

ARTICLE

Electric Pioneers: Nationalist Lobbying, Technology Transfer, and the Origins of the Chinese Electric Lamp Industry, 1921–1937

Ghassan Moazzin 

This article uses the case of Oppel Electric Manufacturing Co. Ltd.—the most important Chinese manufacturer of light bulbs before 1937—to explore the early development of the Chinese electrical lamp industry. The article first explores the Chinese market for electrical lamps before the 1920s and shows how the market was dominated by imports and lamps locally manufactured by foreign firms. It then traces how Oppel was established in the 1920s and subsequently grew into a successful manufacturing business able to compete with foreign products. The article explores how the fact that government institutions were major purchasers of light bulbs allowed Oppel to engage in nationalist lobbying and thereby win government contracts. The article shows how the absence of Western-style intellectual property rights allowed Oppel to transfer technology cheaply, efficiently, and without needing to enter into Sino-foreign joint ventures. These discussions of nationalist lobbying and China’s intellectual property environment contribute to our understanding of China’s early industrialization, both in terms of the rapid industrial growth early twentieth century China saw and the leading role that Chinese firms played in this growth.

Keywords: Hu Xiyuan, Electrification, Shanghai, Light Bulbs

This article explores the development of Oppel Electric Manufacturing Co. Ltd.—the premier Chinese light bulb manufacturer between the company’s beginnings in 1921 and the outbreak of the Second Sino-Japanese War in 1937. To date, Oppel’s development has been covered only in superficial hagiographic accounts of its founder Hu Xiyuan’s life.¹ In following the development

1. See, for example, “Hu Xiyuan jiqi Yapuer,” 3–32. These (often nationalistic) hagiographies for the most part do not make use of primary sources mainly just commend Hu and Oppel and the breaking of the foreign monopoly on light bulbs and largely only uncritically reproduce Hu’s views on Oppel and the light bulb market

Published online December 12, 2022

© The Author(s), 2022. Published by Cambridge University Press on behalf of the Business History Conference. All rights reserved. This is an Open Access article, distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives licence (<http://creativecommons.org/licenses/by-nc-nd/4.0>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided that no alterations are made and the original article is properly cited. The written permission of Cambridge University Press must be obtained prior to any commercial use and/or adaptation of the article.

of Oppel, this article contributes to our understanding of the historical development of the Chinese electric lamp industry, which so far has been neglected. This gap in the literature is surprising given that historians have long studied the development of this industry in other countries.² This article uses the case study of Oppel to explore the challenges the nascent Chinese electric lamp industry faced in the 1920s and 1930s and how it managed to grow and compete with foreign firms and products.³ Thereby, it will also shed light on the history of the Chinese electrical appliances industry more broadly, which has been understudied.⁴

This article also aims to make two broader contributions to the scholarly literature on Chinese early industrialization during the early twentieth century, a period noted for the rapid growth of industry it showed.⁵ Economic historians have pointed out that this rapid growth of industry was mainly driven not by foreign but by domestic Chinese-owned industrial firms, which were

without proper analysis (such as simply superficially praising his success in producing high-quality low-cost bulbs and his consequential success in competing with foreign products). Apart from such hagiographies, Oppel and the light bulb industry is also mentioned in passing in Huang, *Dianqi zhaoming*, 55–59, 68–72. While Huang’s study focuses on the history of technology and not on the light bulb industry, remains superficial and uses only few primary sources (and mainly follows Hu’s memoirs), it makes reference to the survey described in table 2 of this article and briefly mentions the successful transfer of technology (based on personnel and machines) in the light bulb industry (though without reference to the intellectual property environment). Finally, Oppel is also briefly mentioned in Gerth, *China Made*, 182–184; Dikötter, *Things Modern*, 142.

2. See, for instance, Byatt, *British Electrical Industry*, Chapter 2; Bright, *Electric-Lamp Industry*.

3. Following both contemporary usage and the most common scholarly convention, this article sees “Chinese” firms as those firms that were primarily Chinese-operated and -owned and “foreign” firms as those that were primarily foreign-operated and -owned even if the latter were located in the Chinese treaty ports. This is not to deny that in certain cases there was not also Chinese investment in foreign treaty port firms (see, for example, Hao, *Comprador*, 120–21; Rawski, *Economic Growth*, 8). As pointed out in note 62, Oppel’s primary foreign rival, the China United Lamp Company, shortly before the outbreak of war also invited Chinese minority investment.

4. To date, no systematic academic study of the history of this industry exists. The only exception is a government-commissioned study that only provides a basic and largely superficial overview, including a brief mention of the prewar light bulb industry and its breaking of the foreign monopoly on bulbs. All sources by Zhongguo dianqi gongye fazhan shi bianji weiyuanhui: *Zhongguo dianqi gongye fazhan shi: zhuanye juan yi*; *Zhongguo dianqi gongye fazhan shi: zhuanye juan er*; *Zhongguo dianqi gongye fazhan shi: zhuanye juan san*; *Zhongguo dianqi gongye fazhan shi: xuji*; *Zhongguo dianqi gongye fazhan shi: zonghejuan*. Some studies explore the activities of Siemens in China, but they mainly focus on the internal perspective of this multinational firm and largely neglect the larger development of the Chinese electrical appliance industry. See, for example, Mielmann, *Handelsbeziehungen*. Van der Putten’s study of Dutch business in China also covers the light bulb (and radio) business of Philips in 1920s and 1930s China. His focus also is on the operations of Philips. Van der Putten, *Corporate Behaviour*, Chapter 7. Scholarship on Chinese early industrialization has also largely neglected the electrical appliances industry. See, e.g., Rawski, *Economic Growth*. Finally, despite the growing interest in the electrification of modern China, relevant studies have mainly looked at the process of electrification from the perspective of the supply of power and thus focus on the electrical power industry when touching upon businesses. See, for instance, Wright, “Electric Power Production”; Xia, “Foreign Direct Investment”; Tan, *Recharging China*. While his overall study focuses on the electrical power industry and the supply of electricity in modern China, Tan covers the manufacturing of electrical equipment during the Second Sino-Japanese War in Chinese-controlled Western China to a certain extent in Chapter 4. But the book keeps the Chinese electrical appliances industry before 1937 largely unexamined. Dikötter’s study of the introduction of foreign goods in modern China also covers electrical goods. Dikötter, *Things Modern*, 133–52. However, while he briefly mentions competition between light bulb manufacturers and notes that “Bulbs were easy to manufacture and ideally suited to small [Chinese] enterprises,” his study focuses on the social use of foreign goods and not the growth of the electrical appliances industry. Dikötter, *Things Modern*, 142.

5. See, for instance, Brandt, Ma, and Rawski, “Industrialization.”

able to win significant shares of markets that previously were made up of foreign goods.⁶ In connection to this significant industrial growth and competitiveness of Chinese enterprises, the question arises: What drove Chinese consumers' decision making regarding domestic and foreign products? This has been studied by several scholars. Gerth's study of the National Products Movement (NPM) traced the rise of "product nationality" and "nationalistic consumption." On the relationship between entrepreneurs and Chinese governments, Gerth's study of the NPM has shown how this movement lobbied different governments to implement protectionist policies. Specifically, Gerth discusses how entrepreneurs in the Chinese clothing industries lobbied central and local governments to encourage the wearing of clothes that were of traditional Chinese style and made by Chinese with Chinese materials, or even stipulate the wearing of these clothes for certain groups under its sway, such as civil servants or students.⁷ In contrast, Dikötter's monograph on the introduction of new, foreign, modern commodities in nineteenth- and twentieth-century China argued for the central role pragmatic factors such as the price and quality of commodities played in Chinese consumption. Dikötter argues that "The demand for imported goods was such that manufacturers in China could only be competitive by offering similar articles at a cheaper price."⁸

Cochran's study of the Chinese cigarette industry has shown that while Chinese cigarette producers successfully used nationalist marketing, the effect of this marketing had its limitations too, depending on the region and the ebbs and flows of Chinese nationalism.⁹ Nakajima's work on the cosmetics industry takes a balanced approach to this question, highlighting the use of both nationalist and more pragmatic sales strategies.¹⁰ More recently, Sheehan's study of the Dongya Corporation—most importantly, a prominent yarn producer—has shown that while Dongya tried to use both the appeal of modernity and patriotism in their marketing and that the support of patriotic consumers might well have helped the company to some extent, "The evidence from Dongya supports a conclusion that economic considerations . . . were more important than patriotism in consumers' choices."¹¹ Regarding government–business relations and the Nationalist government's policies, Sheehan posits that although Chinese entrepreneurs could at times lobby the government for support in the form of favorable tariffs or bank loans, the Nationalists were an "uncertain developmental state" that supported businesses inconsistently.¹²

This article supports much of this previous research in that it shows that while Opper also made use of nationalist rhetoric in its advertisements, in general the more important factor determining the success of Opper light bulbs was that it could offer high-quality products at a comparatively low price. However, more importantly, this article argues that the question of how useful it was for Chinese businesses in early twentieth-century China to connect their

6. Rawski, *Economic Growth*; Brandt, Ma, and Rawski, "Industrialization." On the capturing of market share, see Rawski, *China's Transition*, 2. For the general competitiveness of Chinese business vis-à-vis foreign businesses, see, for example, Cochran, *Big Business in China*.

7. Gerth, *China Made*.

8. Dikötter, *Things Modern*, quote from 42.

9. Cochran, *Big Business in China*.

10. Nakajima, "Healthful Goods."

11. Sheehan, *Industrial Eden*, Chapter 3, quote from 84.

12. Sheehan, *Industrial Eden*, Chapter 2. He builds on Coble's critique of Nationalist economic policy. See Coble, *Shanghai Capitalists*.

products to Chinese nationalism cannot be generalized.¹³ Rather, the case of the electric lamp industry shows that it needs to be studied industry by industry, looking at the specific sales patterns for each product. The case of the electric lamp industry differs from the clothing, cigarette, cosmetics, or yarn industries in one significant way: unlike other consumer products of the prewar period primarily purchased by individual consumers, an important part of light bulb sales were bulk purchases by government institutions that had an interest in showcasing their commitment to Chinese nationalism. This article shows that when Chinese government organizations acted as major direct purchasers of an industry's products, economic nationalism and nationalist lobbying gave these industries a powerful tool to win government sales contracts, outcompete foreign firms and replace foreign-made products. In turn, this harnessing of economic nationalism to win government contracts was an important element within the wider success of Chinese industrial firms in early twentieth-century China. Even though the Nationalist state might have been an uncertain developmental state, in industries where government institutions were major purchasers, entrepreneurs could use the government's nationalist rhetoric to lobby for government purchases of their goods.

A second contribution this article makes to understanding the industrialization of pre-1937 China is that it explores what role the country's specific intellectual property environment—specifically the absence of a functioning Western-style patent system—played in its early industrialization.¹⁴ In a recent survey of Chinese industrialization, Brandt, Ma, and Rawski stressed that an important driving force behind the impressive growth of Chinese industry during the early twentieth century was an “openness to the international economy” due to its importance for the “access it allows to new technology and knowhow through foreign direct investment (FDI), imports of intermediates and capital equipment, and the movement of people and ideas.”¹⁵ However, despite this emphasis of the importance of global technology flows for Chinese industrialization and the key role patents and intellectual property regimes have played in regulating these flows,¹⁶ scholarship on China's early industrialization has so far neglected the question what role China's specific intellectual property environment played in the growth of Chinese industry during the Republican period.¹⁷

The absence of intellectual property rights (IPR) in early twentieth-century China has traditionally been seen as a sign of Chinese backwardness.¹⁸ Such notions driven by Western

13. Gerth at least hints as this: “Each industry faced its own problems in using nationalistic sentiments to market its products as ‘national products.’” Gerth, *China Made*, 341.

14. I use “Western-style” in reference to the patent systems that historically originated in Europe and North America and were interconnected through the 1883 Paris Convention. For a historical overview, see Kaufer, *Patent System*, Chapter 1. On the Paris Convention, see Donzé, “Global Flow of Technologies.”

15. Brandt, Ma, and Rawski, “Industrialization,” 198, 222–23, quote on 198. They make this statement about the process of industrialization in China in general. Earlier, Rawski also highlighted “the rapid influx of new technology” as an important feature of Chinese industrialization in the early twentieth century. Rawski, *Economic Growth*, xxx.

16. Kranakis, “Patents and Power”; Donzé, “Global Flow of Technologies.” Both Kranakis and Donzé highlight how patents can be used by multinationals to control global markets and technology flows. Such monopolistic behavior has been a long-standing focus of critics of international patent regulations. See Penrose, *Economics*, 232–33.

17. Scholarship on technology transfer in modern China likewise has neglected the issue of intellectual property rights. See, for example, Brown, “Transfer of Technology”; Wang Hsien-chun, “Niuzhuang Oil Mill”

18. Alford, *To Steal a Book*.

determinism have recently been challenged by historians of China,¹⁹ but the question whether the lack of IPR, in particular regarding patents, helped or hampered Chinese early industrialization remains unexplored. This is especially surprising given that the debate to what extent IPR helps or hinders industrialization has remained inconclusive.²⁰ The electric lamp industry is a useful case for studying the impact of the lack of IPR on early industrialization in China because patents were a major tool used by large Western electric lamp manufacturers like General Electric (GE) to control domestic and global markets.²¹ Incidentally, in Schiff's classical study of economic development without patent laws, he highlights how Philips, the leading Dutch light bulb manufacturer, benefited from the absence of a patent system in the Netherlands before 1912.²² As this article will show, a similar argument can be made about Chinese light bulb manufacturers, who, in the absence of an effective Western-style patent system, were able to transfer technology and manufacture light bulbs without fear of infringing on patents.

This article starts by outlining the sale and use of electrical lighting in China before the 1920s. The following two sections then discuss Oppel's growth and performance in the period up to 1937. I then use the case of Oppel and the Chinese electric lamp industry to explore Chinese consumption and intellectual property law in relation to Chinese early industrialization.

Background: Electric Lighting in China Before the 1920s

Electrical lighting entered China in 1878. From the late nineteenth century, it first spread to cities along the China coast and then also increasingly to urban centers in China's interior. Electric light could be found not only in government buildings and public spaces but also in department stores and shops and, after 1911, increasingly in private homes. By the start of the 1920s, electrical lights could be found in over two hundred Chinese cities.²³ Wright has estimated that gross annual output of electrical power in China jumped from 65 million kilowatt hours in 1912 to 756 million in 1922 (and thereafter continued to grow to 3967 million kilowatt hours in 1936).²⁴ Accordingly, it seems accurate to say that by the 1920s, the spread of electrical lighting and lamps had reached a certain level of development in China. Indeed, E. L. Clark, an engineer who worked for GE in Shanghai, explained in 1922:

With over 280000 K.W. of installed capacity in China, electrical development can be said to have passed the experimental stage. . . . The growth in demand for electricity has been very rapid in the last few years, the demand now reaching many of the small cities and villages in China.

19. See Wang, *Pirates and Publishers*; Lean, "Chinese Copycat." Wang's and Lean's studies focus on copyright and trademarks. Lean uses the case of nonpatentable drug recipes and trademarks to show how Chinese actors used "common knowledge" discourse to defy Western firms and the Western property rights regime. However, neither author explores the impact of China's IPR environment on China's early industrialization.

20. For an overview see, for instance, Maskus, "Economic Development Strategy."

21. See, for instance, Reich, "World Cartelization."

22. Schiff, *Industrialization*, Chapter 5.

23. Dikötter, *Things Modern*, 133–44.

24. Wright, "Electric Power Production," 362. Wright includes Manchuria in his estimate.

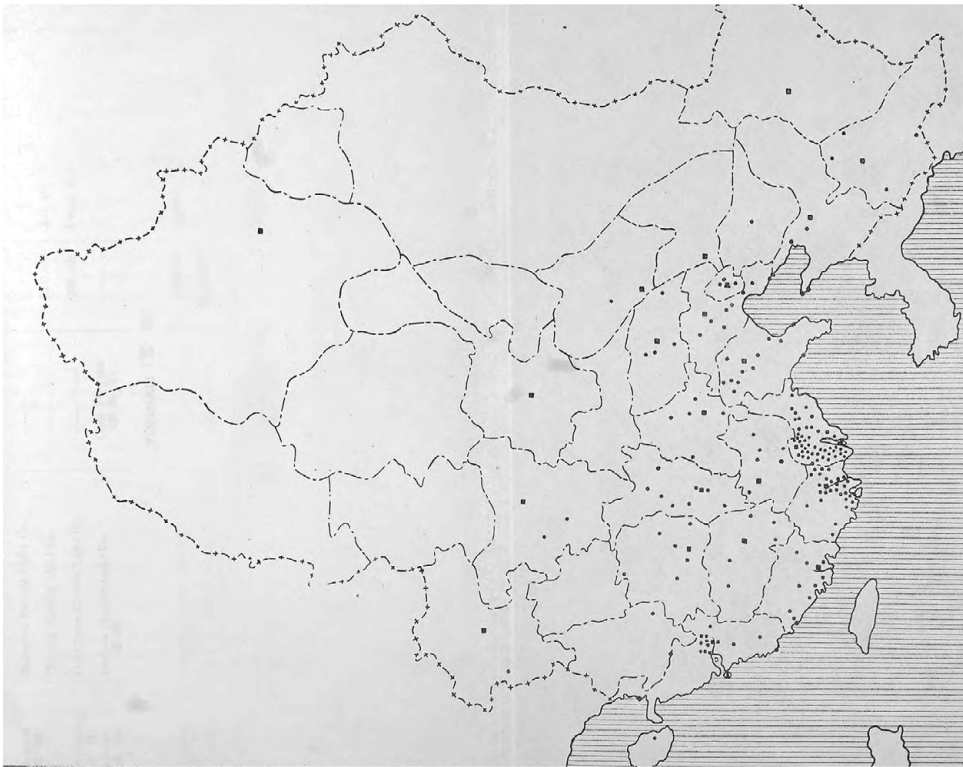


Figure 1. “Map showing the extent of electric light and power plants in China.”

Source: *Chinese Economic Monthly* 1, no. 9 (June 1924): between pages 38 and 39.

He added that “outside of the larger cities, most of the [electrical] power goes for lighting” and also points out that there were large differences between the large power station found in a city like Shanghai and much smaller installations in the interior.²⁵ A similarly striking contrast can be seen in terms of the geographical distribution of electricity supply. As Figure 1 shows, the spread of electrical power and lighting plants in 1924 was heavily concentrated in the Yangzi-Delta.

Given that electricity supply and electrical lighting were relatively widespread at least in parts of China by the start of the 1920s, what were the lamps people in China used and where did they come from? While all sorts of electric lamps could be found in China,²⁶ by the 1920s the incandescent light bulb had become the most widely used electrical lamp.²⁷ At the same

25. E. L. Clark, “Electrical Development in China,” 13–17, quotes from 13, 16. On Clark, see the association’s list of officers in the same issue.

26. Dikötter, *Things Modern*, 136.

27. Guo Songyu, “Diandeng shuo (weiwan),” *Muduo Zhoukan* 130 (1922): 1. The trend toward incandescent lamps is already pointed out in Lundquist, *Electrical Goods*, 65–66. This status of incandescent lamps as the most commonly used electrical lamps in use in China remained during the prewar period. See “Kexue changshi wenda: guanyu diandeng,” *Xinmin* 1, no. 7 (1932): 14–16; Wang Yixiong, “Baire deng de dagai,” *Qingxin yuekan* 1 (1937): 10–11. In fact, in Chinese electric lamps (*diandeng*) were often simply equated with a common term for incandescent light bulb (*diandengpao*). See, for example, Jianshewei yuanhui

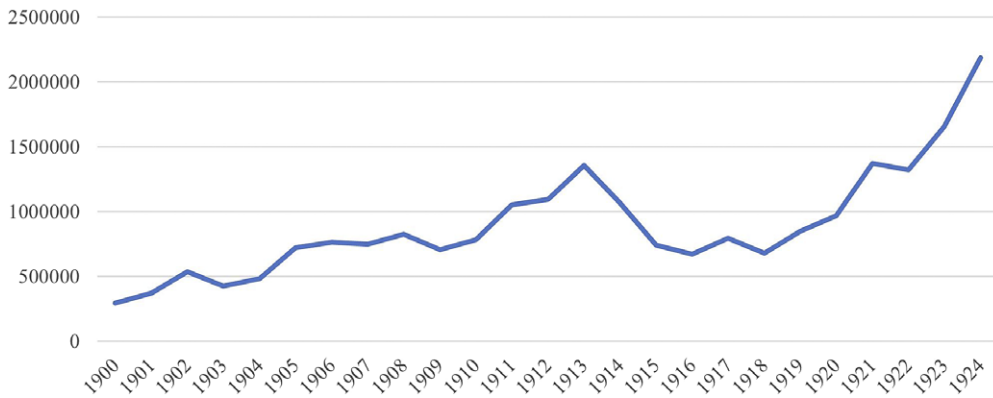


Figure 2. Lamps and Lampware (Net Imports in Haikwan Taels), 1900–1924.

Source: Chinese Maritime Customs Service, *Returns of Trades and Trade Reports*, 1900–1918; Chinese Maritime Customs Service, *Foreign Trade of China*, 1920–1924.

time, electrical light bulbs also became the most widespread and commonly used electrical appliance in China.²⁸ Before the 1920s, the light bulbs used in China were exclusively foreign-made. According to a report by an American trade commissioner, German Osram, Wotan and A.E.G. lamps, American GE lamps, Dutch Philips lamps and, to a lesser degree, the lamps manufactured by the Japanese-American Tokyo Electric Co. (which was a GE subsidiary) were the most popular before World War I.²⁹ Growing Chinese demand for electric lamps was reflected in the significant growth—with a temporary downturn during World War I in line with the general trend of imports during the war—in the imported lamps and lamp ware into China between 1900 and 1924 (Figure 2).³⁰

Just as lamp imports had temporarily dropped during the war, the first foreign lamp manufacturers started to produce light bulbs in China. The first foreign lamp manufacturer that opened its doors in China was the China General Edison Company (CGE), a subsidiary of

dianqichu, *Yongdian bidu*, 11; “Diandeng changshi,” *Zhonghe dengpao yuekan* 1, no. 1 (1933): 12–13; Quanguo jingji weiyuanhui, *Dianqi yongjuye baogaoshu*, 1

28. Jiansheweiyuanhui dianqichu, *Yongdian bidu*, 11; Hu Xiyuan, “Diandengpao changshi (shang),” *Jilian huikan* 127 (1935): 14.

29. Lundquist, *Electrical Goods*, 29, 66–67. Lundquist incorrectly identifies Osram as a British firm. The “well-known American lamp” Lundquist mentions is bound to be General Electric. Oppel founder Hu Xiyuan recalled that during his childhood the most famous light bulb brands were German Osram, Dutch Philips and American General Electric. Hu, “Meng,” 178. On the fact that Chinese manufacturing of light bulbs did not start before the 1920s, see Han, *De Industrialisatie van China*, 348; “Diandengpaoye zhi qiantu,” *Xin Dianjie* 2, no. 19 (1933): 14. As will be discussed below, it is difficult to ascertain when exactly the Chinese production of light bulbs first started. However, the year 1920 provided by Hu Xiyuan in this article from *Xin Dianjie* (also discussed below) is the earliest date that I was able to find. The only possible exception to this might be a Sino-Japanese joint venture called Chung Kuo Venus Lamp Factory in Shanghai listed with an establishment date of 1918 in a Japanese business directory. However, besides the brief entry in the business directory, I have found no other information about the firm. In any case, it was a joint-venture and it is unclear to what extent Chinese controlled the firm at all. See Tōa dōbunkai kenkyū hensanbu, *Jitsugyōmeikan*, 844.

30. On the general decline of imports and their rebound after the war, see Bergère, *Chinese Bourgeoisie*, 65, 77.

GE and established in Shanghai in 1917. CGE produced GE lamps for both the Chinese and export markets. By 1922, it reached a production capacity of “four to five million lamps a year.”³¹ In 1917, the Japanese China Denki Kogyo Co. Ltd. was also established in Shanghai with a yearly production capacity of around 1.5 million bulbs.³² By the first half of the 1920s, the competition among foreign lamp producers that sold their light bulbs in China had become fierce, leading to what the *North-China Herald* called an “Electric Lamp War.” Prices for light bulbs decreased sharply and in February 1925 eventually a price agreement to stabilize prices and prevent competition was concluded after “two years. . . [of] bitter trade war.”³³ In 1924, the Western brands Philips, GE, and Osram possessed “almost complete domination” of the Chinese electric lamp market.³⁴

We thus see that by the 1920s not only were large numbers of electric lamps imported into China, but foreign companies had even begun to manufacture light bulbs in China. Any new Chinese company wishing to enter the electric lamp manufacturing business thus not only would have to deal with foreign products but would even face foreign competitors on the ground.

The Establishment of Oppel

Oppel founder Hu Xiyuan (Figure 3) was born in Zhejiang Province in the late 1890s. He went through the newly introduced modern education system and eventually graduated from the Chekiang Technical Institute (Zhejiang gaodeng gongye xuexiao) where he majored in electrical engineering (*dianji zhuanye*). In 1921, he moved to Shanghai.³⁵

31. Quote from “American Enterprise in China,” *The Far-Eastern Review* 18, no. 12 (December 1922): 746; Chinese Maritime Customs Service, *Decennial Reports on the Trade*, 32; “An American Factory in China,” *The Far-Eastern Review* 23, no. 7 (July 1927): 293; Ferguson, *Andersen, Meyer & Company*, 163. Some sources also state that a Japanese lamp factory had been established before CGE but closed shortly after the establishment of the latter company. See, for instance, “Electric Bulb Manufacture in Shanghai,” *Chinese Economic Bulletin* 23, no. 18 (1933): 273; Yang Dehui, “Diandengpao ye,” *Shangye yuebao* 20, no. 1 (1940): 3.

32. Teishinshō Rinji Chōsakyoku, *Shina ni okeru denki yōhin shijō chōsa hōkokusho*, 34–36. For background on the company and the involvement of the Tokyo Electric Co., see Kikuchi, “Dai ichi ji taisenki,” 115–116. Kikuchi provides the same estimate of the yearly production capacity. He calculates it by using a daily production rate of 5,000 bulbs multiplied by 300 production days. Kikuchi also briefly mentions several other Japanese manufacturers that planned to manufacture light bulbs in China without giving further details (including the Japanese factory discussed in note 31, and two factories established in Dalian). Two of these manufacturers—Shanghai Denki Co Ltd. and one unnamed factory in Tianjin—are also listed in Teishinshō Rinji Chōsakyoku, *Shina ni okeru denki yōhin shijō chōsa hōkokusho*, but there is no further information about their activities. Tōa dōbunkai kenkyū hensanbu, *Jitsugyōmeikan*, also briefly mentions a Sino-Japanese joint-venture in Shanghai with an establishment date of 1918 and a daily production capacity of 2,500 bulbs. Besides this entry, there is no further information on this joint-venture. See note 29.

33. “Electric Lamp War in China,” *North-China Herald*, February 28, 1925. Dikötter cites the same article and speaks of competition between “foreign and local producers.” However, the article does at least not explicitly mention Chinese producers. See Dikötter, *Things Modern*, 142. Van der Putten also comments on the price competition at this time and the consequential elimination of certain Western firms from the market that left GE, Osram and Philips as the dominant market players. See Van der Putten, *Corporate Behaviour*, 199–200.

34. Van der Putten, *Corporate Behaviour*, 200.

35. Hu, *Huiyilu*, 2–3; Qu Zhaohong, “Dianqi gongyejia Hu Xiyuan xiansheng zhuanlüe,” *Jiaoyu yu Zhiye* 177 (1936): 558–59; Chinese Ministry of Information, *China Handbook 1937–1945*, 660. Hu’s exact year of birth



Figure 3. Hu Xiyuan, photo from 1936.

Source: *Xinren zhoukan* 2, no. 22 (1936): 23.

As Hu later recalled, he had since his childhood been fascinated with electric light. After his move to Shanghai, he started to study and experiment with how to manufacture light bulbs by looking for relevant information in libraries and searching for necessary equipment and materials on the market. Initially, he mainly relied on books in his experiments, which however remained unsuccessful. He then switched to the more hands-on try-and-error method of experimenting. He also drew on the help of Zhou Zhilian, an engineer who had attended the Department of Mechanical Engineering (*jixiexi*) at Nanyang University (Nanyang Daxue) and had also studied in Germany, and Zhong Xunzhen, who had studied in Japan and was a graduate of the Nanyang Railway and Mining School (Nanyang Lukuang Xuexiao). In trying to manufacture a lightbulb they were experimenting and probing and gradually improving their manufacturing method. On April 4, 1921, as Hu later recalled, he

is somewhat difficult to ascertain. The *China Handbook 1937–1945* gives 1899 as his year of birth. However, according to the description in *Huiyilu* and “Dianqi gongyejia Hu Xiyuan xiansheng zhuanlüe” and the difference between the traditional Chinese and modern way of counting age, his year of birth could also be 1897 or 1898.

and his colleagues managed for the first time to manufacture a functioning light bulb.³⁶ Such processes of experimentation were not unique to Hu and his collaborators. As Lean has recently shown, informal experimentation played a key role in the process of Chinese industrialization.³⁷

Despite some later claims to the contrary by Hu and Oppel,³⁸ it seems unlikely that Oppel was the first Chinese light bulb factory or the first Chinese factory to manufacture light bulbs. In a 1933 interview on the development of the light bulb industry, Hu himself explained that the first Chinese light bulb factory was established in 1920 and until 1922 several other factories were established. However, due to fierce competition from foreign companies, these factories closed. Hu does not comment on Oppel in the interview and makes no claims of either producing the first Chinese light bulb or of Oppel being the first Chinese light bulb factory. The interview only describes Oppel as the “longest established” Chinese light bulb factory.³⁹ The account given by Hu about the early Chinese electric bulb industry is borne out by two overviews of the industry from the same period that appeared in the *Shangye Yuebao*, the publication of the Shanghai Chamber of Commerce. These explain that the first Chinese light bulb factories failed due to different reasons, such as lack of technical knowledge, the low quality of their products, or a shortage of capital.⁴⁰ Thus, Oppel was likely not the first Chinese light bulb producer, and we should simply see it as the first Chinese light bulb factory that achieved long-term success.

While Hu, Zhou, and Zhong had succeeded in manufacturing a light bulb, this did not mean they were ready to produce them at scale. In 1921, Hu purchased several pieces of machinery for manufacturing light bulbs in Japan and during the summer of the same year sold some of his family estate and used the proceeds from the sale to establish his first light bulb factory at Beifujian Road in Shanghai’s International Settlement. The new factory quickly ran into problems, though. Unskilled workers and issues with the machinery and equipment meant that Hu’s production costs remained high and the quality of the bulbs insufficient, so that the products were not yet ready for the market.⁴¹

Thus, it seems like Hu’s endeavor could have ended in failure similar to other early Chinese light bulb factories. However, in November 1922, Zhou Zhilian introduced Hu to Opel, a German engineer who owned a small light bulb factory in Shanghai. Opel’s factory was not doing well as it was not able to compete with the big foreign light bulb brands. As Opel wanted

36. Hu, *Huiyilu*, 2–4.

37. Lean, *Vernacular Industrialism*.

38. Hu, *Huiyilu*, 4; Oppel advertisement in *Jilian huikan* 164 (1937): 72. The title of the following newspaper article also seems to suggest this: Shuo, “Guohuo dengpao zhi shouchuangzhe: Hu Xiyuan xiansheng,” *Shanghaishi zhi guohuo shiye* 1 (1933): 55.

39. “Diandengpaoye zhi qiantu,” *Xin dianjie*, 14–15. Unless stated otherwise, all translations from the Chinese are my own.

40. Fan Xingzhi, “Zhongguo dengpaoye zhi qianzhan yu huigui,” *Shangye yuebao* 13, No. 2 (1933): 7; Yang, “Diandengpao ye,” *Shangye yuebao*, 3–4. Besides the earliest Chinese light bulb factories that went out of business, Fan and Yang also mention the Kelaiheng Factory. According to Fan, by 1933 the company was already not operational anymore. According to the *Chinese Economic Bulletin*, Kelaiheng’s English name was Clayson, but it also mentions no further details about the factory. See “Electric Bulb Manufacture in Shanghai,” *Chinese Economic Bulletin*, 273.

41. Hu, *Huiyilu*, 4–5. For the location of Beifujian Road (North Fokien Road) in the International Settlement, see North-China Daily News & Herald, *Map of Shanghai*.

to give up the company, Zhou encouraged Hu to buy it to secure better equipment for Hu's factory. Subsequently, Hu bought up Opel's complete machinery. As part of their agreement, Opel worked as an engineer at Hu's factory.⁴² Little is known about Opel's background, but, according to one source, he was an industrial specialist (*gongye zhuanjia*) and had worked for many years at a light bulb factory in Germany before coming to China.⁴³ Subsequently, Opel and Hu worked on the improvement of the light bulbs together until Opel left the factory in May 1924. While Hu focused on the business side of developing the factory, Opel seems to have focused on technical engineering work. Together, helped by specialist advisers, they finally managed to sufficiently decrease the cost of the light bulb production, increase their quality and make them usable for consumers.⁴⁴ It thus seems likely that Hu's decision to buy up and bring in Opel was not solely driven by his desire to acquire Opel's machinery, but also to draw on Opel's expertise in light bulb manufacturing. Drawing on this expertise, it appears, was key in enabling Hu to make his light bulbs usable and his business endeavor successful.

In 1925, Hu reorganized the company as a limited liability joint-stock company with the name China Yapuer Lamp Factory Company Ltd. (*Zhongguo yapuer dengpaochang gufen youxian gongsi*) and registered it as a corporation with the government.⁴⁵ It is from 1928 that we have the first official documentation about the existence of the company in the form of Opel's registration as a limited liability joint-stock company with the new Nationalist government and the registration of its trademark in the same year.⁴⁶ According to the

42. Hu, *Huiyilu*, 5–6. The existing sources at times vary in terms of the details and chronology of Opel's early history and Hu's relationship to Opel. For instance, some sources simply state that Opel's company was established before 1925 and was sold to a Chinese investor or, more specifically, Hu in 1925. See "Electric Bulb Manufacture in Shanghai," *Chinese Economic Bulletin*, 273; Shuo, "Guohuo dengpao zhi shouchuangzhe: Hu Xiyuan xiansheng," *Shanghai shi zhi guohuo shiye*, 56; Quanguo jingji weiyuanhui, *Dianqi yongjuyue baogaoshu*, 6. The latter two also state that it was in 1925 at the time of the supposed sale that Opel left the factory. However, this description of events might be simply because Hu officially registered the firm only in 1925 as discussed below.

43. Shuo, "Guohuo dengpao zhi shouchuangzhe: Hu Xiyuan xiansheng," *Shanghai shi zhi guohuo shiye*, 56. Like many other sources, this article wrongly states that Oppel was the name of the German engineer, most likely inferring it from the company name, and assumes that his Chinese name was Yapuer and that he had established a firm called Yapuer dengpaochang. However, not only is Oppel not identical with the German engineer's name, but, as discussed in note 50, the company's Chinese name did not originate with Opel's name and this misunderstanding was probably because during the company's early years there existed rumors that Oppel was a German firm. Also see Hu, *Huiyilu*, 6.

44. Hu, *Huiyilu*, 6, 84. Hu says that after Opel left the factory, he had to take care of both the business and technical side of the company, which suggests that the technical work had primarily been Opel's duty before then. While it asserts that Hu simply bought the whole company from Opel, a 1933 publication also seems to confirm the important technological base Opel provided Hu with in passing on light bulbs that were already of good quality. See Shuo, "Guohuo dengpao zhi shouchuangzhe: Hu Xiyuan xiansheng," *Shanghai shi zhi guohuo shiye*, 56. This source somewhat differs from Hu's account in his memoirs as it states that Opel came to China in 1923 and left the company in 1925.

45. Hu, *Huiyilu*, 84. This year of establishment as a corporation is confirmed by a later registration document the company filed after 1945: "Shanghai shi dianqiye tongyegonghui huiyuan dengji biao" (January 15, 1946), S21-1-36-1, Shanghai Municipal Archives. While the existing sources and accounts differ on the year of establishment they give for Oppel, 1925 is most commonly given as the establishment date of the company, most likely due to this official registration as a corporation. See, for example "Shanghai diandengpao zhizao ye diaocha," *Gongshang banyuekan* 5, no. 17 (1 September 1933): 76–77.

46. "1928 nian zhongguo yapuer qiye zhuce wenjian" (December 26, 1928), in Sun, *Zhongguo aidisheng* [hereafter: *ZA*], 317–26; "Shending shangbiao di qi yiba hao," *Shangbiao Gongbao* 9 (1928): 61.

documents that Oppel submitted to the government, an initial founding meeting with sixteen shareholders and chaired by Hu was held on October 1, 1927. Hu and four others were elected to the board of directors.⁴⁷ According to the submitted regulations of the firm, it solely focused on the production of light bulbs. Only Chinese nationals could own shares of the company. From the submitted documents, we also learn that Oppel sold around 600,000 lamps per year.⁴⁸ In the trademark registration, we see for the first time the English name of the company: Oppel Lamp Manufacturers Ltd.⁴⁹ Both the Chinese and English names of the company thus reflected that at this time the company only manufactured light bulbs.⁵⁰ We see that by 1928, Hu had built Oppel into a formidable electric lamp manufacturer, even though, judging from its sale numbers, its production capacity still lagged behind foreign factories in Shanghai.

Oppel during the 1930s

During the 1930s, Oppel experienced further growth. Hu grew the company's share capital from 30,000 Yuan in 1928 to 300,000 Yuan in 1933.⁵¹ In 1929, Oppel established a new light bulb factory at Liaoyang Road in the International Settlement.⁵² Besides the production of light bulbs at its main plant at Liaoyang Road, Oppel also started the production of other daily electrical appliances and established a second factory for this purpose. The company changed its name to Oppel Electric Manufacturing Co., Ltd. (Zhongguo yapuer dianqichang). Hu acted as managing director and general manager of the company.⁵³

47. "1928 nian zhongguo yapuer qiye zhuce wenjian," *ZA*, 324.

48. "1928 nian zhongguo yapuer qiye zhuce wenjian," *ZA*, 317–19, 326.

49. "Shending shangbiao di qiyiba hao," *Shangbiao Gongbao* 9 (1928): 61.

50. In choosing the Chinese name Yapuer, Hu was inspired by the Chinese brand names of the Western light bulb manufacturers Osram (Yasiling) and Philips (Feilipu). Based on this and the fact that in the early period of Oppel's existence Hu advertised that it employed German engineers and did not contradict certain rumors that his company was a German company, Gerth has argued that Oppel in order to compete with the "reputation of imports as superior" sought at first to "misrepresent itself as foreign." This, however, seems an overstatement that, if at all, can only be made for the very early period of Oppel's activities, particularly as Hu soon (as we have seen certainly by 1925) added the prefix "China" (Zhongguo) to the company name. See Gerth, *China Made*, 183; Hu, *Huiyilu*, 6; Hu, "Meng," 180–181.

51. Reports of Oppel's capital at times vary. Sources often simply refer to "capital" (*ziben*) without specifying what is included in this. For example, the *Dianqi yongjuyue baogaoshu* explains that Oppel's capital grew from 30,000 Yuan at the start to 100,000 Yuan in 1927, and by 1936 stood at 300,000 Yuan. Quanguo jingji weiyuanhui, *Dianqi yongjuyue baogaoshu*, 6. The best sources on this matter are the official government registration records, which I follow here. They specify that what is meant is Oppel's paid-up stock capital: "1928 nian zhongguo yapuer qiye zhuce wenjian," *ZA*, 317; "Shiyebu zhizhao" (February 13, 1933), 18–23–01–77–14–026, Archives of the Institute of Modern History, Academia Sinica, Taipei.

52. "Yapuer dianpaochang jianzhu xinchang tianbei jiqi," *Shibao* (July 19, 1929): 6. For the location of Liaoyang Road within the International Settlement, see North-China Daily News & Herald, *Map of Shanghai*. For the factory being in the same location in 1937, see Zhongguo Yapuer dianqichang, *Diandengpao*.

53. Zhongguo Zhengxin suo, *Shanghai gongshangye huibian*, 46; Tōa dōbunkai kenkyū hensanbu, *Jitsugyōmeikan*, 844–45. According to *Jitsugyōmeikan*, the second factory for the production of daily electrical appliances was established in 1930, but the production of electrical fans started in 1928. This roughly aligns with Hu's own recollections, which state that he first established a small-scale production site for electrical

Table 1. Overview of the Chinese Electric Light Bulb Industry in Shanghai, 1933

Factory Name	Year Established	Capital in Yuan	Number of Workers	Lightbulb Production Capacity per Day	Estimated Lightbulb Output per Month
<i>Zhongguo Yapuer Dianqichang (Oppel)</i>	1925	300,000	408	15,000	325,000
<i>Shanghai Dengpao Zhizao Gongsì</i>	1933	200,000	200	12,000	250,000
<i>Huade Dianguang Gongsì</i>	1929	100,000	38	3,000	75,000
<i>Yongming Dianpao Chang</i>	1933	40,000	27	2,000	50,000
<i>Fulaisheng Dianpao Chang</i>	1930	40,000	100	6,000	125,000
<i>Huatong Dianpao Chang</i>	1927	30,000	100	6,000	120,000
<i>Zhongguo Dianpao Chang</i>	1932	25,000	40	2,000	46,000
<i>Yaerdeng Dianpao Chang</i>	1930	20,000	150	7,000	130,000
<i>Mingguang Diandengpao Chang</i>	1932	20,000	56	2,000	46,000
<i>Zhonghua Dianpao Chang</i>	1933	20,000	60	2,500	60,000
<i>Haoyou Dianqi Zhizao Chang</i>	1933	20,000	30	2,000	45,000
Total			1,209	59,500	1,272,000

Note: As the “capital” (*ziben*) for Oppel here is congruent with the stock capital given in official government record for 1933, it is fair to assume that in the source of this tabulation “capital” refers to paid up stock capital.

Source: “Shanghai diandengpao zhizaoe diaocha,” *Gongshang banyuekan* 5, no. 17 (September 1, 1933), 76–77.

Oppel’s rapid growth reflects the larger development of the Chinese electric light bulb industry. By 1933, Oppel was clearly the largest Chinese light bulb manufacturer in Shanghai in terms of capitalization and production capacity and thus also in China more broadly, producing around one-fourth of Chinese manufactured light bulbs (Table 1). However, several other light bulb manufacturers were now also operating in Shanghai. In total, they had an estimated output of over one million bulbs per month. This growth had two important consequences. First, according to a Chinese government report from 1936, Chinese electric light bulb manufacturers in Shanghai, the center of light bulb manufacturing in China, by then far surpassed foreign manufacturers in terms of the number of light bulbs produced per year. According to this report, foreign light bulb manufacturers in Shanghai produced around eight to nine million light bulbs a year. This compared to fifteen to sixteen million light bulbs produced by Chinese manufacturers.⁵⁴

Second, Chinese manufacturers managed to capture a large part of the light bulb market formerly controlled by foreign-made bulbs. The 1930s saw a sharp decrease in the import of

appliances (mainly electrical fans) at *Beizhejiang* Road in 1929, before establishing a larger factory later. Hu, *Huiyilu*, 53.

54. Quanguo jingji weiyuanhui, *Dianqi yongjuyue baogaoshu*, 9. According to the *Chinese Economic Bulletin*, “The manufacture of electric bulbs in China [by Chinese firms] . . . has not been developed other than in Shanghai.” See “Electric Bulb Manufacture in Shanghai,” *Chinese Economic Bulletin*, 274. All light bulb manufacturers listed in the *Jitsugyōmeikan*, a Japanese survey from 1934 that gives an overview of companies in different sectors of the Chinese economy (excluding Japanese businesses), are located in Shanghai. Tōa dōbun-kai kenkyū hensanbu, *Jitsugyōmeikan*, 843–847. The *Dianqi yongjuyue baogaoshu* also essentially treats the production of light bulbs by foreign and Chinese businesses in Shanghai as the total production in China. Quanguo jingji weiyuanhui, *Dianqi yongjuyue baogaoshu*, 9. As mentioned in note 32, some sources also mention early Japanese light bulb firms in Dalian and Tianjin, but without giving further details. As discussed below, there is also evidence of a Japanese light bulb manufacturer in Hankou, which, however, was insignificant.

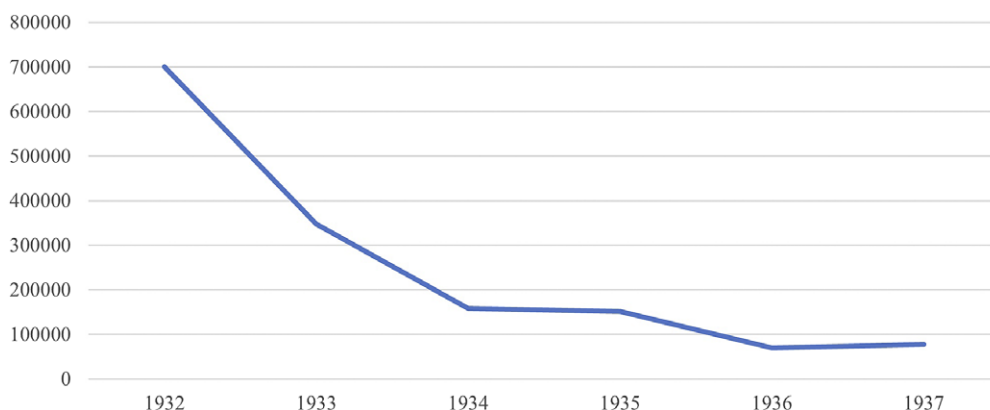


Figure 4. Value of Chinese Imports of Electric Light Bulbs, 1932–1937 in Customs Gold Units.

Source: Chinese Maritime Customs Service, *The Trade of China, 1932-1937*.

electric light bulbs into China (Figure 4). Part of this decrease will have been because in 1932 GE, Philips, and Osram, who in the mid-1920s had dominated the Chinese light bulb market but subsequently had lost market share to cheaper Japanese and Chinese lamp manufacturers, founded a joint venture called the China United Lamp Company (Culco). This joint venture was to handle the distribution of the three brands' light bulbs in China. The three companies hoped this would allow them to reduce prices. As part of the agreement, Osram and Philips lamps were no longer imported but manufactured locally by CGE in Shanghai.⁵⁵ At the same time, Japanese light bulb imports into China saw a steep decline. By the 1930s, anti-Japanese sentiment negatively affected the sale of Japanese bulbs.⁵⁶ Following China's regaining of tariff autonomy in 1929, Japanese manufacturers also felt the negative influence of import tariffs. Moreover, Japanese, and particularly Chinese, producers of light bulbs in Shanghai took market share away from Japanese imports.⁵⁷ Consequently, like the trend of overall light bulb imports, Japanese light bulb imports plummeted from 386,315 Customs Gold Units in 1932 to

55. Van der Putten, *Corporate Behaviour*, 199–202. As Van der Putten explains, due to limitations in the supply of light bulbs by CGE, in the first few years Philips still exported a certain number of lamps to China. However, after 1935, Culco sourced all its lamps locally from CGE. He states that these Asian manufacturers “entered the market with low quality, cheap electric lamps” in the 1920s, but later also highlights the importance of quality for the competitiveness of Chinese manufacturers. Also see the discussion below.

56. Negative influence of anti-Japanese sentiment on Japanese light bulb sales is mentioned in Kankō Nihon Shōkō Kaigisho, *Kankō keizai jijō*, 34. Also see Van der Putten, *Corporate Behaviour*, 200.

57. On this for the case of Hankou, see Kankō Nihon Shōkō Kaigisho, *Kankō keizai jijō*, 34. The same source also mentions light bulbs of Tokyo Electric Co. that were apparently sold in Hankou but also suffered from some of the negative impact on Japanese products described in this paragraph (and the high price they were bound to due to Phoebus cartel). However, this must have been an exception as from the mid-1920s Tokyo Electric Co., as a member of Phoebus, was only allowed to sell in Manchuria. See Van der Putten, *Corporate Behaviour*, 199–200. While only focusing on Opper's perspective, Sun also mentions tariffs against Japanese bulbs (though only two specific cases from 1932 and 1934 Hu was involved in) and the negative effect of anti-Japanese sentiments after 1931 on Japanese businesses (though giving Hu a direct role in using these sentiments without providing a source for this assertion). Sun, “Hu Xiyuan jiqi Yapuer,” 17–19. Tariffs are also mentioned in Miellmann, *Handelsbeziehungen*, 195; and Huang, *Dianqi zhaoming*, 69–70. Huang highlights the impact on Japanese bulbs but without giving a source.

only 35,803 Customs Gold Units in 1936.⁵⁸ Japanese production of light bulbs in China also was limited. In 1936, there existed four Japanese light bulb factories in Shanghai, which produced only two to three million light bulbs per year. This paled compared to the around six million light bulbs produced by the CGE alone or the fifteen to sixteen million produced annually by Chinese manufacturers.⁵⁹ There is also evidence of a Japanese light bulb factory in Hankou, which, however, was small and produced low-quality bulbs.⁶⁰

For GE, Osram, and Philips, who now all produced locally through Culco, import tariffs naturally were no problem. If there had been no formidable Chinese competition, they should have been able to capture much of the market again. As Rawski explains, “In a market economy, it is only after private business responds to new opportunities that tariff or other protection can spur the pace of industrialization.”⁶¹ However, Chinese manufacturers, who, as we saw, came to produce more light bulbs than foreign manufacturers, were ready. Indeed, not only had continued Chinese competition been a driving force behind the decision to found Culco, but despite this new joint venture of GE, Philips and Osram and the growth of anti-Japanese sentiments, Culco was unable to regain the former market share of the three Western brands due to the fierce competition from Chinese manufacturers.⁶² As a Chinese government publication explained in 1933:

Previously bulbs made by CGE, Inc., a foreign concern in Shanghai, were most largely used by Chinese, while Philip’s and Osram lamps, imported from Holland and Germany respectively, were also in fair demand, but these foreign makes have been gradually displaced by Chinese products, especially Ooppel and Hwa Teh [Huade].⁶³

58. Chinese Maritime Customs Service, *The Trade of China*, 1932, Volume III, 155; Chinese Maritime Customs Service, *The Trade of China*, 1936, Volume II, 236.

59. Quanguo jingji weiyuanhui, *Dianqi yongjuyue baogaoshu*, 9.

60. Kankō Nihon Shōkō Kaigisho, *Kankō keizai jijō*, 36.

61. Rawski, *China’s Transition*, 27.

62. Van der Putten, *Corporate Behaviour*, 200–202. Van der Putten notes that nationalism and anti-Japanese sentiments “benefited the Chinese producers much more than it did [Western producers of lamps],” but does not elaborate further beyond there being increasing Chinese competition, mainly stresses price and quality as the strengths of Chinese competitors and does not mention Chinese nationalism in itself as a specific concern of Culco. Also see the discussion of price and quality below. In 1936, Culco even invited Chinese minority investment in the company to better integrate themselves into the Chinese market and become more competitive. On this, see Van der Putten, *Corporate Behaviour*, 203–204. On increasing Chinese competition and market takeover, also see Miellmann, *Handelsbeziehungen*, 195.

63. “Electric Bulb Manufacture in Shanghai,” *Chinese Economic Bulletin*, 275. Tan claims that, before 1937, “Consumers avoided Chinese-made light bulbs, as good and faulty ones were sold together.” Tan, *Recharging China*, 89. This, however, is an overstatement. The source Tan cites is Chūshi Kensetsu Shiryō Seibi Iinkai, *Denki yōgu kōgyō hōkokusho*, 42, which is a Japanese translation of Quanguo jingji weiyuanhui, *Dianqi yongjuyue baogaoshu* from 1936. While it explains that both good- and poor-quality products existed amongst Chinese lightbulbs, it does not outright state that Chinese consumers avoided these products altogether. Rather, it lists this uneven quality together with growing competition among Chinese manufacturers and competition with foreign manufacturers in China as factors that led to an oversupply of light bulbs and difficulties in growing the sales of Chinese-made light bulbs even further. It is also unclear why he states that Chinese light bulb factories “cater[ed] to 40 percent of domestic demand” when the report discusses an oversupply, or why he states that Chinese manufacturers produced “sixteen million light bulbs annually between 1924 and 1934” when the report does not mention this time range and was published in 1936 (the report gives ca. sixteen million light bulbs as the annual production in its conclusion and fifteen to sixteen million as the figure earlier in the report as discussed above).

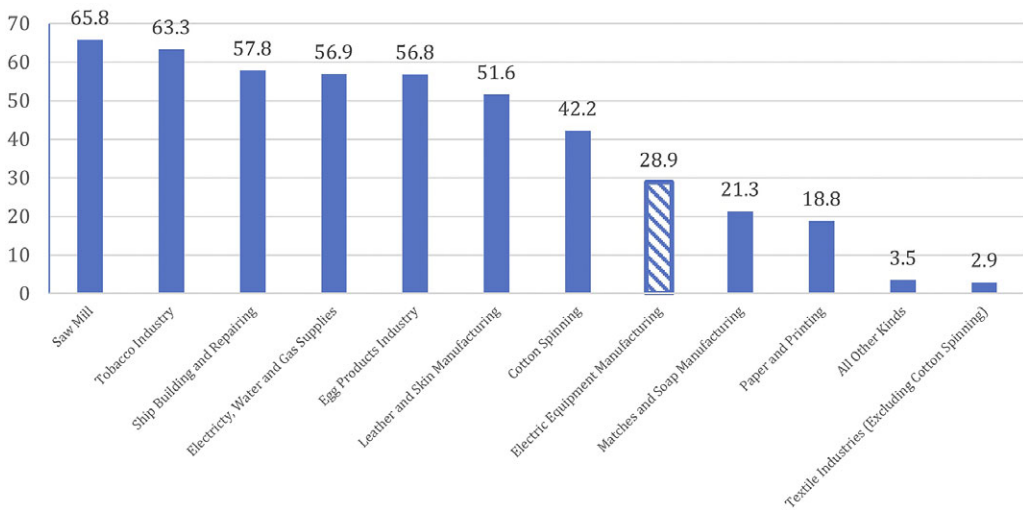


Figure 5. Proportion of Production by Foreign Factories in 1933 in China in %, Different Industries. Source: Cheng, *Foreign Trade*, 40.

A 1936 report by the Japanese Chamber of Commerce and Industry in Hankou confirms this. It explains that by 1936, light bulbs worth around 200,000 Chinese dollars were imported annually into Hankou. Of this, around 40 percent, or 80,000 Chinese dollars’ worth of light bulbs, were produced by Chinese manufacturers.⁶⁴

Thus, we see that, led by Oppel, Chinese light bulb manufacturers managed to make significant inroads into the Chinese light bulb market previously controlled by foreign-made bulbs. This success in competing with foreign manufacturing was representative of the larger electrical equipment manufacturing industry. By 1933, foreign factories made up only 28.9 percent of total production in the electric equipment manufacturing sector. This compared favorably to other industries (See Figure 5).⁶⁵ However, not all was rosy for Chinese manufacturers of light bulbs. Most importantly, by 1936, the competition between Chinese light bulb manufacturers had become intense and some Chinese manufacturers were dumping low-quality goods into the market. Prices dropped and customers lost trust in Chinese light bulbs, which harmed the Chinese light bulb manufacturing industry. Oppel’s business was also dampened somewhat by these developments.⁶⁶

Nevertheless, on the eve of the Sino-Japanese War, Hu could look positively on the rapid development of the company and its leading position within the Chinese light bulb

64. Kankō Nihon Shōkō Kaigishi, *Kankō keizai jijō*, 33. Huang claims that Chinese light bulb manufacturers “all along” held one-third of the market, but does not give a source for this claim. Huang, *Dianqi zhaoming*, 72.

65. Cheng’s data is based on the 1947 estimate of Chinese national income led by Ou Baosan. Cheng, *Foreign Trade*, 52n26. For the 1947 estimate used, see Ou et al., *Zhongguo guomin suode*, 59–76. Ou’s estimates include China proper (*neidi*) and Manchuria but exclude Hong Kong and Taiwan.

66. Quanguo jingji weiyuanhui, *Dianqi yongjuye baogaoshu*, 6–15.

manufacturing industry. Oppel and other Chinese light bulb manufacturers were part of a larger trend in prewar China, whereby foreign-made products and companies first entered the Chinese market and then found “Chinese imitators who rapidly attained strong, often commanding, positions in . . . markets initially dominated by foreign products.”⁶⁷ The following sections will explore what specific conditions made it possible for Oppel to capture this market share, first from the perspective of domestic consumption and then through the lens of technology transfer and intellectual property law.

Nationalist Lobbying and Government Business

As Gerth has shown, many Chinese entrepreneurs in the early twentieth century played to nationalist sentiments to advertise and sell their products and demarcate them from foreign competitors. A crucial element of the movement was the distinction between the categories of “national product” (*guohuo*) and “foreign product” (*yanghuo*).⁶⁸ Oppel was no exception to this. Gerth points to Oppel as a firm that in the beginning concealed that it was Chinese but then used nationalist branding and participated in and benefited from the movement for the promotion of Chinese national products.⁶⁹ A look at Oppel’s advertisements from the 1930s shows that the firm regularly emphasized that its products were Chinese and not foreign. For example, an advertisement from 1933 (Figure 6) states that Oppel’s products are “famous national electrical products.” Another example from 1934 also shows the words “national products” (*guohuo*) superimposed at the top of the advertisement (Figure 7). According to Hu, Oppel’s advertising focused very much on “promoting national products” and often carried the slogan “Chinese people please use Chinese products.”⁷⁰ Clearly, an important pillar of the firm’s marketing strategy was emphasizing the national character of Oppel’s products.

However, the case of Oppel also shows that we also must ponder the specific sales channels of individual products when we consider the importance of nationalist marketing for Chinese products in the early twentieth century. While some products might be mainly sold to and be purchased by individual customers, others might also often be sold in bulk to larger institutions or organizations. According to a 1933 report by Erich Roesler of Culco, their agents’ electric lamp sales in China could be divided into four groups: “A—[Small and big] Dealers, B—Power Companies, C—Municipal & Government Institutions [and] D—Large Consumers.”⁷¹

67. Rawski, *Economic Growth*, 117.

68. Gerth, *China Made*.

69. Gerth, *China Made*, 182–84. Gerth cites Hu as crediting the National Products Preservation Association, a prominent Chinese organization for the promotion of national products, for contributing to Oppel’s success. However, in his discussion of Oppel, Gerth relies on only one historical source (Hu, “Meng”) and largely limits himself to the very early history of Oppel. Gerth also discusses no other factors in the success of the company beyond the question of how first concealing and later embracing its identity as a Chinese firm and participating in the NPM helped the company. On Gerth’s argument that Hu tried to hide the Chinese origin, also see note 50 of this article. Largely following the same historical source, Sun’s nationalist hagiography unsurprisingly also highlights the benefits Oppel received from participating in the NPM without explicating how this compared to other factors in his success. Sun, “Hu Xiyuan jiqi Yapuer,” 29, 32.

70. Hu, *Huiyilu*, 109.

71. Roesler to Osram Hg (Berlin) (May 22, 1933), A Rep. 231, 386, Landesarchiv Berlin.



Figure 6. Opel Advertisement from 1933.
Source: *Tuhua Chenbao*, February 12, 1933, 35.

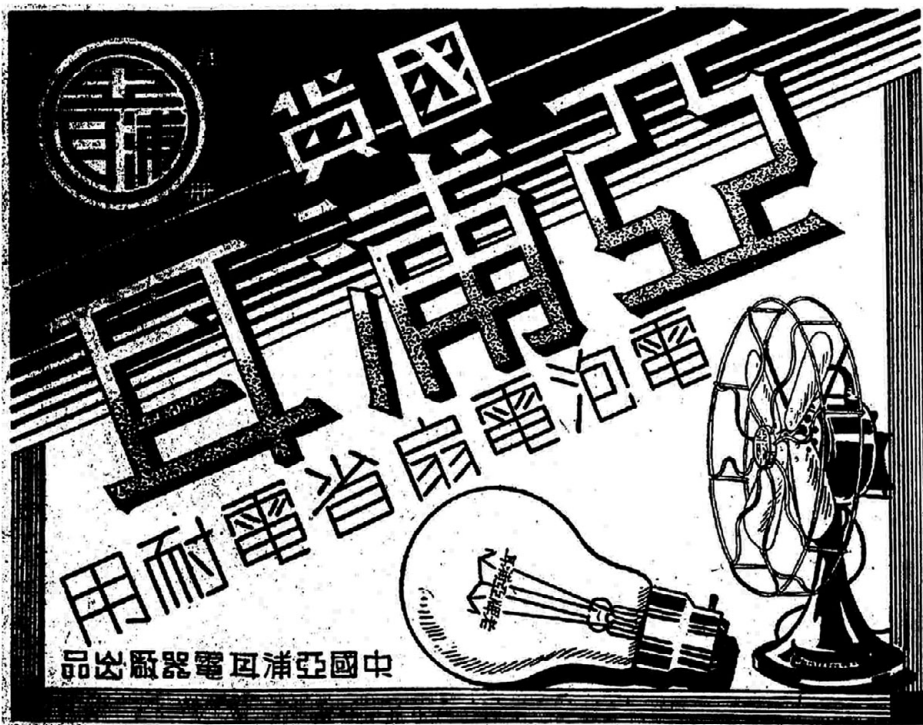


Figure 7. Opel Advertisement from 1934.
Source: *Shishi xinbao*, December 22, 1934.

The fact that institutions of the government and of municipalities were major purchasers of electric lamps in China could be exploited by Chinese lamp manufacturers such as Oppel by playing up the national character of their products. Not only did the early 20th century see a general rise in Chinese nationalism. But the new Nationalist government established in 1927 also strongly supported national products, soon ordering the Ministries of Interior and Education to buy national products if possible and provincial governments and governments of directly administered municipalities to encourage the public to support national goods.⁷²

Several examples help to illustrate how Oppel could exploit its status as a Chinese company to win government contracts from central, provincial and municipal government institutions. First, there is evidence that Oppel used the Association of the Shanghai Electrical Appliances Manufacturers (Shanghaishi dianqi zhizaoye tongye gonghui), whose founding member and chairman Hu was, to lobby the central government. On May 13, 1936, the association wrote to the Executive Yuan, the highest office in the central government's executive branch, and asked that government organizations should buy Chinese electrical goods. The Executive Yuan promptly followed suit and on May 21 ordered subordinate organizations to prioritize Chinese products when buying electrical appliances. Following the issuing of the order, organizations ranging from the Ministry of Finance and the Department of Railways, to provincial governments, such as that of Jiangxi, to municipal governments, such as that of Beijing, accepted and passed on the order to respective subordinate organizations.⁷³

Government-owned companies also bought Oppel products. After prominent businessman Liu Hongsheng had in 1932 taken over the directorship of the state-owned China Merchants Group (Guoying Zhaoshangju, CMG), a major Chinese shipping company, Hu persuaded Liu that CMG should use Chinese-made products and signed an exclusive contract with CMG for the delivery of light bulbs. When a new manager replaced Liu in February 1936, CMG started to purchase foreign bulbs. Hu then used various national products groups and the press to successfully pressure CMG to again utilize Oppel bulbs. Then, on May 20, 1936, it was reported that CMG signed a three-year contract with Oppel that made Hu's company the exclusive provider of bulbs for CMG "in order to avoid the loss of economic rights."⁷⁴ In 1935, the Shanghai-Nanjing

72. "Zhonghua minguo guomin zhengfu ling: Guiding tichang guohuo ling" (April 20, 1928) *Gongshang gongbao* 1, no. 1 (June 15, 1928): 6. On the Nationalist government and its support of national products, also see Gerth, *China Made*; Sheehan, *Industrial Eden*.

73. "Xunling zhixia ge jiguan: feng Xingzhengyuan ming sihou ge jiguan ji minzhong gouzhi dianqi ying jinxian caiyong guohuo tongling zunzhao you" (June 1936), *Beiping shi shizheng gongbao* no. 356 (1936): 8–9; "Tiedaobu tongling ge luju jinxian caiyong guohuo dianqi," *Shenbao* (June 4, 1936): 13. For the other acknowledgments of the order and the exact date of the petition, see the relevant orders in *Jiangxisheng zhengfu gongbao* no. 514 (1936):14–15; *Caizheng rikan* no. 2476 (1936): 1–2. The association's petition specifically focused on electric fans but also included a general request regarding electrical appliances. The Executive Yuan's order also extended to electrical appliances in general. On Hu's role in the association, see "Dianqi zhizaoye gonghui chengli," *Shenbao* (October 7, 1933): 14; "Jiansheweiuyuanhui pi di san er er hao," *Jiansheweiuyuanhui gongbao* no. 72 (1937): 105.

74. Quote from "Guoying zhaoshangju zhuanrong Yapuer dengpao," *Shenbao* (May 20, 1936), 12; Hu, *Huiyilu*, 97–98. Hu provides no specific dates regarding his pressure campaign against CMG, but the change in directorships and date of the article in *Shenbao* suggest that the signing of the contract was the direct consequence of the pressure campaign. On the CMG, see Zhang, *Zhaoshangju*.

and Shanghai-Hangzhou-Ningbo railway lines, which originally had only used foreign bulbs, also signed a contract with Oppel for a large number of light bulbs.⁷⁵

Oppel also directly contacted or petitioned provincial governments to persuade them to use Oppel light bulbs. In 1936, Oppel, referring to the order of the Executive Yuan mentioned above, wrote to the Shandong provincial government to introduce its products and ask the provincial government to promote national products. In response, the Shandong government ordered the mayor of the provincial capital Jinan, the Research Office for Rural Reconstruction (Xiangcun jianshe yanjiuyuan) and various county chiefs and other local officials to order their subordinates to purchase Oppel products as much as possible.⁷⁶ In another instance, in 1937 Oppel petitioned the government of Jiangsu Province to promote its products, including light bulbs. The petition stressed that there existed a substantial demand for light bulbs in Jiangsu. The provincial government obliged and ordered its subordinate institutions, county heads and special commissioners of administrative inspectorates to promote and buy Oppel products.⁷⁷

Two more examples illustrate how Oppel could also exploit its status as a Chinese company to win government contracts from municipal governments. In 1931, the Chinese newspaper *Shenbao* reported that previously the Shanghai's streetlamps had all been foreign-made. However, given that this caused "heavy losses of economic rights every year," Huang Boqiao, the head of the Public Utilities Department of the Shanghai Municipal Government, signed a contract with Oppel for the supply of all streetlamps of the city once the existing contract with foreign merchants expired in that year and the remainder of foreign lamps in the city's storage was used up. Besides the fact that Oppel was a Chinese firm, Huang had been impressed with Oppel's factory and the quality of their light bulbs, which could rival that of foreign producers. Given the continued high quality of Oppel lamps, the contract was extended in 1933.⁷⁸ Another similar example is that of the Nanjing municipal government. Despite being the capital of China since 1928, Nanjing at first only used bulbs manufactured by GE and other foreign brands for its street lighting. While Oppel pressed Nanjing's Public Utilities Department on why it did not use Chinese light bulbs, the company's efforts at first remained without success. Although Oppel guaranteed the high quality of their light bulbs, the municipal authorities stated their skepticism about the quality of the company's products as compared with foreign bulbs. Hu then drew on the help of groups in Shanghai that promoted national products and questioned Nanjing as to why it used GE bulbs, even though Oppel bulbs were of high quality, a lower price and were Chinese products. Oppel also continued to negotiate with the Public Utilities Department and eventually received orders for the supply of a significant

75. "Liang luju dinggou dapi Yapuer dianpao," *Shenbao* (October 21, 1935): 10. On the two railways having originally used foreign bulbs, see Hu, *Huiyilu*, 29. Hu does not give a date for the contract in his memoirs, but I have found no other instance of a contract between the two railways and Oppel.

76. "Shandongsheng zhengfu xunling" (July 13, 1936), *Shandongsheng zhengfu gongbao* no. 400 (1936): 29–30.

77. "Tongchi tichang gouyong Zhongguo Yapuer dianqichang chupin" (April 23, 1937), *Jiangsusheng zhengfu gongbao* no. 2568 (1937): 22–23.

78. Quote from "Gongyongju ludeng gaiyong Yapuer pao," *Shenbao* (May 15, 1931): 16; "Shi Gongjongju xiang Yapuer xuding ludeng hetong," *Shenbao* (August 19, 1933): 15.

part of the streetlamps of Nanjing.⁷⁹ By 1936, various municipal and provincial governments throughout China used Oppel lamps.⁸⁰

In sum, we thus see that the company could leverage the fact that its products were Chinese to win contracts for bulk sales to government institutions. This was a particularly potent means of marketing for light bulb manufacturers like Oppel as the government was one of the major purchasers of light bulbs in the Chinese market. Unfortunately, more detailed quantitative data on individual contracts of Oppel or other Chinese light bulb manufacturers with government agencies is not available. However, from the evidence in this section, we see that Oppel could employ a wide toolkit—ranging from direct petitions to using national products interest groups and the press—to make use of the rising tide of Chinese nationalism and the Nationalist government’s commitment to the support of national products to lobby and persuade Chinese government institutions, which were a major buyer in the light bulb market, to buy large amounts of Oppel-produced lamps. In other words, Oppel managed to translate the support for national products by the Nationalist’s uncertain developmental state into concrete sales. This contributed to the company’s success and helped it win over a share of the market in light bulbs from foreign producers.

Comparing Quality and Price

We have seen that using nationalist marketing in general was an important part of Oppel’s marketing strategy and that it in particular helped the company to win over government institutions as customers. However, we now also need to explore what other factors contributed to the ability of Oppel and other electric lamp manufacturers to compete and win market share from foreign products.

A closer look at Oppel’s advertisements reveals that while they often appealed to nationalist sentiments, they also stressed the quality of Oppel products. For example, the advertisement in [Figure 7](#) emphasizes not only that Oppel products are “national products” but also that they are “durable” and “save electricity.”⁸¹ Given that “Price and quality . . . challenged the supremacy of product-nationality” in China and that foreign products had the reputation of being of high quality,⁸² it is not surprising that Oppel would put forward the quality and price of its products to persuade consumers to purchase their products.

However, Hu himself also time and again stressed the importance of providing high-quality products at a low price. In his memoirs, he explained that “if you want to make national products successful, you first have to ensure that they are of good quality and low price. The reason Oppel light bulbs sold well at home and abroad mainly was due to their high quality and low price.” He continued that “signboards and trademarks only are the initial attraction [for products]. Their development and consolidation [in the market] are completely built on

79. Hu, *Huiyilu*, 54–55.

80. “Beipingshi caiyong Yapuer pao,” *Shenbao* (September 15, 1936): 14.

81. For a similar example, see the Oppel advertisement in *Jilian huikan* 138 (1936): 1.

82. Gerth concedes that a priori “It is safe to assume that consumers wanted to buy the least expensive and best-made goods.” Even nationalist students within the NPM called for the production of “cheap . . . and high-quality substitutes.” Gerth, *China Made*, 19, 154, 180, 355.

them being genuine products at a fair price.”⁸³ We can also find similar points made in Hu’s writings from the 1930s. In a 1934 newspaper article, Hu explained that the main problem of Chinese products was that manufacturers produced large quantities of goods but did not pay enough attention to quality.⁸⁴ A year later, in an article on sales strategies he penned for the publication of the Shanghai Association of Mechanized National Products Manufacturing Factories (Shanghai jizhi guohuo gongchang lianhehui), an association whose members will have needed to compete with foreign products, Hu also emphasized that “whether or not a product sells well is mainly decided by the special strength of its intrinsic quality and its low price.”⁸⁵ Thus, we can see that according to Hu himself, what was key for the success of his light bulbs was producing a high-quality product at a low price.

The importance of a good price–performance ratio as the key determinant for the success of Oppel and other Chinese light bulb manufacturers is also borne out by views from their foreign competitors. Culco was concerned about Chinese manufacturers of light bulbs not because of the nationalist marketing of these manufacturers but because of their growing number, their low price and the fact that “Some of them [including Oppel] were even capable of manufacturing light bulbs with the same quality as those of the Western firms.”⁸⁶ Further evidence of how crucial the production of high-quality bulbs was for Chinese electric lamp manufacturers is found in a report on the electrical appliances industries produced by the Chinese government in 1936. The report emphasized the importance of producing high-quality bulbs for competing with foreign-made bulbs. Moreover, it explained that a major problem caused by the dumping of low-quality bulbs by certain Chinese light bulb manufacturers was that quality amongst Chinese bulbs varied. Many customers could not differentiate between the bulbs of the various Chinese manufacturers and once they had by mistake bought a Chinese-made bulb of low quality, they lost faith in Chinese products as a whole and went back to buying foreign products. As a result, high-quality light bulbs made by Chinese manufacturers were also negatively influenced by the presence of low-quality Chinese products in the market.⁸⁷ The problem of many customers not being able to distinguish different Chinese-made bulbs aside, from this also follows that if a Chinese light bulb manufacturer wanted to succeed in competing with foreign products, it needed to provide high-quality products to buyers. The same report also emphasized the strong reputation foreign-made bulbs had with consumers.⁸⁸ Thus, it is understandable that Hu felt that in order to compete with foreign products, Chinese-made bulbs needed to not only be of high quality but also underbid foreign-made bulbs.⁸⁹

83. Hu, *Huiyilu*, 7.

84. Hu Xiyuan, “Guohuo yu guoqing,” *Libailiu* (October 10, 1934).

85. Hu Xiyuan, “Hupin tuixiao de jiqiao yu xiuyang,” *Jilian huikan* 112 (February 1, 1935): 12–13.

86. Van der Putten, *Corporate Behaviour*, 199–203. Van der Putten also notes that what further amplified the fact that these manufacturers produced lamps of quality similar to that of Western products was the fact that “Such good quality lamps were marketed in ways identical to those employed by Culco: they were branded and packed in individual cartons, presented in window displays, and advertised in newspapers.” In terms of Chinese nationalism, he does not mention it as an important consideration of Culco. On the unimportance of nationalism, also see note 62.

87. Quanguo jingji weiyuanhui, *Dianqi yongjuye baogaoshu*, 13–14.

88. Quanguo jingji weiyuanhui, *Dianqi yongjuye baogaoshu*, 14. The Nationalist government in general also stressed the importance of producing high-quality goods. See Gerth, *China Made*, 237, 252.

89. Gerth mentions how Hu was aware of the superior reputation of foreign products. Gerth, *China Made*, 183.

Having established the importance of producing high-quality, low-price bulbs for Oppel, I now examine whether Oppel lamps exhibited these traits. Besides Culco's acknowledgment of the quality of Oppel products just mentioned, further indicators of the quality of Oppel bulbs were their life span and luminous efficacy. According to a study published by the research institute of Shanghai's Jiaotong University in 1935, Oppel lamps had a life span of over one thousand hours and retained at least 80 percent of their candle power after this period.⁹⁰ In terms of the luminous efficacy of the lamps, if we take Oppel's 100 watts lamps as an example, two such lamps tested by Jiaotong University achieved 11.4 and 11.1 lumens per watt.⁹¹ Both of these indicators were comparable with international standards. First, for instance, GE lamps after 1911 showed a "750- to 1,000-hour average life."⁹² Indeed, the international Phoebus electric lamp cartel, which united all the major international light bulb manufacturers and of which Culco was a part, aimed to fix the life span of light bulbs at one thousand hours, even though longer life spans were technically possible.⁹³ Second, in terms of luminous efficacy, 100-Watt American GE light bulbs achieved 15.2 lumens per watt in 1935.⁹⁴ The difference in the lumens per watt measure might be explained by the different voltages used in China and the United States and the fact that it is unclear whether the lamps manufactured by CGE in Shanghai necessarily achieved the same lumens per watts ratings as those manufactured in the United States.⁹⁵ The fact that Oppel lamps achieved a luminous efficacy similar to that of Western lamps is also borne out by a study conducted by the Chinese government in August 1930 in Shanghai. As we can see in [Table 2](#), the vacuum bulbs manufactured by Oppel had the same candle power as those of Western lamps sold in China.⁹⁶ Thus, these comparisons confirm that Oppel bulbs were similar in quality to foreign light bulbs.

Having discussed the performance of Oppel bulbs, I now turn to their price. Drawing again on the government study (see [Table 2](#)), we see that Oppel bulbs had a clear advantage over their Western competitors as their normal sales price was around half of that of foreign bulbs. Japanese lamps show a price somewhat more comparable to Oppel lamps. However, Japanese merchants mainly seem to have sold light bulbs in China that were of low quality and low price at least until around 1930.⁹⁷ Moreover, as mentioned above, subsequently

90. "Jiaoda yanjiusuo zhengming Yapuer dengpao youdian," *Shenbao* (May 5, 1935): 13. The study can be found in Zhongguo Yapuer dianqichang, *Diandengpao*, appendix.

91. Zhongguo Yapuer dianqichang, *Diandengpao*, appendix, 5.

92. Bright, *Electric-Lamp Industry*, 332.

93. On Phoebus, see Krajewski, "Fehler-Planungen." On Culco being part of Phoebus, see Van der Putten, *Corporate Behaviour*, 198–201.

94. Bright, *Electric-Lamp Industry*, 331. Bright provides the initial lumens per watt for 100-watt tungsten filament lamps. The statistics provided by the report of Jiaotong University do simply give the lumens per watt, which must mean the initial lumens per watt though. According to Hu, Oppel also used tungsten filaments. See, Hu, *Huiyilu*, 9.

95. The Oppel lamps tested at the university used 220 volts. See Zhongguo Yapuer dianqichang, *Diandengpao*, appendix. Bright's data is for 115-volt lamps. Bright, *Electric-Lamp Industry*, 331.

96. Oppel also manufactured gas-filled bulbs. See "Shanghai diandengpao zhizaoye diaocha," 77. These were mass produced by Oppel as early as 1928. See Hu, *Huiyilu*, 13. However, in August 1930, when the survey was conducted by the Chinese government, they do not seem to have been available on the Shanghai market yet.

97. Hu Xiyuan, "Zhizao diandengpao de liangge zhongyao wenti," *Shangye zazhi* 4, no. 10 (1929): 1–5. On the low quality of Japanese bulbs sold in China, also see Miellmann, *Handelsbeziehungen*, 194. Unlike other

Table 2. Shanghai Light Bulb Prices in August 1930

Light Bulb				Price in Yuan (Per 100 Bulbs)		
Brand	Voltage	Candle Power/ Watts	Type of Light Bulb	Electrical Shops Buying Price	Wholesale Price at Electrical Shops	Ordinary Sales Price at Electrical Shops (Menshoujia)
General Electric	170–220V	10–50CP	Vacuum Bulb	30.24	33.6	40
	32–160V	10–50CP	Vacuum Bulb	27.98	31.08	37
	32–220V	40W	Gas-Filled Bulb	34.2	37.8	45
	32–220V	75W	Gas-Filled Bulb	52.92	58.8	70
	32–220V	100W	Gas-Filled Bulb	60.48	67.2	80
Osram and Philips	170–220V	10–50CP	Vacuum Bulb	36.8	40	45
	32–160V	10–50CP	Vacuum Bulb	34.04	37	40
	32–220V	40W	Gas-Filled Bulb	41.4	45	50
	32–220V	75W	Gas-Filled Bulb	64.4	70	80
	32–220V	100W	Gas-Filled Bulb	73.6	80	90
Oppel	170–220V	10–50CP	Vacuum Bulb	17	18.5	20
	32–160V	10–50CP	Vacuum Bulb	16	17	19
			Gas-Filled Bulb		Not Yet Sold on the Market	
Various Japanese Brands	170–220V	10–50CP	Vacuum Bulb	18	20	25
	32–160V	10–50CP	Vacuum Bulb	17	18	20
			Gas-Filled Bulb		Market Price not Uniform	

Source: “Choubei diandengpao zhizaochang jingguo baogao” (without date), 96 (143), 23-22-008-02, Archives of the Institute of Modern History, Academia Sinica, Taipei.

they were negatively impacted by anti-Japanese sentiment and tariffs. What is also noteworthy is the significant mark-up of GE lamps by electrical shops in Shanghai, suggesting that there certainly were buyers willing to pay a premium for foreign-brand lamps.⁹⁸ Table 3 shows selected prices for high-quality Chinese bulbs and bulbs of Culco published in the government report from 1936 mentioned above. While the table does not provide specific data on Oppel lamps, we still see that Chinese manufacturers in relation to the price of light bulbs managed to maintain their edge over Western manufacturers. These price charts and the foregoing discussion on the quality of Oppel lamps, shows that in terms of the price–performance ratio, Oppel possessed a significant competitive

Japanese bulbs sold in China, Tokyo Electric Co. bulbs seem to have been of a higher quality. See Lundquist, *Electrical Goods*, 66. However, they were also bound to a high price because of their membership in Phoebus and were excluded from much of the Chinese market (see note 57). This geographical limitation and the low price for Japanese bulbs given in Table 2 suggest that Tokyo Electric Co. lamps were not included in the government study.

98. This kind of “two-tier economy” between foreign and Chinese products was a more general phenomenon of the Chinese consumer market. See Dikötter, *Things Modern*, 44–47. As Dikötter shows, this two-tier economy was often marked by a contrast between expensive high-quality imports and cheap low-quality Chinese imitations. Rawski mentions the attractiveness of low-quality low-price products for the case of the matches industry. See Rawski, *Economic Growth*, 113. Contradictorily, Gerth asserts that imports were often the products with the lowest price. Gerth, *China Made*, 19. In any case, with Oppel, we see a Chinese company aiming at and succeeding in producing commodities comparable to foreign goods in terms of quality at a lower price.

Table 3. Prices of Light Bulbs, Culco and Highest-Quality Chinese Bulbs, in Yuan, 1936

	Price Per 100 Vacuum Bulbs	Price Per 100 Gas-Filled Bulbs, 40 Watts
Highest-quality Chinese bulbs	28.5	47.5
Culco bulbs	40	55

Note: The data represents the average of the prices given for different kinds of vacuum and gas-filled bulbs.

Source: Author's compilation based on *Quanguo jingji weiyuanhui*, *Dianqi yongjuye baogaoshu*, 9–12.

advantage over Western light bulbs sold in China. More broadly, this also explains how Oppel and other Chinese light bulb manufacturers took over market share from foreign producers.

Managing Quality and Price

How did Oppel produce such high-quality lamps at a comparatively low price? Here, China's specific intellectual property environment regarding patents is of key importance. To appreciate this, it is useful to briefly review the role patents and foreign investment played in the nascent Japanese light bulb industry. Following the introduction of a Western-inspired domestic patent system in the 1880s and the signing of the Paris Convention for the Protection of Industrial Property in 1899, both Japanese citizens and foreigners could register patents and enjoyed patent protection in Japan. Subsequently, GE acquired a majority stake in the Japanese light bulb manufacturer Tokyo Electric and provided it with light bulb technology and the exclusive right to GE patents in Japan. Using Tokyo Electric and its patents (including patent litigation), GE eliminated many Japanese competitors and maintained control over the Japanese light bulb market into the 1930s.⁹⁹ Following the GE takeover, Tokyo Electric, relying on GE's patents, expertise, and technical support, including GE personnel and machinery, was able to quickly transfer technology and modernize its factory. At the same time, Uchida has argued that:

Before [the granting of patent protection to foreigners], Japanese manufacturers were free to copy any imported goods; but under the new Patent Law, foreign patent rights became one of the greatest obstacles to development in the electrical equipment and chemical industries, because technological progress was quickest in these sectors, and without a patented Western technology, scarcely any advancement was possible. The entrepreneurs were apt to rely on licensed technology from the Western patentees, thus stunting the development of the home industries.¹⁰⁰

99. Donzé, "Global Flow of Technologies," 193–95; Nishimura, "American Patent Management"; Nishimura, "International Patent Management"; Uchida, "Big Business"; Heath, "Patent Law," 423–426.

100. Uchida, "Big Business," quote on 148.

In early twentieth-century China, the intellectual property environment was markedly different from Japan's. Before 1937, little effective protection of patents existed in China. In 1903, a Sino-American treaty promised that China would venture to grant some patent protection to American citizens, but without setting a date from which such protection would commence. Subsequently, legislation introduced in 1912 and 1932 even in theory protected only inventions of Chinese citizens but, in any case, was not effectively implemented and enforced.¹⁰¹ Indeed, in 1924, Norwood F. Allman, an American lawyer who had worked at Shanghai's Mixed Court, lamented that "there is now widespread unauthorized reproduction in China of foreign patented articles. . . . So far there has been no successful prosecution of Chinese or of other persons subject to Chinese jurisdiction. . . . There is little hope of any successful prosecution under present conditions, since no foreigners have been granted patent rights."¹⁰² Similarly, Paul Kops, another American lawyer practicing in Shanghai, explained in 1937 that "up until the present time no adequate legislation has been passed in the matter [of trademarks and patents]." Regarding patents, he added that Chinese law only allowed foreigners to "take out certificates on invention, and yet this offers no protection."¹⁰³ However, while this state of affairs might have been problematic for foreign businesses holding patents, it made things much easier for Chinese businesses wanting to cut into markets occupied by foreign products.¹⁰⁴ It might be argued that technology transfer—which can be defined as "the transfer of knowledge, usually embodied in men or machines"¹⁰⁵—would have been even more rapid through joint ventures similar to Tokyo Electric. Yet Oppel was able to

101. Alford, *To Steal a Book*, Chapter 3. Alford seems to suggest that some twenty years after the 1903 Sino-American treaty, "foreigners received . . . nominal protection" for patents, but it is unclear what law he refers to and both Alford and, as discussed below, contemporary sources clearly stress the lack of legal protection for foreign patents. China joined the Paris Convention for the Protection of Industrial Property only in 1985. See "Paris Convention for the Protection of Industrial Property."

102. Allman, *Handbook*, 96–97. While citizens of foreign treaty powers enjoyed extraterritoriality in China and Shanghai's International Settlement was under foreign control, the International Settlement's Chinese inhabitants as defendants remained under the jurisdiction of Chinese courts and the Mixed Court, which was charged with cases involving foreign plaintiffs and Chinese defendants and where trials were run jointly by Chinese magistrates and foreign assessors, applied "mainly the Chinese laws, ordinances, rules and regulations in force in Chinese courts." See Commission on Extra-territoriality in China, *Report*, quote on 20. Also see Kotenev, *Mixed*, 292. On the general principle in Sino-foreign cases "that the plaintiff follows the defendant into the court of the latter's nation," see Koo, *Status of Aliens*, 179. There is no evidence that the Mixed Court ever dealt with patents. See, for instance, the tabulation of criminal cases of the Court between 1912 and 1924 (which lists trademark infringement but makes no mention of patents) in Kotenev, *Mixed*, 314–316. The local byelaws on the running of the settlement also did not mention patents. See Kotenev, *Mixed Court*, 566–575. The Mixed Court was replaced first in 1927 by a new Provisional Court under the Jiangsu provincial government and then in 1930 by two Chinese courts under the Chinese central government. The role of foreign representatives in trials was first strictly curtailed in 1927 and then ended in 1930. These courts applied Chinese law to cases with Chinese defendants. See Wakeman, *Shanghai*, 70–72, 341n82; "New Provisional Court Agreement," *North-China Herald* (February 25, 1930); "Rendition Agreement On Courts Extended," *The China Press* (April 2, 1936); Millard, *Extraterritoriality*, 138–41, 180–84, 191, 251–257; Pollard, *Foreign Relations*, 381–382.

103. "Patent Laws Discussed by Paul Kops," *The China Press* (April 16, 1937). On Kops, see "Kops Takes Position with Allman Company," *The China Press* (December 2, 1933).

104. On the lack of patent protection in China, the awareness of foreign merchants of this problem, and the ease with which Chinese firms could consequently copy products like light bulbs, also see Mielmann, *Händlerbeziehungen*, 206–208, 251.

105. Brown, "Transfer of Technology," 181. On the importance of persons and machinery for technology transfer, also see Donzé and Nishimura, "Introduction."

transfer technology by relying on imported human capital and machinery, and, as we have seen, produce light bulbs that were similar in quality to foreign products.¹⁰⁶ Importantly, Oppel and other light bulb manufacturers did not need to worry about litigation foreign patentholders might bring against them.

Regarding human capital, Hu relied much on foreign or foreign-trained staff. While Hu himself had not been trained abroad, his earliest collaborators in manufacturing light bulbs, Zhou Zhilian and Zhong Xunzhen, studied in Germany and Japan, respectively. We also saw that it seems to have been his acquaintance and collaboration with Opel, the German engineer and light bulb specialist, that marked an early turning point in Hu's endeavor to establish a successful light bulb factory. Hu continued to rely on foreign-trained staff. In 1927, Hu hired Feng Jiajing, who had graduated from Jiaotong University in Shanghai with a degree in electrical machinery (*dianji zhuanke*). Due to his interest in light bulbs, Feng had studied in the United States for a period and had interned at GE. Feng helped improve Oppel's products and stayed at the company, first as deputy engineer (*fugongchengshi*) and then as full engineer until 1936.¹⁰⁷ Hu also employed foreign specialists in his factory. Following some of the difficulties Hu had encountered when first trying to manufacture light bulbs, he "not only hired several Chinese specialists as consultants, but also employed Germans and Japanese as engineers and technicians in the technical department (*jishubu*)."¹⁰⁸ We thus can see that foreign knowledge acquired by hiring foreign or foreign-trained staff here played an important role in the transfer of technology. This will have been key in enabling Oppel to produce high-quality lamps.

Second, complementing its foreign and foreign-trained staff, Hu also transferred technology through the extensive use of foreign-made machinery. For example, when Oppel first tried to manufacture gas-filled light bulbs, the firm purchased necessary machinery from abroad.¹⁰⁹ According to a report from 1929, in that year Oppel purchased new machinery from Germany to improve its production.¹¹⁰ In 1933, Oppel purchased the newest testing device (*yanguangji*) from the United States to test and ensure the quality of its light bulbs before they left the factory as the previous one had been insufficient. It was the first of its kind imported into China.¹¹¹

106. Conversely, for the Japanese electrical appliances industry, Donzé highlights that Japanese firms initially had difficulties competing with foreign-made products in price and quality but later cooperated with foreign firms "to acquire the necessary technological know-how to develop a domestic industry." He contrasts this with the Japanese consumer goods industry, where the "traditional mode of copying and adaptation, without the consent of the relevant Western firms" remained dominant. See Donzé, "Global Flow of Technologies," quotes from 200.

107. "Feng Chia Tseng, Chekiang," *Jiaotong Daxue Shanghai xuexiao bingyinji jniance* (May 1922): 63; Hu, "Diandengpao changshi (shang)": 14; Shuo, "Guohuo dengpao zhi shouchuangzhe," *Shanghaishi zhi guohuo shiye*, 56; Hu, *Huiyilu*, 72, 80. In his hagiography, Sun not only like Hu mentions the contribution of new machinery and foreign and foreign-trained staff to the process of improving Oppel products (see note 114), but particularly stresses the contribution of Feng and his background with GE to the development of a particular light bulb type, but it is unclear what source (either in Hu's writing or elsewhere) this specific assertion is based on. See Sun, "Hu Xiyuan jiqi Yapuer," 7, 9–10, 12–13.

108. Hu, *Huiyilu*, 4.

109. Hu, *Huiyilu*, 12.

110. "Yapuer dianpao changxiao nanyang," *Shenbao* (March 30, 1929).

111. "Yapuer dao zuixin yanguangji," *Shenbao* (July 21, 1933): 12.

In October 1933, the complete equipment of Oppel's light bulb factory was renewed.¹¹² Given its previous usage of foreign machinery, much of this renewal must have also consisted of foreign machines. In 1936, Oppel purchased from Germany a set of state-of-the-art machinery for manufacturing a specific type of light bulb.¹¹³ Thus, besides its staff, Hu also transferred technology for manufacturing high-quality light bulbs through the purchase of foreign machines.¹¹⁴

Turning now to the low price of Oppel bulbs as compared to foreign bulbs, it can be traced mainly to two factors: royalties and distribution. First, a major reason why the price of lamps of the major Western producers was so much higher than those of Oppel were the royalties that Culco had to pay to GE, Osram, and Philips for the use of these companies' trademarks. For example, in 1933, Culco had to pay 0.05 Yuan per bulb to its parent companies, which came to 5 Yuan per one hundred bulbs.¹¹⁵ This was a substantial amount when compared to the total price of Culco bulbs in Table 3. As Van der Putten has shown, these high royalties (and correspondingly low-set dividends) were simply a way for the parent companies to evade taxes they would have needed to pay if they had remitted these profits from Culco as dividends and not as royalties.¹¹⁶ Thus, had the parent companies been willing to reduce their profits from their sales in China, a substantial reduction of the price would have been possible. There is less known about the relationship between CGE and GE before 1932, but it is likely that CGE had to pay GE similar royalties or dividends, which would then partly explain the high prices of GE lamps before 1932 as well.

With regards to possible royalty payments, the absence of an effective Western-style patent system in China also proved helpful to Chinese electric lamp manufacturers. Instead of having to pay royalty fees for patents to foreign patent holders like GE,¹¹⁷ Oppel and other Chinese light bulb manufacturers could transfer advanced technology cheaply while keeping the price of their bulbs low.

Besides the issue of royalties, weaknesses in the light bulb distribution networks of foreign manufacturers also seem to have increased prices. While some foreign companies in China in the 1920s and 1930s established their own distribution networks in the Chinese

112. Tōa dōbunkai kenkyū hensanbu, *Jitsugyōmeikan*, 845.

113. "Yapuer dianqichang xindao zuixinshi zhipaoji," *Shenbao* (August 2, 1936): 16.

114. Brandt, Ma, and Rawski note that such importation of foreign machinery and use of foreign and foreign-trained experts was widespread amongst Chinese firms. Brandt, Ma, and Rawski, "Industrialization," 207. Hu also seems to suggest that new machinery and foreign and foreign-trained staff helped the process of lowering production costs in the beginning and improving his product's quality so that they could compete with foreign products. See Hu, *Huiyilu*, 4–6, 79–81, 108. The success in transferring technological knowledge (though without reference to the intellectual property environment) through foreign and foreign trained personnel and foreign machinery is also briefly mentioned in Huang, *Dianqi zhaoming*, 57, 68.

115. Van der Putten, *Corporate Behaviour*, 201, 205–206. In 1935 the Hungarian Vereinigte Glühlampen also joined Culco with a minor stake of 7.5 percent, meaning that its lamps were also marketed and royalties paid to it by the company. Van der Putten, *Corporate Behaviour*, 201, 205.

116. Van der Putten, *Corporate Behaviour*, 205–206.

117. On royalty fees charged by GE (in the US market and within the Phoebus cartel), see Reich, "World Cartelization." An international example of such fees outside of Phoebus is Japan. When Tokyo Electric extended the use of its patents to twelve other Japanese manufacturers, it was to receive 275,000 Yen in compensation over a ten-year period. See Nishimura, "American Patent Management," 73.

interior,¹¹⁸ foreign light bulb manufacturers mainly distributed their products through foreign firms in China that acted as their agents.¹¹⁹ This use of foreign agents necessarily added another intermediary and layer of costs to the sales mechanism. For instance, as early as 1927, Osram complained that its agents in the smaller Chinese ports could mark up the price for its light bulbs by up to 17.5 percent.¹²⁰ As mentioned above, in 1932, Osram, Philips, and CGE established Culco to reduce the prices of their light bulbs. Specifically, they were hoping to accomplish this by “abolishing their respective sales organizations in China and consolidating the sale of all lamps ... under a centralized management and control.”¹²¹ Nevertheless, each brand retained its own network of agents. It was only when this measure proved ineffective in combating the Chinese competition that Culco in the years immediately preceding the outbreak of the Sino-Japanese War drastically reduced the number of its foreign agents, started direct distribution of bulbs in parts of southern China, more directly engaged with Chinese dealers, and invited Chinese investment to be better connected with Chinese sales networks.¹²²

In contrast, from the start, Hu built a sophisticated network of sales offices and distributors and sought very close relations with Chinese vendors. When he registered Opiel with the government in 1928, the company already operated its own distribution offices in Shanghai and Ningbo. Later, additional distribution offices were established in several other major cities, such as Guangzhou and Tianjin. In addition, from the early 1920s, Hu also entered into special distribution agreements with local Chinese electrical materials vendors in various major cities in Jiangsu, Zhejiang, Anhui, Jiangxi, and other provinces. Altogether, Opiel thus managed to establish a wide distribution network for its products.¹²³ Compared with Culco, Hu was able to engage with the Chinese market more directly and thus save expenses.¹²⁴

Conclusion

This article has traced the development of Opiel Electric Manufacturing Co. Ltd. during the 1920s and 1930s, and explained how Opiel managed to successfully adopt a recently introduced technology and grow into a large manufacturing company. More broadly, we have seen how the Chinese electric lamp industry grew rapidly in the pre-war period and managed to win over significant shares of a market formerly occupied by foreign products. Taking Opiel as an example, this article has shown that while nationalist marketing played a role in its overall marketing strategy, the main advantage from branding itself as a Chinese firm was that

118. As Osterhammel explains, such foreign distribution networks in the Chinese interior only existed in a limited areas of business, namely oil, paint, sugar, tires, fertilizer, and cigarettes. See Osterhammel, *Britischer Imperialismus*, 143–144.

119. Van der Putten, *Corporate Behaviour*, 196, 201.

120. Jensen to Fletcher (May 10, 1927), A Rep. 231, 1028, Landesarchiv Berlin.

121. “Agreement” (January 1, 1932), A Rep. 231, 388, Landesarchiv Berlin.

122. Van der Putten, *Corporate Behaviour*, 201–04.

123. “1928 nian zhongguo yapuer qiye zhuce wenjian,” ZA, 319; “Yapuer fenfaxingsuo kaimu,” *Shenbao* (February 20, 1935); Hu, *Huiyilu*, 17–18; Hu, “Meng,” 186.

124. For a general discussion of sales networks of foreign and Chinese businesses in modern China, see Cochran, *Encountering Chinese Networks*.

Oppel was able to engage in nationalist lobbying and win over large government contracts. This was particularly useful in the light bulb market, where the government was a major purchaser of lamps. We have also seen that it were in fact the high quality of its light bulbs and their low price that mainly explain Oppel's success and ability to compete with foreign manufacturers. In turn, Oppel's ability to produce high-quality lamps at a low price was helped much by the absence of a functioning Western-style patent system in China. Finally, Oppel's superior distribution network allowed it to save costs as compared to its main foreign competitor.

The beginnings of China's light bulb industry presented in this article also furthers our understanding of China's early industrialization during the early twentieth century more generally. First, overall, the case of the light bulb industry confirms previous research that has argued that pragmatic factors, and not nationalist fervor, were the main determinant of the choices of modern Chinese consumers. Even so, and despite the inconsistencies in Nationalist economic policy that previous literature has noted, in industries where the government was a major purchaser in the market, firms like Oppel could use nationalist lobbying to win government contracts and capture parts of the market. Such nationalist lobbying thus contributed to the overall competitiveness of Chinese industrial businesses vis-à-vis foreign products and firms. This is particularly remarkable given that scholarship on government-business relations in Republican China has typically highlighted the weakness of business elites toward the government.¹²⁵

Second, while the scholarly literature has noted the importance of global technology flows for China's early industrialization before, this article highlights how China's specific intellectual property environment—specifically the absence of a functioning Western-style patent system—made it possible for Chinese entrepreneurs to easily take advantage of global flows of technical knowledge and cheaply transfer Western technology without needing to cooperate with foreign firms or pay high licensing fees. While direct Sino-foreign cooperation under the umbrella of a functioning Western-style patent system might have led to more rapid technology transfer, the case study presented in this article shows that Chinese firms nevertheless were able to transfer technology efficiently and reach Western standards of product quality. Moreover, as the example of GE's long-term dominance in Japan's light bulb industry suggests, it is questionable whether under a functioning Western-style patent system domestic Chinese-owned firms could have played the leading role in the rapid industrial growth of early twentieth-century China that scholars have highlighted.

Finally, while there are comparative studies of IPR regimes and their impact on economic development for Europe,¹²⁶ we still lack such a comparison for East Asian economies. The fact that the Chinese light bulb industry showed significant development during the prewar period although, unlike Japan, it lacked an effective Western-style patent system, combined with scholarship by economic historians that has shown Chinese industrial growth between 1912 and 1936 to exceed that of Japan,¹²⁷ suggests that more in-depth comparative research on the

125. See, for instance, Coble, *Shanghai Capitalists*.

126. Schiff, *Industrialization*.

127. Brandt, Ma, and Rawski, "Industrialization," 198 and 203. They base their assessment on industrial output growth data.

connection between IPR and economic development would help our understanding of early industrialization in East Asia.

For a bibliography of sources in Chinese and Japanese with Chinese and Japanese characters and English translation of titles, please see the online appendix.

GHASSAN MOAZZIN is assistant professor at the Hong Kong Institute for the Humanities and Social Sciences and the Department of History (School of Humanities) at the University of Hong Kong. Contact information: Hong Kong Institute for the Humanities and Social Sciences, Office 110, May Hall, University of Hong Kong, Pok Fu Lam Road, Hong Kong. E-mail: gmoazzin@hku.hk

Acknowledgments

The author would like to thank the panelists and audiences at the Business History Society of Japan Annual Conference 2020 (particularly Pierre-Yves Donzé for bringing the case of GE in Japan and the Japanese light bulb industry to the author's attention) the Business History Conference Annual Meeting 2021 and the 2nd World Congress of Business History for their feedback. He would also like to thank the two anonymous reviewers and Koji Hirata and Zhaojin Zeng for their comments on previous drafts of the paper; and Andrew Popp for his guidance throughout the publication process. He is also grateful to Lila Stromer for her help with copyediting. The author acknowledges financial support from a Sin Wai-Kin Fellowship at the Hong Kong Institute for the Humanities and Social Sciences and from an Early Career Scheme grant (27601920) from the Research Grants Council of Hong Kong.

Supplementary Materials

To view supplementary material for this article, please visit <http://doi.org/10.1017/eso.2022.34>.

Bibliography of Works Cited

Books

- Alford, William P. *To Steal a Book Is an Elegant Offense: Intellectual Property Law in Chinese Civilization*. Stanford, CA: Stanford University Press, 1995.
- Allman, Norwood F. *Handbook on the Protection of Trade-Marks, Patents, Copyrights, and Trade-Names in China*. Shanghai: Kelly & Walsh, 1924.
- Bergère, Marie-Claire. *The Golden Age of the Chinese Bourgeoisie 1911–1937*. Trans. Janet Lloyd. Cambridge: Cambridge University Press, 1989.
- Bright, Arthur. *The Electric-Lamp Industry: Technological Change and Economic Development from 1800 to 1947*. London: Macmillan Company, 1949.
- Byatt, Ian. *The British Electrical Industry, 1875–1914: The Economic Returns to a New Technology*. Oxford: Clarendon Press, 1979.
- Cheng, Yu-Kwei. *Foreign Trade and Industrial Development of China: An Historical and Integrated Analysis through 1948*. Washington, DC: University Press of Washington, 1956.
- Coble, Parks. *The Shanghai Capitalists and the Nationalist Government, 1927–1937*. Cambridge, MA: Harvard Asia Center, 1980.

- Cochran, Sherman. *Big Business in China: Sino–Foreign Rivalry in the Cigarette Industry, 1890–1930*. Cambridge, MA: Harvard University Press, 1980.
- . *Encountering Chinese Networks: Western, Japanese, and Chinese Corporations in China, 1880–1937*. Berkeley: University of California Press, 2000.
- Dikötter, Frank. *Things Modern: Material Culture and Everyday Life in China*. London: Hurst, 2007.
- Ferguson, Charles. *Andersen, Meyer & Company Limited of China: Its History, Its Organization Today, Historical and Descriptive Sketches Contributed by Some of the Manufacturers It Represents*. Shanghai: Kelly and Walsh, 1931.
- Gerth, Karl. *China Made: Consumer Culture and the Creation of the Nation*. Cambridge MA: Harvard University Press, 2004.
- Han Tiau-w Tjong, *De Industrialisatie Van China*. Nijhoff, 1922.
- Hao, Yanping. *The Comprador in Nineteenth Century China: Bridge between East and West*, Cambridge: Cambridge University Press, 1970.
- Hu Xiyuan, *Zhuyi shanghai wangshi qianchen: Hu Xiyuan huiyilu*. Beijing: Zhongguo wenshi chubanshe, 2015.
- Kankō Nihon Shōkō Kaigisho. *Kankō keizai jijō: dai issū*. Hankou: Kankō Nihon Shōkō Kaigisho, 1936.
- Kaufer, Erich. *The Economics of the Patent System*. Chur: Harwood Academic Publishers, 1989, reprint, Abingdon: Routledge, 2011.
- Koo, Vi Kyuin Wellington. *The Status of Aliens in China*. New York: Longmans, Green & Co, 1912.
- Kotenev, A.M. *Shanghai: Its Mixed Court and Council*. Shanghai: North-China Daily News & Herald, 1925.
- Lean, Eugenia. *Vernacular Industrialism in China: Local Innovation and Translated Technologies in the Making of a Cosmetics Empire, 1900–1940*. New York: Columbia University Press, 2020.
- Lundquist, Ruben. *Electrical Goods in China, Japan, and Vladivostok*. Washington, DC: Government Printing Office, 1918.
- Mielmann, Peter. *Deutsch-chinesische Handelsbeziehungen am Beispiel der Elektro-industrie, 1870–1949*. Frankfurt: Peter Lang, 1984.
- Millard, Thomas. *The End of Extraterritoriality in China*. Shanghai: A.B.C. Press, 1931.
- North-China Daily News & Herald. *Map of Shanghai*. Shanghai: North-China Daily News & Herald, 1933.
- Osterhammel, Jürgen. *Britischer Imperialismus im Fernen Osten. Strukturen der Durchdringung und einheimischer Widerstand auf dem chinesischen Markt, 1932–1937*. Bochum: Brockmeyer, 1983.
- Ou Baosan, Wang Fusun, Zhang Jihong, Ma Liyuan, Nan Zhongwan, Bei Youlin. *Zhongguo guomin suode 1933 nian, shangce*. Shanghai: Zhonghua shuju, 1947.
- Penrose, Edith Tilton. *The Economics of the International Patent System*. Westport, CT: Greenwood Press, 1951.
- Pollard, Robert T. *China's Foreign Relations 1917–1931*. New York: Macmillan, 1933.
- Rawski, Thomas G. *China's Transition to Industrialism: Producer Goods and Economic Development in the Twentieth Century*. Ann Arbor: The University of Michigan Press, 1980.
- . *Economic Growth in Prewar China*. Berkeley: University of California Press, 1989.
- Schiff, Eric. *Industrialization without National Patents: The Netherlands, 1869–1912, Switzerland, 1850–1907*. Princeton, NJ: Princeton University Press, 1971.
- Sheehan, Brett. *Industrial Eden: A Chinese Capitalist Vision*. Cambridge, MA: Harvard University Press, 2015.
- Sun Shangren (comp.) *Zhongguo aidisheng: Hu Xiyuan yu Zhongguo Yapuer dengpao (qiye) shiliao*. Beijing: Zhongguo wenshi chubanshe, 2011.
- Tan, Ying Jia. *Recharging China in War and Revolution, 1882–1955*. Ithaca, NY: Cornell University Press, 2021.

- Teishinshō Rinji Chōsakyoku. *Shina ni okeru denki yōhin shijō chōsa hōkokusho*. Tokyo: Teishinshō Rinji Chōsakyoku Denkibu, 1917.
- Tōa dōbunkai kenkyū hensanbu, *Chūkaminokoku jitsugyōmeikan*. Shanghai: Tōa dōbunkai kenkyū hensanbu, 1934.
- Wakeman, Frederic. *Policing Shanghai 1927–1937*. Berkeley: University of California Press, 1995.
- Wang Fei-Hsien. *Pirates and Publishers: A Social History of Copyright in Modern China*. Princeton, NJ: Princeton University Press, 2019.
- Zhang Houquan. *Zhaoshangju shi: Jindai bufen*, 2nd ed. Beijing: Zhongguo shehui kexue chubanshe, 2007.
- Zhongguo Yapuer dianqichang. *Diandengpao*. Shanghai: Zhongguo Yapuer dianqichang, 1937.
- Zhongguo Zhengxin suo. *Shanghai gongshangye huibian*. Shanghai: Zhongguo Zhengxin suo, 1937.
- Zhongguo dianqi gongye fazhan shi bianji weiyuanhui. *Zhongguo dianqi gongye fazhan shi: zonghe juan*. Beijing: Jixie gongye Chubanshe, 1989.
- . *Zhongguo dianqi gongye fazhan shi: zhuan yue juan yi*. Beijing: Jixie gongye chubanshe, 1989.
- . *Zhongguo dianqi gongye fazhan shi: zhuan yue juan er*. Beijing: Jixie gongye chubanshe, 1990.
- . *Zhongguo dianqi gongye fazhan shi: zhuan yue juan san*. Beijing: Jixie gongye chubanshe, 1990.
- . *Zhongguo dianqi gongye fazhan shi: xuji*. Beijing: Jixie gongye Chubanshe, 1995.

Articles, Chapters in Books, Dissertations

- Brandt, Loren, Debin Ma, and Thomas G. Rawski. “Industrialization in China.” In *The Spread of Modern Industry to the Periphery since 1871*, edited by Kevin Hjortshøj O’Rourke and Jeffrey Gale Williamson, 197–228. Oxford: Oxford University Press, 2017.
- Brown, Shannon R. “The Transfer of Technology to China in the Nineteenth Century: The Role of Direct Foreign Investment.” *Journal of Economic History* 39, no. 1 (1979): 181–197.
- Clark, E. L. “Electrical Development in China.” *Journal of the Association of Chinese & American Engineers* 3, no.10 (1922): 13–17.
- Donzé, Pierre-Yves. “The International Patent System and the Global Flow of Technologies: The Case of Japan, 1880–1930.” In *The Foundations of Worldwide Economic Integration: Power, Institutions, and Global Markets, 1850–1930*, edited by C. Dejung and Niels P. Petersson, 179–202. Cambridge: Cambridge University Press, 2013.
- Donzé and Nishimura. “Introduction.” In *Organizing Global Technology Flows: Institutions, Actors, and Processes*, edited by Pierre-Yves Donzé and Shigehiro Nishimura, 1–14. London: Routledge, 2014.
- Heath, Christopher. “Patent Law.” In *History of Law in Japan Since 1868*, edited by Wilhelm Röhl, 423–442. Leiden: Brill, 2005.
- Hu Xiyuan. “Guohuo dengpao Yapuer zhi meng.” In *Zhongguo jindai guohuo yundong*, edited by Pan Junxiang, 178–187. Beijing: Zhongguo wenshi chubanshe, 1996.
- Huang Xing. *Dianqi zhaoming jishu zai Zhongguo de Chuanbo, yingyong he fazhan (1879–1936)*. MA thesis, Inner Mongolia Normal University, 2009.
- Kikuchi Yoshihiko. “Dai ichi ji taisenki no sekai denkyū shijō to nippon no denkyū sangyō.” *Kenkyū nenpō keizaigaku* 75, no. 3/4 (2017): 93–121.
- Krajewski, Markus. “Fehler-Planungen: Zur Geschichte und Theorie der industriellen Obsoleszenz.” *Technikgeschichte* 81, no. 1 (2014): 91–114.
- Kranakis, Eda. “Patents and Power: European Patent-System Integration in the Context of Globalization.” *Technology and Culture* 48, no. 4 (2007): 689–728.
- Lean, Eugenia. “Making the Chinese Copycat: Trademarks and Recipes in Early Twentieth-Century Global Science and Capitalism.” *Osiris* 33 (2018): 271–293.

- Maskus, Keith E. "Incorporating a Globalized Intellectual Property Rights Regime into an Economic Development Strategy." In *Intellectual Property, Growth and Trade*, edited by Keith E. Maskus, 497–524. Amsterdam: Elsevier, 2008.
- Nakajima, Chieko. "'Healthful Goods': Health, Hygiene, and Commercial Culture In Early Twentieth-Century Shanghai." *Twentieth Century China* 37, no. 3 (2012): 250–274.
- Nishimura Shigehiro. "The Adoption of American Patent Management in Japan: The Case of General Electric." In *Organizing Global Technology Flows: Institutions, Actors, and Processes*, edited by Pierre-Yves Donzé and Shigehiro Nishimura, 60–79. London: Routledge, 2014.
- . "General Electric's International Patent Management before World War II: The 'Proxy Application' Contract and the Organizational Capability of Tokyo Electric." *Japanese Research in Business History* 21 (2004): 101–125.
- Reich, Leonhard. "General Electric and the World Cartelization of Electric Lamps." In *International Cartels in Business History*, edited by Akira Kudo and Terushi Hara, 213–228. Tokyo: University of Tokyo Press, 1992.
- Sun Shangen. "Hu Xiyuan ji qi Yapuer." In *Zhongguo aidisheng: Hu Xiyuan yu Zhongguo Yapuer dengpao (qiye) shiliao*, comp. Sun Shangen, 3–70. Beijing: Zhongguo wenshi chubanshe, 2011.
- Uchida Hoshimi. "Western Big Business and the Adoption of New Technology in Japan: The Electrical Equipment and Chemical Industries 1890–1920." In *Development and Diffusion of Technology: Electrical and Chemical Industries*, edited by Akio Okochi and Hoshimi Uchida, 145–172. Tokyo: University of Tokyo Press, 1980.
- Van der Putten, Frans-Paul. *Corporate Behaviour and Political Risk: Dutch Companies in China, 1903–1941*. PhD diss, Leiden, 2001.
- Xia Chenxiao. "Foreign Direct Investment in China's Electrification: Between Colonialism and Nationalism, 1882–1952." *Enterprise & Society* 22 (2021): 1–43
- Wang Hsien-chun. "Revisiting the Niuzhuang Oil Mill (1868–1870): Transferring Western Technology into China." *Enterprise & Society* 14 (2013): 749–768.
- Wright, Tim. "Electric Power Production in Pre-1937 China." *China Quarterly* 126 (June 1991): 356–363.

Newspapers and Magazines

Beiping shi shizheng gongbao
Caizheng rikan
Chinese Economic Bulletin
Chinese Economic Monthly
Gongshang banyuekan
Gongshang gongbao
Jiangxisheng zhengfu gongbao
Jiansheweyuanhui gongbao
Jiaotong Daxue Shanghai xuexiao bingyinji jiniance
Jiaoyu yu Zhiye
Jilian huikan
Libailiu
Muduo Zhoukan
North-China Herald
Qingxin yuekan
Shandongsheng zhengfu gongbao
Shangbiao Gongbao

Shanghaishi zhi guohuo shiye
Shangye yuebao
Shangye zazhi
Shenbao
Shibao
Shishi xinbao
The China Press
The Far-Eastern Review
Tuhua Chenbao
Xin Dianjie
Xinmin
Xinren zhoukan
Zhonghe dengpao yuekan

Government Papers

- Chinese Maritime Customs Service. *Decennial Reports on the Trade, Industries etc of the Ports Open to Foreign Commerce, and on the Condition and Development of the Treaty Port Provinces, 1912–1921. Volume II, southern and frontier ports (with appendix)*. Shanghai: Statistical Department of the Inspectorate General of Customs, 1924.
- . *Returns of Trade and Trade Reports*. Shanghai: Statistical Department of the Inspectorate General of Customs, 1900–1918.
- . *Foreign Trade of China*. Shanghai: Statistical Department of the Inspectorate General of Customs, 1920–1924.
- . *The Trade of China*. Shanghai: Statistical Department of the Inspectorate General of Customs, 1932–1937.
- Chinese Ministry of Information. *China Handbook 1937–1945*. London: Macmillan, 1947.
- Chūshi Kensetsu Shiryō Seibi Iinkai. *Denki yōgu kōgyō hōkokusho*. Shanghai: Chūshi Kensetsu Shiryō Seibi Jimusho, 1940.
- Commission on Extra-territoriality in China. *Report of the Commission on Extra-territoriality in China*. London: H.M. Stationery Office, 1926. Reprint, San Francisco: Chinese Materials Center, 1975).
- Jiansheweyuanhui dianqichu, *Yongdian bidu*. Nanjing: Jiansheweyuanhui tushuguan, without date.
- “Paris Convention for the Protection of Industrial Property.” <https://www.wipo.int/treaties/en/ip/paris>
- Quanguo jingji weiyuanhui. *Dianqi yongjuye baogaoshu*. Nanjing: Quanguo jingji weiyuanhui, 1936.

Archives

Archives of the Institute of Modern History, Academia Sinica, Taipei
 Landesarchiv, Berlin
 Shanghai Municipal Archives

Cite this article: Moazzin, Ghassan. “Electric Pioneers: Nationalist Lobbying, Technology Transfer, and the Origins of the Chinese Electric Lamp Industry, 1921–1937.” *Enterprise & Society* 25, no. 1 (2024): 213–247.