powder” (*Ma yinglong yanyao fen* 馬應龍眼藥粉). It was popular both in Tianjin and in many other parts of China starting in the 1920s. Ma Jintang 馬金堂, a local Muslim Chinese physician in Dingzhou 定州 of the Hebei 河北 province, started

²⁸ Ibid.

²⁹ Ibid.

using this powder for eye treatment in the late sixteenth century. For over four centuries, continuing to this day, his descendants have manufactured the powder according to the original recipe, distributing it through domestic dispensaries, and exporting it worldwide. As of 2006, the Chinese government has recognized Ma Jintang's powder as a cultural heritage. It includes musk, which was also an ingredient contained in the powder that Lespinasse analyzed. It seems that the powder was popular in the 1920s. When Guion Moore Gest (1864-1948), an American engineer and businessman, did business in China in the 1920s, he used the powder, recommended by Irwin van Gillis, an American Navy Commander, to treat his long-lasting glaucoma and obtained some relief. Van Gillis also informed Gest of the existence of "unusual" remedies in China and the traditions of Chinese medicine recorded in books used by local traditional Chinese physicians to formulate their remedies. Inspired by improvement in his eye condition and his interest in Chinese remedies, Gest established an agency in Beijing with help from van Gillis, and collected rare Chinese books on medical cures. These books now comprise the Gest Collection at the East Asia Library of Princeton University. This subject of the Ma eye powder deserves further investigation.³⁰

Some of the contemporary Western-trained ophthalmologists, who were sometimes affiliated with the League, also found serious problems of eye diseases and blindness in local factories. A Tianjin eye physician, Li Zongyao 黎宗堯, visited local carpet factories and took many eye patients to be treated at the Daren Poor-Relief Hospital 達仁濟貧醫院, founded by

³⁰ Chih-Ping Chou, ed., *English Writing of Hu Shih: Literature and Society*, 1 (New York: Springer, 2013), 178; Bruce Swanson et al, *A Plain Sailor in China: The Life of and Time of Cdr. I. V. Gillis, USN, 1875-1948* (Annapolis, MD: Naval Institute Press, 2012), 160-192. Fan Hong 范泓, *Zai lishi de touying zhong* 在歷史的投影中 (Reflection on History) (Taipei: Xiu wei zixunkeji chuban, 2008), 85.

Drs. Hong Linge 洪麟閣 and Lian Yinong 連以農.³¹ Such experiences confirmed the prevalence of eye diseases in the local Tianjin factories and ateliers. Vaccinating the workers against smallpox would therefore be effective in bringing down the rate of blindness.

With local observation, Lossouarn also speculated that other causes of blindness included the climate conditions and varieties of diet common to China. He thus explored causes of eye diseases that went beyond germ theory of diseases. He observed that China, as a large country, encompassed a variety of climates that could play a part in causing or preventing eye diseases.³² The “Mongolian eye,” for instance, with “its narrow palpebral aperture, black iris, reacted or defended itself much better against outside influences.”³³ Nowadays, we understand the “Mongolian eye” as the epicanthic fold, a skin fold of the upper eyelid covering the inner corner of the eye, common to many Asians in East, Southeast, and Central Asia. Its causes in climatic and genetic factors are only conjectured without conclusive proof.³⁴ In Lossouarn’s time, Western-trained ophthalmologists also suspected the local diet and prevalent malnutrition as possible causes of the “Mongolian eye” and blindness. They asked that “how it could be explained that the Indochinese and Indians, who also suffered from trachoma and ate much the same food as the Chinese, had a much lower rate of blind individuals.”³⁵ Wang prescribed cod liver oil to his young patients, but obtained no positive results.³⁶

³¹ Tianjinshi defang shi zhi bianxiu weiyuanhui 天津市地方史志編修委員會 (Committee of Tianjin Local History), ed., *Tianjin jindai renwu lu* 天津近代人物錄 (Recent Historical Figures in Tianjin) (Tianjin: Tianjinshi defang shi zhi bianxiu weiyuanhu, 1987), 374.

³² Lossouarn, 4.

³³ *Ibid.*, 5.

³⁴ Carolyn Fluehr-Lobban, *Race and Racism: An Introduction* (Oxford: AltaMira Press, 2006), 65.

³⁵ Lossouarn, 5.

³⁶ *Ibid.*

Based on such studies of blindness in China, comprising numerous visits to local factories and small workshops and attendance on patients at these locations, the physicians identified smallpox vaccination, personal hygiene, and abstention from using local eye drugs as the most effective preventive measures.

Local Collaborative Practices at Makeshift Eye Clinics

Starting with the establishment of the League in 1924, until 1942, the Western-trained Chinese eye physicians, foreign private physicians, colonial physicians, and Catholic missionaries worked on blindness and smallpox prevention at the Hospital for Blindness Prevention and ten more clinics in or near Tianjin, as well as at numerous factories in the city. In these facilities they accepted a moderate fee from patients who were able to pay but offered free consultations and medicine and refunded all fees to the poor, thus extending medical care to a population that ordinarily would have been out of its reach. These facilities, with limited staff, functioned as centers for exchanging information about public health, where the patients learned about the necessity of vaccination and prevention of eye diseases and blindness through printed pictures or verbal instructions by the residing physicians.³⁷

Following the League's instructions, all of these makeshift eye clinics were located near the poor neighborhoods and the factories that employed many of them. Among these ten clinics eight were in the Chinese territory. Four of these eight were located in the Chinese City, a separate district in Tianjin governed by the Chinese government until the Japanese invasion in 1937, including Tung-Ma-Lu 東馬路 (1927-1942), His-Men-Li 西門里 (1927-1931), Fu-Shin-Chwang 富辛莊 Catholic Church (1933-1942), and Jen Ts'e T'ang 仁慈堂 (1934-?). (Figure 4.2)

³⁷ Ibid.

Within the Chinese City, there were no ophthalmologists. The other four clinics in the Chinese territory, including Tien Ts'ing Li 天慶里/下瓦房 (1934-1942), Ho-Tung (1929-1931), Sien Shui Kou 鹹水沽 (1937-?), Ts'angchow 滄縣 (1937-1942), were located in the suburb areas of Tianjin. Two clinics were located outside of the Chinese territory, one at the outskirts of the French concession in Lao Hsi K'ai 老西開 (1939-1940), and another in the British concession (1931-?). In addition to these ten clinics, the Hospital for Blindness Prevention was a fixed and more established location in the center of the French concession.

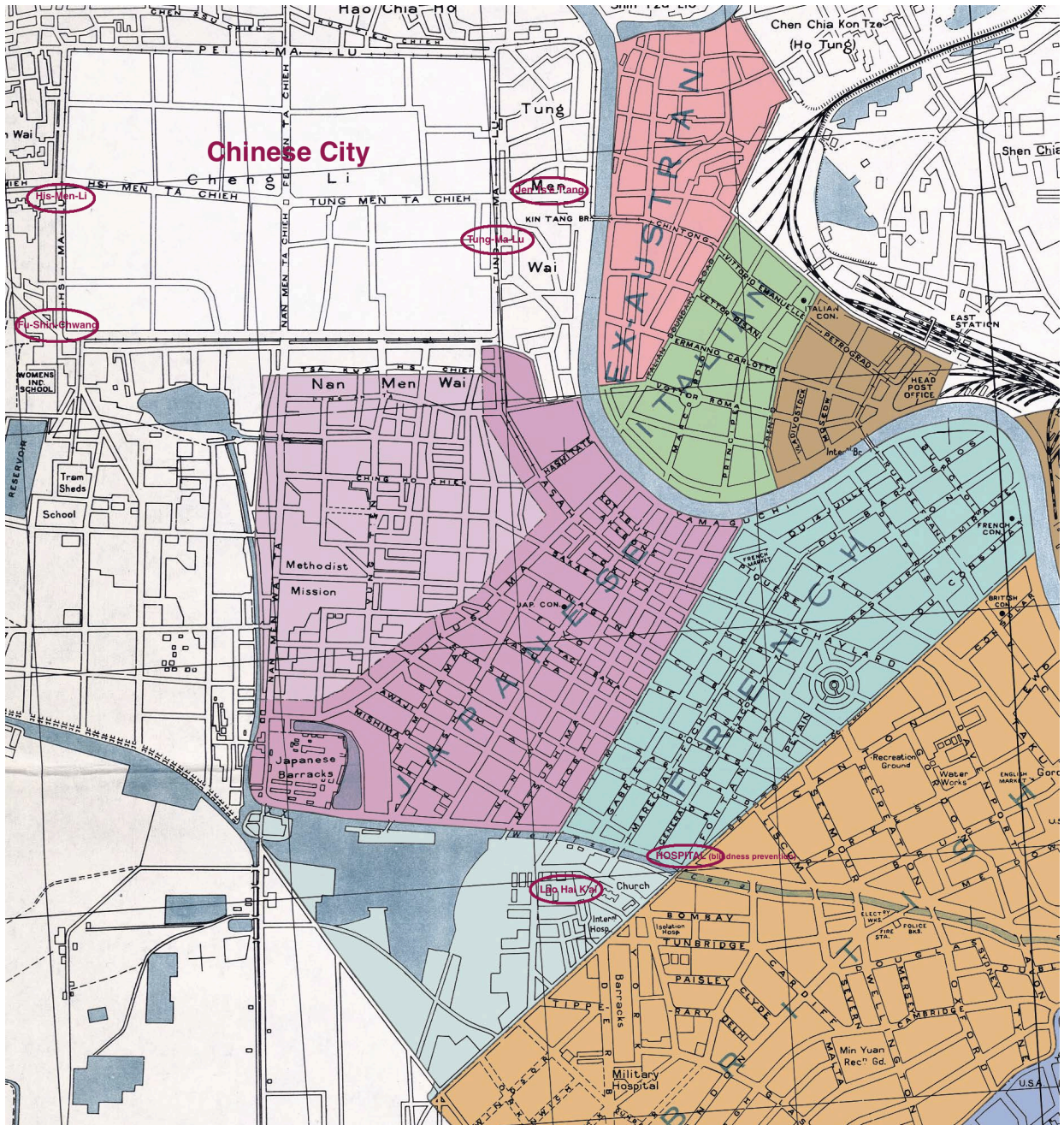


Figure 4.2: Clinics Directed under the Collaborative Franco-Chinese Control - The Hospital for Blindness Prevention and Five Clinics, Four in the Chinese City and One on the Outskirts of the French Concession.

On 7 May 1927, Tian Dawen 田大文(1897-1966), a Western-trained Chinese ophthalmologist, founded the first two clinics operating under the authority of the League: the

Tung-Ma-Lu Clinic 東馬路施診所 and the His-Men-Li Clinic 西門里施診所, located respectively on the east and west side of the Chinese City. Tian Dawen graduated from Peiyang Naval Medical School in 1924 with concentration in ophthalmology and continued postgraduate work at University of Bordeaux in France. Upon his return to China, he collaborated with Lossouarn for blindness prevention in the League. He also collaborated with Zhang Zixiang (also known as T. H. Chang), who acted as the secretary of the League and was in charge of death certification for the Public Health Service at the French concession. When necessary, Tian and Zhang assisted the municipal medical service during epidemics and vaccination campaigns.³⁸ Tian and another eye physician, along with two nurses, took charge of these two clinics, offering smallpox vaccination and eye treatment.³⁹

The Tung-Ma-Lu Clinic was situated near the Hai River at the major road on the east side of the Chinese City. It was a geographically convenient location in a densely populated area. The clientele consisted mainly of factory laborers and paupers. Tian Dawen was dedicated and accommodating working hours convenient for the factory laborers. The League credited the location as the key to its success. From 1927 to 1942, it was the most reputable and busiest among all of the clinics. In early years, it provided 50% more medical care than the Hsi-Men-Li Clinic, even though both of them were located within the Chinese City and treated clients of similar status. (Table 4.1)⁴⁰ From 1929 to 1939, the Tung-Ma-Lu Clinic had constantly provided smallpox vaccination, a total of 4,706 procedures throughout the years.⁴¹ Even though the Hsi-

³⁸ MAEN, Tientsin 691PO/1/16, J. Lataste, "Projet d'Organisation d'un Service d'Hygiène et Service Médical de la Concession Française de Tientsin," 06/1939, 3.

³⁹ "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1931, 1.

⁴⁰ I have compiled the numbers in Table 1.

⁴¹ The number is calculated according to the survey in the "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine" in the years of 1928-31, 1933, 1934, 1936, 1937, and 1939.

Men-Li Clinic operated on a much smaller scale and only lasted from 1927 to 1931, it also constantly performed smallpox vaccination from 1929 to 1931, 505 procedures in total.⁴² During the 1939 flood, thanks to the location the Tung-Ma-Lu Clinic remained undamaged owing to its location.⁴³ With this advantage, it lasted the longest of all the clinics, for at least sixteen years. Up to 1942, the Clinic treated 52,156 individual patients.⁴⁴ After the Japanese occupation in 1937, its yearly number of consultations increased to between 26,000 and 39,000.⁴⁵ In 1941, it had to increase its staff to accommodate the increasing number of patients. Many patients came from remote areas and neighboring sub-prefectures.⁴⁶

In addition to these two secular clinics in the Chinese City, another small secular clinic was located at Ho-Tung, near the East Station at the Tianjin harbor in the Chinese territory. In July 1929, H. de Garcia, a private physician, collaborated with the League in setting up this clinic. Even though it was small in scale, treating only around 300 patients on average every year, it offered smallpox vaccination nearly every year until 1937.⁴⁷

Four of the other clinics operated in collaboration between the League and the Catholic missionaries. In 1933, S. G. Bishop of Vienna constructed two apartments in the courtyard of the Fu-Shin-Chwang Cathedral, and offered them to the League for setting up a clinic. The Clinic was located at the southwest side of the Chinese City. Most of the residents of this area were

⁴² According to the survey in the “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1931.

⁴³ “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1939, 3.

⁴⁴ According to the survey in the “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” in the years of 1928-31, 1933, 1934, 1936, 1937, 1939, 1940, 1941, and 1942.

⁴⁵ “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1937, 8.

⁴⁶ “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1941, 4.

⁴⁷ According to the survey in the “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” in the years of 1928-31, 1933, 1934, 1936, and 1937.

poor day laborers.⁴⁸ Until 1942, the League provided them free treatment and medicine, with only two interruptions, one during the Japanese occupation in 1937 and the other due to the flood in 1939. Smallpox vaccination was offered from 1933 to 1937, adding up to nearly 900 procedures.⁴⁹ Through 1942, the Clinic treated 8,112 individual patients, with its yearly number of consultations ranging from 1,600 to 6,900.⁵⁰

Another example is the Jen Ts'e Tang Clinic. In 1934, the Sister Superior of the Daughters of Charity (*Soeur Supérieure des Filles de la Charité*) in the Chinese City offered the League space in a chapel located between the East Gate of the former walled city and the Hai River.⁵¹ The chapel also served as an orphanage. This was one of the places where the Tianjin Massacre of 1870 took place.⁵² The League provided free treatment and medicine to the residents in the area. Unfortunately, there are no available statistics of its smallpox vaccination.⁵³

On 1 August 1934, R.P. Civelle of the Mission in Weihufu provided two large rooms in Tien Ts'ing Li, situated in the former German concession, which had been incorporated into the Chinese territory in 1917 as the First District of the Tianjin city.⁵⁴ The Tien Ts'ing Li Clinic served four nearby villages. There were factories and small workshops in this area. Until 1940,

⁴⁸ "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1940, 4.

⁴⁹ According to the survey in the "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," in the years of 1933, 1934, 1936, and 1937.

⁵⁰ According to the survey in the "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," in the years of 1939, 1940, 1941, and 1942.

⁵¹ "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1934, 2.

⁵² The Tianjin Massacre was one of the missionary incidents of the late Qing Dynasty, involving local Chinese people's attacks on French Catholic priests and nuns, a violent response by French diplomats and armed foreign intervention in Tianjin in 1870. Barend J. ter Haar, *Telling Stories: Witchcraft and Scapegoating in Chinese History* (Leiden: Brill Academic Publishers, 2005), 154-201.

⁵³ "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1934, 3.

⁵⁴ *Ibid.*

three-fifth of the patients were day laborers.⁵⁵ The League collaborated with the priest by offering eye treatment and medicine to the residents in the area through 1942, with only one brief interruption due to the flood in 1939. The League's annual report in 1940 noted that since the opening of this Clinic, the number of new patients did not increase as expected, because they did not yet "trust the physicians and foreign medicine."⁵⁶ There is no evidence of explaining the distrust. However, it might account for why no smallpox vaccination occurred in this Clinic and why the Clinic had fewer patients than the others.⁵⁷

Lastly, in 1937, R. P. Giaccone 賈國安神父 helped the League to set up and supervise a clinic at Ts'angchow in the Hobei province. The clinic was located seventy-five miles south of Tianjin, east of the Jinpu 津浦 Railway and west of the South Canal.⁵⁸ In the 1930s, thanks to its location, this area enjoyed prosperity in commercial, agricultural, and industrial activities. However, eye diseases were common and the rate of blindness was so high that local authorities had to open schools for the blind.⁵⁹ The clinic provided free care and treatment. The priest housed and fed the poor patients who came from afar. The clinic also offered smallpox vaccination on a regular basis, administering nearly 2,000 vaccinations between 1937 and 1942.⁶⁰ The number of patients it treated increased throughout the years. The League considered

⁵⁵ "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1940, 5.

⁵⁶ Ibid.

⁵⁷ According to the survey in the "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," in the years of 1934, 1936, 1937, 1939, 1940, 1941, and 1942.

⁵⁸ "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1940, 6.

⁵⁹ "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1941, 5.

⁶⁰ "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1940, 6.

this clinic the second best after the one at Tung-Ma-Lu. It had a good reputation and served many patients, rich and poor, who traveled from afar for treatment.⁶¹

Other than the Hospital for Blindness Prevention, the Lao-Hsi-K'ai Clinic was the only facility to provide eye treatment in the French concession. The residents of Lao-Hsi-K'ai were mostly paupers. Before 1939, the League had attempted to found a clinic in this area but could not find any suitable premises. After the flood in 1939, over 10,000 refugees gathered up and sought care in *Gao Lan* Village (also known as *Kao Lan cun* 高蘭村) at Lao-Hsi-K'ai. In collaboration with the French Municipal Public Health Service, the League operated a temporary clinic in November 1939, and offered free service from two to four hours a day to the refugees and local residents. In the same month, Jean Lataste, Director of the Pasteur Laboratory in Tianjin from 1932 to 1943 and the Chief Medical Officer at the Public Health Service at the French concession, instructed the League to move the clinic to a permanent location and continue its service. The Lao-Hsi-K'ai Clinic could not last long and it was closed on 1 May 1940, when the Young Women's Christian Association took over the building.⁶²

⁶¹ According to the survey in the "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," in the years of 1937, 1939, 1940, 1941, and 1942.

⁶² "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1939, 4; "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1940, 5.

Table 4.1: Statistics of the Clinics for Blindness Prevention

| Year | Clinic | Consultations/Non-First visits | Vaccinations (smallpox) | Individual clients |
|------|--------------------|--------------------------------|-------------------------|--------------------|
| 1928 | Tung-Ma-Lu | 864 | | |
| | Hsi-Men-Li | 413 | | |
| 1929 | Tung-Ma-Lu | 979 | 185 | |
| | Hsi-Men-Li | 787 | 264 | |
| | Ho-Tung | 240 | | |
| 1930 | Tung-Ma-Lu | 1,024 | 77 | |
| | Hsi-Men-Li | 760 | 189 | |
| | Ho-Tung | 413 | 49 | |
| 1931 | Tung-Ma-Lu | 944 | 104 | |
| | Hsi-Men-Li | 645 | 52 | |
| | Ho-Tung | 314 | 32 | |
| | British-Concession | 93 | 12 | |
| 1933 | Tung-Ma-Lu | 13,442 | 634 | 1,701 |
| | Fu-Shin-Chwang | 6,924 | 455 | 972 |
| 1934 | Tung-Ma-Lu | 16,742 | 528 | 2,651 |
| | Fu-Shin-Chwang | 6,287 | 322 | 854 |
| | Tien Ts'ing Li | 692 | | 173 |
| | Jen Ts'e T'ang | 695 | | 165 |
| 1937 | Tung-Ma-Lu | 31,474 | 724 | 4,032 |

| | | | | |
|------|------------------------------|--------|-------|-------|
| | Fu-Shin-Chwang | 2,340 | 56 | 468 |
| | Tien Ts'ing Li | 2,293 | 101 | 393 |
| | Ho-Tung | 220 | 12 | 39 |
| | Sien Shui Kou | 2,497 | | 325 |
| | Ts'angchow | 2,460 | | 626 |
| 1939 | Tung-Ma-Lu | 38,467 | 2,451 | 6,776 |
| | Fu-Shin-Chwang | 3,241 | | 671 |
| | Tien Ts'ing Li | 1,247 | | 276 |
| | Lao Hsi K'ai (temporary) | 328 | | 54 |
| | Lao Hsi K'ai (Rue No. 59) | 223 | | 38 |
| | Ts'angchow | 3,179 | 367 | 873 |
| 1940 | Tung-Ma-Lu | 35,422 | | 6,451 |
| | Fu-Shing-Chwang | 1,687 | | 351 |
| | Tien Ts'ing Li | 1,379 | | 310 |
| | Lao Hsi K'ai (Rue No. 59) | 485 | | 78 |
| | Ts'angchow | 3,355 | | 1,002 |

| Year | Clinic | consultations/non-first visits | vaccinations(smallpox) | individual clients |
|------|-----------------|--------------------------------|------------------------|--------------------|
| 1941 | Tung-Ma-Lu | 30,592 | | 16,901 |
| | Fu-Shing-Chwang | 6,147 | | 663 |
| | Tien Ts'ing Li | 2,835 | | 419 |
| | Ts'angchow | 4,310 | 827 | 1,410 |
| 1942 | Tung-Ma-Lu | 26,821 | | 6,798 |
| | Fu-Shing-Chwang | 4,569 | | 1,038 |
| | Tien Ts'ing Li | 3,917 | | 633 |
| | Ts'angchow | 4,756 | 728 | 1,143 |

International Collaboration at the Hospital for Blindness Prevention

International collaboration within the League extended to the governmental level with the French Municipality and Chinese authorities after 1931. In 1930, the League registered with the French Municipality and the Chinese Ministry of Hygiene under the name of “The International League in Cooperation with the Rotary Club of Tianjin for the Prevention of Blindness in China.” (*Ligue Internationale en Coopération avec le Rotary Club de Tientsin pour la Prévention de la Cécité en Chine*)⁶³ After 1931, the French Municipality subsidized the League to open a municipal hospital for eye treatment and smallpox vaccination. In addition to the lotteries during 1932-1933 used as a source of public funding,⁶⁴ other funding came to the League mostly from private and

⁶³ “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1937, 2.

⁶⁴ “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1933, 1; “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1934, 1.

local sources.⁶⁵ In practice, the Pasteur Laboratory under the French Municipality collaborated with the League on bacteriological examinations and smallpox vaccination. As most of the League's members were professors or graduates of Peiyang Naval Medical School, when the school closed in 1931, the League became the sole remnant of the School. Thus collaboration between the League and the Pasteur Laboratory enhanced the Franco-Chinese working relationship.⁶⁶

The Hospital for Blindness Prevention was the most important medical institution that the League and the French Municipality relied on for eye treatment, as well as for blindness and smallpox prevention, within the French concession, and in the whole Tianjin.⁶⁷ The Hospital was established on 1 April 1931 under Wu Qiaosen 吳喬森 (also known as C. S. Wu),⁶⁸ a graduate of Peiyang Naval Medical School. In 1933, its management was taken over by Tian Dawen, the pioneering Chinese ophthalmologist, founded the League's first two clinics.⁶⁹ In 1933, there were a total of seven beds at the hospital, five for paupers, and two reserved for patients able to

⁶⁵ It included missionary donations in 1933, annual medical payments, interest earned at Chinese banks since 1932, dividends and interest from the Franco-Chinese Real Estate Society (*Société Foncière Franco-Chinoise*, known as Yee Loong Real Estate Co. 義隆房產公司 Yilong fanchang gonsi, 1922-1941) since 1939, the Schmidt & Co in 1941, members of the League in 1941, and the Charity Fund of the French Concession (*Caisse des Oeuvres de la Concession Française*) in 1942. "Rapport General, Ligue Internationale pour la Prévention de la Cécité en Chine, 1933," 2. The Bank of Communications had offered the League of high interest rate 12% for five years (1932-1937) on a deposit of 22,000 *yuan* and the same offer was renewed for another five years (1937-1942). Other banks included Central Bank, Yienyieh Bank, and Sin Hua Trust & Saving Bank. The Bank of Indochina joined in 1940. "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1937, 2 and 5; "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1939, 1; "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1941, 1; "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1942, 1.

⁶⁶ MAEN, Tientsin 691PO/1/114, "Lettre du Dr. Lossouarn au Président du Conseil Municipal," 24/03/1931.

⁶⁷ The Hospital of Blindness Prevention was originally the "International Hospital of Blindness Prevention" located in Peiyang Naval Medical School, founded by Lossouarn and Dr. Cong Hongzao 從鴻藻 (also known as H. T. Tsung) in 1925. Xiao Yinghua 蕭英華, "Cong Hongzao yu fang mang shiye" 從鴻藻與防盲事業 (Cong Hongzao and Blindness Prevention), in *Tianjin wenshi ziliao xuan ji* 天津文史資料選輯 (Historical Materials of Tianjin), 62 (Tianjin: Tianjin renmin chubanshe, 1994), 126-127.

⁶⁸ "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1931, 1.

⁶⁹ Chen Zhenshou 陳貞壽, *Tu shuo Zhongguo haijun shi* 圖說中國海軍史 (Chinese Naval History), 1 (Fuzhou: Fujian jiaoyu chubanshe, 2002), 202.

pay a modest fee for the service.⁷⁰ In 1934, it added an optical unit, offering prescription glasses to the paupers, at a cost of 1.5 *yuan*. The 10 *yuan* price charged by commercial shops elsewhere was beyond their reach.⁷¹

The hospital continued offering its services even after the Japanese invasion in July 1937, through the Tianjin Incident of 1939 and the floods in the same year both caused brief suspensions. Tianjin Incident (16 June 1939- 20 August 1939) resulted from a dispute between Japanese and British authorities over Chinese nationalists.⁷² The Japanese blockaded the British concession in Tianjin. After the Japanese invasion, the number of patients at the hospital diminished slightly, but it spiked after September in the same year to exceed the numbers logged in the peacetime, as refugees gathered at the French concession. Including many people from the refugee camps, the hospital vaccinated nearly 1,200 patients in 1937, twice as in previous years.⁷³ During the second half of 1939, the barricades set up between the Chinese City and the concessions because of the Tianjin Incident made communication difficult. After the flood receded, for a month or so, there were few patients, and the hospital briefly closed down. However, the physicians and medical staff of the hospital did not stop working. Responding to a request by the French Municipal Public Health Service, the hospital kept offering its service for residents at the French and British concessions during the barricade regime, which ended only in July 1940. The patients outside of these two concessions could not come to the hospital during this period. With all these difficulties, the hospital continued to offer smallpox vaccination. It

⁷⁰ “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1933, 2.

⁷¹ “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1944, 2.

⁷² The Tianjin Incident of 1939 is covered in detail in the last section of this chapter.

⁷³ “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1937, 7.

still consulted from 100 to 200 patients a day, adding up to only 256 fewer individual clients than in 1938.

After July 1937 the Japanese controlled all of the Chinese territory in Tianjin, leaving only the British, French, and Italian concessions intact. Nevertheless, they allowed the League's services to continue in its clinics in the Chinese territory, including the ones located in the Chinese City, even though their delivery slowed down considerably. The occupation also created an opportunity to increase medical services in the areas where refugees gathered, such as at the hospital in the French concession. However, the hospital's services declined in 1939 and 1940, as city residents suffered from wartime increase in the cost of living, with many eventually leaving the city after the flood.⁷⁴ Even with the reduced number of patients in this period, these man-made calamities and natural disasters did not put an end to the services provided by the hospital and most of the clinics under the League.

In addition to their daily practices, the hospital also cooperated with the French Public Health Service in health campaigns, such as the ones against smallpox and cholera. In April and May of 1939, the hospital received instructions from the League to assist the French Municipality with a smallpox vaccination campaign. In addition to continuing the vaccination service in the hospital, it also sent a medical team to vaccinate students at the Cheng Kong Girls School (*École des Filles du Cheng Kong*), the Hsi-K'ai School (*École de Hsi-K'ai*), the Josephine School (*École des Joséphines*), and the Seminary of the Catholic Mission (*Séminaire de la Mission Catholique*). Altogether, the Hospital vaccinated 25,996 patients against smallpox in the course of this campaign, more than 70% of the total vaccinations practiced in all of the medical facilities affiliated with the League.⁷⁵ During the flood in 1939, the League sent one or

⁷⁴ "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1940, 1-2.

⁷⁵ "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1939, 2.

two nurses daily to provide medical care at the Josephine School, where many refugees gathered. An outbreak of gastroenteritis occurred in the refugee camps in early autumn of 1939. The League procured anti-cholera vaccine and administered it to 1,352 people.⁷⁶ It continued cholera vaccination every year thereafter through 1942, vaccinating 22,575 people in total.⁷⁷

The Chinese authority in Tianjin continued requesting the hospital to aid the prevention of epidemics. The hospital vaccinated 4,013 people against smallpox in spring and 2,698 against cholera in the summer of 1941. In winter, the hospital assisted the French Municipality's smallpox vaccination campaign, vaccinating 9,949 people during December 19-31.⁷⁸

Continual Factory Inspection and Treatment for Blindness Prevention

Drawing upon their experience of treating factory workers and children, as well as their discovery of the eye damage caused by the "native eye drugs," Lossouarn and his colleagues were able to take effective measures for the prevention of blindness in factories and small workshops in Tianjin. These enterprises placed their workers at risk owing to insufficient nutrition, long working hours, and dust accumulation in the confined working space.⁷⁹ Many of the laborers were children, not yet vaccinated and at a higher risk of contracting smallpox.⁸⁰

Continuing inspection of factories was an important activity of the League. Physicians of the League traveled to local factories in the Chinese City and in the French, British, and Italian

⁷⁶ Ibid.

⁷⁷ According to the survey in the "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," in the years of 1939, 1940, 1941, and 1942.

⁷⁸ "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1941, 3.

⁷⁹ "Projet d'une Ligue Internationale de Prévention de la Cécité en Chine," 1; "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1933, 43.

⁸⁰ "Projet d'une Ligue Internationale de Prévention de la Cécité en Chine," 1.

concessions, as well as some locations in the Hebei province. These physicians in charge included Cong Hongzao 從鴻藻 (also known as H.T. Tsung), Chen Shaoxian 陳紹賢 (also known as S.H. Chen), Joseph Wang, and Tian. Like Tian, Cong and Chen had received Western-training and graduated from Peiyang Naval Medical School. Cong started working with Lossouarn in the early 1920s, later in the French General Hospital. Half of the League's inspections took place in the Chinese City, as the sanitary conditions of factories and small workshops located in the Chinese City seemed much worse than the ones in the concessions, according to these physicians' observation.⁸¹ Assisted by local police, inspections began on 5 January 1927.⁸² Free smallpox treatments and vaccination were administered as needed at the time of examination. The visiting physicians sought to convince the factory owners to institute preventive measures and oversee the eye hygiene of the workers. In addition to vaccination, these measures included washing hands and face thoroughly and abstaining from the use of "native eye drugs."⁸³

⁸¹ "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1931, 3-9. The list and names of the factories, 185 in total; "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1934, 4.

⁸² "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1931, 2; "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1933, 3.

⁸³ "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1933, 3.

Table 4.2: Statistics of the Visits to the Factories and Small Workshops

| Year | Physician | # Factories | # Workers Examined | # Cases Treated | Vaccinations |
|-------------------|---------------|------------------------|--------------------|-----------------|--------------|
| 1927 | Cong Hongzao | | 20,000 | 3,000 | |
| 1928 | Cong Hongzao | 697 | 16,853 | 4,660 | 4,526 |
| Jan.-June 1930 | Chen Shaoxian | 106 | 12,734 | 3,363 | |
| July-Dec. 1930 | Chen Shaoxian | 82 | 2,740 | 179 | |
| 1931 | Joseph Wang | 192 | 8,488 | 2,558 | |
| 1933 | Tian Dawen | refuge de l'Arsenal | | 420 | 336 |
| 1933 | | 259 | 10,874 | 3,863 | 1,467 |
| 1934 | | 255 | 10,032 | 3,449 | 1,382 |

This medical practice at factory sites functioned as an ongoing part of blindness prevention campaigns, supported by public awareness measures in the forms of lectures, posters, and French, English, and Chinese newspaper articles.⁸⁴ In 1927, Cong examined 20,000 factory workers. He found that 3,000 of them suffered from eye diseases. In one carpet factory, 76 out of 101 workers had eye diseases. Except two very severe cases supposedly resulting from “some native medicine,” these patients continued to work in the factory without treatment. (Table 4.2)⁸⁵ At first, Cong was stymied by the Chinese patients refusing to follow his advice. According to his account, this was due with their lack of familiarity with his Western methods, often involving sharp instruments and syringes. After numerous visits and his success in curing several patients, the Chinese workers started to follow his advice.⁸⁶ Continuing in 1928, Cong visited 697 factories where he examined 16,853 workers. Among them, he treated 4,660, more than a quarter of the workforce. He also vaccinated 4,526 people against smallpox.⁸⁷

⁸⁴ Lossouarn, 5.

⁸⁵ I have compiled the numbers in Table 2.

⁸⁶ MAEN, Tientsin 691PO/1/114, “International League for Prevention of Blindness Holds Annual General Meeting: Many Speeches Delivered by Local Doctors, Outlining Work of League in Past Year and Program for the Coming Year,” *North China Star*, 08/03/1928.

⁸⁷ “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1931, 2.

Taking over in 1930, Chen Shaoxian visited 188 factories in the Chinese City, examined 15,474 workers, and treated 3,542 cases of eye disease, many of which resulted from smallpox. In 1931, Joseph Wang visited 192 factories, where he examined 8,488 workers and treated 2,558 cases.⁸⁸ In 1933, these physicians of the League visited 16 factories and 243 small workshops, examined 10,874 workers, treated 3,863 eye cases, and vaccinated 1,467 workers.⁸⁹ In the same year, Tian Dawen from the Hospital of Blindness Prevention visited the refuge of the Arsenal (*refuge de l’Arsenal*) in Tianjin, treating 420 eye cases and administering 336 vaccinations.⁹⁰

In 1934, the visits were limited to the factories in the Chinese City. From time to time, the League held meetings at factories to give information about the danger of eye diseases and the importance of personal hygiene. In that year, the physicians visited 18 factories and 237 small workshops, examined 10,032 workers, treated 3,449 cases, and vaccinated 1,382 workers.⁹¹

Over eight years from 1927 through 1934, the results were quite extraordinary. The medical work at factories examined at least 81,721 workers, treated 21,492 cases, and vaccinated 7,711 workers. Counting the vaccinations alone, these factory visits added up to only 447 vaccinations fewer than all of the vaccinations, counting as 8,158, administered in all of the ten clinics from 1927 through 1942.

⁸⁸ Ibid.

⁸⁹ “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1933, 3.

⁹⁰ Ibid., 2

⁹¹ “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1934, 4.

Collaboration with the Remote Missionary Posts in the Interior of China

Since the establishment of the League in 1924, Tian Dawen had represented it outside of Tianjin and throughout China, collaborating with Catholic missionaries of many nationalities in setting up a great number of free clinics and vaccination stations in 353 cities within 23 provinces, including remote provinces in the southwest of China, such as Yunan and Guizhou.⁹² The League emphasized to the missionaries the importance of smallpox vaccination as the most critical measure against blindness. Because the League sent no physicians to the interior, the missionaries there thus played an important role in assisting it in treating eye patients and performing vaccinations with free ocular boxes, each of which contained a small quantity of Jennerian vaccine, a strip lamp, and instruments for vaccination, sent by the League. They also assisted the League in distributing 1,265 books, over 60% of them in the Chinese language, and the rest in French and English. (Table 4.3)⁹³ The books introduced common eye diseases and causes, as well as vaccination methods and ocular hygiene.⁹⁴ In 1924, the League sent out 5,000 circular letters to the missionaries in China.⁹⁵ For seven years from 1928 to 1934, the League sent out 692 ocular boxes, each of which contained a small quantity of Jennerian vaccine, a strip lamp, and instruments for vaccination. The League also supplied these missionaries with 3,226 vaccinostyles, which were pointed lancets used in vaccination against smallpox, and 597,039

⁹² “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1931, 10. The list and names of the missionaries. Ibid., 11-39. Hebei province, 21; Shanxi 山西 province, 25; Shandong province, 16; Henan province, 27; Hubei province, 41; Hunan province, 11; Guangdong province, 12; Guangxi province, 13; Anhui province, 11; Zhejiang province, 6; Jiangxi province, 9; Jiangsu province, 3; Shaanxi 陝西 province, 4; Gansu province, 2; Suiyuan province, 4; Sichuan Province, 7; Yunnan province, 5; Guizhou province, 10; Jilin province, 1; Rehe province, 3; Fujian province, 3; Fengtian (Liaonin) province, 17; Heilongjiang province, 1. In total: 23 provinces, 252 names and addresses of missionaries and persons in charge.

⁹³ I have compiled the numbers in Table 3.

⁹⁴ “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1931, 10.

⁹⁵ Lossouarn, 5; “Lettre du Dr. Lossouarn aux Missionnaires.”

doses of Jennerian vaccine, including dry vaccine which could be preserved better for remote areas.⁹⁶ There is no exact record of how many people were vaccinated. However, normally each dose would suffice for two vaccinations, therefore the supply could have vaccinated 1,194,078 people at its full capacity.

Table 4.3: Statistics of the Materials Sent to the Missionary Posts in the Interior of China

| Year | Doses of Smallpox Vaccine | Boxes of Ocular Medicine | Tubes of Eye Ointment | # Vaccinostyles | Tubes of Dry Smallpox Vaccine (for remote areas) | Series of Medicine to Refill Ocular Boxes | Bottles of Anti-Cholera Vaccine | Books in Chinese | Books in French | Books in English | Illustrations of Eye Diseases |
|------|---------------------------|--------------------------|-----------------------|-----------------|--|---|---------------------------------|------------------|-----------------|------------------|-------------------------------|
| 1928 | 160,000 | 271 | | 0 | | | | | | | |
| 1929 | 83,800 | 51 | 415 | 544 | | | | 237 | 147 | 32 | |
| 1930 | 89,600 | 78 | | 0 | | | | | | | |
| 1931 | 58,620 | 77 | 454 | 1,450 | 117 | 136 | | 365 | 165 | 69 | |
| 1933 | 94,782 | 103 | | 584 | 120 | 224 | | 54 | 48 | 17 | |
| 1934 | 110,000 | 112 | | 648 | | | | 62 | 58 | 11 | |
| 1937 | 87,200 | 61 | 67 | 1040 | | | | 56 | 42 | 7 | 73 |
| 1939 | 4,330 | 16 | | 91 | | | | 4 | 6 | 1 | 5 |
| 1940 | 7,980 | 49 | | 119 | | | 11 | | 6 | 6 | 18 |
| 1941 | 1,520 | 33 | | 12 | | | | 13 | 3 | | 3 |
| 1942 | 512 | 6 | | 2 | | | | 4 | 2 | | 3 |

Despite the Japanese invasion in 1937, the League continued supplying the missionaries, sending 128 ocular boxes, 87,200 doses of Jennerian vaccine, 1,040 vaccinostyles, 105 books, and 73 illustrations of eye diseases.⁹⁷ As the Second Sino-Japanese War spread, communication and shipment between the League and the missionaries became more difficult. Still, in 1939 the League managed to send out supplies, including 4,330 doses of Jennerian vaccine.⁹⁸ After 1940, as difficulties deepened due to the war, the League could only reach fewer and fewer provinces. However, it could still at least send out Jennerian vaccine and some supplies for vaccination.⁹⁹

⁹⁶ According to the survey in the “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” in the years of 1928-31, 1933, and 1934.

⁹⁷ “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1937, 10-11.

⁹⁸ “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1939, 6.

⁹⁹ “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1940, 7; “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1941, 7; “Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine,” 1942, 3.

1939 Tianjin Flood: the Inter-Concessional and League's Collaborative Campaigns against Smallpox

In late August 1939, the typhoon rain, compounded with Tianjin's particular topographical position and dykes purposefully destructed during the war, caused the most severe flood in Tianjin during the first half of the twentieth century. Floodwater broke the South Canal dyke and swept over the city. The flood covered eighty percent of the city, collapsed more than 14,000 houses, and caused 30,000 deaths. More than half of the population, about 8,000,000 people within 650,000 households, became refugees. The floodwater receded only after one and half months.¹⁰⁰ After it had receded, most of the residents were left exposed to diseases, surrounded by human and animal corpses, with garbage and mud accumulated because sewers had been destroyed, suffering from food shortages, and having no home to return to.¹⁰¹ However, such catastrophe was not reflected its intensity in the low number of smallpox cases on the statistical charts collected by the Japanese, French, and British medical officers. The survey included the Chinese populated areas. These colonial physicians, joined by the local Chinese physicians who practiced Western medicine, attributed such fortunate consequence to the previous smallpox prophylactic measures and campaigns.¹⁰² These measures then continued being implemented after the flood.

In addition to other measures already discussed undertaken by the League, inter-concessional public health collaboration among colonial physicians had started already prior to

¹⁰⁰ Aaron Stephen Moore, *Constructing East Asia: Technology, Ideology, and Empire in Japan's Wartime Era 1931-1945* (Stanford: Stanford University Press, 2013), 120.

¹⁰¹ MAEN, Tientsin 691PO/1/16, "Rapport sur la Situation Sanitaire de la Concession Française de Tientsin," 17/11/1939-26/01/1940, 1.

¹⁰² MAEN, Tientsin 691PO/1/16, "Rapport sur l'État Sanitaire de la Concession en 1939," Service Médical et d'Hygiène, 2.

the 1930s. Medical collaboration between the British and the French was established early on. Patients suffering from infectious diseases at the French concession were transferred to the Isolation Hospital at the British concession since 1917. They were treated the same as patients at the British concession, under the care of the physicians of their choice. In return, the French Municipality paid 1,500 *tael* per year to the British Municipality under a six-year contract (1 September 1917- 1 September 1923). When the contract expired in September 1923, the French decided to continue because they were unable to establish their own quarantine due to the spatial and financial constraints in the French General Hospital.¹⁰³

Compared to the British-French collaborations, the collaboration among other concessions became frequent after 1937, intensifying after 1939. A multi-concessional collaborative campaign of compulsory vaccination against smallpox had already started during April and May of 1939 before Tianjin flooded that summer. The Japanese Consul-General Shigenori Tashiro in Tianjin initiated this smallpox vaccination campaign in order to achieve a comprehensive prophylaxis during the epidemic season in 1939. All residents in the Japanese concession and the Chinese territory (then under Japanese control) were required to undergo vaccination. The Japanese authority also requested their counterparts at the British, French, and Italian concessions to join the vaccination campaign. Anyone who did not possess a certificate certifying that vaccination had taken place within six months prior would not be allowed to purchase railway tickets at the station in Tianjin and could be refused entry to any port in China under the control of the Japanese military authorities.¹⁰⁴

¹⁰³ MAEN, Tientsin 691PO/1/16 “Procès-Verbal de la Séance de la Commission Sanitaire & d’Hygiène & de la Réunion Trimestrielle du Personnel du Service Médical & Sanitaire du 22 octobre 1924,” 3-4.

¹⁰⁴ MAEN, Tientsin 691PO/1/16, “Letters from Shigenori Tashiro, Japanese Consulate General in Tientsin, to French Consul L. Colin,” 11-18 April 1939.

Within the French concession, the vaccination collaboration in the vaccination campaign took place among Chinese physicians and medical staff, French physicians, French military and police, the International League for the Prevention of Blindness in China, the Pasteur Laboratory in Tianjin, and local enterprises. Lataste requested the Pasteur Institute of Shanghai to send 100,000 doses of Jennerian vaccine to the Public Health Service of the French concession in Tianjin.¹⁰⁵ The quantities requested by different local medical facilities were then distributed from the French Public Health Service.¹⁰⁶

Between 18 April and 12 May in 1939, the French municipal Public Health Service coordinated four medical facilities, two mobile teams, and thirty-four police posts. The four medical facilities, including the Dispensary of the French General Hospital, the Hospital for Blindness Prevention, the Pasteur Laboratory, and the French Military Center, operated between two and five o'clock every afternoon, and eventually vaccinated 35,565 people in total. A. Przyemski, the senior commander of the Health Service of French Troops in China, took charge of the Military Center.¹⁰⁷ The work at the Hospital for Blindness Prevention was particularly effective, vaccinating 25,996 people out of the total 35,565 vaccinations performed at these facilities.¹⁰⁸ Drs. Sung and Fong, two Chinese physicians recruited temporarily for the campaign by Tian Dawen, then the director of the Hospital for Blindness Prevention, took charge of the two mobile teams. Every morning from nine o'clock to noon they travelled to different quarters

¹⁰⁵ MAEN, Tientsin 691PO/1/16, "Bordereau des Pièces Adressees à Monsieur le Consul de France à Tientsin," 178.

¹⁰⁶ MAEN, Tientsin 691PO/1/16, "Note from Dr. T. H. Chang to Dr. J. Lataste," July 1941; MAEN, Tientsin 691PO/1/16, "Letter from Director of the International League for the Prevention of Blindness in China to Dr. J. Lataste," 08/04/1941.

¹⁰⁷ Ministère de la Défense État-Major de l'Armée de Terre Service Historique, Château de Vincennes, Chine (11H), 11H63, Dossier 3, Correspondance diplomatique (1937-1940), 102, "Commandant A. Przyimemski, Directeur du Service de Santé des Troupes Françaises en Chine."

¹⁰⁸ MAEN, Tientsin 691PO/1/16, "Lettre du Dr. Lataste au Consul de France à Tientsin," 14/05/1939, 2.

within the concession where the police had arranged appropriate locations for them to vaccinate people. These two mobile teams, along with fourteen depots at the Central Post, thirteen at Post Foch, and seven at the West Post in the area of Lao-Hsi-Kai, vaccinated 19,015 people in total. In addition to these regular hours, in collaboration with the League the physicians also vaccinated the administrative staff, including those in the French Municipality, the Police, the French schools, and the commercial houses and factories, such as Cie des Tramways, Olivie Chine, Far East Oxygène Co., Perrin Cooper-Ruslive Motors Co., Imperial Chemical Industries, L'Vrard & Co., United Engineering Works, Defag Co., Iladis Soap Co., and American President Lines. The number of vaccinated patients reached 55,277 in total, nearly 60% of the population at the French concession.¹⁰⁹

During September and October in 1939, after the flood, Lataste undertook further campaigns taking on smallpox and cholera vaccinations in cooperation with neighboring municipal and medical authorities.¹¹⁰ Within the French concession, he continued a strategy similar to the one implemented before the flood, increasing the mobility and adaptability of vaccination and sanitary works to the movement of the population. Thus he established temporary hospitals, vaccination centers and teams, as well as sanitary and disinfection teams. At the Military Center, Przyemsky collaborated with Dr. Lucie Yeu Kuei, a French-educated Chinese physician and an active advocate for blindness prevention working in the League.¹¹¹ Chinese physicians in service to the French Municipality were grouped and assigned to different

¹⁰⁹ MAEN, Tientsin 691PO/1/114, Ligue Internationale pour la Prévention de la Cécité en Chine, "Rapport sur le Résultat des Travaux de l'Hôpital pour la Préservation de la Cécité," 1939-1940, 1; "Lettre du Dr. Lataste au Consul de France à Tientsin," 14/05/1939.

¹¹⁰ "Rapport sur l'État Sanitaire de la Concession en 1939," 10. By no means was this the only medical practice at the time. Local Chinese physicians who practiced traditional medicine also participated in treating the refugees. For instance, pediatrician Wang Yuchen 王雨臣 took a boat to the refugee camps every day to treat children at no charge with herbal medicine that he prepared himself. Tianjin shi defang shi zhi bianxiu weiyuanhui, 28.

¹¹¹ 'Rappel de la 23e Assemblée du Conseil d'Administration et des Réunions Régulières de l'année 1937,' in "Rapport Général, Ligue Internationale pour la Prévention de la Cécité en Chine," 1937, 1.

medical facilities and areas, including the Hospital and dispensaries of Peiyang Naval Medical School, vaccination centers, and the medical centers for refugees.¹¹² Many people were vaccinated in these temporary-established locations.¹¹³ Lataste considered that vaccinating refugees and disinfecting the refugee camps had been most effective for preventing epidemics after the flood.¹¹⁴

In addition to vaccination, the municipal Public Health Service at the French concession, in collaboration with local foreign and Chinese people, systematically cleaned and disinfected the flooded areas. Led by two French municipal engineering chemists, the service followed a similar strategy, developed and supervised by the Pharmacist-Major A. Duval after the 1917 flood in Tianjin, to use the same chemical known as the Duval solution and target the areas most likely to be contaminated. They succeeded in destroying “all nests of germs and culture media which would not reappear in the spring and cause typhoid fever, gastronomical problems, and even plague and cholera.”¹¹⁵

These vaccination campaigns before and after the 1939 summer flood serve as a representative example of the multi-concessional collaboration against smallpox. The mode of compliance with the Japanese colonial authority and collaboration among the British, French, and Italian concessions on vaccination continued until 1942, including further campaigns in November of 1940, in March 1941, in the winter of 1941, and October of 1942.¹¹⁶

¹¹² “Rapport sur l’État Sanitaire de la Concession en 1939,” 10.

¹¹³ MAEN, Tientsin 691PO/1/16, “Rapport sur la Situation Sanitaire de la Concession Française de Tientsin,” 08/09/1939-22/09/1940.

¹¹⁴ “Rapport sur la Situation Sanitaire de la Concession Française de Tientsin,” 17/11/1939-26/01/1940, 2.

¹¹⁵ “Rapport sur l’État Sanitaire de la Concession en 1939,” 3.

¹¹⁶ MAEN, Tientsin 691PO/1/16, “Rapport Mensuel sur la Situation Sanitaire de la Concession Française de Tientsin,” March 1941; MAEN, Tientsin 691PO/1/16, “Note de Service pour Dr. Tchang, Médecin de la Municipalité Française, Chargé des Vaccinations et des Visites Extérieures du Chef du Service Médical et d’Hygiène de la Concession Française, Jean Lataste,” 14/03/1941. “L’Ecole Franco-Chinoise, ayant de nombreux

Before discussing them, it is worth noting that local political tension between Japanese and European colonial authorities within Tianjin did not invariably reflect political conflicts and alliances on the global level. In December 1941 marked a turning point of WWII, as Japan officially declared war against the United States and Britain.¹¹⁷ Before this event, in July 1937, Tianjin had fallen into Japanese hands as a result of the Second Sino-Japanese War. However, the Japanese did not fully occupy Tianjin. For the most part, until 1941 they respected and collaborated with other colonial authorities in British, French, and Italian concessions. The Japanese occupied the British concession from their declaration of war against Great Britain on 7 December 1941 until the end of WWII. The Italians collaborated with the Japanese until 10 September 1943, when Italy signed an armistice with the Allies, whereupon the Imperial Japanese Army occupied the Italian concession. The Japanese allowed administrative independence for the French concession until the end of WWII, but in many ways took indirect control over it, as the local colonial officials at the French concession were loyal to Vichy government (June 1940-September 1944).¹¹⁸ The Japanese fully controlled the Chinese authorities – the Provisional Government (1937-1940) and later the North China Executive Committee (1940-1945). They also controlled the lands that belonged to the Chinese authorities,

élèves qui paraissent n’avoir jamais été vaccinés contre la variole, ou l’avoir été depuis fort long-temps, je vous serais obligé de vous entendre avec le Frère Claudius, Directeur de l’Ecole, pour vacciner contre la variole les 600 élèves de cet établissement, dès la semaine prochaine, c’est-à-dire, à partir du 17 Mars 1941. Le vaccin vous sera fourni par le Laboratoire Pasteur (de Shanghai).” A request of 10,000 doses of Jennerian vaccine from the Japanese authorizes. MAEN, Tientsin 691PO/1/16, “Lettre du Dr. Lataste au Consul de France à Tientsin,” 08/03/1941.

¹¹⁷ “Imperial Rescript,” in Philip Kaplan, *World War Two at Sea: The Last Battleships* (Barnsley: Pen & Sword, 2014), 56 and 59.

¹¹⁸ In September 1940, the Japanese invaded Vichy French Indochina to prevent China from importing arms and fuel through French Indochina via Sino-Vietnamese Railway. The fight lasted several days before France and Japan came to an agreement. Japan was able to occupy Tonkin in northern Indochina, tightening the blockade of China. Bill Yenne, *The Imperial Japanese Army: The Invincible Years 1941-42* (Oxford: Osprey Publishing, 2014), 73-76. The Hankow Incident (12 July 1941) was a test case of Japanese policy towards all French concessions in China. Tokyo would finally consider it necessary to bring the concessions under Japanese control, without actually taking them over. US Department of Defense, *The “Magic” Background of Pearl Harbor*, 2 (12 May 1941 – 6 August 1941) (Ann Arbor: University of Michigan Library, 1978), 161.

including the former German, Austria-Hungarian, Russian, and Belgian concessions, as well as the Chinese City.

On the other hand, the local situation sometimes elevated tension to the global level, in many cases, the local authorities still attempted to conduct business as usual, amending their practices only in deference to major global developments. Taking the Tianjin Incident of 1939 as an example, in June 1939, the Imperial Japanese Army surrounded and blockaded the British and French concessions over the refusal of the British authorities to hand over six Chinese nationalists who took refuge in the British concession after assassinating the manager of the Japanese-owned Federal Reserve Bank of North China at the Grand Theater in Tianjin. Although the French seemed uninvolved in this political incident, because of the location of their concession, the Japanese had to control it to blockade the British concession effectively. At the time, it seemed that the situation would precipitate an Anglo-Japanese war, especially when the British media showed Japanese abuse of British subjects attempting to enter or leave the concession. British public opinion was especially offended by reports of British women being forced by Japanese soldiers to strip in public at bayonet point. It had led to a flood of “yellow peril” stereotypes being widely invoked in the British media.¹¹⁹ This crisis ended in July 1940, when the British Royal Navy and the Foreign Office advised Neville Chamberlain, the British Prime Minister, that the only way to force the Japanese to lift the blockade was to send the main British battle fleet to Far Eastern waters. However, given the war with Germany and lack of the aid from the United States, it would be unadvisable for the British fleet to depart from European waters. The British eventually turned over these six Chinese nationalists to the Japanese, who

¹¹⁹ Donald. C. Watt, *How War Came: the Immediate Origins of the Second World War, 1938-1939* (London: Heinemann, 1989), 354.

executed them.¹²⁰ However, this incident, lasting from June 1939 to July 1940, did not prevent local Japanese, French, and British authorities from collaborating on ongoing medical and public health services, sharing resources and ideas, and even on flood relief in the summer of 1939.

During these campaigns, collaboration among these concessions followed the lead of the Japanese authorities. Work in common was pursued in various aspects of public health: a consensus on the interval between revaccinations was agreed, effective vaccine transportation and supply was organized, mobile vaccination facilities and staff were deployed, reports of infectious diseases were circulated among the concessions, and vaccination certificates, which was agreed to be widely used and considered valid within China.

First off, the Japanese colonial authorities took the lead in these campaigns after 1937, requesting collaboration from their counterparts in other concessions. The Japanese were dependent on the help from other concessional authorities to protect the health of local Japanese population, then the largest foreign nationality in Tianjin. Previously, we have observed Japanese Consul-General Tashiro's leading position in the 1939 campaign. In the November 1940 campaign, Nitta, the Japanese Medical Colonel, initiated the meeting and propounded a mandate of smallpox vaccination in case of epidemics. Irwin, the chief of the Health Department of the British Municipal Council, pointed out that although the legislation within the British concession did not make vaccinations mandatory, he was willing to "work with the Japanese authorities in the same direction and spirit."¹²¹ Lataste from the French Municipal Public Health Service also complied, while stressing that with nearly 60% of the concessional population having been vaccinated within French concession in the spring of the same year, fewer vaccinations might be

¹²⁰ D. C. Watt argues that the partial diplomatic victory by the Japanese helped to keep Japan neutral during the first year of WWII. It also highlighted the weakness of the UK's position in Asia, both militarily and diplomatically, with its failure to enlist the US to take a stronger position in its support. *Ibid.*, 359.

¹²¹ MAEN, Tientsin 691PO/1/16, "Compte-Rendu de la Séance Inter-médicale Tenue au Cercle Militaire Japonais le 30 septembre 1940, a/s des Mesures Sanitaires à Prévoir pour Lutter contre la Variole," 04/10/1940, 2.

expected this time around. Nitta also initiated the Franco-Japanese collaboration on smallpox vaccination during the winter of 1941 and in October 1942 campaigns.

The interval of revaccination was not always agreed upon among different colonial authorities and the Chinese population by no means fully complied with revaccination. During the campaign of November 1940, the British medical officer Irwin questioned the duration of immunity. In his opinion, even though the immunity could last from six to seven years in Europe, it was preferable to revaccinate every three or four years in China. Nitta pointed out that annual revaccination was even better. Thereupon, annual revaccination became the norm in all concessions.

During these campaigns, the Japanese authorities were willing to provide Jennerian vaccine at each concession's request, given that the other concessions had exhausted their vaccine supply. For instance, during the November 1940 campaign, Nitta promised to supply Jennerian vaccine for the campaign, if necessary, but he was hoping that Lastate and Irwin could acquire their own supplies. The Japanese acquired the vaccine produced locally by the Japanese Army's medical laboratory under the Public Health Office (*Eisei Bureau*) at the Japanese concession in Tianjin.¹²² The British and the French authorities both had ways to replenish their supply. The French usually acquired Jennerian vaccine from the Pasteur Institute of Shanghai. In the winter of 1941, when the Shanghai Institute was unable to supply in time, Nitta responded by offering all the vaccine that the French concession needed, which added up to the 30,000 doses that Lastate requested. The Japanese health officers took turns to check the work at each vaccination center set up at the French concession.¹²³

¹²² Ruth Rogaski, "Hygienic Modernity in Tianjin," in *Remaking the Chinese City: Modernity and National Identity, 1900-1950*, ed. Joseph W. Esherick (Honolulu: University of Hawaii Press, 2000), 43.

¹²³ MAEN, Tientsin 691PO/1/16, "Compte-Rendu de Mon Entrevue avec la Direction du Service de Sante Militaire du Détachement Tominaga, le 19/12/41," 22/12/1941.

We have documented the mobile nature of the vaccination facilities and staff within the French concession in the 1939 campaigns. In order to better accommodate the local population, several vaccination depots were created in existing hospitals and temporary medical centers, such as those in refugee camps. The physicians not only provided their services at the permanent locations, but also attended vaccination locations temporarily established around the city. The French authority applied similar strategies during subsequent campaigns. For instance, in the winter of 1941, there was a concern for smallpox “imported” by people coming from the northern provinces where vaccination was less common.¹²⁴ The residents at the French concession were advised to vaccinate without delay, with the goal to vaccinate all of the residents at the concession.¹²⁵ The French Municipal Public Health Service published the list of six centers that performed vaccination. They included the Fou Tchong Hotel (*Hôtel Fou Tchong*), the Soup Kitchen (*Soupe populaire*), the International League for the Prevention of Blindness,¹²⁶ the Foch Post (*Poste Foch*), the Bishopric (*Evêché*), and the Pasteur Laboratory.¹²⁷ During smallpox vaccination campaigns in the late 1930s and early 1940s, the Pasteur Laboratory was designated as one of the important centers for vaccination.¹²⁸ The Hospital for Blindness Prevention under the League achieved the best vaccination results. It alone administered 9,949

¹²⁴ MAEN, Tientsin 691PO/1/16, “Rapport Mensuel sur la Situation Sanitaire de la Concession Française de Tientsin,” February 1941, 2.

¹²⁵ “Compte-Rendu de Mon Entrevue avec la Direction du Service de Sante Militaire du Détachement Tominaga, le 19/12/41”; MAEN, Tientsin 691PO/1/16, “Note de Service,” 175, 30/12/1941.

¹²⁶ “Compte-Rendu de Mon Entrevue avec la Direction du Service de Sante Militaire du Détachement Tominaga, le 19/12/41”; “Letter from Director of the International League for the Prevention of Blindness in China to Dr. J. Lataste,” 08/04/1941.

¹²⁷ “Compte-Rendu de Mon Entrevue avec la Direction du Service de Sante Militaire du Détachement Tominaga, le 19/12/41”; MAEN, Tientsin 691PO/1/16, “Rapport de Vaccinations Antivarioliques,” 19/12/1941-07/02/1942.

¹²⁸ One of the examples was to warn the local population about the “native eye powders” and the correct measures to treat eyes. MAEN, Tientsin 691PO/1/114, Patseur Laboratory, “Liushen hai mu yanyao” 留神害目眼藥 (Do Not Use the Harming Powders!)

vaccinations in December 1941.¹²⁹ The total number of patients vaccinated during this period reached 65,745, nearly 70% of the concessional population.¹³⁰

Amongst the concessions and within the French concession, a procedure for reporting infectious diseases, including smallpox, was set up and maintained by joint effort. During the November 1940 campaign, the Japanese authorities required reporting smallpox cases along with other contagious diseases such as scarlet fever, typhoid fever, diphtheria, paratyphoid, dysentery, cerebrospinal meningitis, measles, cholera, and plague. The colonial authorities in other concessions complied. The ensuing reports included the dates and places of smallpox verification, names and ages of the patients, the hospitals that admitted the patients, dates and duration of hospitalization, and progress during hospitalization. These reports then were circulated among the concessions.¹³¹ During the winter 1941 campaign, the French Municipal Public Health Service circulated a notice to physicians within the concession, requiring them to report any apparent smallpox cases, with the name, age, nationality and address of the patient, to the Central Post of the Sanitary Service (*Service Sanitaire du Poste Central*). The Service would then subject the patient to hospitalization, disinfection, and isolation. The physicians who failed to do so would have their licenses revoked and could no longer practice at the concession.¹³²

Throughout these campaigns, a standardized certificate asserting temporary immunity was given the vaccinated patient. Validity of this certificate was broadly acknowledged within China. For example, pursuant to an agreement between the Japanese and French colonial

¹²⁹ MAEN, Tientsin 691PO/1/114, Ligue Internationale pour la Prévention de la Cécité en Chine, “Rapport sur le Résultat des Travaux de l’Hôpital pour la Préservation de la Cécité,” 1941, 3.

¹³⁰ “Rapport de Vaccinations Antivariables, 19/12/1941-07/02/1942; MAEN, Tientsin 691PO/1/16, “Rapport Mensuel sur la Situation Sanitaire de la Concession Française de Tientsin,” December 1941, 2.

¹³¹ “Compte-Rendu de la Séance Inter-médicale Tenue au Cercle Militaire Japonais le 30/09/1940, a/s des Mesures Sanitaires à Prévoir pour Lutter contre la Variole,” 04/10/1940; MAEN, Tientsin 691PO/1/16, “Letter from the Japanese Consul General to the Consulate of France,” 04/05/1939.

¹³² MAEN, Tientsin 691PO/1/16, “Note pour les Médecins de la Concession Française,” 23/12/1941.

authorities, the numbered certificate was written in French, Japanese, and Chinese, with the name and age of the vaccinated person and a stamp identifying the date and the unit of the sanitary service. People were required to present their vaccination certificate at checkpoints, international bridges, and gates between concessions, as well as in theaters and on the street. Also, no travel by boat or railway was allowed without the certificate. Those who failed to present the certificate had to be vaccinated at the nearest vaccination centers. The police enforced these measures.¹³³ The validity of the certificate extended beyond the Tianjin boundary. Colonial authorities in other Chinese cities recognized them.¹³⁴

The French, Japanese, British, and Italian colonial authorities joined forces in various smallpox vaccination campaigns right before and after the catastrophic flood in the summer of 1939 and continued doing so on a regular basis during the 1940s. Despite their nations' military conflicts and political animosities elsewhere in the world, these colonial authorities coped with medical problems in turbulent times, in close collaboration, both among themselves and with the Chinese.

Conclusion

International and inter-concessional collaboration among Chinese practitioners of Western medicine and colonial physicians facilitated the contemporaneous prophylactic effectiveness of measures against smallpox and blindness in Tianjin and its surrounding areas. In this chapter, I argue that such medical practices were effectively internationalized. The International League for

¹³³ "Compte-Rendu de Mon Entrevue avec la Direction du Service de Sante Militaire du Détachement Tominaga, le 19/12/41"; MAEN, Tientsin 691PO/1/16, "Note de Service," 172, 20/12/1941.

¹³⁴ MAEN, Tientsin 691PO/1/16, "Lettre de A. Tatarinoff, Agent Consulaire de France à Tsingtao au Consul de France à Tientsin," 26/03/1941.

the Prevention of Blindness in China from the 1920s through the 1940s acted as an international network, initially dedicated to prevention of blindness and vaccination against smallpox, through work with individual philanthropists, Catholic missionaries, and charitable organizations, as well as local private enterprise. It later on collaborated with the French and other colonial authorities. Within the League, the leading physicians of various nationalities, mostly professors and graduates of Peiyang Naval Medical School, were also active at the Pasteur Laboratory and the Public Health Service at the French concession. Most importantly, the Western-trained Chinese physicians constituted the main force behind these medical practices.

Drawing upon their medical practice at the Hospital of Peiyang Naval Medical School and fieldwork in the local factories and ateliers during the early 1920s, these international physicians acquired knowledge indispensable for implementing measures against blindness and smallpox. Local fieldwork widened their experience by identifying the causes of blindness, such as local hygiene standards and local eye drugs. They found that smallpox was the biggest cause of blindness in China, and concluded that smallpox vaccination was the best method for preventing it. Local fieldwork also helped them to identify the best locations to implement these measures, especially in the areas close to factories and poor quarters. Lastly, their local fieldwork was crucial for treatment and prophylaxis, since the affliction was concentrated in these places, with children most susceptible to smallpox comprising the main working force.

Knowledge gained by these physicians at the hospital and the eye clinics affiliated with the League from experience in visiting factories and small workshops translated into actual practices in the areas inhabited by paupers and factory workers during 1924-1942. Most of these facilities focused on smallpox vaccination as a major and continual endeavor. The physicians visited various factories to treat and vaccinate their workers. In close collaboration with Catholic missionaries in as many as twenty-three provinces, the League provided Jennerian vaccine and

instruments for vaccinating local people. Collaborating with the concessional authorities, the League disseminated of smallpox vaccination widely in order to prevent blindness. Through international collaboration extending from Tianjin to interior China, the League was the world pioneer of the movement for the prevention of blindness through the prevention of smallpox. In conjunction with the effort resulting from the multi-concessional collaborations, vaccination and related measures formed a single crucial solution for two problems in public health.

CONCLUSION

Pastorism and the Pastorian Legacy in China

“Fortune favors the prepared mind.” Thus Tu Youyou 屠呦呦, the Chinese Nobel Laureate of 2015 in physiology and medicine, quoted Louis Pasteur in her Nobel lecture at the Aula Medica, Karolinska Institutet in Stockholm.¹ She continued: “my prologue of *Western medical training* (*xixue* 西學) prepared me for the challenges when the opportunities in searching for antimalarial Chinese medicine became available.”² (Emphasis added) Tu received her award for discovering artemisinin derived from *Qinghao* 青蒿 (*Artemisia annua*, sweet wormwood), a natural substance used in traditional Chinese medicine for treatment of malaria. Interestingly, Tu correlates Pasteur’s idea of intellectual preparation with her Western medical training. Even more notably, the official English translation of this last phrase replaces “Western medical training” with “integrated training in the modern and Chinese medicines.” I choose to remain faithful to the original speech by translating literally what she actually said in Chinese. However, we should not treat the English version as a mere mistranslation. By treating it as an interpretation, we can identify the context in which Tu has conducted her work since the late 1960s and the implications of the connections between Western medical practices and the

¹ Tu Youyou’s quote is adapted from the original phrase: “Dans les champs de l’observation le hasard ne favorise que les esprits préparés.” (In the fields of observation fortune favors only the prepared mind) in Louis Pasteur’s lecture at the University of Lille on 07/12/1854. Louis Faya, “La Méthode Expérimentale de Pasteur et ses Rapports avec les Théories de Claude Bernard,” *Bulletin de la Société des Sciences Naturelles et d’Enseignement Populaire de Tarare* 5 (1903): 13.

² Tu Youyou was awarded “for her discoveries concerning a novel therapy against malaria.” The entire video of lecture, entitled “Discovery of Artemisinin – A Gift from Traditional Chinese Medicine to the World,” lecturing in Mandarin with English subtitle on 07/12/2015, can be found at the official website of the Nobel Prize: http://www.nobelprize.org/nobel_prizes/medicine/laureates/2015/tu-lecture.html The Chinese transcript can be found here: <http://alturl.com/gqqpq>

practices of integrative medicine in China.

The Pastorian Spirit in Tu Youyou's Investigation of Traditional Chinese Medicine

After graduating from the Department of Pharmaceutical Sciences at the Medical School of Beijing University in 1955, as a practitioner of Western medicine, Tu participated in the courses of traditional Chinese medicine, following the Mao's policy that required biomedical doctors to learn traditional Chinese medicine. Afterwards, she worked at the Chinese Academy of Chinese Medical Sciences in Beijing.³ During the Cultural Revolution (1966-1976), Tu might have been assigned to do manual agrarian labor in the countryside like many other scientists and intellectuals.⁴ Instead, she was recruited to a secret military project for developing antimalarial drugs from traditional Chinese medicine.⁵ In 1967, during the Vietnam War, Ho Chi Minh, the Communist leader of the North Vietnam, asked Chinese Premier Zhou Enlai 周恩來 for help with an effective malaria treatment for his soldiers traveling down the Ho Chi Minh Trail, where malaria had caused many casualties. Since malaria was also a major cause of death in Southern China, Zhou convinced Mao to set up the secret project, named Project 523, after its inception

³ See Tu's biographical information in Wang Changlu, ed., *Tu Youyou zhuan* 屠呦呦傳 (Biography of Tu Youyou) (Hong Kong: Sanlian shudian, 2016).

⁴ The Cultural Revolution was a socio-political movement, taking place in China during 1966-1976. Initiated by Mao Zedong, it sought to impose Maoist thoughts as the dominant ideology within the Chinese Communist Party, and purged capitalist and traditional elements from Chinese society. Intellectuals, including scientists, were condemned as bourgeois and counter-revolutionaries, as their attitudes and practices were considered opposed to the interests of the masses. Individual scientists were made the object of public criticism and persecution and often sent to the countryside to "learn political virtue" by laboring with poor farmers. Many research institutes ceased their work, except those related to military. Michael Schoenhals, ed., *China's Cultural Revolution, 1966-1969: Not a Dinner Party* (New York: Routledge, 2015), 3-27 and 41.

⁵ Tu Youyou, "Discovery of Artemisinin – A Gift from Traditional Chinese Medicine to the World," Nobel Lecture 2015.

date of 23 May 1967.⁶ Tu was one of five hundred Chinese scientists recruited for the project. The project staff was divided into two teams using different approaches, one through developing synthetic compounds, and the other by investigating traditional Chinese medicine. In 1969, the Communist government appointed Tu as the leader of the latter team, comprising the scientists at the Institute of Chinese Materia Medica of the China Academy of Chinese Medical Sciences.⁷

Leading her team, Tu reviewed ancient traditional Chinese medical texts and folk recipes, and interviewed renowned and experienced traditional Chinese physicians who provided her with prescriptions. Tu and her team eventually collected two thousand prescriptions and recipes containing herbal, animal, and mineral substances that claimed efficacy in treating “intermittent fevers” as found among the symptoms of malaria.⁸ After collecting all these prescriptions and recipes, Tu’s task was to identify the varieties of plants from which the ingredients were derived. In 1971, after Tu and her team made 380 extracts based on some of these prescriptions and tested them on mice, they started to focus on one particular plant, *Qinghao*.⁹ However, they first had to identify the right plant among the different species of *Qinghao*. The earliest historical record of using *Qinghao* as an herbal medicine was found among the silk manuscripts unearthed from the Han Tomb No. 3 at Mawangdui, an archaeological site dated between the third century BCE and the first century CE. The application is found in one of the manuscripts, entitled “Recipes for Fifty-Two Ailments” (*Whshi'er bingfang* 五十二病方). The medical application of *Qinghao* was

⁶ Elisabeth Hsu, “Reflection on the ‘Discovery’ of the Antimalarial Qinghao,” *British Journal of Clinical Pharmacology* 61. 6 (2006): 666-667.

⁷ Ibid.

⁸ Tu summarized 640 prescriptions from her collection in the published summary, entitled *Antimalarial Collections of Recipes and Prescriptions* (*Nueji dan yanfang ji* 瘧疾單驗方集). Her team subsequently produced 380 herbal extracts based on these prescriptions before testing them on mice. Tu, “Discovery of Artemisinin.” “Intermittent fevers” was a traditional Chinese medical term that denoted a variety of conditions associated with fevers, including malaria. Hsu, 667.

⁹ Tu, “Discovery of Artemisinin.”

also recorded in “The Classic of Herbal Medicine” (*Shennong bencaojing* 神農本草經), “Handbook of the Supplement to Leigong’s Methods of Preparing Medicine” (*Buyi Leigong paozhi bianlan* 補遺雷公炮製便覽), and “Compendium of Materia Medica” (*Bencao gangmu* 本草綱目). However, these texts yielded no clear classification or standard nomenclature for *Qinghao*. Tu and her team had to test six different species of *Qinghao* at hand. They made extracts out of them and tested them on mice.¹⁰

In the beginning, the extracts did not have any antimalarial efficacy. Tu went back to the Chinese medical texts and came across a passage in Ge Hong’s “The Handbook of Prescriptions for Emergencies” (*Zhouhou beiji fang* 肘後備急方, composed during the third and the fourth century CE): “A handful of *Qinghao*, immerse it into two *sheng* [equal to 2.2 liters] of water, wring out the juice, and drink it all.”¹¹ The keys were the freshness of leaves and temperature. The passage inspired Tu to replace dry leaves with raw ones, and use the solvent of ethyl ether with a lower boiling point for making the extracts. They then removed acidic impurities from the extracts by using an alkaline solution and retained the neutral portion. Tu and her team continued to test this neutral portion on mice. Finally, they identified *Artemisia annua* as the plant that yielded the most effective neutralized extract. They tested the neutral portion on mice and monkeys. Having achieved success in the laboratory animals, Tu and her team members proceeded to test the extract on themselves as the first human subjects. Promising results encouraged them to carry out a clinical trial in the Hainan 海南 Province, where they cured thirty *Plasmodium falciparum* malaria patients.¹² *Plasmodium falciparum* malaria has been the form of

¹⁰ Ibid.

¹¹ “Qinghao yi wo. Yi shui er sheng zi, jiao qu zhi. Jin fu zhi” 青蒿一握。以水二升漬，絞取汁。盡服之。Ge Hong, *Zhouhou beijifang*, 3. 16, <http://alturl.com/odk9w>

¹² Tu, “Discovery of Artemisinin.”

malaria with the highest rates of complications and mortality. In 1972, Tu and her team isolated the active chemical compound from the neutral portion. The compound was later named *Qinghaosu* 青蒿素, “artemisinin” in Chinese. Since the 1980s artemisinin and its derivatives have been proven to be the most effective drugs for treating *Plasmodium falciparum* malaria patients in China. Following its investigation by the World Health Organization in the 1990s and its subsequent promotion on a large scale, it has been likewise identified worldwide since 2004.¹³

Tu pointed out that collection and interpretation of traditional prescriptions and recipes laid down a sound foundation for the discovery of artemisinin. She also differentiated “the approaches taken by Chinese medicine and general phytochemistry in searching for novel drugs.”¹⁴ The distinction that Tu made speaks as well to the different methods taken by the two separate teams assigned to Project 523, one being her own team investigating traditional Chinese medicine and the other, the team that employed phytochemistry (the study of chemicals from plants) for developing synthetic compounds.

Unfortunately, the research report of the team assigned to develop synthetic compounds is not available, but in general practice, the phytochemical approach usually involves a conventional order of a standard scientific research procedure: chemical analysis – animal experiment – clinical application – artificial synthesis – structure modification. In the first step, the chemists perform a chemical analysis and isolate a pure alkaloid, a naturally occurring chemical compound containing mostly nitrogen atoms, from a living organism that could be a

¹³ Hsu, 666. According to World Health Organization guideline 2010, artemisinin-based combination therapies (ACTs) are recommended as the first line of antimalarial treatments against *Plasmodium falciparum*. World Health Organization, *Guideline for the Treatment of Malaria* (Geneva: WHO Press, 2015), 16 and 32. *Plasmodium falciparum* malaria is much more prevalent in sub-Saharan Africa than in many other regions in the world. It comprises 75% of the malaria cases. J. T. Griffin et al, “Estimates of the Changing Age-Burden of Plasmodium Falciparum Malaria Disease in Sub-Saharan Africa,” *Nature Communications* 5. 3136 (2014), doi: 10.1038/ncomms4136.

¹⁴ Tu, “Discovery of Artemisinin.”

plant, an animal, or even a bacterium. This pure alkaloid acts as the active component that presumably yields medical efficacy. The chemists go on to conduct pharmacological and physiological experiments with this isolated alkaloid by testing it on laboratory animals. Having succeeded in the animal experiment, they proceed to test it on human subjects. Once the clinical efficacy is confirmed, the chemists synthesize the chemical component by artificial methods. Finally, the scientists undertake the final modification of the chemical structure to rid it of unwanted side effects or to improve its curative capacity before launching industrial production on a large scale.¹⁵ As we do not have this team's research details at hand, we do not know what had hindered these chemists. They might have yielded to a political resistance, or failed to achieve a breakthrough at some stage, or not have advanced far enough before Tu and her team delivered their successful results. What we know is that their research did not come to fruition.

Japanese and Japanese-educated Chinese students introduced the phytochemical approach within modern pharmacology to China in the beginning of the 1920s. However, in the following decades, when practitioners of Chinese medicine studied medicinal drugs with scientific methods, they did not adopt such an approach. Instead, as Lei observes, they proceeded in a reverse order: “clinical experiment [after acquiring a prescription claimed to be effective]– animal experiment – chemical analysis – retesting and artificial synthesis – structure modification.”¹⁶ In the 1940s, the practitioners of Western medicine criticized it as unethical in taking the “clinical experiment” as the first step of the approach to studying *Changshan* 常山 (*Dichroa febrifuga*), an anti-malaria herb used in traditional Chinese medicine.¹⁷ They condemned traditional practitioners for treating their patients as guinea pigs by giving them untested drugs. They also refused to see the

¹⁵ Lei, *Neither Donkey Nor Horse*, 209.

¹⁶ *Ibid.*, 211.

¹⁷ Regarding the details on the history of the research on the “new” antimalarial drug *Changshan*, see Lei's work in *ibid.*, 193-221.

approach as an alternative research strategy of “overcoming the barrier to entry,” starting with testing on human subjects a medicinal drug known to have been used and proven through experience to be effective from readily accessible Chinese medical texts or prescriptions credited to experienced traditional practitioners.¹⁸ As Lei points out, “the key to scientizing Chinese medicine lay not in conceptual reasoning but in using the tool of clinical trials to validate the therapeutic efficacy of their experience with the human body. For the traditional practitioners who valorized ‘experience with the human body’ as the essential strength of Chinese medicine, the ‘clinical experiment first [, rather than the ‘chemical analysis first, ’] approach of the reverse-order protocol was not only a more appropriate protocol for conducting research on Chinese drugs, but also a political strategy for further developing Chinese medicine.”¹⁹

Since its founding in 1955, the Institute of Chinese Materia Medica, where Tu worked after her university biomedical training, has integrated the phytochemical and reverse-order approaches in the study of Chinese medicinal drugs, while drawing more from the reverse-order approach than from the standard scientific one. Scientist like Tu and her team proceed their work as the following: collection of Chinese medical prescriptions and recipes – animal experiment – clinical application – chemical analysis – retesting and artificial synthesis – structure modification. In both the reverse-order approach and Tu’s procedure, the step of the chemical analysis has to wait until the right prescription or plant has been proven by tests on animals and human subjects, by contrast to the conventional phytochemical approach that took the chemical analysis as the first step of its research. Tu and her team did not make up this procedure from scratch. They inherited certain features of the *Changshan* research conducted during the Republican period. Contemporary practitioners of Western medicine criticized the *Changshan*

¹⁸ Ibid., 198.

¹⁹ Ibid., 214.

research for employing a “reverse-order” approach, as distinct from the standard approach used in scientific experiments. Ironically, Tu’s procedure, adapted from this reverse-order approach, eventually became adopted as the standard for researching Chinese medicinal drugs, as a result of integrating Chinese and Western medicine. The Nobel Prize awarded to Tu for her team’s work ratifies this approach to research and validates its scientific value on an international level.

Tu acknowledges her reading of Ge Hong’s medical text, which inspired her to use raw leaves and reduce the extraction temperature, as the turning point that led to the success of her research. We have seen several examples of both French and Chinese Pastorian following the Chinese textual tradition in their fermentative experiments on opium, rice liquor, and *nuoc-mam*, research on nutrition in soyfood, therapeutics of leprosy with chaulmoogra seeds, and studies of rabies and snake venoms. Reliance on this tradition distinguished the Pastorians in China from their counterparts practicing elsewhere. As we see in Tu’s example, this tradition continues in today’s Chinese medical community. It does not come as a surprise that Tu’s Western medical training and practice exhibit the spirit of Pastorian research, as she shares such spirit with her predecessors who employed Pastorian practices in China.

Pastorism in China: A Special Style of Practice by Its Emphasis on Localism and the Scientific Explanations

Before identifying the particular patterns of Pastorian practices in China, we must recognize that the Pastorian principles, which constituted Pastorism, have become established in France and expanded elsewhere in the world, with various local modifications, since the late nineteenth century. The Pastorians studied in this dissertation abided by the Pastorian principles in their research and public health work, albeit evincing a special concern for, and making appropriate

accommodations to, local conditions. First off, Pastorism began with germ theory of disease. Thus Pastorian hygiene has been aptly characterized as bacteriologically centered. Among the examples given in this dissertation, we see that every Pasteur Institute and its associated municipal public health department in China implemented measures, examining the quality of foods and milk, as well as inspecting the sanitary condition, whether the presence of microorganisms or not, in slaughterhouses, brothels, factories, and so forth. We also see Pastorians in Tianjin collaborating with other international physicians to prevent blindness, and to contain the spread of infectious diseases by getting rid of pathogenic microorganisms with various sanitary measures.

The second dimension of Pastorism is immunization, proceeding from the development of a vaccine or serum using the attenuated form of the microorganism otherwise identical with or related to the microorganism that causes the disease, and the application of this practice to public health. Even though the Chinese (as regards variolation) and the British (as regards Jenner's discovery of cowpox vaccination) are within their rights to claim their originality for immunization, Louis Pasteur and his followers advanced it further by establishing the standard procedure of making a vaccine or serum, and applying it to many other diseases, such as rabies, typhoid, plague, tuberculosis, and cholera. The French law that mandated compulsory smallpox vaccination in 1902 asserted this procedure by calling it "Pastorian legislation."²⁰

Lastly, Pastorism involves rabies research and treatment. Continuing Louis Pasteur's legacy, most of the overseas Pasteur Institutes, including all of the Pasteur Institutes in China, established a department for treating rabies. Many contemporaneous Pastorian-trained colonial physicians identified rabies treatment as an integral part of Pastorian practices. At times they

²⁰ Moulin, "Patriarchal Science," 310.

even sought out cases of rabies to popularize the anti-rabies vaccine.²¹ For example, the Pastorians at the Pasteur Institute of Chengdu did not produce an anti-rabies vaccine locally until 1926. Between 1926 and 1927, the number of rabies treatments was limited to seven cases. The Chengdu Pastorians attributed that to rabies having supposedly been uncommon in Sichuan. Nevertheless, they set up rabies treatment as part of their mission, and had the facilities for making anti-rabies vaccine at hand.²²

Bearing in mind these common features of Pastorism, we turn to its particular applications in China. On the one hand, in addition to relying upon the Chinese textual tradition, Pastorians in China had to accommodate Chinese political circumstances and socio-cultural practices in their vaccination campaigns. On the other hand, they needed to account for local environmental specificities, such as climate, geographical distance, and acclimatization of the local rabies virus and animal hosts. This emphasis on localism in their medical practices is an integral part of Pastorism.

In the political and socio-cultural aspect of their work, the Pastorians conducting Jennerian vaccination in Chengdu had to collaborate with local Chinese practitioners in disseminating vaccination that incorporated traditional Chinese variolation practices within its procedure, in addition to working with the local Chinese authorities and Catholic missionaries. Thus they accommodated the Chinese preference of inserting Jennerian vaccine into acupunctural points, performed vaccination against smallpox in the spring, and coordinated vaccination with the worship of the Smallpox Goddess. As also happened in Tianjin, French Pastorians and their international colleagues at the International League for the Prevention of

²¹ “La vaccination antirabique, inséparable de toute activité pastorienne.” M. A. Chabaud and R. Néel, “Le Instituts Pasteur de Tanger et de Casablanca,” *Maroc Médical* 456 (1963): 350. For example, the Pasteur Institute in Teheran justified its establishment with the presence of rabid wolves in the Zagros Mountains in Kurdistan. Moulin, “Patriarchal Science,” 312; Chakrabarti, 113.

²² MAEP, Série E, Asie, Chine, 175-176, “Rapport du Dr. Jouvelet,” 22/02/1927.

Blindness in China worked with various colonial authorities, conducted field research in local factories, and discovered that the main cause of blindness in Tianjin was smallpox, in combination with poor hygiene and the use of the “native eye powders.” Their discovery led them to identify the locations close to the surveyed factories and the poor neighborhoods as the most appropriate sites to implement vaccination for blindness prevention. In close collaboration with Catholic missionaries in as many as twenty-three provinces in the interior of China, the League provided Jennerian vaccine and instruments for vaccinating local people. Cooperating with the multi-concessional authorities during epidemics from 1939 to 1942, the League achieved a wide dissemination of vaccination in order to prevent blindness. In areas arranged from coastal Tianjin to inner China, this international collaboration in implementing vaccination and related public health measures created a single effective solution for two distinct problems.

As regards local environmental specificities in Pastorian practices, Pastorians in China took advantage of the acclimatization of local animals and pathogens. In selecting animal vaccine producers, Albert Calmette, the founder of the Pasteur Institute in Saigon, concluded from his experiments in French Indochina that water buffaloes were best suited for this purpose. His successors relied exclusively on water buffaloes as their source of vaccine production in the Far East. However, the French Pastorians in Chengdu found that the local water buffalo in Sichuan resisted infections much better than its counterpart in French Indochina. They also discovered that local heifers could serve as a good source of vaccine when water buffaloes were scarce. Moreover, in order to acquire local animals, the Pastorians had to negotiate with local Muslim farmers, accommodating disparate cultural perceptions and attitudes.

In a similar vein, the discovery that the naturally occurring rabies virus in China was more virulent than that in Europe became the focus of the Pastorian work in Shanghai during the first half of the twentieth century. Experiments demonstrated the more intensive nature of the

Shanghai strain, compared to its counterpart in Paris. However, this discovery did not necessarily comport with the conventional logic of treatment. In treating the more virulent strain of rabies, the Shanghai Pastorians chose to use the inactivated vaccine rather than the more potent live one. In consideration of local geographical distance and climate, their choice of a vaccine was motivated less by its original efficacy than by its transportability and durability.

The European Pastorians and their Chinese colleagues at the Pasteur Institutes in China deemed their work scientific because of its empirical nature that followed Pastorian guidelines and standards, notwithstanding various local adaptations.²³ That was the case when they sought to find effective animal hosts for vaccine production in Chengdu, to discover the nature of a local virus strain in Shanghai, or to identify the major cause of blindness in Tianjin. Their conclusions all resulted from empirical studies by direct observation, investigation, and multiple experiments. They conducted some of these studies in conventionally organized laboratories that hosted rabies studies in Shanghai and others in unconventional sites, such as when surveying factories and poor neighborhoods in Tianjin, or administering animal vaccination in makeshift spaces like a cowshed in Chengdu. They regarded their adaptation to the natural and social environment as an integral part of their empirical research, which helped to maintain its scientific integrity.

Along similar lines, the Pastorians' accommodation to local cultural customs and medical practices was necessary to achieve the goals of their scientific mission. However, the scientific perception of accommodation had changed over time. The year of 1929 was the turning point. Through the first three decades of the twentieth century, the Chengdu Pastorians successfully produced the Jennerian vaccines locally and provided an ample supply of it to the southwest of China. They largely relied on the local Chinese practitioners to disseminate vaccination.

²³ The Pastorian empirical guidelines derived from scientific experimentation, which was to control and even eradicate an infectious disease by administering the pathogen in an attenuated form.

Accommodating the “neither new, nor European” practices of the local Chinese practitioners, with whom the Chengdu Pastorians chose not to compete but to collaborate, became the next best strategy. In the view of physicians in China prior to the 1929 confrontation between the practitioners of Western medicine and their traditional competitors, such “neither new, nor European” practices were neither ill-conceived nor doomed to fail. However, for the European Pastorians, their accommodation of these practices did not always stand on solid scientific ground, as there was no empirical evidence for the correlation between these practices and the success rate of vaccination. However, the accommodation strategy worked, as shown by the decreasing incidence of smallpox. In certain locations, such as Tianjin or Shanghai, the Pastorians often confronted “silent” resistance to vaccination whenever they failed to take into account the local seasonal preferences, Chinese medical culture, and the belief in the Smallpox Goddess. The local people simply did not show up to vaccinate their babies.

During the 1929 confrontation, the traditional practitioners of Chinese medicine successfully counteracted the proposal of abolishing Chinese medicine by promising to put traditional Chinese medicine in concert with scientific medicine. From then on, their practices remained under scrutiny, evaluated by scientific methods. Some of the details of the earlier “neither new, nor European” practices, such as altering the vaccine content, would have been disparaged by the practitioners of Western and Chinese medicine alike as “mongrel practices,” lacking a “scientific” ground according to Western standards.²⁴ Aligning with the Nationalist government’s pursuit of modernization, vaccination services and campaigns became more uniform and subject to enforcement as part of public health work under the auspices of the Chinese governmental or foreign colonial authorities, leaving little room for individual vaccinators to earn a living. However, some parents still chose to have their children vaccinated

²⁴ Lei, *Neither Donkey Nor Horse*, 161-164.

only in the springtime, or took their soon-to-be-vaccinated or just-vaccinated babies to the Smallpox Goddess temple to pray for a successful vaccination and recovery.

Both European and Chinese Pastorian provided scientific explanations in fermentative studies, pharmacology, toxicology, immunology, and physiology, meant to validate traditional Chinese medicine. We have seen Calmette test the recipe of forty-six herbal ingredients and local people's experience in making rice liquor before identifying the fermentative superiority of the "Chinese yeast." Li Yuying and Hu Jiamo applied the Pastorian principles of biochemistry to analyze soy, a popular ingredient of the Chinese diet that was also used in traditional Chinese medicine. Bož tested the medical efficacy of the chaulmoogra seed, an herb used in traditional Chinese medicine for treating skin conditions seen in leprosy. In the matter of anti-rabies treatment, Liu Yongchun verified the Chinese medical concept of "tackling poison with poison" with the medicinal uses of snake venom recorded in traditional Chinese medical texts. Liu also credited the effectiveness of traditional Chinese therapeutics, such as acupuncture, with empirical evidence derived from the clinical application of physiology and endocrinology. Validating traditional Chinese medicine through empirical experiments and clinical studies, usually inspired by Chinese medical or historical texts, became one of the distinguishing characteristics of Pastorian practices in China.

The Pastorian Legacy in Postwar China

After the Chinese Communist government came to power in 1949, the Europeans either moved away from, or lost control of, the Pasteur Institutes in China. The Pasteur Laboratory in Tianjin was the last to yield, merging into the Tianjin Hospital of Gynecology and Obstetrics in 1952. Not until the twenty-first century would the Pasteur Institutes resume their operation in China,

the first established in 2000 in Hong Kong, then in 2004 in Shanghai, as a joint venture between the Pasteur Institute of Paris and local research institutions. Both of these Pasteur Institutes continue integrating Chinese medicine and biomedicine, in addition to their general work in microbiological research, public health, and education concerning infectious diseases, especially virology, immunology, epidemiology, and vaccinology. At the new Pasteur Institute of Shanghai under the Chinese Academy of Sciences, working in collaboration with the Pasteur Institute in Paris, some scientists focus on medicinal drugs used in traditional Chinese medicine in the hope of discovering new chemical compounds for treating disease.²⁵ A similar focus can be found at the Pasteur Institute of Hong Kong (Hong Kong University-Pasteur Research Pole). For instance, researcher Suki Lee, in collaboration with researchers at the Hong Kong University of Science and Technology and at the Center for Microbial Disease and Immunity Research of the University of British Columbia, has led a project on the therapeutic effect of Chinese medical herbs in treating influenza.²⁶ A fifty-year-long gap of institutional history separates them from their precursors in the first half of the twentieth century. However, the physical absence of the Pasteur Institutes did not necessarily entail a discontinuity of the Pastorian culture. Thus the Pastorian scientific spirit and principles outlived their original imperial institutional setting.

Just a few years after the last Pasteur institution relinquished its affiliation in 1951, Mao assigned the responsibilities for reorganizing, developing, and promoting traditional Chinese medicine to the practitioners of Western medicine. Mao regarded the clinical experience, drawn both from ancient texts and experienced traditional practitioners, as the most precious treasure to found within traditional Chinese medicine. Mao's policy of "integration of Chinese and Western

²⁵ "Inauguration of the Institut Pasteur of Shanghai-Chinese Academy of Sciences," Press Release by the Pasteur Institute of Paris, 11/10/2004.

²⁶ Suki Lee and Huiling Yen, "Targeting the Host or the Virus: Current and Novel Concepts for Antiviral Approaches against Influenza Virus Infection," *Antiviral Research* 96 (2012): 391-404.

medicine” has played a decisive role in medical research, education and the healthcare system as practiced in today’s China. However, this integration did not begin with Mao’s orders in the 1950s. It started in the 1930s, when practitioners of both traditional and Western medicine, including Pastorians, conducted their research and practiced their trades in reliance on Western scientific principles and methods. This integration continued through the 1950s as Gao Jinglang compiled and composed the text book of Chinese ancient pediatric diseases, and from the 1960s onwards within the scope of Tu Youyou’s derivation of artemisinin from *Qinghao*. The practitioners of integrative medicine today recognize certain microorganisms as the pathological causes of infectious diseases such as smallpox and malaria. They acknowledge the therapeutic efficacy of remedies recommended by Chinese medical texts and borne out by experience and verify it with empirical tests and clinical experiments subject to scientific standards. Even though Tu neither studied nor worked at any Pasteur Institute in the world, as indicated in her Nobel lecture, she sees herself as carrying forth the Pastorian spirit to this day. Thus Pastorism continues to transform medicine in China.

Appendix 1.1: Chinese Pastorians

| Name ¹ | Name in Chinese characters | Life time | Birth place | Period at the Pasteur Institute of Paris (PIP) | Laboratory in PIP | Advisor(s) | Attended Grand Course | Thesis |
|----------------------------------|----------------------------|-----------|-------------------|--|-------------------|-------------|-----------------------|------------------|
| Wu Lienteh | 伍連德 | 1879-1953 | Penang, Malaysia | 1902-1903 | E. Metchnikoff | | | |
| Li Yuying (Li Zhizeng) | 李煜瀛 (李石曾) | 1881-1973 | Gaoyang, Henan | 1906-1910 | G. Bertrand | G. Bertrand | No | Yes ² |
| Liu Yongchun (Lieou Yong-Tchéou) | 劉永純 | 1897-1953 | Yangzhou, Jiangsu | 1922-1923/01; 1928 | R. Legroux | | Yes | |
| Hu Tingfu | 胡廷黻 | 1893-1926 | Tianyuan, Shangxi | 1923/01-04 | R. Legroux | | Yes | |
| Song Guobin (Song Kuo-Pin) | 宋國賓 | 1893-1956 | Yangzhou, Jiangsu | 1923/01-04 | R. Legroux | | Yes | |
| Li Yuanbai | 李元白 | 1897-1967 | Taiwan | 1927 | | | | |
| Gao Jinglang | 高鏡朗 | 1893-1983 | Shangyu, Zhejiang | 1928 | | | | |
| Lo Kuangting (Lo Kuangting) | 羅廣庭 | 1901-1982 | Beihai, Guangxi | 1929/01-04 | E. Marchoux | E. Marchoux | | Yes ³ |

¹ The names in apprentices were also in contemporary use or better known in the Pastorian community.

² Later turned into Li, *Le Soja*.

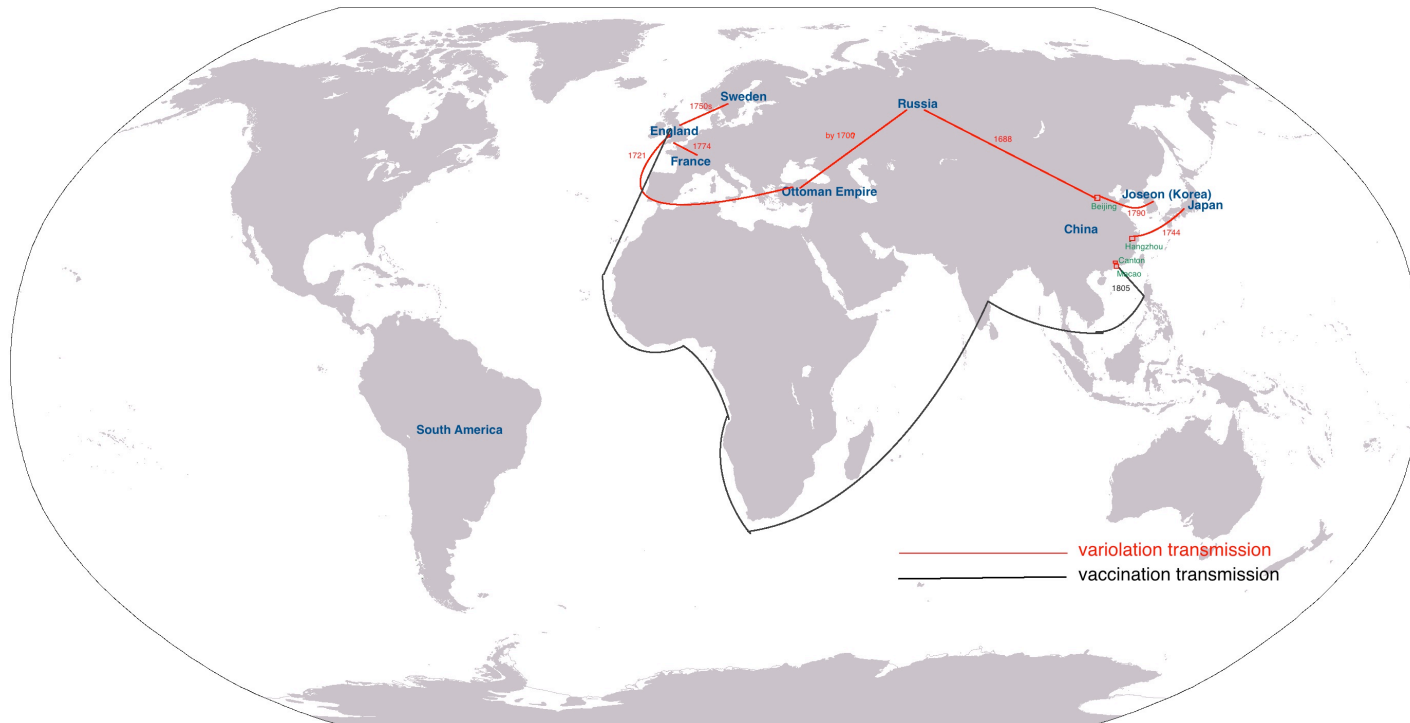
³ Lo Kuangting, *La Pest au Sud de Kouang-Toung* (Paris, Marcel Vigne, 1929). Regarding Luo engaged with the controversy over the theory of “Spontaneous Generation” during the Republican period, see Fati Fan, “The Controversy over Spontaneous Generation in Republican China: Science, Authority, and the Public,” in *Science and Technology in Modern China, 1880s-1940*, ed. Jing Tsu and Benjamin Ellman (Leiden: Brill, 2014), 209-244.

| | | | | | | | | |
|--------------------------------|-----|-----------|--------------------|-----------------------------------|------------|---|-----|------------------|
| Yuan Junchang (Yuen Singtsong) | 袁濬昌 | 1898-1988 | Zhejiang | 1929 | R. Legroux | P. J. Teissier, PIP: A. Calmette and others | Yes | Yes ⁴ |
| Luo Yiqian | 羅易乾 | 1900-? | Guangdong | Some time during 1921-1931 | | | | |
| Zhang Ruilun | 張瑞綸 | 1907-? | Hebei | Some time during 1933-1938 | A. Peyron | | | |
| Chen Bojun | 陳博君 | 1916-? | Hebei | Some time during 1938-1945 | | | | |
| Xiong Zuo | 熊佐 | 1902-? | Guangdong | 1923 | | | | |
| Wang Liang (Wang Leang) | 王良 | | Chengdu, Sichuan | 1931-1933 | R. Legroux | | Yes | |
| Hu Jiamo | 胡嘉謨 | | | 1931-1933 | | G. Bertrand | | Yes ⁵ |
| Chen Hengxin | 陳恆鑫 | | | 1934 (in PI, Saigon) | | | | |
| Huang Rong | 黃榮 | | | 1934 (in PI, Saigon) | | | | |
| Zhu Shiyang | 朱世英 | 1892-1953 | Tianjin | 1928-1950 (worked at PI, Tianjin) | | | | |
| Ding Ting | 丁霆 | 1911-2006 | | 1932 (in PI, Shanghai) | | | | |
| Guo Chengzhou | 郭成周 | 1916- | Hangzhou, Zhejiang | 1940-1950 (worked at PIP) | | | | |

⁴ Yuan Singtsong, *Étude Comparative des Souches de Vaccine Antivaricelleuse* (Paris: Librairie M. LAC, 1929).

⁵ Hu Jiamo, *Contribution à l'Étude de l'Action des Ferments de la Graine de Soja sur les Lipides* (Paris: Les Presses Modernes, 1933).

Appendix 2.1: Map of Variolation and Vaccination Transmission Routes, Late Seventeenth Century - Early Nineteenth Century



Note:

The lines in this map are meant to connect countries. The actual routes were not necessary in a straight line. The year along a line was the time when variolation/vaccination started in the destined country. The main source of this sketch is from F. Fenner, *Smallpox and Its Eradication* (Geneva: World Health Organization, 1988).

Note: In making this map, I have used the base map of 1900, from the source: Gustave Bouffard, “Notes Médicales Recueillies à Tchentou,” *Annales d’Hygiène et de Médecine Coloniales* 3 (1900), on the page between p. 172 and p. 173. It is advisable to read the map as follows. First, the Guangdong province in the south of China was the starting point of the dissemination, which later went towards north, east, and west. However, the routes were not necessary in a straight line between towns as appeared in the map. Secondly, vaccination usually took place in major towns, not in rural areas. The lines in different colors indicate directions. Vaccination usually did not necessarily occur along the lines. Thirdly, vaccination was disseminated westwards to Guangxi province. I link the line from Canton to Nanning, where I considered as the then capital of Guangxi, and it might not be the exact town where vaccination was practiced. The exact town was not specified in the literature. Fourthly, vaccination was also disseminated westwards to the southwest frontier, including Tibet and Xikang. Lastly, this map is meant to show that the vaccination dissemination mainly took place in Southern China. The vaccination also disseminated from Canton to Beijing, which does not show in this map. The source of the routes is from Chen Yuan 陳垣, “Niudou ru Zhongguo kao lue” 牛痘入中國考略 (The Brief History of Vaccination Dissemination in China) in *Chen Yuanan xiansheng quanji* 陳援菴先生全集 (Collection of Mr. Chen Yuanan), 16 (Taipei: Xin wen feng chu ban gong si, 1993), 780.

BIBLIOGRAPHY

Archives and Libraries

Archives de l'Institute Pasteur

Archives du Ministère des Affaires Étrangères, La Courneuve, Paris

Archives du Ministère des Affaires Étrangères, Nantes

Archives Nationales d'Outre Mer

Academia Sinica, Taiwan

Bibliothèque Interuniversitaire Santé

Bibliothèque Municipale de Lyon

Bibliothèque Nationale de France

Chinese Medical Association Library, Beijing

Peking Union Medical College Library

Peking University Library

Services Historique de la Défense, Vincennes, Paris

Shanghai Municipal Archives

Shanghai Municipal Library

Chinese, Japanese, and Korean Language Sources

Cao Xueqin 曹雪芹. *Hongloumeng* 紅樓夢, 21. Shanghai: Shanghai cishu chubanshe, 2000.

Chang Chiafeng 張嘉鳳. "Shijiu shiji chu niudou de zaidi hua" 十九世紀初牛痘的在地化 (Localization of Vaccination in the Nineteenth Century). *Zhongyang yanjiuyuan lishi yuyan yanjiusuo jikan* 中央研究院歷史語言研究所集刊 (Journal of Institute of History and Philology, Academia Sinica) 78.4 (2007): 755-812.

Chen Xianfu 陳先賦, ed. *Sichuan yilin renwu* 四川醫林人物 (Chinese Practitioners in Sichuan). Chengdu: Sichuan renmin chubanshe, 1981.

Chen Yuan 陳垣. "Niudou ru Zhongguo kao lue" 牛痘入中國考略 (The Brief History of Vaccination Dissemination in China). In *Chen Yuanan xiansheng quanji* 陳援菴先生全集 (Collection of Mr. Chen Yuanan), 16, 776-783. Taipei: Xin wen feng chuban gongsi, 1993.

- Chen Zhenshou 陳貞壽. *Tu shuo Zhongguo haijun shi* 圖說中國海軍史 (Chinese Naval History), 1. Fuzhou: Fujian jiaoyu chubanshe, 2002.
- Chun, C. H. "The History of Smallpox Prevention in Korea." *Uisahak* 2.2 (1993): 122-125.
- Cun cui xueshe 存萃學社, ed. *Minguo yila Sichuan dongluan shilao huiji* 民國以來四川動亂史料彙輯 (Collection of Historical Materials on Sichuan Political Turbulence in Republican Era). Hong Kong: Dadong tushu gongsi, 1977.
- Fan Hong 范泓. *Zai lishi de touying zhong* 在歷史的投影中 (Reflection on History). Taipei: Xiu wei zixunkeji chuban, 2008.
- Fan Xingzhun 范行準. *Zhongguo yufang yixue sixiangshi* 中國預防醫學思想史 (Chinese Preventive Medical History). Beijing: Renmin weisheng chubanshe, 1953.
- Fei Puquan 費溥泉. "Dou zheng you sun ni xian san zhong ji zhi fa zhi dalue" 痘症有順逆險三種及治法之大略 (Smallpox of Three Kinds, Flowing, Opposing, and Dangerous, and Their Treatments). *Zhongyi zazhi* 中醫雜誌 (Journal of Chinese Medicine) 19 (1926): 12-13.
- Jia Sixie 賈思勰. "Section 64 Zao shen qu bing" 造神麴餅第六十四 (Worshiping with Qu Doug). *Qimin yaoshu* 齊民要術 (Essential Techniques for the Welfare of the People), 7. In *Siku Quanshu*, Zi Bu 4, Nongjia Lei, 5-15. Assessed 14/05/2016. <http://ia600205.us.archive.org/16/items/06049860.cn/06049860.cn.pdf>
- Gao Jinglang 高鏡朗. *Gudai erke jibing xin lun* 古代兒科疾病新論 (New Interpretation of Ancient Pediatric Diseases). Shanghai: Shanghai kexue jishu chubanshe, 1983.
- Ge Hong 葛洪. *Zhouhou beijifang* 肘後備急方 (The Handbook of Prescriptions for Emergencies), 7. 54. Assessed 14/05/2016. <http://ctext.org/wiki.pl?if=gb&res=267669>
- Gong bu ju dongshihui huiyi lu 工部局董事會會議錄 (The Minute of Shanghai Municipal Council). Shanghai: Shanghai guji chubanshe, 2001.
- Hidehisa Tomita 富田英壽. *Ogata Shunsaku: Shutō no so*. Fukuoka: Nishinohon Shinbunsha, 2005.
- Kai Zhao and Zhang Yihao, ed. *Zhongguo shengwu zhipin fazhan shi lue* 中國生物製品發展史略 (The Short History of the Development of Biological Products in China). Beijing: Beijing shengwu zhipin yanjiusuo, 2003.
- Kuang Sanji 匡珊吉. *Sichuan junfa shi* 四川軍閥史 (History of Sichuan Warlords). Chengdu: Sichuan renmin chubanshe, 1991.
- Li Shizhen 李時珍. *Bencao Gangmu* 本草綱目 (Compendium of Materia Medica), 25. In *Siku Quanshu*, Zi Bu 5, Yijia Lei, Assessed 14/05/2016. <http://ctext.org/library.pl?if=gb&res=5266>

- Li Xiaocen 李曉岑 and Zhu Xia 朱霞. *Kexue yu jiyi de lichen: Yunnan minzu keji* 科學與技藝的歷程: 雲南民族科技 (The Development of Science and Technology: Yunnan Ethnic Technology). Kunming: Yunan jiaoyu chubanshe, 2000.
- Li Yuying. *Dado* 大豆 (The Soy). Paris: Société Biologique de l'Extrême Orient, 1910.
- Liao Yuqun 廖育群. *Qihuang yi dao* 岐黃醫道 (Chinese Traditional Medicine). Shenyang: Liaoning jiaoyu chubanshe, 1991.
- Lin Xiaoping 林曉平. *Kejia minjian xinyang yu minsu wenhua* 客家民間信仰與民俗文化 (Hakka folk beliefs and culture). Beijing: Zhongguo shehui kexue chubanshe, 2012.
- Liu Yongchun 劉永純. "Baside yanjiuyuan yu Zhongyao zhi guanxi" 巴斯德研究院與中藥之關係 (The Relationship between the Pasteur Institutes and Chinese Medicinal Drugs). *Zhonghua yixue zazhi* 中華醫學雜誌 (Chinese Medical Journal) 28. 9 (1942): 308.
- . "Shanghai qi du yanjiu zhi yi de" 上海瘧毒研究之一得 (Learning from the Shanghai Rabies Research). *Zhonghua yixue zazhi* 32. 102 (1945): 58-77.
- . "Qigoubin zhi shiguan jiqi zhenzhifa de chubu tantao" 瘧狗病之史觀及其診治法的初步探討 (History of Rabies and the Preliminary Studies of Its Therapeutics). *Yishi zazhi* 醫史雜誌 (Chinese Journal of Medical History) 1. 2 (1947): 1-4.
- . "Zhongguo jinzhen zhiliaofa zai Faguo de gaikuang" 中國金針治療法在法國的概況 (The Overview of the Chinese Acupuncture Treatment in France). *Zhonghua yixue zazhi* 中華醫學雜誌 (Chinese Medical Journal) 35. 11 and 12 (1949): 455-458.
- "Liu Yongchun boshi rongshou Faguo xunzhang jixiang" 劉永純博士榮受法國勳章記詳 (The Report on Dr. Liu Yongchun's Reception of the Legion of Honor). *Yiyaoxue* 醫藥學 (Dr. Huang's Medical Journal) 1.1 (1948): 42.
- Leung Ki Che. *Miandui jibing: chuantong Zhongguo shehui de yiliao guannian yu zuzhi* 面對疾病: 傳統中國社會的醫療觀念與組織 (In Face of Illness: Medical Concepts and Institutions in Traditional Chinese Society). Beijing: Zhongguo remin daxue chubanshe, 2012.
- Lo Chengzheng 駱承政 and Le Jiexiang 樂嘉祥. *Zhongguo da hongshui* 中國大洪水 (Floods in China). Beijing: Zhongguo Shudian, 1996.
- Ma Boying 馬伯英. *Zhongguo yixue wenhuashi* 中國醫學文化史 (History of Chinese Medical Culture). Shanghai: Shanghai remin chubanshe, 1994.
- Miu Junde 繆俊德. *Dou kexue* 痘科學 (Science of Smallpox). Rugao: Yan ling yi she, 1935.
- Qiu Xi 邱熿. *Ying dou lue* 引痘略 (Introduction of Inducing Smallpox by Cowpox Vaccine), 1817, 1. In *Xuxiu Siku quanshu*, Zi Bu 5, Yijia Lei, 1012. Shanghai: Shanghai guji chubanshe, 2002.

- Qiu Zhonglin 邱仲麟. “Ming Qing de ren dou fa: diyu liubu, zhishi chuanbo yu yimiao shengchan” 明清的人痘法—地域流佈、知識傳播與疫苗生產 (Smallpox Inoculation in Ming-Qing China: Regional spread, Knowledge Dissemination, and Vaccine Production). *Zhongyang yanjiuyuan lishi yuyan yanjiusuo jikan* 中央研究院歷史語言研究所集刊 (Journal of Institute of History and Philology, Academia Sinica) 77.3 (2006): 451-516.
- Saburo Miyashita 宮下三郎. “「李仁山種痘書」について” (About Li Renshan’s Book of Variolation). *Sekko to Nihon (浙江と日本)*, edited by Masumi Fujiyoshi 藤善真澄, 117-131. Suita-shi: Kansai Daigaku Shuppanbu, 1997.
- Sichuansheng minzu yanjiusuo 四川省民族研究所, ed. *Qingmo Chuan Dian bianwu dang’an shiliao* 清末川滇邊務檔案史料 (The Archival Documents of the Southwestern Frontier in the Late Qing Dynasty). Beijing: Zhonghua shuju, 1989.
- Sichuansheng wenshi yanjiu guan 四川省文史研究館 (Sichuan Research Institute of Culture and History), ed. *Minguo Sichuan junfa shilu* 民國四川軍閥實錄 (History of Sichuan Warlords in Republican Era). Chengdu: Sichuan renmin chubanshe, 2011.
- Tianjinshi defang shi zhi bianxiu weiyuanhui 天津市地方史志編修委員會 (Committee of Tianjin Local History), ed. *Tianjin jindai renwu lu* 天津近代人物錄 (Recent Historical Figures in Tianjin). Tianjin: Tianjinshi defang shi zhi bianxiu weiyuanhu, 1987.
- Tu Youyou. “Discovery of Artemisinin – A Gift from Traditional Chinese Medicine to the World.” Assessed 14/05/2016.
http://www.nobelprize.org/nobel_prizes/medicine/laureates/2015/tu-lecture.html
- Wang Changlu, ed. *Tu Youyou zhuan* 屠呦呦傳 (Biography of Tu Youyou). Hong Kong: Sanlian shudian, 2016.
- Wang Zhenzhong 王振忠. “Huizhou wenshu suo jian zhongdou ji xiangguan xisu” 徽州文書所見種痘及相關習俗 (The Relating Customs of Vaccination in Huizhou Documents). *Minsu yanjiu* 民俗研究 (Folklore Studies) 1 (2000): 37-68.
- Xiao Yinghua 蕭英華. “Cong Hongzao yu fang mang shiye” 從鴻藻與防盲事業 (Cong Hongzao and Blindness Prevention). In *Tianjin wenshi ziliao xuan ji* 天津文史資料選輯 (Historical Materials of Tianjin), 62, 126-127. Tianjin: Tianjin renmin chubanshe, 1994.
- Yang Wei 楊威 and Li Zhiping 李志平. “Shanghai Baside yanjiuyuan de yanjiu gongzuo” 上海巴斯德研究院的研究工作 (The Research at the Shanghai Pasteur Institute). *Zhonghua yishi zazhi* 38. 2 (2008): 92-98.
- “Yangzhouren shouchuang Kajiemiao fang lao” 揚州人首創卡介苗防癆 (First Yangzhou People Introduced BCG against Tuberculosis). *Yangzhou Wangbao* (Yangzhou Evening Post), 26/05/2012. Assessed 14/05/2016.
<http://wenhua.yzwb.com/system/2012/05/26/010564950.shtml>

Youke zhongdou xinfa yaozhi 幼科種痘心法要旨 (The Key Aspects of Pediatric Variolation), 1742. In “Neke” 內科 (Internal Medicine). *Yizong Jinjian* 醫宗金鑒 (Golden Mirror of the Medical Tradition), 2. 5. Taipei: Da Zhongguo tushu gongsi, 1971.

Zeng Ding 曾鼎. *Douzhen huitong* 痘疹會通 (Understanding of Pox), 1, 1786. Beijing: Huaxia chubanshe, 1999.

Zhang Yan 張琰. *Zhongdou xinshu* 種痘新書 (New Book of Variolation), 1741. In *Siku Quanshu*, Zi Bu 5, Yijia Lei. Assessed 14/05/2016.
<http://ia600302.us.archive.org/34/items/02093464.cn/02093464.cn.pdf>

Zhao Er-Feng 趙爾豐. “She yiyao ju shi zhen shi yaopian” 設醫藥局施診施藥片 (Establishing a Medicinal Dispensary for Medical Practice and Distribution of Drugs). In *Zhao Er-feng Chuan bian zoudu* 趙爾豐川邊奏牘 (Zhao Er-Feng’s Reports of the Frontier to the Emperor), edited by Wu Fengpei 吳豐培, 105. Chengdu: Sichuan minzu chubanshe, 1984.

Zho Qiuming 左丘明. *Zuo Zhuan* 左傳. Changsha: Yuelu shushe, 1988.

Zhu Chungu 朱純嘏. *Douzhen Dinglun* 痘疹定論 (The Final Argument on Smallpox), 2, 1713. Assessed 14/05/2016. <http://ia600301.us.archive.org/11/items/02093461.cn/02093461.cn.pdf>

Zhu Yiliang 朱奕梁. *Zhong dou xin fa* 種痘心法 (The Method of Variolation), 1808. In *Zhongyi Dianji Baoku* 中醫典籍寶庫, 23. Beijing: Xianzhang shuju, 2006.

French Language Sources

Abrami, Pierre. “Les Troubles Fonctionnels en Pathologie (Leçon d’Ouverture du Cours de Pathologie Médicale).” *Presse médicale* (1936): 2081.

“Article R.128.” In *Légion d’Honneur, Médaille Militaire, Ordre National du Mérite: Législation et Réglementation*. Paris: Grande Chancellerie de la Légion d’Honneur, 2015.

Barbier, Hervé. “Les Canonnières du Yang-tsé, 1900-1941.” In *La France en Chine, 1843-1943*, edited by Jacques Weber, 131-144. Nantes: Presse Académique de l’Ouest, 1997.

Bastid-Bruguière, Marianne. “Instituts et Laboratoires Pasteur en Chine avant 1949.” In *L’Institut Pasteur: Contributions à son Histoire*, edited by Michel Morange, 253-268. Paris: La Découverte, 1991.

Bodard, Lucien. *Monsieur le Consul*. Paris: B. Grasset, 1999.

Bretelle-Establet, Florence. *La Santé en Chine du Sud, 1898-1928*. Paris: CNRS Éditions, 2002.

Bouffard, Gustave. “Notes Médicales Recueillies à Tchentou.” *Annales d’Hygiène et de Médecine Coloniales* 3 (1900): 172-183.

———. “Notes de Voyage au Se-Tch’Oan.” *Annales de Géographie* 10. 50 (1901): 177-181.

Calmette, Albert. “Notes sur la Rage en Indochine et sur les Vaccinations Antirabiques Pratiquées à Saïgon du 15 Avril au 1 Août 1891.” *Annales de l’Institut Pasteur* 5. 10 (1891): 633-641.

———. “Contribution à l’Étude des Ferments de l’Amidon – La Levure Chinoise.” *Annales de l’Institut Pasteur* 6. 9 (1892): 604-620.

———. “Le Fermente de l’Opium des Fumeurs et la Fermentation Artificielle des Chandoos.” *Archives de Médecine Navale et Coloniale* 57(1892): 132-138.

———. “Contribution à l’Étude du Venin des Serpents. Immunisation des Animaux et Traitement de l’Envenimation.” *Annales de l’Institut Pasteur* 8 (1894): 275-291.

Calmette, Albert and G. Lepinay. “Mémoire sur l’Organisation et le Fonctionnement du Service de la Vaccine en Cochinchine de 1867 à 1890.” In *Rapport Général Présenté par l’Académie de Médecine sur les Vaccinations et Revaccinations pendant l’Année 1892*. Paris: Masson, 1908.

Capatti, Alberto. *Le Goût du Nouveau: Origines de la Modernité Alimentaire*. Paris: Albin Michel, 1989.

Chabaud, M. A. and R. Néel. “Le Instituts Pasteur de Tanger et de Casablanca.” *Maroc Médical* 456 (1963): 350.

De Fleury, Maurice. *Pasteur et les Pastoriens*. Paris: Rueff, 1895.

Dedet, Jean-Pierre. *Les Instituts Pasteur d’Outre-Mer: Cent Vingt Ans de Microbiologie Française dans le Monde*. Paris: L’Harmattan, 2000.

Faure, Marguerite. “Cent Années d’Enseignement à l’Institut Pasteur.” In *L’Institut Pasteur: Contributions à son Histoire*, edited by Michel Morange, 62-74. Paris: La Découverte, 1991.

Faya, Louis. “La Méthode Expérimentale de Pasteur et ses Rapports avec les Théories de Claude Bernard.” *Bulletin de la Société des Sciences Naturelles et d’Enseignement Populaire de Tarare* 5 (1903): 13.

Genevray, J. and J. Doderò. “Le Virus Rabique Fixe de l’Institut Pasteur de Hanoï.” *Annales de l’Institut Pasteur* 57. 6 (1936): 639-642.

Girard, Georges. “Jean Raynal (1897-1954).” *Bulletin de la Société de Pathologie Exotique* 47 (1954): 756-757.

Guillerm, J. *L’Industrie du Nuoc-Mam en Indochine*. Saïgon: Imprimerie A. Portail, 1931.

Hérait, Louis-Armand. “La Médecine Militaire Coloniale Française. Une Aventure Médicale de Trois Quarts de Siècle, 1890-1968.” *Histoire des Sciences Médicales* 40. 4 (2006): 381-392.

Hu, Jiamo. *Contribution à l'Étude de l'Action des Ferments de la Graine de Soja sur les Lipides*. Paris: Les Presses Modernes, 1933.

Institut de Vaccine Animale. *Institut de Vaccine Animale: 8 Rue Ballu, Paris*. Paris: S. N., 1895.

Jacotot, Henri. "Le Docteur Noël Bernard à la Direction des Instituts Pasteur d'Indochine." *Bulletin de Liaison de l'Association des Anciens Élèves et Diplômés de l'Institut Pasteur* 53. 3 (1972): 38-42.

Jacotot, Henri, M. Colson, and G. Le Roux. "Contribution à l'Étude Expérimentale de la Vaccination Antirabique." *Annales de l'Institut Pasteur* 61. 1 (1938): 92-103.

Jouveau-Dubreuil, H. "Service de la Vaccine à l'Institut Pasteur de Tchen-Tou." *Annales de Médecine et de Pharmacie Coloniales* (1920): 64-77.

———. "La Variolisation au Setchouen." *Bulletin de la Société de Pathologie Exotique* 14 (1921): 93-97.

Le Camus, M. "Maladies Qui Ont Régné à Paris pendant le Mois de Septembre." *Journal Economique* (Octobre 1755): 121-129.

Legendre, Aimé-François. *Le Far-West Chinois: Deux Années au Setchouen*. Paris: Librairie Plon, 1905.

Li, Yuying and L. Grandvoinet. *Le Soja: Sa Culture, ses Usages, Alimentaires, Thérapeutiques et Industriels*. Paris: Augustin Challamel, 1912.

Lo, Kuangting. *La Pest au Sud de Kouang-Toung*. Paris, Marcel Vigne, 1929.

Manouélian, Y. and J. Viala. "D'Où Vient la Virulence de la Bave chez les Animaux Rabiques?" *Comptes Rendus de l'Académie des Sciences* 183 (1926): 1357-1359.

Mouillac, Marie Joseph. "Le Poste Medical de Tchentou." *Annales d'Hygiène et de Médecine Coloniales* 11 (1908): 5-29.

Moulin, Anne-Marie. *Le Dernier Langage de la Médecine: Histoire de l'Immunologie de Pasteur au SIDA*. Paris: Presse Universitaire de France, 1991.

Phisalix, Césaire and Gabriel Bertrand. "Recherches sur la Toxicité du Sang de Crapaud Commun." *Archives de Physiology Norm, et Pathology* 5 (1893): 511-517.

Phisalix, Marie. "Vaccination contre la Rage Expérimentale par la Sécrétion Cutanée Muqueuse des Batraciens, puis par le Venin de Vipère Aspic." *Comptes Rendus de l'Académie des Sciences* 158 (1914): 111-113.

Raoul, Y. "Gabriel Bertrand (1867-1962)." *Bulletin de la Société de Chimie Biologique* 44 (1962): 1051-1055.

Regnault, Jules. "L'Opothérapie en Chine et en Indochine." *Revue de Médecine* 10 (1900):1028-1030.

———. "Médecine Européenne et Médecine Indigène en Extrême-Orient." *Archives de Médecine Navale* 78 (1902): 270-273.

———. "Précurseurs de Pasteur et ... de beaucoup d'autres inventeurs." *Côte d'Azur Médicale* 4.8 (1923): 8.

———. "Création d'une Faculté de Médecine Française en Chine." In *Revue Politique et Parlementaire* 38. 112 (1903): 102-103.

Remlinger, P. A. "Le Passage du Virus Rabique à Travers les Filtres." *Annales de l'Institut Pasteur* 17.12 (1903): 834-849.

Roux, Émile. "Note sur un Moyen de Conserver les Moelles Rabiques avec Leur Virulence." *Annales de l'Institut Pasteur* 1. 2 (1887): 87.

Segalen, Victor and Sophie Labatut. *René Leys*, 2. Paris: Chatelain-Julien, 1999.

Yuan, Singtsong, *Étude Comparative des Souches de Vaccine Antivariolique*. Paris: Librairie M. LAC, 1929.

English Language Sources

Abrams, L. and D. J. Miller. "Who were the French Colonialists? A Reassessment of the Parti Colonial, 1890-1914." *Historical Journal* 19.3 (1976): 685-725.

Ackerman, Evelyn Bernette. "The Intellectual Odyssey of a French Physician: Jules Regnault and Far Eastern Medicine." *French Historical Studies* 19. 4 (1996): 1083-1102.

Altman, Lawrence K. *Who Goes First? The Story of Self-Experimentation in Medicine*. Berkeley: University of California Press, 1986.

Anderson, Warwick. *The Collectors of Lost Souls: Turning Kuru Scientists into Whitemen*. Baltimore: The Johns Hopkins University Press, 2008.

Andrews, Bridie. "In Republican China, Public Health by Whom, for Whom?" In *Science, Public Health and the State in Modern Asia*, edited by Liping Bu, Darwin H. Stapleton, and Ka-che Yip, 177-194. New York: Routledge, 2012.

———. *The Making of Modern Chinese Medicine, 1850-1960*. Vancouver: UBC Press, 2014.

Baer, George M. *The Natural History of Rabies*. Boca Raton, Florida: CRC Press, 1991.

Bailey, Paul. "The Chinese Work-Study Movement in France." *The China Quarterly* 115 (1988): 441-461.

- . “Cultural Connections in a New Global Space: Li Shizheng and the Chinese Francophile Project in the Early Twentieth Century.” In *Print, Profit, and Perception: Ideas, Information, and Knowledge in Chinese Societies, 1895-1949*, edited by Peiyin Lin and Weipin Tsai, 17-39. Leiden: Brill, 2014.
- Baldwin, Peter. *Contagion and the State in Europe, 1830-1930*. Cambridge: Cambridge University Press, 2005.
- Beers Mark H., ed. *The Merck Manual of Medical Information*. Whitehouse Station, NJ: Merck, 2003.
- Benedict, Carol. *Bubonic Plague in Nineteenth-Century China*. Stanford: Stanford University Press, 1996.
- Bonavia, David. *China's Warlords*. Oxford: Oxford University Press, 1995.
- Bullock, Mary Brown. *An American Transplant: The Rockefeller Foundation and Peking Union Medical College*. Berkeley: University of California Press, 1980.
- Chakrabarti, Pratik. *Bacteriology in British India*. Rochester: University of Rochester Press, 2012.
- Chang, Chiafeng. “Aspects of Smallpox and Its Significance in Chinese History.” Ph.D. Dissertation, University of London School of Oriental and African Studies, 1996.
- Chang, Zhang and Yue Liu. “International Concessions and the Modernization of Tianjin.” In *Harbin to Hanoi: The Colonial Built Environment in Asia, 1840 to 1940*, edited by Laura Victoir and Victor Zatsopine, 83-102. Honk Kong: Hong Kong University Press, 2013.
- Chen, Chen-Jen and Samuel H. Zia. “Study of Fixed Rabies Virus Propagated in the Brain of Guinea Pig Fetus.” *Journal of Immunology* 60 (1948): 17-21.
- “Chinese MD Gets Legion of Honor.” *North-China Daily News*, 01/10/1946.
- Chou, Chih-Ping, ed. *English Writing of Hu Shih: Literature and Society*, 1. New York: Springer, 2013.
- Creager, Angela. *The Life of a Virus: Tobacco Mosaic Virus as an Experimental Model, 1930-1965*. Chicago: University of Chicago Press, 2001.
- Croizier, Ralph. *Traditional Medicine in Modern China: Science, Nationalism, and the Tensions of Cultural Change*. Cambridge: Harvard University Press, 1968.
- De Ridder, Koen, ed. *Footsteps in Deserted Valleys: Missionary Cases, Strategies and Practice in Qing China*. Leuven: Leuven University Press, 2000.
- “Dr. Edward Henderson's Memorandum on Steppe Murrain in Shanghai.” *Customs Gazette* 3 (Oct. 1871-March 1872 March): 66-75.

- Duddukuri, Govinda Rao, A. Naga Brahmam, and D. N. Rao. "Suppressive Effect of Strychnos Nux-Vomica on Induction of Ovalbumin-Specific IgE Antibody Response in Mice." *Indian Journal of Biochemistry and Biophysics* 45. 5 (2008): 341-344.
- Dunlop, Robert H. and David J Williams. *Veterinary Medicine: An Illustrated History*. St. Louis: Mosby, 1996.
- Elman, Benjamin A. *On Their Own Terms: Science in China, 1550-1900*. Cambridge: Harvard University Press, 2005.
- Fan, Fati. "The Controversy over Spontaneous Generation in Republican China: Science, Authority, and the Public." In *Science and Technology in Modern China, 1880s-1940*, edited by Jing Tsu and Benjamin Elman, 209-244. Leiden: Brill, 2014.
- Fang, Xiaoping. *Barefoot Doctors and Western Medicine in China*. Rochester: University of Rochester Press, 2012.
- Fenner, F. *Smallpox and Its Eradication*. Geneva: World Health Organization, 1988.
- Fluehr-Lobban, Carolyn. *Race and Racism: An Introduction*. Oxford: AltaMira Press, 2006.
- Freeman, C. W. "Report on the Health of Chungking for the Year Ending 30th September, 1909." *Chinese Medical Journal* 24.2 (1910): 215-217.
- Freidberg, Susanne. "French Beans for the Masses: A Modern Historical Geography of Food in Burkina Faso." *Journal of Historical Geography* 29. 3 (2003): 445-463.
- Furth, Charlotte. "Becoming Alternative? Modern Transformations of Chinese Medicine in China and in the US." *Canadian Bulletin of Medical History* 28.1 (2011): 5-41.
- Gear, H. S. "The Study of Disease Prevalence in China." *Transactions of the Royal Society of Tropical Medicine and Hygiene* 29. 6 (1936): 679-683.
- Geison, Gerald L. *The Private Science of Louis Pasteur*. Princeton: Princeton University Press, 1995.
- Gervaise, Albert. *Medicine Man in China*. Translated by Vincent Sheean. New York: Frederick A. Stokes Company, 1934.
- Gold, Thomas, ed. *Social Connections in China: Institutions, Culture, and the Changing Nature of Guanxi*. Cambridge: Cambridge University Press, 2002.
- Gordon, Charles A. *An Epitome of the Reports of the Medical Officers to the China Imperial Maritime Customs Service, 1871-1882*. London: Baillière, 1884.
- Griffin J. T., Neil M. Ferguson, and Azra C. Ghani. "Estimates of the Changing Age-Burden of Plasmodium Falciparum Malaria Disease in Sub-Saharan Africa." *Nature Communications* 5. 3136 (2014). Accessed 14/05/2016. doi: 10.1038/ncomms4136

- Guénel, Annick. "The Creation of the First Overseas Pasteur Institute, or the Beginning of Albert Calmette's Pastorian Career." *Medical History* 43.1 (1999): 1-25.
- Hanson, Marta. "Conceptual Blind Spots, Medical Blindfolds: Controlling 2003 SARS Risk in Taiwan." In *Health and Hygiene in Chinese East Asia: Policies and Publics in the Long Twentieth Century*, edited by Angela Ki Che Leung and Charlotte Furth, 228-254. Durham: Duke University Press, 2010.
- Harrison, Henrietta. "Rethinking Missionaries and Medicine in China: The Miracles of Assunta Pallota, 1905-2005." *Journal of Asian Studies* 71. 1 (2012): 127-148.
- . *The Missionary's Curse and Other Tales from a Chinese Catholic Village*. Berkeley: University of California Press, 2013.
- Hirst, Fabian. *The Conquest of Plague: A Study of the Evolution of Epidemiology*. Oxford: Clarendon Press of Oxford University, 1953.
- Hopkins, Donald. *Princes and Peasants: Smallpox in History*. Chicago: University of Chicago Press, 1983.
- Horvath, A. A. *The Soybean as Human Food*. Shanghai: Bureau of Industrial and Commercial Information, 1927.
- Howard, Harvey J. *Trachoma in China*. Beijing: Peking Medical College, 1925.
- Hsu, Elisabeth. "Reflection on the 'Discovery' of the Antimalarial Qinghao." *British Journal of Clinical Pharmacology* 61. 6 (2006): 666-667.
- "Imperial Rescript." In Philip Kaplan, *World War Two at Sea: The Last Battleships*, 56-59. Barnsley: Pen & Sword, 2014.
- "Inauguration of the Institut Pasteur of Shanghai-Chinese Academy of Sciences." Press Release by the Pasteur Institute of Paris, 11/10/2004.
- Jackson, Alan C. *Rabies: Scientific Basis of the Disease and its Management*. New York: Elsevier, 2013.
- Janes, Lauren. "The Familiar and the Exotic: Colonial Foods in Interwar Paris." PhD Dissertation, University of California Los Angeles, 2010.
- Jannetta, Ann. *The Vaccinators, Smallpox, Medical Knowledge, and the "Opening" of Japan*. Stanford: Stanford University Press, 2012.
- Jordan, J. H. "Prognosis in Rabies." *The Lancet* 234. 6060 (1939): 884-885.
- Jordan, J. H., H. Pedersen, and S. Shu. "Bites of Rabies Animals Treated by Experimental Cautery with Ultra Violet Rays and Eosin." *Transactions of the Royal Society of Tropical Medicine and Hygiene* 29. 2 (1939) 233-234.

- Kumar, Deepak. "Unequal Contenders, Uneven Ground: Medical Encounters in British India, 1820-1920." In *Western Medicine as Contested Knowledge*, edited by Andrew Cunningham and Bridie Andrews, 172-190. Manchester: Manchester University Press, 1997.
- Lafon, Monique. "Rabies virus receptors." *BMC (BioMed Central) Proceedings* 2. Supplement 1 (2008): S26.
- Lachelal, Guillaume. "The Intimate Rules of the French Cooperation: Morality, Race and the Postcolonial Division of Scientific Work at the Pasteur Institute of Cameroon." In *Evidence, Ethos and Experiment: The Anthropology and History of Medical Research in Africa*, edited by Wenzel Geissler and Catherine Molyneux, 373-400. New York: Berghahn Books, 2011.
- Lee, Suki and Huiling Yen. "Targeting the Host or the Virus: Current and Novel Concepts for Antiviral Approaches against Influenza Virus Infection." *Antiviral Research* 96 (2012): 391-404.
- Lei, Sean Hsianglin. "How Did Chinese Medicine Become Experiential?" *Positions* 10. 2 (2002): 333-364.
- . "Sovereignty and the Microscope: Constituting Notifiable Infectious Disease and Containing the Manchurian Plague (1910-1911)." In *Health and Hygiene in Chinese East Asia: Policies and Publics in the Long Twentieth Century*, edited by Angela Ki Che Leung and Charlotte Furth, 73-106. Durham: Duke University Press, 2010.
- . *Neither Donkey Nor Horse: Medicine in the Struggle over China's Modernity*. Chicago: University of Chicago Press, 2014.
- Lépine, Pierre. "On the Evolution of Fixed Strains of Rabies Virus." *Journal of Hygiene* 38. 2 (1938): 180-184.
- Leung, Angela Ki Che. "Variolation and Vaccination in Late Imperial China, ca. 1570-1911." In *Vaccinia, Vaccination and Vaccinology: Jenner, Pasteur and their Successors*, edited by S. Plotkin and B. Fantini, 65-71. Paris: Elsevier, 1996.
- . "The Business of Vaccination in Nineteenth Century Canton." *Late Imperial China* 29. 1 Supplement (2008): 7-39.
- . *Leprosy in China: A History*. New York: Columbia University Press, 2009.
- Li, Shengjen. "British Imperial Medicine in Late Nineteenth-Century China and the Early Career of Patrick Manson." PhD Dissertation, University of London, 1999.
- Liu, Li and Xingcan Chen. *The Archaeology of China: From the Late Paleolithic to the Early Bronze Age*. Cambridge: Cambridge University Press, 2012.
- Liu, Michael Shiyung. *Prescribing Colonization: the Role of Medical Practice and Policy in Japan-Ruled Taiwan*. Ann Arbor: AAS, 2009.

- Lock, Margaret and Patricia Kaufert. "Menopause, Local Biologies, and Cultures of Aging." *American Journal of Human Biology* 13 (2001): 494-504.
- Löwy, Ilana. "Yellow Fever in Rio de Janeiro and the Pasteur Institute Mission (1901–1905): The Transfer of Science to the Periphery." *Medical History* 34.2 (1990): 144-163.
- Marie, A. C. *Reports to the International Rabies Conference at the Pasteur Institute of Paris in 1927*. Geneva: League of Nations, 1927.
- Marr, David. "Vietnamese Attitudes Regarding Illness and Healing." In *Death and Disease in Southeast Asia*, edited by Norman Owen, 162-186. Oxford: Oxford University Press, 1987.
- Mayers, William F. *The Chinese Government: A Manual of Chinese Titles*. Shanghai: Kelly and Walsh, 1897.
- McCann, James. *Maize and Grace: Africa's Encounter with a New World Crop, 1500–2000*. Cambridge MA: Harvard University Press, 2005.
- McKendrick, A. G. "Analytical Review of Reports from Pasteur Institutes on the Results of Anti-rabies Treatment." 1930-1941, *Quarterly Bulletin of the Health Organization*, 1-9. Geneva: League of Nations, 1930-1941.
- Meng Sheng-Li, Ge-Ling Xu, Jia-Xin Yan, Ping-Gang Ming, Jie Wu, Xiao-Ming Yang, He-Tian Ming, Feng-Cai Zhu, Dun-Jin Zhou, Qi-You Xiao, and Guan-Mu Dong. "Molecular Epidemiology and Sequencing of the G-L intergenic Region of Rabies Viruses Isolated in China." *Virologica Sinica* 22. 1 (2007): 26-33.
- Metchnikoff, Élie. *Immunity in Infective Diseases*. Translated by Francis G. Binnie. Cambridge: Cambridge University Press, 1905.
- . *The Prolongation of Life: Optimistic Studies*. Translated by P. Chalmers Mitchell. New York: Springer Publishing Company, 2004.
- Mitchell, Allan. "Bourgeois Liberalism and Public Health: A Franco-German Comparison." In *Bourgeois Society in Nineteenth-Century Europe*, edited by Jürgen Kocka and Allan Mitchell, 346-364. Oxford: Berg, 1993.
- Miller, Genevieve. *The Adoption of Inoculation for Smallpox in England and France*. Philadelphia: University of Pennsylvania Press, 1957.
- Moore, Aaron Stephen. *Constructing East Asia: Technology, Ideology, and Empire in Japan's Wartime Era 1931-1945*. Stanford: Stanford University Press, 2013.
- Moulin, Anne-Marie. "Patriarchal Science: the Network of the Overseas Pasteur Institutes." In *Science and Empire*, edited by Patrick Petitjean, Catherine Jami, and Anne-Marie Moulin, 307-322. London: Kluwer Academic Publishers, 1992.

- . “Bacteriological Research and Medical Practice in and out of the Pastorian School.” In *French Medical Culture in the Nineteenth Century*, edited by Ann La Berge and Mordechai Feingold, 327-349. Amsterdam: Atlanta GA, 1994.
- . “The Pasteur Institutes between the Two World Wars. The Transformation of the International Sanitary Order.” In *International Health Organisations and Movements, 1918-1939*, 244-265. Cambridge: Cambridge University Press, 1955.
- . “The Pasteur Institute’s International Network: Scientific Innovations and French Tropisms.” In *Transnational Intellectual Networks: Forms of Academic Knowledge and the Search for Cultural Identities*, edited by Christophe Charle Jügen Schriewer, and Peter Wagner, 135-164. Frankfurt: Campus Verlag GmbH, 2004.
- Moulin, Ann Marie, Jerald Hage and Jonathon More. “Transformational Organizations and Institutional Change: the Case of the Institut Pasteur and French Science.” *Socio-Economic Review* 6. 2 (2008): 313-336.
- Nathan, Carl. *Plague Prevention and Politics in Manchuria, 1910-1931*. Cambridge: Harvard University Asia Center, 1967.
- Neill, Deborah J. “Finding the ‘Ideal Diet’: Nutrition, Culture, and Dietary Practices in France and French Equatorial Africa, c. 1890s to 1920s.” *Food and Foodways* 17.1 (2009): 1-28.
- . *Networks in Tropical Medicine: Internationalism, Colonialism, and the Rise of a Medical Specialty, 1890-1930*. Stanford: Stanford University Press, 2012.
- “New Anti-Rabies Clinic Planned.” *North China Herald and Supreme Court & Consular Gazette*, 1870-1941, 26/11/1921. Retrieved from ProQuest, *Historical Newspapers: Chinese Newspapers Collection, 1832-1953*, 579.
- Osborne, Michael. *The Emergence of Tropical Medicine in France*. Chicago: University of Chicago Press, 2014.
- Pearce, J. M. S. “Barré-Liéou ‘syndrome’.” *Journal of Neurology Neurosurgery and Psychiatry* 75 (2004): 317-319.
- Pelis, Kim. “Prophet for Profit in French North Africa: Charles Nicolle and the Pasteur Institute of Tunis, 1903-1936.” *Bulletin of the History of Medicine* 71.4 (1997): 583-622.
- Peltier, Maurice. “Yellow Fever Vaccination, Simple or Associated with Vaccination against Smallpox, of the Populations of French West Africa by the Method of the Pasteur Institute of Dakar.” *American Journal of Public Health* 37 (1947): 1026-1032.
- Peters, Erica J. “National Preferences and Colonial Cuisine: Seeking the Familiar in French Vietnam.” *Proceedings of the Western Society for French History* 27 (1999): 150–159.

———. “Taste, Taxes, and Technologies: Industrializing Rice Alcohol in Northern Vietnam, 1902-1913.” *French Historical Studies* 27. 3 (2004): 569-600.

Phillips, James McIlvaine. “Prophylactic Treatment for Rabies by Means of Standardized Glycerinated Virus.” *Journal of Immunology* 7. 5 (1922): 409-421.

Porter, Andrew, ed. *The Oxford History of the British Empire, 3: the Nineteenth Century*. Oxford: Oxford University Press, 1999.

Porter, Roy. *The Greatest Benefit to Mankind: A Medical History of Humanity*. New York: W. W. Norton, 1997.

Prasad, S. Ananda and Donald Oberleas. *Trace Elements in Human Health and Disease: Essential and Toxic Elements*. New York: Academic Press, 1976.

Raj, Kapil. *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650-1900*. New York: Palgrave Macmillan, 2007.

‘Review of H. Koenigsfeld’s *The Diagnosis of Rabies* (1913).’ in “Experiment Station Records of July-December 1914,” 31. Washington: Office of Experiment Stations of the United States, 1915.

Rheinberger, Hans-Jörg. “Patterns of the International and the National, the Global and the Local in the History of Molecular Biology.” In *The Local Configuration of New Research Fields*, edited by Martina Merz and Phillippe Sormani, 193-204. Cham, Switzerland: Springer International Publishing, 2016.

Rich, Jeremy. *A Workman is Worthy of His Meat: Food and Colonialism in the Gabon Estuary*. Lincoln: University of Nebraska Press, 2007.

Robinson, Hugh L. “A County-Wide Vaccination Campaign in Lintsing, Shantung.” *Chinese Medical Journal* 44.9 (1930): 1052-1062.

Rogaski, Ruth. “Hygienic Modernity in Tianjin.” In *Remaking the Chinese City: Modernity and National Identity, 1900-1950*, edited by Joseph W. Esherick, 30-46. Honolulu: University of Hawaii Press, 2000.

———. *Hygienic Modernity: Meanings of Health in Treaty Port China*. Berkeley: University of California Press, 2004.

Rosenberg, Clifford. “The International Politics of Vaccine Testing in Interwar Algiers.” *American Historical Review* 117.3 (2012): 671-697.

Schoenhals, Michael, ed. *China’s Cultural Revolution, 1966-1969: Not a Dinner Party*. New York: Routledge, 2015.

- Setnikar, I., W. Murmann, M. J. Magistretti, P. Da. Re. "Amino-Methylchromones, Brain Stem Stimulants and Pentobarbital Antagonists." *Journal of Pharmacology and Experimental Therapeutics* 128 (1960): 176-181.
- Sfakianos, Jeffrey N. and Alan Hecht. *West Nile Virus*. New York: Chelsea House Publications, 2009.
- Shen, Min, Jiang Wanjie and Zheng Shusen. "China's Medical Periodicals: From Localization to Internationalization." *Learned Publishing* 23. 4 (2010): 303-311.
- Shurtleff, William and Akiko Aoyagi, ed. *History of Soybeans and Soyfoods in France, 1665-2015*. Lafayette, CA: Soyinfo Center, 2011.
- Scheid, Volker and Sean Hsianglin Lei. "The Institutionalization of Chinese Medicine." In *Medical Transitions in Twentieth-Century China*, edited by Bridie Andrews and Mary Brown Bullock, 244-266. Bloomington and Indianapolis: Indiana University Press, 2014.
- Sheridan, James E. *China in Disintegration*. New York: Free Press, 1977.
- Sircar, R. L. "Report on the Health of Tengyueh for the Two Years Ended the 31st March, 1911." *Chinese Medical Journal* 26.1 (1912): 318-319.
- Sivin, Nathan. *Traditional Medicine in Contemporary China*. Ann Arbor: University of Michigan Press, 1987.
- . Prologue to *The Theoretical Foundations of Chinese Medicine: Systems of Correspondence*, by Manfred Porkert. Cambridge: MIT Press, 1974.
- Smith Jean S., Lillian A. Orxiari, Pamela A. Yager, H. David Seidel, and Cynthia K. Warner. "Epidemiologic and Historical Relationships among 87 Rabies Virus Isolated as Determined by Limited Sequence Analysis." *Journal of Infectious Diseases* 166. 2 (1992): 296-307.
- Snapper, Isidore. *Chinese Lessons to Western Medicine*. New York: Grune and Stratton, 1965.
- Spence, Jonathan. *In Search of Modern China*. New York: W. W. Norton & Company, 1991.
- Srinivasan, A. and the members of the Rabies in Transplant Recipients Investigation Team. "Transmission of Rabies Virus from an Organ Donor to Four Transplant Recipients." *New England Journal of Medicine*, 352. 11 (2005): 1103-1011.
- Stanley, Arthur. "The Shanghai Pasteur Institute." *Journal of Hygiene* 1. 2 (1901): 260-268.
- Storer, Horatio R. "The Medals, Jetons, and Tokens Illustrative of Sanitation." *The Sanitarian* 22. 231 (1889): 134-145.
- Strachan, John. "The Pasteurization of Algeria?" *French History* 20.3 (2006): 260-275.

- Strong, Richard. *Report of the International Plague Conference, Mukden, April 1911*. Manila: Bureau of Printing, 1922.
- Swanson, Bruce, Vance Morrison, Don H. McDowell, and Norton Tomasko. *A Plain Sailor in China: The Life of and Time of Cdr. I. V. Gillis, USN, 1875-1948*. Annapolis, MD: Naval Institute Press, 2012.
- Taylor, Kim. *Chinese Medicine in Early Communist China, 1945-63*. New York: Routledge Curzon, 2005.
- Ter Haar, Barend J. *Telling Stories: Witchcraft and Scapegoating in Chinese History*. Leiden: Brill Academic Publishers, 2005.
- “The International Association for the Prevention of Blindness.” *British Journal of Ophthalmology* 15.4 (1931): 245-250.
- The League of Red Cross Societies. *The Prevention of Blindness - Minutes of the Constitutive Assembly of the International Association for the Prevention of Blindness*. Paris: The League of Red Cross Societies, 1929.
- “The Pasteur Institute.” *British Veterinary Journal* 27 (1888): 422.
- Tilley, Helen. *Africa as a Living Laboratory: Empire, Development, and the Problem of Scientific Knowledge, 1870-1950*. Chicago: University of Chicago Press, 2011.
- Trousseau, Armand. *Lectures on Clinical Medicine: Delivered at the Hôtel-Dieu, Paris, 2*. Translated by John Rose Cormack. London: The New Sydenham Society, 1869.
- Unschuld, Paul. *Medicine in China: A History of Ideas*. Berkeley: University of California Press, 1985.
- . *Nan-Ching: The Classic of Difficult Issues*. Berkeley: University of California Press, 1986.
- US Department of Defense. *The “Magic” Background of Pearl Harbor, 2* (12 May 1941 – 6 August 1941). Ann Arbor: University of Michigan Library, 1978.
- Wang, Jessica. “A Tale of Three Laboratories: Rabies Vaccination and the Pasteurization of New York City, 1885-1920.” Paper presented in the History of Science Colloquium at UCLA, 1 April 2013.
- “Virus.” *Oxford English Dictionary*. Assessed 14/05/2016.
<http://www.oed.com/view/Entry/223861>
- Watt, Donald. C. *How War Came: the Immediate Origins of the Second World War, 1938-1939*. London: Heinemann, 1989.

- Wilkinson, Lise. "History." In *Rabies*, edited by Alan C. Jackson and William H. Wunner, 1-22. New York: Academic Press, 2002.
- Williams, Samuel Wells. *The Chinese Commercial Guide*. London: Shortrede, 1863.
- Wilson, Adrian. *Ideas and Practices in the History of Medicine, 1650-1820*. New York: Routledge, 2014.
- Wong, K. Chimin. "Smallpox in China." *Chinese Medical Journal* 33 (1919): 53-55.
- Wong, K. Chimin and Lienteh Wu. *History of Chinese Medicine: Being a Chronicle of Medical Happenings in China from Ancient Times to the Present Period*. New York: AMS Press, 1973.
- Worboys, Michael. *Spreading Germs: Disease Theories and Medical Practice in Britain, 1865-1900*. Cambridge: Cambridge University Press, 2000.
- World Health Organization. *Guideline for the Treatment of Malaria*. Geneva: WHO Press, 2015.
- Wright, Arnold. *Twentieth Century Impressions of Hong-Kong, Shanghai, and other Treaty Ports of China*. London: Lloyd's Greater Britain Pub. Co, 1908.
- Wu, Yulin. *Memories of Dr. Wu Lienteh: Plague Fighter*. Singapore: World Scientific Company, 1995.
- Yenne, Bill. *The Imperial Japanese Army: The Invincible Years 1941-42*. Oxford: Osprey Publishing, 2014.
- Zhang, Taisu. "Beyond Methodological Eurocentricism: Comparing the Chinese and European Legal Traditions." *American Journal of Legal History* 56 (2016): 195-207.