Remeasuring China: the Global and Local Dimensions of Nanjing Metrological Reform (1927-1937)

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Abstract

This dissertation examines the history of meter, liter, and gram in republican China. It seeks to understand the historical transition of Chinese metrology from indigenous measures to the global metric system and its global entanglements. Nanjing's metrological reform in the 1930s was a result of historical precursors of the Beijing government period and the Late Qing. Chinese customary measures were stigmatized as chaotic and unscientific by foreign and domestic reformists at the time. Inspired by global trends of standardization since the late 19th century, the KMT government aimed to strengthen its monopoly on metrological affairs as an inroad to ensure the political unity of the new nation-state and to build a metricized modern regime of accuracy. The reform incurred complicated responses either from all echelons of society, ranging from small vendors, hawkers, housewives, commercial guilds, and local governments to scientists and other highly educated intellectuals. Out of drastically different motives and grounds, different social players chose to cooperate or resist the reform and developed their own ways to fly under the radar of state supervision.

While charting a local story, this dissertation also reveals the global dimension of China's metrological history. China's contested and pluralistic landscape of metrology coincided with the wider trans-Atlantic debate of metrication at the time. Metrology became a forum where new and old, global and local, universal and traditional were constantly debated. The desire to revive Chinese metrological tradition never died throughout Nanjing's reign, and some scholars even proposed to offer Chinese metrology to the world as an alternative to the metric system. The polemic eventually resulted in a public confrontation between the state and scientists in 1935.

Throughout the 1930s, Nanjing's ambition expanded from metrological unification to full standardization of cultural, agricultural, and industrial sectors, which were also inspired by the transnational condemnation of Chinese characteristics, circulating western sociological knowledge, and the European experience after WWI. Moreover, Nanjing's acceptance of the French metrological approach of building a nation-state via the unification of measures clashed with the Benthamite tradition of Shanghai's colonial powers who tended to have a non-intervention attitude toward measures. In sum, using measures as an analytical prism, this dissertation sheds light on various social, economic, and political ramifications brought by this hitherto neglected historical change.

Keywords: history of metrology, modern China, global history, metrication

Zusammenfassung

Diese Dissertation untersucht die Geschichte von Meter, Liter und Gramm im republikanischen China. Es versucht, den historischen Übergang der chinesischen Metrologie von einheimischen Maßen zum globalen metrischen System und seine globalen Verflechtungen zu verstehen. Die metrologische Reform in Nanjing in den 1930er Jahren war ein Ergebnis historischer Vorläufer der Pekinger Regierungszeit und des späten Qing. Chinesische Gewohnheitsmaßregeln wurden damals von ausländischen und einheimischen Reformisten als chaotisch und unwissenschaftlich gebrandmarkt. Inspiriert von globalen Standardisierungstrends seit dem späten 19. Jahrhundert wollte die KMT-Regierung ihr Monopol auf metrologische Angelegenheiten stärken, um die politische Einheit des neuen Nationalstaates zu gewährleisten und ein metrisches modernes Regime der Genauigkeit aufzubauen. Die Reform löste komplizierte Reaktionen aus allen Gesellschaftsschichten aus, von kleinen Verkäufern, Straßenhändlern, Hausfrauen, Handelszünften und Kommunalverwaltungen bis hin zu Wissenschaftlern und anderen hochgebildeten Intellektuellen. Aus unterschiedlichen Motiven und Gründen entschieden sich unterschiedliche gesellschaftliche Akteure für die Kooperation oder den Widerstand gegen die Reform und entwickelten ihre eigenen Wege, unter dem Radar der staatlichen Aufsicht zu fliegen.

Während diese Dissertation eine lokale Geschichte aufzeichnet, enthüllt sie auch die globale Dimension der metrologischen Geschichte Chinas. Chinas umkämpfte und pluralistische Landschaft der Metrologie fiel zu dieser Zeit mit der breiteren transatlantischen Debatte über Metrik zusammen. Die Metrologie wurde zu einem Forum, in dem Neues und Altes, Globales und Lokales, Universelles und Traditionelles ständig diskutiert wurden. Der Wunsch, die chinesische metrologische Tradition wiederzubeleben, erstarb während der Regierungszeit von Nanjing nie, und einige Gelehrte schlugen sogar vor, der Welt chinesische Metrologie als Alternative zum metrischen System anzubieten. Die Polemik führte schließlich 1935 zu einer öffentlichen Konfrontation zwischen dem Staat und Wissenschaftlern. In den 1930er Jahren weiteten sich Nanjings Ambitionen von der metrologischen Vereinheitlichung auf die vollständige Standardisierung der kulturellen, landwirtschaftlichen und industriellen Sektoren aus, die auch von der transnationalen Verurteilung chinesischer Merkmale inspiriert waren, zirkulierendes westliches soziologisches Wissen und die europäische Erfahrung nach dem Ersten Weltkrieg. Darüber hinaus kollidierte Nanjings Akzeptanz des französischen metrologischen Ansatzes, einen Nationalstaat durch die Vereinheitlichung von Maßnahmen aufzubauen, mit der benthamitischen Tradition der Kolonialmächte Shanghais, die dazu neigten, Maßnahmen nicht einzugreifen. Zusammenfassend beleuchtet diese Dissertation anhand von Maßen als analytisches Prisma die verschiedenen sozialen, wirtschaftlichen und politischen Auswirkungen dieses bisher vernachlässigten historischen Wandels.

Schlüsselwörter: Geschichte der Metrologie, modernes China, globale Geschichte, Metrik

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Introduction

Problematizing Measures

"The past is a foreign country." History provided a sense of novelty that distanced modern experience from that of our ancestors, as "they did things differently there." Nowadays, seldom do we notice the existence of measures or give them any intellectual attention. They are footnotes resting silently in the corners of a book, flickering readings of gas volume, or marks on food packaging guaranteeing the contents inside. Everything is unified and pre-calculated during production, and one would not bother to ask how heavy a piece of meat is or whether the weight is correct. Measures are taken for granted. However, for a person living in China during the late 19^{th} and early 20^{th} century, measures resembled a versatile aspect of life. Chinese households kept their steelyards as everyday essentials when visiting local markets. Customers had to argue with dealers and check the accuracy of measuring by themselves. Moreover, one had to be "fluent" in Chinese and foreign measures, and their conversion, as pounds were for milk, English foot for clothes, Sheng and Dou for rice, gallons for water and kerosene, centimeters for postcards and kilograms for train luggage. Nowadays, as measures are unified within the realms of the nation-state, the ability to navigate from one metrological system to another has disappeared. However, we seldom feel any nostalgia for this lost art of the past. Precision, interchangeability of goods, uniform global norms, and world knowledge in a consistent metrological format are exhorted as basic infrastructures for our modern world. They decidedly changed the milieu of humanity and our metrological mindset. For many, measures are practical tools to facilitate globalization and everyday life. They are facts without history, bearing no direct political or cultural meanings.

This dissertation tries to problematize measures as historical carriers of political, economic, and cultural struggles in modern China. China's metrological change is but one of many local ripples triggered by the global process of standardization since the 19th century. Before we delve into the details of China, it is essential to answer why metrology matters to humanity. Bruno Latour is one of the few theorists that pointed out the "framing effect" of metrology. Latour viewed society as a lab report of modern science, and metrology was the format of a piece of paper on which "the outside world" facts were translated with epistemic meanings. Sociality is bounded by a "metrological chain," a gigantic enterprise that gives stability to social facts. Without basic frameworks of time and space, one starts to be "uncertain," and "the only way to regain certainty is to get in touch again with the metrological chains."[1]

Latour gave a solid case to explain how different local frameworks of metrological knowledge worked before a universal metrological chain was invented. On 17 July 1787, the French statesman and adventurer, Lapérouse was on his way to an expedition around the world. However, the fleet could not locate Sakhalin and know for certain whether it was a peninsula or an island. Lapérouse nevertheless met several Chinese men on the beach. An older Chinese sketched on the sand the country of Manchuria and his island, then he indicated with gestures the size of the strait separating the two. Lapérouse kept asking the Chinese where they were in terms of longitude and latitude but did not get an answer at all. Instead, a younger Chinese took up Lapérouse notebook and pencil and drew another map noting the scale by little marks, each signifying a day of travel by

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[1] Bruno Latour, *Science in action: How to follow scientists and engineers through society*. Harvard: Harvard university press, 1987, p. 251.

canoe. Importantly, Lapérouse was "uncertain" about the information and decided to scout the strait by himself.[2]

The Sakhalin Island was later located by De Lesseps, a younger officer of Lapérouse. He traveled there on horseback by person, with the aid of the precious notebook, maps, and other astronomical instruments. Metrology, either by longitude or by counting canoe travel days, defined the basic understanding of the world for both parties. On the other hand, the metrological understandings of both parties were not on the same terms. Correctness or precision of information was not the question here. We could not say that the Chinese Lapérouse met did not know the shape of their coasts. They knew it very well; they had to since they were born there. But world knowledge was not possible (at least from the western point of view) without the agreement of "same" weight, "same" volume, and "same" length.

The predicament that Lapérouse encountered would soon disappear, as Louis XVI, who sent Lapérouse to his expedition, was overthrown by the French Revolution. As one of the most prestigious legacies of this historical event, the metric system was born. The French National Assembly decided to unify France's archaic and variegated measures and place the foundation of new metrology on natural facts, which were unchangeable and verifiable by all people. The French Academy of Sciences set up a commission for this purpose in 1791. They defined that length to be the "meter," which was one ten-millionth of the length of an Earth quadrant, or the length of the meridian arc on the Earth's surface from the equator to the north pole. Two astronomers, Jean Baptiste Joseph Delambre and Pierre Méchain, led the north and south expedition, respectively. One measured the meridian from Dunkirk to Rodez, and the other measured the same line from

[2] Ibid., p.216.

Rodez to Barcelona. Their surveys finished in 1799, and the new system was launched.[3]

The motto of the metric system was "for all time and for all people," but even in France, it met paramount resistance in local societies initially. These bizarre new measures contradicted France's customary units. People made folklores to express their dissatisfaction with the practical difficulties the system brought in daily use: one must be a scholar or "sorcerer" to manage groceries since even asking for a "pound" of candles required some calculation and conversion of units.[4] Napoleon had no choice but to suspend the new system in 1812. However, Napoleon's army brought the new system to his many puppet states in western Europe. His defeat did not end the spreading process of the metric system, as restored European governments kept and promulgated French measures.

The so-called "Napoleonic Expansion" before 1850 was soon overshadowed by global metrication in the second half of the 19th century when the system was legalized in Eastern Europe, the whole of Latin America, the Ottoman Empire, and a constellation of colonies in northern Africa. This result was but one of many paralleling processes of unification and standardization triggered by the global expansion of capital since the 1860s. Eric Hobsbawm described the latter half of the 20th century as a time of global unification. Steamships, railways, and telegraphs brought remote areas together. These capitalist infrastructures flattened the world and decidedly shaped the preconditions of human existence.[5] Standards were carried out by these material manifestations

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[3] There is a constellation of works on the invention of the metric system. Just to give several more recent examples, Ken Alder, *The Measure of all Things: The Seven-Year Odyssey and Hidden Error that Transformed the World*, New York: The Free Press, 2002; Charles Coulston Gillispie, S*cience and Polity in France: The Revolutionary and Napoleonic Years*, Princeton: Princeton University Press, 2004; Denis Guedj, *The Measure of the World: A Novel*, Chicago: University of Chicago Press, 2001.

[4] Edward Franklin Cox, *A History of the Metric System of Weights and Measures: With Emphasis on Campaigns for its Adoption in Great Britain and in the United States prior to 1914* unpublished dissertation, Indiana University, 1956, pp.129-130.

[5] Eric Hobsbawm, *The Age of Capital, 1848-1875,* New York: Charles Scribner's Sons, 1975, pp. 13-18, pp. 64-87.

of global capital, be it 1. 425m standard railway gauge, nautical miles, Newtons, or Hertz. This time also saw the rise of international organizations, which were a product of standardization. Bureau International des Poids et Mesures was founded in Paris in 1875, along with the International Telegraph Union (1865), the Universal Postal Union (1874), and the International Association of Railway Congresses (1884). For European statesmen and scientists who pioneered global standardization at the time, unification was more in reality already than in the future. Human beings would follow the global meantime, adopt the Gregorian Calendar, use the metric system, run on the transcontinental railway network, and even possibly speak Esperanto, the same language.

For Eric Hobsbawm, such major changes in the frameworks of social reality, be it time or space, were only the results of socio-political "earthquakes," which came with enough momentum to break off the chains of social, political and cultural habitus and bring about a new imagination of the world. He used the Russian and French revolutions to describe this "dual revolution" of time and space:

> Since Russia still operated by the Julian calendar, which was thirteen days behind the Gregorian calendar adopted everywhere else in the Christian of Westernized world, the February revolution actually occurred in March, the October revolution on 7 November. It was the October revolution which reformed the Russian calendar, as it reformed Russian orthography, thus demonstrating the profundity of its impact. For it is well known that such small changes usually require socio-political earthquakes to bring them about. The most lasting and universal consequence of the French revolution is the metric

system.[6]

For China, this dual revolution of time and space converged at the same point. The nation experienced a political "earthquake" as Qing rulers were toppled by revolutionaries in 1911. The young Republic took a more radical stance to embrace global norms, as the Gregorian calendar and the metric system were introduced to China simultaneously and titled "universal calendar" and "universal system." Indeed, for many reformists in China, what concerned them were not the actual benefits that global norms would bring about. They tended to justify their reforms with a sole global rationale that "everyone else followed it." The same argument also pushed the KMT government to continue Chinese metrication in the 1930s.

On the other hand, this is not to say that homogenization was the only topic of global norms. Quite the contrary, locality was in constant tension with globality. Kang Youwei was one the most global-minded intellectuals of his time. But he did not accept the Gregorian calendar and advocated setting the birth of Confucius as the starting point of time. Kang's view later on expanded. After knowing about the international time conference that happened in Hague in 1899, he proposed to set the year 1900 as the commencement of the global calendar for a unified world empire he envisioned in his *Datong Shu*(大同书).[7] His student, Liang Qichao, who again claimed that China should be understood as a part of the world instead of a self-sustaining entity in his new Chinese historiography, followed Kang's reservations about unified western time and proposed the

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[6] Eric Hobsbawm, *The Age of Extremes*, London: Abacus, 1995, p. 57.

[7] Jürgen Osterhammel and Niels P. Petersson, "Ostasiens Jahrhundertwende. Unterwerfung und Erneuerung in west-östlichen Sichtweisen," in Ute Frevert ed., *Das Neue Jahrhundert. Europäische Zeitdiagnosen und Zukunftsentwürfe um 1900*, Göttingen: Vandenhoeck & Ruprecht, 2000, pp. 265–306, p. 278. The original Chinese text was in *Datong Shu (Yi bu)*, chapter 4, entry no. 13.

birth of Huang Di, an ancient sage king as the genesis of temporality. A similar case happened in metrology. As I will elaborate, the doubts about the metric system have never disappeared since the 1910s. Many Chinese scientists tried to revive customary measures. In a similar way to Kang, some also proposed to offer Chinese metrology as a global alternative for the English metrological world.

How do we then make sense of the tension between local tradition and the universal metric system? To be sure, the metric system is the most global metrology contrived by men so far. Compared to other failed endeavors at the time, such as the global gold standard, it is probably also the most successful one. However, it could not be denied that it was of a French origin and "made" global. Bruno Latour alleged that:

> Before science studies and ANT (Actor-Network-Theory), standardization and metrology were sort of dusty, overlooked, specialized, narrow little fields. This is no wonder since their truly wonderful achievements were cut off by the gap between local and global [...]. Take, for instance, the case of the platinum kilogram maintained by the International Bureau of Weights and Measures in a deep vault inside the Breteuil Pavilion at the Sevres Park outside of Paris. [...] Is a metrological reference like the kilogram local or global? Local, since it always resides somewhere and circulates inside special boxes using specific signals, at certain specified times, following specific protocols. Is it global? Sure, since without standards like the watt, the newton, the ohm, the ampere, that is, without the Systeme International d'Unites, there would be no global of any sort because no locus would have the 'same' time, the 'same' distance, the 'same' weight, the same

intensity of electric current, the same chemical 'reagents', the 'same' biological reference materials, etc. There would be no baseline, no benchmark. All sites would be incommensurable for good.[8]

The universality of the metric system, therefore, is questioned in this dissertation, for it was a product of history and was justified by former writing of history too. While many in Europe and China at the beginning of the 20th century defended global metrication for its intrinsic advantage of being "scientific," universal science itself must also be disenchanted by placing it in a concrete historical context. Rather than a stable carrier of universal applicability, Latour pointed out that science since the Enlightenment was a "black box" with its own professional numerical jargon that rejected outside scrutiny. This leads to the fact that we are "so used to the pervasive presence of all these meters [...] which pave the way for centers of calculation that we forget to consider each of them as the sure trace of an earlier *invasion* by a scientific profession."[9]

Combining Local and Global

If the metric system was a globalized local specificity, Chinese metrication would be equally justifiable to be seen as a re-localization of this globality. Following Latour and Hobsbawm's observations, this dissertation concentrates on how metrology "framed" the KMT's visions of modernizing China in the 1930s and how the global and local entanglements of metrological

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8 Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory*, Oxford: Oxford University Press, 2005, pp. 227-229.

9 Latour, *Science in action*, p. 252.

change since the Late Qing decidedly defined this process.

This approach to the combination of global and local aspects of Chinese metrological change differs from that of former studies. There is no denying that the history of metrology enjoyed its own tradition in China. A significant corpus of literature on Chinese pre-modern metrological history has striven to explain the domestic changes of measure units throughout time.[10] As part of Jinshi Xue (金石学, Epigraphy), a series of archaeological discoveries around the turn of the 19th century attracted prestigious scholars such as Wang Guowei(王国维) to this field.[11] Wang believed that Chi, the length unit grew longer as the state tended to squeeze more from taxation. The measure only stabilized after the Song Dynasty when taxation on clothes was monetarized. Indeed, the emphasis of the state was the dispensable dimension. In a similar vein, Wu Chengluo(吴承洛), a pivotal figure in Nanjing's metrological reform, wrote the first general history of Chinese metrology. Wu's monography concentrated on the evolvement of metrological statecraft. His major point was that historical fluctuation of measures indicated the lack of effective metrological administration from the state, which justified the reform at the time that he and his colleagues launched.[12]

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[10] For a detailed, classified bibliography that covers the literature on all periods up until the end of the Qing Era, see Cao Jin, Hans Ulrich Vogel, and Ulrich Theobald eds., *Chinese, Japanese and Western Research in Chinese Historical Metrology: A Classified Bibliography (1925-2012)*, Eberhard-Karls- Universität, Tübingen, 2012.

[11] An early example in Late Qing which employed experimental techniques and textual research, see, Wu Dacheng, Quanhengduliang shiyan kao [Experimental research on metrology]. Wang Guowei's works on Chinese historical metrology were published on *Xueheng*(学衡), or the Critical Review, see, Wang Guowei, "Zhongguo lidai zhi chidu"[Chinese historical Chi], in *Xueheng*, 1926, no. 57, pp. 36-42; also, "Mangliang kao" [Study on Wang Man's volume measures] in *Xueheng*, 1926, no. 58, pp. 22-27. Some mistakes and of Wang's studies were later on corrected by new archaeological discoveries, see, Lin Guangcheng, Chen Jie, *Zhongguo Duliangheng* [Chinese metrology], Shanghai: shangwu yinshuguan, 1934; Yang Kuan, *Zhongguo lidai duliangheng kao* [Study on Chinese historical metrology], Shanghai: shangwu yinshuguan, 1938. Qiu Guangming was the probably most influential scholar on the topic after the 1970s, who published her various monopolies on historical metrology, see, Qiu Guangming, Qiu Long, *Zhongguo gudai duliangheng tuji* [Pictorials of Chinese historical metrology], Beijing: Wenwu chubanshe, 1981. Qiu Guangming, *Zhongguo gudai duliangheng* [Chinese historical metrology], Tianjin: Tianjin jiaoyu chubanshe, 1991; Qiu Guangming, *Zhongguo duliangheng* [Chinese metrology], Beijing: Xinhua chubanshe, 1993.

[12] Wu Chengluo, *Zhongguo Duliangheng shi* [History of Chinese metrology], Shanghai: shangwu yinshuguan, 1937.

These studies, as a whole, challenged the Orientalist myth of China as a stale empire lacking changes. Instead, studies on this period showcased that the inter-dynastic difference in measures is rather visible, and measures have been deeply interwoven with domestic economic activities. In this regard, economic historians paid great interest in measures recently. For instance, the local rice market has been shaped by various measures, which helped the forging of a multi-level trans-regional trade network. Measures were also pivotal to local land taxation since measures had to be used to scale the land. The monetary issue always resulted in political riots, for silver had to be weighted and re-casted during the taxation, and in most cases, to the favor of tax collectors instead of farmers.[13] All in all, measures provide us with some fundamental tools to understand the Chinese economy, but these studies failed to place measures in the center of a more complicated social and political matrix.

Generally speaking, historians of Chinese metrological history have focused less on the units used in border-crossing contacts or during intercultural encounters.[14] Even beyond that, China's complex transformations to international metric standards during the first decades of the twentieth century have thus far only received insufficient levels of attention. In western academia, up to this point, not a single monograph in English or German has been dedicated to this transformation in modern China period. In China, former studies on Chinese historical metrolgy were characterized by its "general history" nature, with a time span from the Warring States period

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[13] Zhang Peiguo, "Jingdai Shangdong nongcun tudi fengpei zhong de dulianghen ji bizhi wenti" [The Measurement and Monetary Systems in the Land Distribution of Modern Shangdong Province], in Zhongguo Nongshi, 1998, vol. 17, no.2, pp. 71-78; Wang Tao, Li Yushang, "Minguo shiqi Fengtian diqu duliangheng kao" [Weights and Measures of the Mukden Area in the Republican Period], in Shanghai jiaotong daxue xuebao, 2011, vol. 19, no. 3, pp. 56-63; and Wang Chunfang, "Kangzhan qian Hubei Mianhua shichang jiliang wenti chutan" [Thoughts on Measurements in Hubei's Cotton Market before the Sino-Japanese War], in Zhongguo jinjishi yanjiu, 2016, vol. 2, no.2, pp. 140-49.

[14] There are certainly exceptions to this trend; for example: Guan Zengjian, "Chuanjiaoshi dui zhongguo jiliang de gongxian" [Missionaries' Contributions to Chinese Metrology], in *Ziran Kexueshi Yanjiu*, 2003, vol. 22, no.11, pp. 33-46.

all the way to Republican times. Chinese metrological history in modern period, at best, is a brief chapter in such general history.[15]

However, some new potentials begin to appear. Similar to case studies of China's pre-modern metrological history, most of the works concentrated on economic history measures during republican times. Scholars advocated an area-study approach due to the mere fact that measures and local conditions vary and fluctuate drastically in the vast realm of China. These works recorded local resistance to new weights and measures introduced by the Nanjing reform in the 1930s. Some remote ethnic areas, such as Qinghai and Gansu have a number of distinctive measures different from those of China proper, which has also been taken into consideration.[16] The most successful area study has been delivered by a group of scholars working in Anhui province, which is partially a result of the well-kept archives of local measurement inspection branches. Their work reveals the tensions around budgets between Nanjing and its many local administrative limbs. While studies privileging limited spaces are more likely to offer deep descriptions of local contingencies, modern metrological transition in China could not be fully explained without considering the pivotal role of government. In the recent decade, works have been dedicated to this end. Some focus on single administrators like Wu Chengluo. For example, one recently completed doctoral dissertation not only gave a detailed recording of key aspects of the three institutional reforms before 1949 but also traced the continuity of relevant administrative patterns into the era of the PRC's metrological reforms.[17]

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[15] Just to name one example in this nature: Qiu Guangming, Zhongguo kexue jishushi: duliangheng juan [History of Chinese Technologies and Science: Measures], Beijing: Kexue chubanshe, 2001

[16] Li Jianguo, "Jindai Ganqin minzu diqu dulianghen zhi kaoyi" [On Modern Measures in the Ethnic Areas of Qinghai and Gansu], in Qinghai shehui kexue, 2010, vol. 31, no. 5, pp. 128-132.

[17] Fang Wei, *Mingguo duliangheng zhidugaige yanjiu*, [Research on Institutional Reform of Weights and Measures in the Republic of China], unpublished doctorate dissertation, Anhui University, 2017. Wu Miao, *Wu Chengluo yu Zhongguo xiandaihua jincheng* [Wu Chengluo and China's Modernization Process], Shanghai: Fudan University Press, 2011. Yang Dongdong, *Shanghai jiliangzhidu de tongyi* [The Unification of Shanghai's Measures(1949-1959)],

Despite such promising research developments, the current literature on the field has two significant constraints. Firstly, most works situate the history of metrological reforms during the Republican period almost exclusively within institutional or economic historical contexts. Consequently, the involvement of people outside governmental agencies has received much less attention. Yet groups ranging from public intellectuals to peasants, craftsmen, and retailers were all connected with the momentous transformation of measurements during this period. They were not only passive recipients of top-down reforms but also partaking in wider debates, which often could be connected with passive and even active levels of resistance. Thus far, not many studies have even attempted to put the socially multifaceted dimensions of the great Chinese metrological reforms during the first decades of the 20th century into the picture.[18]

Secondly and more importantly, the vast majority of literature in the field utilizes either decidedly local or China-centered approaches. By implication, the wealth of international power relations and colonial and semi-colonial contexts that framed the history of Chinese metrological reforms has not been sufficiently explored yet. The same is the case with more small-scale entanglements between international or global structures on one side and Chinese or local agents

unpublished master thesis, 2013, Shanghai Jiaotong University; Zhao Yukun, "Lun mingguo zhengfu huayi quanguo duliangheng" [On the Republic China's Unification of Measures], in *Mingguo dangan*, 2003, vol. 18, no. 2, pp. 76-79, and Wu Miao and Zheng Chenkun, "Mingguo shiqi duliangheng zhidu gaige: yiersan shiyongzhi de queli" [Measurement Reforms in the Republican Era: the Establishment of "One, Two, Three System"], in *Jiangxi shehui kexue*, 2008, vol. 27, no. 10, pp. 121-125. Wang Chunfang, *Daomi liutong yu jindai Anhui difang sheihui* [Circulation of Rice and Anhui's Local Society], unpublished doctoral dissertation, Shanghai Normal University, 2010.

18 Some new developments in the field jumped out the state framework and focused more on the responses from non-governmental social groups in the reform, see, Zheng Chenglin and Shi Huijia, "Nanjing guomin zhengfu duliangheng gaizhi zhongde shanghui canyu" [The Participation of Chambers of Commerce in the Unification of Weights and Measures under the Nanjing Nationalist Government], in *Lishi yanjiu*, 2017, no.4, pp. 95-112. Most recent studies also shifted their focus to the reform in rural settings, for example, Xie Rui, *Sichuan sheng tongyi xinzhi duliangheng yanjiu* [Research on the New Unified System of weights and measures in Sichuan Province (1935-1946): Centering on the First Administrative Supervision Zone], unpublished Master thesis, Sichuan Normal University, 2022.

on the other side. For instance, throughout much of the period of metrological reforms, people in international cities like Shanghai lived in a pluralistic metrological world, which as a reflection of competing global hegemonies, was characterized by concession-specific (British and French) measurements. In addition, in many parts of China, international companies ranging from Russia to the United States have established their headquarters. Moreover, questions such as why China adopted the metric system instead of English measurements at the beginning of the 20th century, should also be partially related to the wider global scenario, in which French *Metric Convention* expanded to many nations and the English system has faced violent criticism domestically.

This academic gap coincides with a new trend in the history of global standards and standardization processes, which has become highly visible research that is entangled with other – global and local – branches of historical scholarship.[19] The study of late 19th and early 20th century China marks no exception: a significant number of historians has studied topics such as the impact of industrial standards in the railway and telecommunication (telephone and telegram) sectors on parts of the Chinese economy and society. In its attention to the complex dynamics between local specificities and global entanglements, much of this literature is related to studies of other facets of the "internationalization of China,"[20] including aspects of educational standards, facets of urban planning, and patterns of consumerism.

As part of this research landscape, the introduction of standard time has also received due

[19] An overview of a rather recent state of related literature is provided by Andrew L. Russell, "Standardization in History: A Review Essay with an Eye to the Future", in Sherrie Bolin, ed., *The Standards Edge: Future Generations*, Sheridan Books, 2005. For standardization processes in the urban sector, see, Jürgen Osterhammel, *The Transformation of the World: The Global History of the Nineteenth Century*, Princeton: Princeton University Press, 2014, pp. 241-311. For railway standardization processes, see Douglas J. Puffert, *Tracks Across Continents, Paths Through History: The Economic Dynamics of Standardization in Railway Gauge*, Chicago: University of Chicago Press, 2009.

[20] For some older, yet still significant reflections on the "internationalization of China", see Kirby, William. "The Internationalization of China: Foreign Relations at Home and Abroad in the Republican Era" in *The China Quarterly,* No. 150, Special Issue: Reappraising Republic China (1997), pp. 433-58.

attention, both as a global historical theme and a facet of modern Chinese history. A remarkable example is Vanessa Ogle's work on the globalization of standard time. While in Germany, standardized time helped building a nation-state, in India, standard time hybridized with local ones and was connected with the struggle of colonialism, and in the middle east, standard time also collided with local religious time, bringing other elements such as pan-Islamic ideas into the discussion. The study of global mean time showcased that globalizing norms have been inevitably caught into a web of local variations. In China, the standardized meantime was first established in Shanghai's concession at the end of the 20th century. This global standard soon began to cater to local needs when five different time zones were established in 1919 to cover the vast geographical span of China.[21] The globalizing factors "within" established social, political, and cultural units such as nation-states indicated the proliferation of local heterogeneities under cross-national homogenizing processes.

More importantly, the emphasis on locality in the global history of time could overcome some shortcomings of the current global history approach. By privileging route over root, current global historiography indeed successfully challenged the European prototypes of modernity, but this method also tended to place connectivity as the most highlighted theme. Bring back local story to global history became a chorus of historians in and outside of China.[22] The metric system was less

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[21] For the standardization of time, see Vanessa Ogle, *The Global Transformation of Time, 1870–1950*, Harvard: Harvard university press, 2015. An example for a work dealing with China is Guan Zengjian, "Ershi shijichu woguo biaozhunshi fazhan yuanliu chutan" [The Development of Standard Time in China in the Early Years of the 20th Century] in *Zhongguo Kejishi Zazhi*, 2014, vol. 35, no.2, pp. 138-46.

[22] A more direct critique of connectivity, see, Sebastian Conrad, "'Nothing is the way it should be': Global Transformations of the Time Regime in the Nineteenth Century", in *Modern Intellectual History*, Nov. 2018, vol. 15, no. 3, pp. 821-848. Important theoretical reflections on combining local and global, see, Natalie Zemon Davis, "Decentering History: Local Stories and Cultural Crossings in a Global World," in *History and Theory*, May 2011, vol. 50, no. 2, pp. 188-202; Walter D. Mignolo, Local Histories/Global Designs: Coloniality, Subaltern Knowledges, and Border Thinking, Princeton: Princeton University Press, 2012. We witnessed in recent years, a rising interest in this approach in Chinese history, see, Dominic Sachsenmaier, Global Entanglements of a Man Who Never Traveled: A Seventeenth-Century Chinese Christian and His Conflicted Worlds, New York: Columbia University Press, 2018; also, Henrietta Harrison, *The Missionary's Curse and Other Tales from a Chinese Catholic Village*, Berkeley: University of

of a pure imperialist imposition, such as opium, than a tool of nation-building for Nanjing's reform in the 1930s. Nor were the administration of metrological affairs rested in the hands of foreign agencies like Chinese customs. Rather, Chinese intellectuals and states since the late Qing actively embraced metrological modernity actively, which decidedly made it a local or even nation-state story.

On the other hand, being a profound and fundamental category, the metric system transcended national borders. However, its local manifestations were highly decentralized and plural in their nature. Some recent works have already begun to dig into the dirt and cover local histories of metrication in Poland, France, England, the United States, Canada, Mexico, Japan, Malaysia, and India.[23] Despite the lack of more research in other non-western settings, these studies showed that the metric system did not make itself a universal language overnight. Rather, the historical transformation of metrology in various local milieus is characterized by the negotiation between the state and society and by contested universalisms and domestic conflicts of various social groups.

As Kenneth Pomeranz once summarized it, measurements are the result of historical processes, social struggles, and conceptual revolutions. The marching of global metrication did not simply mean the obliteration of local metrologies; constant appropriation and hybridization happened in

California Press, 2013. A most recent and important discussion on "global history within China" from Chinese scholars, see, Zhang Xupeng, "Quanqiushi yu mingzu xushi: zhongguo tese de quanqiushi heyi keneng" [Global History and National Narrative: The Possibility of a Global History with Chinese Characteristics], in *Lishi yanjiu*, 2020, no.1, pp.155-173. Hu Cheng, "Guanyu zhongguo shijiao de quanqiushi zhi sikao: yi ruogan gainian gongju wei zhongxin" [Global History in Chinese Perspectives: Rethinking Several Conceptual Tools], in *Shilin*, 2022, no.2, pp. 158-168.

[23] For recent studies on non-western settings, Aashish Velkar, "Rethinking Metrology, Nationalism and Development in India, 1833–1956", in *Past & Present*, May 2018, vol. 239, no. 1, pp. 143–179. Por Heong Hong and Tan Miau Ing, "Contested Colonial Metrological Sovereignty: The daching riot and the regulation of weights and measures in British Malaya", in *Modern Asian Studies*, January 2022, vol. 56, no. 1, pp. 407-426. Héctor Vera, "Counting Measures: The Decimal Metric System, Metrological Census, and State Formation in Revolutionary Mexico, 1895–1940", in *Histoire & mesure*, June 2017, vol. 32, no.1, pp. 121-140.

the encounter of conflicting metrological traditions. It also imposed a real challenge for common people to image some modern categories that are abstract and scientific in nature instead of former anthropomorphic ones.[24] The metric system penetrated political borders, but local historical containers, such as nation-states, still draw contours for global metrication.[25] After all, any global norm must also be "landed," resituated, and institutionalized in the complexity of local conditions in order to gain its various manifesting forms in a given society, be it social, political, economic, or cultural.[26] In this regard, Chinese metrication during the 1930s provides us an opportunity to dig into the nexus of individual societies and test globalization's pluralistic nature.

Local Meanings of Global Measures

This dissertation is fundamentally a social history. If Chinese metrology and Chinese metrication merit such a history in their own right, we must first point out which social meanings metrology carries. For human beings, measures are many things: political and social institutions, a language and a culture, instruments, economic productions, various practices and standards, cosmology, and world views. All these aspects were interwoven and entangled with each other in local and global measures.

Measures are carriers of worldviews. Ancient Chinese metrology was based on the width of millet grains. The length of ten middle-sized grains placed end to end amounted to one Cun(寸),

[24] Kenneth Pomeranz and Steven Topik, *The World that Trade Created. Society, Culture, and the World Economy, 1400 to the Present*, London and New York: Routledge, 1999, pp. 204-207.
[25] Stefan Berger, "Introduction: Towards a Global History of National Historiographies," in Stefan Berger ed., *Writing the Nation: A Global Perspective*. Houndmills: Palgrave Macmillan, 2007, p. 24.
[26] Roland Robertson, "Glocalization: Time-Space and Homogeneity and Heterogeneity", in Mike Featherstone et al eds., *Global Modernities*, SAGE Publications, 1995, pp.25-42.

and ten Cun was one Chi(尺). This approach also correlated with Huangzhong, a musical instrument, to ascertain the volume and weight unit. Huangzhong was a bamboo-made tube that was as long as ninety grains. A hollowed Huangzhong could hold 1200 grains, and the weight of these grains was twelve Zhu(铢) or half Liang(两). The hollow space in Huangzhong was one He(合), and ten He equal one Sheng(升). In ancient musicology, Huangzhong was "the base of all tones" because the sound it produced was in between high and low pitches. Exactly because Huangzhong's essential role in ritual music and its correlation with metrology, Hans Vogel coined the term "metrosophy" as the combination and intercorrelation of proto-science, cosmology, political and politico-ethical thought, and magic and mystery since the Han Dynasty.[27] Ritual music with correct notes and pitches indicated the harmonious relationship between heaven and man, proper secular politics, and accurate measures. Metrology became an arena of political struggles in officialdom. Particularly in the Northern Song Dynasty, ceremonial music(雅乐) along with metrology went through calibrations six times as newly ascended emperors utilized it as a symbol of their competence to control the court and renew policies.[28] The musical measures became more and more irrelevant to everyday measures after the Song dynasty. The process of separation came to full fruition when ancient metrosophy was replaced by modern metrological understandings in the second half of the 19th century. Chinese elites placed more weight on the value of precision and all

[27] Hans Vogel, "Metrology and Metrosophy in Premodern China: A Brief Outline of the State of the Field", in Jean-Claude Hocquet (ed.), *Une activité universelle: Peser et mesurer à travers les âges*, (Acta Metrologiae IV, VIe Congres International de Metrologie Historique, Cahiers de Métrologie, Tomes 11-12, 1993-1994), Caen: Editions du Lys, 1994, pp. 315-332. Also, Hans Vogel, "Aspects of Metrosophy and Metrology during the Han Period", in *Extrême-Orient Extrême-Occident*, 1994, no. 16, pp. 135-152.

[28] A good reflection on pre-modern Chinese metrosophical thoughts, see, Cao Jin, "'leishu' yu 'zhilu': zhongguo gudai duliangheng sixiang luelun" [Of Millet Grains and Fingers: An Introduction to Ancient Chinese Metrosophy], in *Zhongguo wenhua*, 2017, no.2, pp. 96-115. For a historical analysis of musicology in the Song Dynasty, see, Ya Zuo, "Keeping Your Ear to the Cosmos: Coherence as the Standard of Good Music in the Northern Song", in Martin Hofmann, Joachim Kurtz, Ari Daniel Levine eds., *Powerful Arguments: Standards of Validity in Late Imperial China,* Leiden: Brill, 2020, pp. 277–309.

the practical benefits that accurate measures could bring about. Scientific rationality overshadowed cosmological resonance as the basic rationale of proper metrology. The metric system became analogous to progressiveness, modernity, and universalism and sucked cosmological meaning out of metrology. Metrication was essential for China's admission to a "civilized" and standardized modern world.

Concomitantly with it was the shifting views on the Chinese metrological tradition. Measures, after all, were also a language and a culture. Before metrication became an inevitable trend in Europe in the 1870s, western expatriates indeed noticed the chaotic situation of Chinese measures. In all its complexity, it had its own inner mechanisms and advantages for many groups of agents, and as such, it was not without parallels in other pre-modern societies elsewhere in the world.[29] It did not strike them as a problem but simply a mathematical difference they had to deal with, just like in Goa, Manila, Osaka, and other common metrological encounter zones. However, as unified measures became a reality in Europe, China was portrayed as a metrological third world, despite the fact that it would be wrong to discard the highly diverse landscape of China's measurement systems prior to the 20th century as dysfunctional. Missionaries along with Chinese reformists, attributed the disorderly metrological affairs to the malfunctioning state and Chinese national characteristics. The Chinese were stigmatized as a race of inaccuracy, with no acute sense of punctuality and appreciation for precision.

This making of local knowledge and problematization of measures coincided with Eurocentric observations from Max Weber, who alleged in his "Preface" of *Essays on the Sociology of Religion,* that calculation in decimal notations and algebra came from India, but "it was only made use of by

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[29] For instance, France before its unification of measures had up to 250,000 different units of weights and measures. See Alder, *The Measure*, p. 10.

developing capitalism in the West, while in India it led to no modern arithmetic or book-keeping," which was essential to cultivate a grasp on abstract concepts like "capital."[30] Weber might not know that the Chinese customary system was exhorted by English reformists as a better tool to teach mathematical knowledge than the English system in the 1850s because it was fundamentally decimal. When Weber came to his intellectual maturity in the late 19th century, these voices had already disappeared. It might also be entertaining to consider India's metrication in the 1950s, when Indians justified their reform by contending that the metric system was not a product of European (French) culture, but Indian's own child since the nation invented zero symbols and decimal numeration.

As a result, the Chinese began to look at the world for a metrological alternative. Traditional metrology began to shake around the beginning of the 20th century, when the imperial court dispatched delegates in order to investigate the measurement administration of "advanced" nations, primarily in the hope of fostering new types of economic exchange. The ensuing Beijing reform selected the metric system as China's legal system and started the process of metrication, which was inherited by the KMT government in the 1930s. In this context, metrology provided the arena where conflicting notions and conceptual binaries, such as west and east, cultural conservatism and universalism, and progress and tradition, were constantly wrestling. Measures, after all, are a unique language expressing cultural stances. As a language, the metric system was the most spoken one in the world. Almost the entire population in the world is metric literate,

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[30] Max Weber, T*he Protestant Ethic and the Spirit of Capitalism*, London: Routledge, 2001, pp. xxxvii-xxxviii. A good sociological analysis on Weberian view of metrology, see, Hector Vera, "Economic Rationalization, Money and Measures: A Weberian Perspective", in David Chalcraft et al eds*., Max Weber Matters: Interweaving Past and Present,* London: Ashgate, 2008, pp. 135-147.

whereas 1.4 billion speak Chinese, and around 1.35 billion speak English. However, the metric system was also a set of foreign and bizarre nomenclature to Chinese ears and tongues for its distinctive Greco-Latin origin. In 1935, a big debate was ignited by Chinese scientists who opposed Nanjing's nomenclature of the metric units. They criticized the government for keeping too many traditional terms, such as Chi, in the legal nomenclature. This demonstrated the governmental attitude of sticking to corrupted and dying metrological tradition. On the contrary, they insisted on keeping the original terms of the metric system intact and translated it phonetically. For them, the metric system symbolized universal science that could and should transcend political and cultural boundaries.

Concerning common people, responses were far more complicated. The disappearance of multiple local metrologies that formerly had conditioned common people's everyday life was the direct result of the reform. Not only did they find that their choice of vocabulary on the metrological lexicon significantly shrunken, but also many practices and metrological instruments were now strictly forbidden by the state. Measures were also technological inventions and social habitus that were cultivated by them. In the 1930s, measuring practices, such as adding weights to attract customers, were deemed as contrary to Nanjing's ambition to build an accurate regime guided by metrological modernity. Customary instruments like Chinese steelyards were also under the growing supervision of the state because they were not as accurate and delicate as western platform scales or spring scales. Steelyards' flexibility to measure goods with two independent sets of scales on a single beam, which was once an advantage since it enabled trans-regional trades and helped common people cope with pluralistic metrological life scenarios, was now a downside. Metrological bargains were also a hotbed of moral decay and fraud in the eyes of Nanjing. The state wished to establish its monopoly on metrological affairs and, therefore, took the divine power of measuring and the definition of accuracy from the hands of customers, storekeepers, and guilds. The state's invasion of social metrological autonomy solicited wide resistance from steelyard makers, peddlers, individual merchants, and chambers of commerce to rural organizations such as Yahang. By developing an art of not being governed, they managed to bypass the expansion of state power in many private sectors, and their incorporation weakened the depth and width of Nanjing's reform.

Indeed, metrication around the world always indicated struggles between the state and society. It meant new institutions and administrational networks that kept the vast population of nation-states in check. In China, the Qing court had actually long taken a laissez-faire approach toward measurement administration. The latest official calibration of irregular measures had occurred around the middle of the 18th century, yet in real Late Qing life, actual measures varied dramatically. The same unit varied in different regions and industries. As a sharp comparison, the Nanjing regime accepted a modern mode crystalized by "one metrology, one nation, and one state." Metrology became an essential prerequisite for industrial nation-states and served as a lubricant for a functional national economy. In the 1930s, Nanjing's reform also resulted in other governmental directives such as industrial standardization or populist cultural movement that aimed at making the masses fluent in metric units. For Nanjing, the metric system represented an adherence to a culture of accuracy, which could alter the image of the Chinese as an inaccurate and careless people.

However, Nanjing met no small amount of resistance in its marching toward the regime of accuracy. Various social players challenged the nation-state model of metrication. Like international standard time, the metric system penetrated deeply into everyday life. The change of time regime only touched an extremely limited industrial population in China, whereas metrological reform led to the direct fluctuation of market prices with immediate consequences for their own livelihood. This, in turn, triggered a series of discussions and protests and eventually organizational reforms within local textile guilds and governmental measures such as the conflict-ridden enforcement of new small-scale market regulations by the police.

The story was also multifaceted due to the great pluralism of domestic politics and the compound international connections and dependencies. Between the Late Qing Period and the founding of the People's Republic of China in 1949, there were dramatic regional differences in the introduction of unified length and volume measures – differences that were even aggravated by the political fragmentation during the Warlord Era. Adding to this regional and societal complexity, China was not exposed to one international hegemonic force but to various, partly contending colonial powers and corporations. Many of them had their own metrological standards. The metric system pushed by the central government and other forces was not the only foreign influence on the world of Chinese weights and measurements. Other than in the case of time, various metrological standards were being disseminated around the world, and in many cases, such dissemination was tied to competing colonial ambitions. Hence in the British concessions on Chinese soil, measures like pounds, inches, and ounces were being widely used, just as in the rest of the British Empire. Traditional Japanese units of measurement were being used in Japanese treaty port concessions as well as in Taiwan. Russian weights in turn, were common in many border cities in Northeast China. This pluralism of competing international standards was also clearly visible among foreign trading and construction companies. For instance, depending on their main affiliations, foreign railway companies operated with English miles, French kilometers, or Russian milya in China, with their respective gauge standards. Simultaneously operating with pounds and kilograms was a daily routine for bakeries or vegetable markets in Shanghai's foreign concession, and many school textbooks simultaneously used French, English, or Chinese measurement systems.

This encounter of multiple worlds of units generated a kaleidoscopic pattern of forms, initiatives, and counter-initiatives, which affected large parts of the Chinese state, economy, and society. Many sectors of society, ranging from peasants and local commercial guilds to business elites and state authorities, were forced to navigate their own ways through China's landscape of units in transformation. Based on these observations, this dissertation is structured into six chapters, with each addressing an aspect of the compound social meanings of measures.

In the first chapter, I reconstructed the pre-metric story before the 1930s and challenged the theological assumption that China was bound to turn metric since the system was the most global, progressive, and scientifically-sound one. Rather, China's metrological chaos was an intellectual and ideological construction buttressed by foreign and domestic reformists at the time. The stigmatization of Chinese metrology was partially the product of European metrication, which placed stress on the essential role of unified metrology for civilized nations. On the other hand, the British system also joined the competition for China's metrological future, hoping to secure and expand its economic interests by solidifying pounds and feet as China's official system. Far from being a passive receiver of global norms, China's unsuccessful metrication before the Nanjing regime had wider repercussions in the trans-Atlantic debate of metrication, thus also actively shaping the metrological affairs outside of China. Adding to the picture were also efforts made by Michel Vittrant, Liu Jinyu, Ye Zaiyang, and Zeng Houzhang to revive traditional Chinese metrology. Many even imagined connecting Chinese measures with the English system and providing a global alternative for other nations.

The second chapter revisited Nanjing's institutional efforts to promote measures. While current literature tended to emphasize the sole importance of the KMT government in the 1930s reform, this chapter also paid due attention to the important roles of local governments, warlordism, and global factors such as railway imperialism. Nanjing aimed at establishing a working network of metrological administration consisting of hundreds of specialized inspectors and local inspection branches. However, this scheme did not deliver a satisfactory result due to the resistance of other influential players. Warlords tended to ignore standardizing requirements from the central governments to defend political fragmentation and their regional interests. Local governments were equally lukewarm, as the reform was an expensive burden on their budgets. Inspectors failed to carry the reform to local societies, meeting hostility by local governments. China's well-established metrological pluralism in the railway system also proved to be a hindrance to promote the reform in transportation. All these factors challenged Nanjing's monopoly on measures and testified to the limitations of this government-centered reform.

The third chapter continued to deconstruct the nation-state narrative of the Nanjing reform. I contended that the central government's monopoly on metrological affairs as a symbol of national unification did not fully explain Nanjing's motives. Instead, Nanjing used measures as an inroad to build a metricized China and solve actual social and economic problems, which was greatly informed and inspired by various global trends of the time. The circulating sociological knowledge and social surveys made the agricultural crisis and metrological disorder in the countryside more visible in the 1930s. Global industrial standardization inaugurated after the Great War in Europe also enabled the state to imagine a standardized economy. The stigmatization of Chinese metrological chaos was accompanied by the essentialization of Chinese national characteristics, which labeled the Chinese as an inaccurate race. This also pushed leading intellectuals and the Chinese state to pursue a culture of accuracy among people. Together, all these aspects indicated constant global entanglements of Chinese metrication and how they must be understood in the global framework, which went beyond the nation-state boundary.

The fourth chapter detailed the social responses to the Nanjing reform. Despite the state's aim of pushing consistent unification processes within its realm, the reform was out of sync in urban and rural settings. In major urban hubs, the state managed to mobilize influential local players such as chambers of commerce due to thorough propaganda works and better-fledged administration apparatus such as the police force. However, the relative success in the cities did not suggest that resistance would not happen. Instead, as the government took the privilege of measuring from established commercial organizations, the reform broke the long-standing invested interests and exposed the metrological corruptions, which caused no small social turmoil in urban settings. In the countryside, Nanjing failed to touch local societies for its lack of resources. Baojia and other rural influencers did not participate in the reform, and the metrological affairs were practically in the hands of Yahang and other metrological autonomous groups. This chapter then shifted to even lower echelons of the society and analyzed the wider civil resistance from housewives, small vendors, steelyard makers, etc. They smartly detected the loopholes of Nanjing's supervision and developed an art of not being governed. Again, all these aspects indicated that a nation-state narrative would not do justice to a multifaceted story like Chinese metrication, which changed the daily life of a vast and layered population.

The fifth chapter concentrated on the 1935 debate of metric nomenclature. The debate was the most influential public event about measures in the Nanjing reform, attracting many leading figures of the Chinese scientific circle and resulting in an institutional dispute in the central government. Chinese scientists developed their distinctive metric nomenclature since the beginning of the 20^{th} century, which phonetically translated the original terms of the metric system with numerical prefixes. On the other hand, Nanjing inherited the Beijing government's terms, which were characterized by appropriating traditional terms for the metric units, a practice that was unique in global metrication. Chinese physicists attacked inconsistent and unscientific governmental terms in the 1930s, which later on escalated into a public debate in the magazine *Eastern Miscellany.* Behind the debate of who got the right to define the nomenclature was the confrontation between the strong metrological universalism of scientists and an accommodating conservatism of the state. I contended that, far from a minor fuss within the elite circle of experts, the debate was connected to Nanjing's efforts to control science. The government patronized the populist and culturally conservative approach to popularizing science among ordinary Chinese people in the 1930s. This policy clashed with a rather elitist and universal ideal of science held by many Chinese scientists. This conflict, therefore, provided essential context to understand the stance of both sides in the debate.

In the last chapter, I revisited the semi-colonial negotiation of metrological affairs between the Chinese state and colonial powers in Shanghai. The circulating British Benthamite tradition in colonies, that is, keeping metrological pluralism without mandatory unification from the authorities, was transplanted in the Shanghai International Settlement. As Nanjing followed the French approach and took metrological unification into its nation-building agenda, two conflicting traditions resulted in a marathon of negotiations in the 1930s. The semi-colonial setting of

Shanghai, which was characterized by the interdependence of the Chinese nation-state and colonial authorities, shaped and defined the local story. On the one hand, the Chinese state gave up its ambitious and, at times, aggressive demands to fully implement their reform in the settlement and limited the scope of unification in Chinese citizens and old Chinese measures. On the other hand, foreign authorities also had to agree with China's demand to moderately unify measures markets and allow Chinese agents to operate in their territory so as to maintain orders in municipal markets. Colonial intermediaries, such as high-ranked Chinese officials in colonial administration, and cross-border organizations, such as Shanghai's general chamber of commerce and its many guilds, facilitated the negotiation. Semi-colonial conditions of Shanghai also provided a social cleave for hawkers to evade the supervision of the Chinese state and continue their illegal business of selling old measures. However, this freedom soon disappeared as political authorities stroke an agreement. I argued in this chapter that rather than viewing the Nanjing reform in a narrow nation-state framework, foreign and semi-colonial authorities on Chinese soil also took their due parts in Chinese metrication.

Chapter 1: Global Entanglements of Chinese metrication from the 1850s to the 1920s

Introduction

The metric system has come a long way. As a beloved child of the Enlightenment and French revolution, the system marked the embarking of scientific and universal metrology, which was based not on the palm of a certain king but on the meridian line. This indisputable natural fact could be applied around the globe and verified by all human beings. Global metrication was the ultimate testimony of its supremacy. From 1799 when the French peasants suspected Jean-Baptiste Delambre and Pierre Méchain, fathers of the origin metric system, as British spies since they carried strange scientific instruments,[31] to 1837, when the metric system was fully implemented in France, then since the 1870s, when most European Nations recognized it together with Latin America and Japan, and finally in 1915 when China legalized French units as her own official weights and measures, it seemed that the ideal of universal metrology, a system for all people, triumphed at last.[32] Indeed, as Martin Geyer pointed out, the metric system was one of "the powerful signifiers of nineteenth-century liberal internationalism and popularized a language of 'civilization' and economic and social 'progress' that characterized this movement before the First World War."[33]

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[31] Ken Alder. *The Measure of all Things: The Seven-Year Odyssey and Hidden Error that Transformed the World*, New York: The Free Press, 2002. For the spy quote, see "Prologue".

[32] For the global diffusion of the metric system from France 1795 to 2000, see Hector Vera, *The social life of measures: Metrication in the United States and Mexico, 1789-2004*, unpublished dissertation, The New School, 2011. Ch.1. For early metrication process in Europe, see, Edward Franklin Cox, *A History of the Metric System of Weights and Measures, with the Emphasis on Campaigns for its Adoption in Great Britain and the United States Prior to 1914*, unpublished dissertation, University of Indiana, 1956, Ch. 5.

[33] Martin H. Geyer, "One Language for the World: The Metric System, International Coinage, Gold Standard, and

However, there are several flaws to this popular mega-narrative of global metrication. First, it foregrounds the French system as the only model of global metrology. Competing metrological global norms, such as the British Imperial System, which was and is in use in Britain and the United States, were downplayed as unscientific relics of history in arrears in the global race of metrological modernity. Second, exactly because the metric system is the embodiment of Enlightenment rationality and intrinsic "universal," this narrative tends to ignore local metrological traditions that had been swept out during the march of metrication. Should local resistances happen, they are likely to be dismissed due to path dependency. The attachment to the dying past, deserving of sympathy as it might be, bears no historical importance since the metric system wins eventually.[34]

This theological narrative shaped the Chinese history of metrology. Current works seemed to treat Chinese metrication as an inevitable result since the metric system was "better" than China's own measures. This assumption was rooted deeply not only in the minds of Chinese reformists then; neither was it questioned with due scholarly scrutiny now. Voices against metrication or alternative visions of the Chinese metrological future were deviated or reactionary to modernizing causes and thus received little attention. In other words, practitioners of metrological history in China cared about "how" China promoted metrication, "if or not" Chinese metrication succeeded, but not much about the question "why" China chose metrication in the first place. The result was the lack of a "pre-history"(前史) of Nanjing reform as if China suddenly adapted these alien and

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the Rise of Internationalism, 1850-1900", pp.55-92, p. 56, in Martin H. Geyer, Johannes Paulmann eds., *The Mechanics of Internationalism: Culture, Society, and Politics from the 1840s to the First World War*, London: Oxford University Press, 2001.

[34] To give just one example of this enlightenment and rational writing of metrication, see, R. E. Zupko, *Revolution in Measurement: Western European Weights and Measures since the Age of Science*, Memoirs of the American Philosophical Society, vol. 186, Philadelphia, 1990. Interestingly, a most recent essay in China revisited this "natural reason" of the metric system but chose not to question it. See, Huang Yanhong, "Faguo qimeng yu geming shidai de ziran lixing jiqi xiaoying: yi gongzhi danwei mi de dansheng wei zhongxin de kaocha" [Natural Reason and Its Effects in France in the Age of Enlightenment and Revolution: A Study Focusing on the Birth of the Metric Unit of Metre], in *Shijie lishi*, 2021, no. 6, pp. 117-132.

bizarre French units in 1929 without due attention being paid to its historical connections with earlier metrication efforts in the late Qing and era of the Beijing government before the 1930s.[35]

The second problem was that the global entanglements of Chinese metrication were missing. Chinese metrication seemed to be a strict Chinese business. It did not interact with metrication in other regions. China's connections with British metrology were ignored. However, metrication might be the choice of the world nowadays, but not necessarily for every Chinese in the 19th and 20th centuries. As British Empire and the United States acted successively as global economic juggernauts, they provided an indispensable alternative to the global metrological norm for China. British measures have been dominant in the Chinese economy ever since the late Qing. The competition between the metric and British systems defined an interwoven dual-globality in the world and China. Still, only the story of the metric system has been told so far.[36]

This chapter tried to deconstruct the aforementioned narrative and reconstruct the pre-history of Chinese metrication with an emphasis on the interactions of local and global elements. I revisited in the first part the conceptualization of the metrological problem in China. I argued that the shifting metrological landscape of Europe and the expansion of metrication turned foreign and indigenous to problematize the Chinese metrological world as a mess, which justified further unification. As a result, the cries for reforming became the catalyst for the late Qing reform. In the

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[35] Only Shi Huijia covered these two earlier reforms in a detailed manner. See, Shi Huijia, "Minchu Beijing zhengfu huayi duliangheng de zhidu jianshe yu shijian" [The System Construction and Practice of the Unification of Weights and Measures of Beijing Government during the Early Years of the Republic of China], in *Jindaishi xuekan*, 2018, vol.19, no. 1, pp. 151-170. Also, Shi Huijia and Zheng Chenglin, "Qingji huayi duliangheng de yunniang yu changshi" [The Discussion on and Practice of Unifying Weights and Measures in the late Qing Dynasty], in Xueshu yanjiu, 2016, no. 5, pp.125-134. However, both articles did not give an account of global ties in these reforms.

[36] The best effort made so far to place Chinese metrication in a global context was from, Yi Ci Lo, *Measuring Up to Modernity: Metrological Reform in China, 1870s-1940s* unpublished dissertation, University of California, Irvine, 2021, Ch. 1. Hector Vera also discovered a fascinating story of how Mexican metrication and its effort to bring decimal currency made a further turmoil of Chinese markets. See, Vera, *The social life of measures*, pp. 252-253, pp. 258-264.

second part, I traced interactions between Britain and China at the beginning of the 20th century. Metrological affairs were not China's own concern alone. Rather, British merchants demonstrated a great desire to establish their measures in China as a global metrological alternative. This effort also reflected their domestic metrication struggle since the 1850s, which later on formed a trans-Atlantic debate. The third part discussed how the Beijing government's decision to go metric in 1915 shaped this debate, as China's metrological reform gave a new rhetoric weapon for the pro-metric camp in the United States and Britain. Therefore, China was not merely the influenced, but also an influencer for global metrication. The last part revisited the jointed efforts from foreign and Chinese scholars to revive Chinese customary metrology since the late Qing. They represented not only an attachment to and a recreation of metrological tradition but also the ambition to provide a non-metric global metrological alternative for Britain and the United States.

Measuring a Problem

It is hard to say when English measures or the metric system first come to China. Many traced the first governmental recognition of foreign measures in 1840 after the first Opium war. Qing court signed the Treaty of Tianjin, which settled the official conversion ratio of Guangdong's local measures with the metric and English systems when imported goods were registered in custom houses. Countries such as Russia, the United States, Japan, Belgium, Italy, Germany, and Austria followed suit later. The inception of these so-called "customs chi"(海关尺) marked the colonization of Chinese metrological sovereignty in the eyes of many in republican times.[37] However, these

[37] Wu Chengluo, *Zhongguo Duliangheng shi* [History of Chinese metrology], Shanghai: shangwu yinshuguan, 1937, pp. 281-283.

“translated” foreign measures failed to leave strong impressions on Chinese elites then, as scarce records noticed their origin at all.

However, for the metric system, former studies have pinned down the earliest mentioning of the metric system to Zeng Jize (曾纪泽) or Marquis Zeng, son of Zeng Guofan(曾国藩).[38] Zeng was appointed as Chinese ambassador to France in 1878. In January 1879, Zeng arrived in London first, where he met his old friend, Samuel Halliday Macartney, who then served as an interpreter for the Chinese embassy. He was from the same family as George Macartney, who led the first British delegation to China in the 1790s. Zeng and Macartney were long-time friends, as they had engaged in regular correspondence since 1870[39]. Macartney accompanied Zeng on his way to France. On March 15th, Macartney had a long conversation with Zeng when Macartney introduced the metric system to Zeng as “the best metrology in this world.” Because the system is based on a natural fact, the meridian line, “most European scholars firmly believed in it.” Macartney also brought another piece of information that the English parliament had debated about following the metric system or not, and the final result was still pending.[40] It seemed that Macartney was ardent about spreading this information. In June, Guo Songdao (郭嵩焘), former ambassador to France, received a letter with the exact same content from Ma Jianzhong (马建忠), Guo’s interpreter. It was likely that Macartney fed this information to Ma, as Ma and Macartney were well acquainted with each other since both worked for the Chinese embassy in London.[41]

Not a French, but a British boasted the metric system as “the best metrology” to the Chinese. While this fact might surprise modern readership, Macartney’s appraise of French measures

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[38] Shi and zheng, “Qingji huayi”, p. 126.
[39] Zeng Jize, *Zeng Jize riji* [Diary of ZengJize], Beijing: zhonghua shuju, 2013, p.12, 442-444. 4
[40] Yu yueheng ed., *Zeng Jize Ji* [Collection of Zeng Jize’s works], Changsha: Yuelu shushe, 2008, p. 333.
[41] Liang Xiaojin, *Guo Songdao quanji* [Full collection of Guo Songdao’s works], vol. 11, Changsha: Yuelu shushe, 2012, p. 146.

reverberated with the laud appeal of going metric in Britain since the 1860s. The sentiment of progress defined the social and intellectual atmosphere by the middle of the nineteenth century in Europe. It seemed that Britain, as the motor of the industrial revolution, was leading in this march towards modernity. However, despite steam power or mechanization, Britain failed on the front of metrology. The metric system by 1851 was already followed by 12 nations besides France, whereas British customary measures were criticized since the 1850s. Metrology became first problematized during the Great Exhibition in 1851. British government intended to display its craftsmanship and advanced engineering. However, the judges of this event of international progress discussed a hindrance to international cooperation and global trade in different units that nations brought to the show. The problem became more visible four years later, at the Paris exhibition when the judges urged for a decimal and universal system again. In the meanwhile, international congresses provided an additional forum where the continental metric movement gained more momentum. The International Statistical Congresses assembled statisticians, economists, and government officials. A serious of congresses during the 1850s and 1860s (Brussels in 1853, Paris in 1855, Vienna in 1857, London in 1860, Berlin in 1863, and Florence in 1867) made universal metrology then consensus among European nations.[42]

As a result, the International Association for Obtaining a Uniform Decimal System of Weights and Measures was born as the first international metrological organization, with fifteen European nations as its inaugural members. Alleging to pursue a decimal system, the organization aimed at promoting the metric system in particular. In 1861, the Association's British branch submitted its petition to adopt the metric system to the British parliament. While the Franco-British trade treaty

[42] Edward Franklin Cox, "The Metric System: A Quarter-Century of Acceptance (1851-1876)" in *Osiris*, 1958, vol. 13, pp. 358-379, pp. 361-367.

of 1860 added weight to metrological unification, the parliament was skeptical about making French metrology compulsory in Britain. The Association was not discouraged, as it presented its compulsory bill two times again in 1864. The voice of blocking unnecessary entanglements with the continent also appeared in 1869.[43] The government published an official report against compulsory metrication, which favored the metric system in principle, but doubted compulsion was desired. At the same time, the metric system gained more global weight, as the 1870 Commission Internationale du Mètre was formed in Paris, and in 1875, the Convention du Mètre was signed by 17 nations. Feeling the competition, Britain promulgated the Weights and Measures Act in 1878, which officially defined its measures for the first time. But it was rather apparent that the metric system became ever-more dominant in the world. In 1884, even Britain joined the Convention du Mètre.[44]

The change in the metrological landscape in Europe also inspired many foreigners to muse upon the possibility of transplanting this "universal system of weights and measures" onto the soil of China. One of the early examples was from William Alexander Parsons Martin (丁韙良). Martin was an American missionary who arrived in China in 1854. He began to serve as the head of Tongwen Guan(同文馆), an official school for translating foreign books and training interpreters in Beijing, in 1862, and later became the first chancellor of Peking University. In 1874, Martin published his essay "The Metric System for China." He began by deploring the chaotic nature of Chinese measures in use. Even though the Chinese had official metrology, which was not entirely without scientific ground, for it was almost decimal, people respected the official system not. Catty, or "Chinese pound," was "with an inconstancy which defies all rules." Shopkeepers shifted their

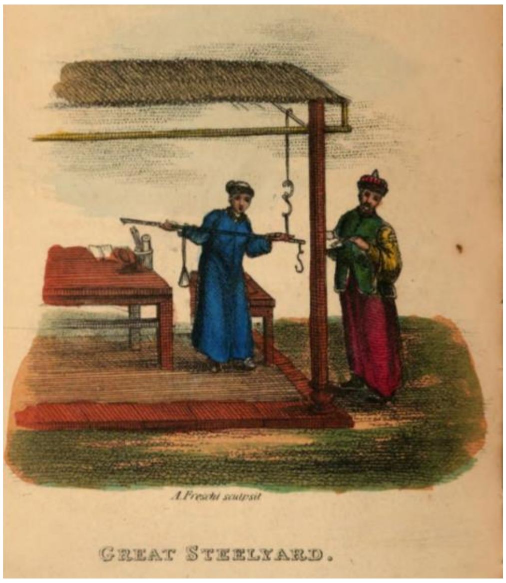
[43] Ibid., pp. 368-371. Also, Martin H. Geyer, "One Language for the World", pp.62-64.
[44] Ibid., pp. 372-376. A more detailed coverage of British metrication before 1871, see, Cox, *A History*, pp. 238-327.

measures for different transactions. Martin viewed measures as a material display of "a kind of visible conscience." In this regard, Chinese measures were a hotbed for commercial fraud and moral decay, and Chinese steelyards were magical "Cheating wands." China should have one unified metrology implemented. The problem was which metrology it should be. While the government could implement its official metrology more strictly, the better option was the metric system, for it was scientific in nature. Martin came to his main argument here that only the metric system should come to rescue China because it was recognized by "28 of the most civilized of the nations of the earth" and has already constituted itself as "the only proper international medium for mankind." If any system was "destined to universal adoption, the French is the one."[45]

Martin's criticism of China's unordered metrological status sharply contrasted with earlier foreign observations before 1870. An example after the metric revolution was from Henri Bertin and Jean Baptiste Joseph Breton. Bertin was the controller general of finances of Louis XV. Fascinated by China, he viewed Chinese metrology with strong cultural curiosity. Bertin's works later were published in 1811 by Breton titled *La Chine en miniature* with the latter's comments and further explanations. Although both men did not travel to China, their works attracted a lot of attention in Europe and were translated into English. For them, the inaccuracy of Chinese measures seemed not to be their first impression. There were no complaints about the fact that Chinese metrology was not entirely decimal, even though they knew that one Jin equals 16 Liang. Rather, the similarity of western and Chinese metrological instruments was highlighted, as they noticed that "the Chinese make use of two kinds of weighing-machines; one, which has two scales; the other, which is the more generally used, resembling the Roman balance. This last is what is termed

[45] W.A.P Martin, "The Metric System for China," *The Chinese Recorder and Missionary Journal*, Mar 1, 1874, 57.

in mechanics a lever of the first power." With a strong cultural curiosity, the book gave a lengthy description of Chinese steelyards: "the bearing point is not in the middle, but very near one of the extremities, where to the resistance of the weight of the burthen is applied. The power of weights is moveable on the great arm of the lever, which is marked off in a certain number of divisions." Even though the Chinese scales were not always "correct" for they sometimes differed, governmental measures did not vary a lot. [46]



Moreover, Chinese metrology was viewed at times as even superior to the British system. Sir John Bowring, the fourth governor of Hong Kong and an adherent of British metrication, testified in the parliament in 1853 that Chinese metrology had the same advantage as the metric system over British standards since both were decimal in nature. He ventured to say that "a boy in a Chinese school will, in one month, acquire a more thorough knowledge of all purposes to which figures are ordinarily applied than would be obtained in a year with our complicated system." He

[46] M. Breton (Jean-Baptiste Joseph), *China: Its Costume, Arts, Manufactures*, 2nd ed. London: J.J. Stockdale, 1812 pp. 106- 108. The illustration is on p. 106.

promised that he has "scarcely ever known an instance, even among the working people, of an inaccuracy of account in China."[47]

However, the chaotic situation of the Chinese metrological universe began to receive the attention of foreigners in China, such as W. A. P. Martin, in the 1870s. This change was partially connected to a shifting understanding of metrology for a nation. As the metric system became firmly established in Europe and the unification of customary measures succeeded in Britain during the 1860s and 1870s, a coherent and unified national metrology became an indispensable infrastructure in the "civilized" world. In this regard, China's metrological image was highly negative compared to the European metrological progress. While formerly foreigners might view confusing measures in China as a simple regional difference or cultural specificity, they now refused to accept the practical difficulties of messy Chinese measures, particularly regarding trade. For instance, in 1870, Alexander Williamson (韦廉臣), a Scottish Protestant missionary to China with the London Missionary Society, published his traveling logs in China, in which he specifically investigated monetary metrology. A table of the various silver taels in use in Shandong was given. Within the limits of a single province, so great a difference existed as between 3.2% under and 5% over the ordinary tael.[48] In 1871, an article fiercely attacked Chinese metrology in *The North China Herald*, in which the author deplored the difficulties in commerce:

> "Nothing, perhaps, interferes more with the extension of internal trade in China, than the multiplicity and irregularity of the weights, measures and currency [...] No two cities

[47] G. E. M. Johnson, C*urrency Reform and the Need for a Nickel Coinage on a Decimal Basis*, the Decimal Association, 1920, p. 5.

[48] Alexander Williamson, *Journeys in North China, Manchuria, and Eastern Mongolia; with some account of Corea*, 2 vols. London: Smith, Elder & Co. Appendix C, pp. 437-438.

perhaps have exactly the same tail of silver. It varies in touch and in weight […] A foot in Shanghai is very different form the same measures at Canton; so near as Chinkiang it differs from the Shanghai standard by a still greater amount than does Shanghai from the Southern measure. Every trade, besides, has its local customs; a tailor's foot differs widely from a carpenter's; both, from the rude standard made use of to measure land. A pecul of rice is by no means the same as a pecul of coals, nor is a string of cash in Shanghai at all equivalents to its representative in other parts of the Empire."

The metrological discrepancy reminded the author of the situation in France and Britain before 1870, which "at one time were not far behind the irregularity of the Chinese in respect of weights and measures" In this regard, the Chinese government's inaction was to be blamed, compared to the efforts of unification made by European governments. [49]

As Yi Ci Lo pointed out, the next wave of foreign accounting on Chinese metrology came in the 1880s when leading members of the north China branch of the Royal Asiatic Society (RAS) conducted a series of surveys on Chinese measures. The RAS asked its respondents to answer questions like "What is the average size of the agricultural holdings or Farms in the part of the Country best known to you?" and "What is the average annual production per Mou(亩)—say of rice (paddy) or barley—by weight, and what is the local selling price?" And in early 1900, the society published a preliminary summary of the results of this survey based on data provided by 30 respondents, who were almost all missionaries. The paper laid down tables with solid figures, enumerating China's metrological mess with a clear specificity.[50] These surveys and metrological

[49] "Chinese Weights and Currency", in *The North China Herald*, Jan 25, 1871.
[50] Yi Ci Lo, *Measuring Up*, pp.29-36.

works during the 1870s and 1890s cultivated a conviction among foreigners in China that the messy metrological status should and could be changed by new unified metrology and the metric system seemed to be a foremost alternative to the Chinese customary system.

Foreigners' criticism of Chinese metrology coincided with that of Chinese reformists since the 1890s. It was important to note that the metric system was not the only metrology that received the attention of Chinese elites. Jiang Baoyan(江宝衍)was a reformist and newspaper editor in Guangdong. As one of the most vocal voices to introduce foreign measures to the Chinese in the late Qing, he published a serious of his metrological studies in his newspaper, *Nonggongshang bao* (农工商报)and *Shangwu Guanbao*(商务官报). He opined that while "the French system was the most scientifically coherent, English measures were prevalent in China" alongside Japanese measures, which were "brought by imported books and goods." Therefore, Jiang introduced all three metrologies to his readers simultaneously as equal metrologies.[51] A similar observation came from Liang Qichao(梁启超). Liang Qichao highlighted the importance of "properly translating foreign metrological terms" in publication. By "foreign metrological terms," Liang did not mention the metric system. Instead, English measures seemed to be the only foreign measures that caught his attention, for which he advocated attaching a conversion table to Chinese measures in all translated books.[52]

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[51] "Zhongwai duliangheng tongzhuan: rensheng shishang" [General views of Chinese and foreign metorlogies: for life], in *Nonggongshang bao*, 1908, no. 24, pp. 46-47. Jiang published his works on metrologies with the name Xia An (侠庵). These articles included: "Zhongwai duliangheng tongzhuan: faguo dulianghengshuo" [General views of Chinese and foreign metorlogies: on French metrology], in *Nonggongshang bao*, 1908, no. 24, pp. 48-51; "Yingguo duliangheng lun", in *Nonggongshang bao*, 1908, no. 26, pp. 30-33; "Xueli: Yingguo duliangheng shuo (xu ershiliu qi)"[Scientific research: English metrology (Following installment of no. 26)], in *Guangdong quanye bao*, 1910, no. 97, pp. 6-11; "Xueli: Zhongguo duliangheng shuo"[Scientific research: Chinese metrology], in *Guangdong quanye bao*, 1910, no. 101, pp. 6-9; "Xueli: Zhongguo duliangheng shuo (xu qianqi)"[Scientific research: Chinese metrology (Following installment of last issue)], in *Guangdong quanye bao*, 1910, no. 102, pp. 8-9; "Xueli: Riben dulianghengshuo" [Scientific research: Japanese metrology], in *Guangdong quanyebao*, 1910, no. 98, pp. 7-10.;

[52] Liang Qichao, "Bianfa tongyi lun yishu" [General arguments for a reform, on translating foreign books], in *Yinbing shi heji diyi ce* [Collected works of the room of ice drinking, vol.1], Beijing: zhonghua shuju, 2015, pp 64-76. The original article was written in 1898 on *Shiwu bao.*

However, the metric system's dominant status as global metrology was soon recognized. Public media noticed that British measures were "complicated in their names," despite Britain was China's foremost trade partner then.[53] The ongoing debate of metrication in England was also known to the Chinese, as newspapers noticed that "there were three motions of using the metric system in the British parliament, which most members agreed on" in 1897. [54] Several surveys of global metrologies also admitted that the metric system seemed to be better metrology than British measures, as it was adopted by Germany and partially recognized by the U. S. and Britain.[55]

One of the major rationales for metro logical unification at the time was the monetary measures. Instead of being saturated with the progressive and modern visions of the metric system, Chinese elites justified their advocacy for unified metrology through the actual economic benefits that it could bring. As early as 1898, Yan Fu (严复) already addressed the importance of monetary metrology in his letter to Emperor Guangxu. Yan opined that it was "a universal rule of metrology"(计学之公例) that the nation without unified measures and a monetary system was doomed to poverty. In this regard, China's chaotic metrology amounted to "a rare case around the globe."[56] Though Yan's letter was never sent to Guangxu since the emperor lost his power in the ensuing coup d'etat, it nevertheless represented many Chinese elites' concerns at the time. Mai Menghua (麦孟华), a student of Liang Qichao and a reformist in the late Qing, also pointed out that chaotic monetary measures and strong social autonomy in metrological affairs indicated a

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[53] "Wenda: di yibaijiushiwu wen" [Answering questions: no. 159], in *Gezhi xinbao*, no. 13, 1898, pp. 10-11.

[54] "Duliang daxing" [prevailing measures], in *Zhixin bao*, no. 1, 1897, no. 9. "Yingguo: biantong duliang" [Britain: metrological change], in *Cuibao*, no. 18, 1897, p. 14.

[55] "Wangguo duliangheng zhidu gaishuo" [global survey of metrological systems], in *Shangwu guanbao*, no. 8, 1907, pp. 16-18. "Wangguo duliangheng zhidu gaishuo(xu)" [global survey of metrological systems (following instalment)], in *Shangwu guanbao*, no. 9, 1907, pp. 17-22.

[56] Yan Fu "Nishang qingdi shu" [Tentative letter to the Qing emperor] in Wang shi ed., *Yan Fu ji* [Collection of Yan Fu's works], vol. 1, essays and poems, Beijing: Zhonghua shuju, 1986, p. 61 and p. 76.

weak monarchial power of Qing court, whereas "in western countries, monetary and ordinary measures were officially controlled and unified."[57]

Indeed, accurate measures were closed related to a working monetary and financial system, particularly so when the value of the major currency, silver, was measured by its actual weight. According to an investigation of the late Qing, chaotic metrology caused a big problem for China's monetary system. Beijing and Shanghai, Caoping (漕平) measures were standards for silver coinage and taxation, whereas, in Guangdong, English pounds were dominant in measuring silver. Since the Qing court also allowed local merchants to mint silver money, Caoping measures and the price of silver measured by the Caoping system also varied, depending on the producers' credibility or the production place.[58] Silver money also came in different shapes and weights, with different origins ranging from southeast Asia to Mexico.[59] Unification of monetary metrology and concomitant sorting out the disarray of various currencies (整理杂币), therefore, became a major task in Qing's New Policies reform when the new Ministry of Commerce was established in 1903. At the same time, public opinion also saw the importance of monetary metrology. An article in *Shenbao* alleged that China's metrological unification should start with the monetary system since it was impossible to measure ordinary goods accurately without labeling them with stable and accurate prices.[60]

The discussion of monetary metrology quickly led to cries for the unification of measures in general, as foreign and domestic trade also depended on working metrology.[61] For Qing officials,

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57 Mai Menghua, "Lun Zhongguo yi zun junquan yi minquan" [China should strengthen monarchial power and suppress civil autonomy], in *Shiwubao*, 21 February 1897.

58 Zeng Houzhang, *Zhongwai duliangheng bi tongkao* [General research on Chinese and foreign measures and curreny], Beijing: Jinghua shuju, 1926, p. 105.

59 Man-houng Lin, *China Upside Down: Currency, Society, and Ideologies, 1808-1856*, Cambridge: Harvard University Press, 2006, p. 44.

60 "Lun zhengdun huanfa dangxian huayi duliang" [On improving of currency should base on metrological unification], in *Shenbao*, 21 September 1905.

61 Ibid.; also, "Zhang Bishi shilang dulaingheng huanfa yigui huayi yi" [Zhang Bishi's proposal for metrological and monetary unification], in *Shenbao*, 8 October 1903.

Japan instead of Europe provided a convincing model of metrological reform. Since China lost its war with Japan in 1894, the Qing court paid increasing attention to Japan's modernization policies. Japan officially joined the Metric Convention in 1886 and managed to unify its customary measures simultaneously. Chinese elite tracked Japan's metrological policies closely and translated its metrological law.[62] In 1905, Shen Yuqing (沈瑜庆), an official in Beijing, suggested the court follow suit with Japan by establishing an official monopoly for the manufacture of metrological instruments and forbidding all other civil measures to increase governmental revenue.[63] Shen's proposal was endorsed later by four ministers and Prince Yi Kuang (奕劻).[64] In 1906, the Qing court sent an official delegation to Japan to investigate metrological policies.[65] At the same time, the governmental interest in the metric system continued to rise. Shui Junzhao (水钧昭), then a commercial officer of the Chinese embassy in Germany, was instructed by the Qing court to translate the Meter Convention, which was published later in public media.[66]

In October 1907, the Qing court finally began its metrological reform.[67] Half a year later, a proposition was presented by the Ministry of Finance and the Ministry of Agriculture and Industry. The Qing court was aware that the metric system was prevalent in the world, except for "a few countries, the rest of world had already joined the convention." In China, English measures were

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62 "Riben gaiding duliangheng tongxing fa" [Japan changed its metrological law], in *Hubei shangwu bao*, no. 35, 1900. "Riben duliangheng fa" [Japanese metrological law], in *Shangwu bao*, no. 55, 1905, pp. 45-53.
63 Chinese First Historical Archive (hereafter CFHA): 03-7129-019, "Sheli duliangehng bing zaozhi guanju" [Establishment of official metrological and paper-making bureau], 26 October 1903.
64 CFHA: 03-7129-020, "Yifu Shen Yuqing qingshe duliangheng deng you" [Reply to Shen Yuqing's case of metrology], 20 December 1903. 12.20
65 Aacdemia Sinica, the Institute of Modern History Archive (hereafter, ASIMHA): 02-12-045-03-001, "Pai Sa Yintu deng furi kaocha zaozhi yinshu geshi you" [Sending Sa Yintu to Japan for investigation of paper making and printing industries], 7 February 1906.
66 ASIMHA: 02-13-004-01-005 "Xiangchen duliangheng shi fushu yiben" [Detailed reply of metrological inquiry and attachment of a book], 7 March, 1908. Also, Shui Junzhao, "Zhuangjian: wanguo duliangheng gonghui tiaoyue" [The meter convention], in *Shangwu guanbao*, 1908, no. 3, pp 35-36; "Zhuangjian: wanguo duliangheng gonghui tiaoyue (xu)" [The meter convention (following instalment)], in *Shangwu guanbao*, 1908, no. 6, pp. 38-40.]
67 "Shangyu"[Imperial Orders], in *Shenbao*, 10 October, 1907.。

dominant in Customs and treaty ports in China, while factories and schools depended on the metric system. However, the Qing court viewed Chinese metrological traditions were at risk. Taking foreign measures was “forgetting the past” and “a travesty to our ancestors”(数典忘祖). Even if China was going to join the Metre Convention one day, traditional measures should not be abandoned.[68] Therefore, Qing’s final arrangement of metrological reform was rather conservative. Customary measures such as Yinzao Chi(营造尺), Caohu(漕斛), and Kuping (库平) were kept. However, these measures were made in decimal. The manufacture and shapes of standard measures also followed western examples. The unification process also copied that in Japan and Europe, in which a central metrological institute would be established, and modern governmental factories equipped with western machinery would supply legal measures.[69]

“Inching” towards a Different Future

At the same time, the message of China’s forthcoming metrological reform excited many foreign merchants. British merchants saw a great opportunity to expand their commercial influence by persuading China to switch to English measures. On November 4th, 1907, Li Jingfang (李经方), Chinese ambassador in London, received a letter from George Moores, the secretary of the British Weights and Measures Association (hereafter BWMA), claimed to be glad on hearing that China was going to have a metrological reform. For the sake of improving bilateral trade between the two countries, Moores recommended Qing court use the British system or a system

[68] CFHA: 21-0587-0002, *Zoudind duliangquanheng huayi zhidu tushuo zongbiao tuixing zhangcheng* [Imperial proposal of metrological unification with pictorials and promotion procedure.], 1908, pp.1-2.
[69] Ibid. Also, CFHA: 21-0587-0003. “Chouban duliangheng huayi shiyi bing sheli zhizao yongqi gongchang qingxing zhe” [Report on the preparatory works of measures factory and metrological unification].

that kept a “simple numerical ratio” with it. A month later, Moores again sent several copies of the Association’s propaganda materials. He alleged that even the French did not entirely follow the metric system. The French system was not fitted to common daily use. The triumph of the anti-metric camp in parliament debates of 1906 was the best proof that Britain would not turn metric in the foreseeable future. On the other hand, since the association “studied all existing metrologies in this world,” Moores assured Li that British measures were most used in international trade. He demanded to meet Li personally to give a more detailed explanation. However, Li proved to be skeptical or lukewarm at best to Moores’ suggestion, as he shirked the meeting for he was “too much occupied by other duties.”[70]

On December 19th, Manchester’s chamber of commerce sent a petition letter to Li again on behalf of local textiles industries. Like Moores, strengthening economic ties with China was the chamber’s major concern, as textile industries in Manchester and adjacent areas enjoyed a dominant share in Sino-British trade then. The letter laid down the following fact: in 1906 alone, 114.140.094 pounds out of a total of 19.319.007 were textile-related, which amounted to 60% or annual transactions between the two countries.[71] The chamber’s appeal was likely arranged by Moores, as the Association was located at 14 Cross Street, Manchester, and the letter mimicked major points of Moores’ former letters.

British merchants’ petition was not an isolated incident but rather a reflection and development of Britain’s domestic metrological struggles. After metrication failed in the early 1870s, the advocacy for going metric never disappeared. British scientists and the British

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[70] ASIMHA: 02-13-003-02-045, “Zhaoyi ying duliangheng hui laihan bing yingshan gong bing zi chengyou” [Translation of letters from the British Weights and Measures Association and their requirements], 14 January 1908.
[71] Ibid.

Association for the Advancement of Science continued their attacks on customary measures. By 1888, the Decimal Association, the major British metrication organization, was formed. The Association waged another wave of metrication movement. Merchants became allies of the metric camp. They demanded to legalize the metric system, if not fully adopted, to facilitate international trade. In 1897, the metric camp in Britain harvested its victory as the government officially legalized the use of metric units for most commercial transactions. In 1904, the Decimal Association furthered its efforts to require compulsory metrication, as it alleged that the metric system helped the industrial expansion of Germany and gained the favor of public opinion also in Britain. However, the British Weights and Measures Association was created in the same year to combat the Decimal Association. BWMA managed to increase the voice of the anti-metric camp and successfully killed the 1904 Bill.[72]

In 1907, a new bill by the Decimal Association reached the parliament. This time, Lancashire textile industries and BWMA chaired the opposition. Their main argument was that the export of textiles amounted to almost a quarter of Britain's total export value. Particularly, the huge market in China they cultivated for decades constituted more than 99 percent of China's cotton imports. Metrication meant a loss of lucrative business because "Oriental was always doubtful and suspicious of any change." The U. S. would most likely fill up the gap left by the British since it could offer goods in English measures. Moores and BWMA backed Lancashire merchants, claiming that he did not know a single manufacturer or spinner in Britain who wanted or used the metric system.[73] The parliament favored the anti-metric camp this time, and the 1907 bill was eventually

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72 Cox, *A History*, pp. 328-381.

73 George Moores, "Discussion: compulsory introduction of the metric system", in *Journal of the Society of Arts*, November 23, 1906, p. 61.

defeated.[74] From this point on, British commercial interests in China became an indispensable part of the metric debate in Britain, which we will continue to witness during the 1900s and 1910s.

The British passion for increasing its commercial interests by influencing China's metrological future did not easily vanish. As the efforts in London resulted in vain, in early 1918, another petition letter was transferred by the British embassy in Beijing to China's Ministry of Foreign Affairs. With a hundred signatures of British firms trading with China, this letter pointed out that the English weights and measures were dominant in current use in Sino-British commercial connections and enjoyed almost universal application in the world's international trade. Instead of combating the metric system in the front of science, the letter championed the English system as "the most practical for manufacturing and trading purposes." To quote their words, this fact was a testimony of "the survival of the fittest."[75]

We must stop here to elaborate on this specific choice of rhetoric in the letter. The emphasis on the practical advantages of English measures and "the survival of the fittest," the popular social Darwinism slogan ironed out by Hebert Spencer, did not randomly appear here. Hebert Spencer happened to be a leading intellectual in the transatlantic anti-metric camp. In 1896, discussions appeared in the British Parliament about passing a bill that would make the use of the metric system compulsory. Spencer uttered his voices of fierce opposition and later printed his opinion as pamphlets and sent them to all members of the House of Commons and some members of the House of Lords. As the United States Congress considered passing a similar bill, he also sent these pamphlets to all representatives of Congress. [76]

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[74] Frederik Hyttel, *The Working Man's Pint: An Investigation of the Implementation of the Metric System in Britain 1851-1979*, undergraduate dissertation, Bath Spa University, 2009, pp. 17-18.
[75] "The Pound or the Kilogramme", in *The North China Herald,* January 17, 1908.
[76] Héctor Vera, *The Social Life of Measures, Metrication in the United States and Mexico, 1789-2004,* unpublished dissertation, New School University, 2011, p.342.

Spencer's counterarguments against metrication were on two sides. First, Spencer believed that British measures were far superior to the decimal number and metric systems. The former was more suited to meet real-life needs and solve practical problems. The reality of life was based on a duodecimal number system in which the number 12 was a radix, such as a day divided into 24 hours. In this sense, the metric system was synchronized with the decimal number system and failed to facilitate "working men" in their daily metrological needs. Spencer alleged that he was "struck by the fact that the ancient wise men of the East and the modern working men of the West have agreed upon the importance of great divisibility in numerical groups." In this sense, the decimal number system and metric system were bound to fail. Second, Spencer was convinced that global metrication amounted to tyranny, particularly so when its mandatory use was promoted by the state. The worries of bureaucratic coercion made his opposition political. American and Great Britain, with their vast colonies, would serve as Avant-gardes of metrological democracies to fence off such compulsory global metrication.[77]

Spenser's major enemy in the trans-Atlantic debate was Lord Kelvin or Sir William Thompson. Lord Kelvin was known as the most famous physicist in the world of his time. He dedicated himself to scientific measurement, whose contributions were recognized as the unit of measurement for temperature, *Kelvin* was named after him. Kelvin harshly criticized English measures as "the British no-system" for its "monstrous complexity," whereas the metric system served as a sharp contrast for its "uniform simplicity." He engaged in a debate with Spencer in the British newspaper, *The Times,* in 1896. In 1902, as spencer had distributed his anti-metric arguments in the U. S. Congress, Kelvin traveled to Washington to defend global metrication. On April 24th, Kelvin appeared before

[77] Ibid., pp. 341-353.

the House Committee on Coinage, Weights, and Measures in the United States. Kelvin expressed his frustration with England's lack of action and encouraged the United States to lead the efforts in adopting the metric system, which would also convince his own country to follow. Kelvin attacked Spencer's preposterous fascination with the duodecimal system: "We had better wait until we have six digits on each hand before we refuse to be satisfied with the experience of mankind in the experience to old Arabic numeration."[78]

The bitter rivalry marked a contestation of two global metrologies at the beginning of the 20th century, which later became a historical reference to Chinese metrication. Thirty-two years later, Nanjing's National Bureau of Weights and Measures translated Calvin's testimony for the U. S. Congress word by word and distributed it to its inspectors. Although the Bureau mistook it for a debate in the British parliament, the article, titled "justification of the metric system by a great scientist," proved the metric system's advantages over other metrologies.[79] However, Calvin's defense of the metric system did not suffice as a final settlement for the debate. On the contrary, Spencer's "rational opposition" (his own words) against compulsory metrication greatly impacted the transatlantic anti-metric circle.[80]

Following the "practical" argument of Spencer were two leaders in the American anti-metric circle: Frederick Halsey and Samuel S. Dale. Halsey was educated at Cornell. As I will elaborate in this dissertation, he helped pioneer "systematic management," which became one of the governmental directives of KMT's metrological administration in the 1930s. Samuel S. Dale was an editor for several key trade magazines in the textile business, such as *Textile World Record*. At the

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[78] Vera, *The Social Life of Measreus*, pp. 360-364.
[79] Kai Erwen (Lord Kelvin), "Da kexuejia duiyu duliangheng gongzhi zhi lunzheng"[The justification of the metric system by a great scientist], in Gongye biaozhun yu duliangheng, 1934, vol. 1, no. 1, pp. 9-14.
[80] Ibid., pp. 353-359.

turn of the century, Halsey had emerged as the greatest mind of the American anti-metric camp. He wrote and distributed a voluminous study as a report to combat the 1912 metrication bill in the hearing of the U. S. congress, which was published as the book.[81]

The Metric Fallacy came out in 1904 as the single most influential book in the history of the metric system in America. Dale also added his own volume, *The Metric Failure in the Textile Industry,* to the book. They argued that the transition to the metric system was undesirable based on practical and economic reasons. Specifically, changing an established system of weights and measures represented the destruction of the existing mechanical standards. Foreign commerce did not desire the adoption of a new system in manufacturing. Industrialization would suffer, as the metric system was incompatible with existing production processes. Britain and the United States thus had "the simplest and the most uniform system of weights and measures of any country in the world."[82]

To prove their points, China was once again an argument. Halsey wrote to the Chinese Vice Consul in New York and got confirmed information that English measures were widely used in China. In China customs, English inches were the legal standards in the tariff settled by treaty between the two nations. On the other hand, Halsey alleged (though falsely) that the metric system was only confined to 28 treaty ports.[83] Because of the prematurity of English textile industries and their dominant position in 19the century, some English industrial standards were more authoritative and general than any metric standard. As an expert in textile industries, Dale confirmed that the British 300-yard system was the world's single standard for linen, jute, hemp,

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[81] Stephen Mihm, "Inching toward Modernity: Industrial Standards and the Fate of the Metric System in the United States", in *Business History Review*, 2022, vol. 96, no. 1: Standards and the Global Economy, pp. 47-76, p. 67-70.
[82] Frederick A. Halsey and Samuel S. Dale, *The Metric Fallacy and The Metric Failure in the Textile Industry*, New York: D. Van Nostrand, 1904, pp. 16-17.
[83] Ibid., p.23, 48, 72.

and allied fibers. A pinner in Chinese was identical to that in any other country.[84]

In Britain, George Moores also followed the way Spencer, Halsey, and Dale laid down. Since 1904, Moores constantly used practical arguments to combat his enemy.[85] Samuel Dale, particularly, gained great attention for his defenses for English standards in the textile industry and foreign trade.[86] While their viewpoints were shiningly evident in the petition letter given to the Chinese Ministry of Foreign Affairs, the Ministry was not entirely persuaded by it. The Ministry consulted the issue of turning English metrologically with various Chinese embassies abroad. Zhou Ziqi (周自齐), the counselor of the Chinese embassy in the U. S., replied by suggesting ignoring the petition. Zhou confirmed that even British people themselves quarreled about abandoning English measures for the metric system in their parliament. Instead of taking British measures, Zhou recommended a direct adaption of the metric system.

Zhou even managed to secure the support of the National Bureau of Standards of the U. S. The Bureau was founded in 1901 and was the child of the American metrication movement formed in the 1890s.[87] It was modeled on Germany's famed Physikalisch-Technische Reichsanstalt and aimed at advancing scientific and technological studies. As the federal institute of metrological affairs, the Bureau was also the major pusher of metrication in America in the first half of the 20th century. The campaign that the Bureau waged during 1902-1906 almost led to an officially recognized compulsory metrication in the United States, and naturally, it became the bitter foe of the American anti-metric camp clustering around Halsey and Dale.[88] Naturally, it applauded

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[84] Ibid, p. 160.

[85] For example, George Moores, "The Inch Versus the Metre for a Universal Metric System", in *Cassier's Magazine*, November 1904-April 1905, vol. 27, pp. 157-160.

[86] One of the imitations of Dale's viewpoints, see, "The Metric System", in *Journal of the Royal Society of Arts*; December 5, 1913, p. 62.

[87] It was already the second campaign after the 1890s. The first campaign, from 1866 to the 1880s, had failed Infront of the attacks of engineers. For both campaigns, see, Cox, *A History*, Ch. 8&9.

[88] Mihm, "Inching Toward", pp.64-65.

Zhou's idea of making China metric and offered to select Chinese students in the U. S. and train them as metrological inspectors for China.[89] Receiving Zhou's reply, the Ministry of Foreign affairs denied the English merchants' petition, together with Zhou's proposal, as the Qing court had already made up its mind to keep Chinese customary measures.[90]

Outside Qing's officialdom, British merchants' ambition to influence the Chinese metrological future caught the worrisome attention of some Chinese elite, for the former's passion was easily viewed as an attack on China's metrological sovereignty. Sun Hongzhe(孙鸿哲), a British-trained railway expert, stated later in 1914 that the BWMA's letter to the Chinese ambassador was an "unreasonable demand from foreigners" because the metrological reform was China's internal affairs: "Foreign powers have absolutely no rights or reason to interfere." Sun correctly saw the motives of such violation, as he noted that "the countries following the British system, such as Great Britain and U. S., have considerable commercial interest and investment in China. China's possible switch to the metric system gave Germans, Austrians, and Italians the opportunity to compete for markets, which would surely jeopardize Britain's business".[91]

However, Sun opined that China could successfully fence off this "unreasonable demand" because the metric system was on the winning side of history. After all, voices advocating for the metric system never ceased, even in England. Sun followed the fore-mentioned debate on *The Times*. Although the 1907 metrication bill was a failure in Britain, in his view, he stood with the pro-metric camp and saw "the defeat of few merchants in front of the coordinated and lengthy criticism

[89] ASIMHA: 02-13-003-02-054, "Zhu meiguo daiban diancheng yingmei shang yaowo gaibian duliangheng zhi qing heban you" [The reply from Counselor of Chinese embassy in the U. S. to the requirement of changing measures form American and English merchants], 27 January 1908. 7

[90] "Duliangheng gaizhi zhi jiahua" [The plan for metrological change], in *Guangyi congbao*, no. 164, February 1908.

[91] "Teilul gaiyong duliangheng xinzhi yanjiu an" [Research on metrological change for railway system], in *Tielu xiehui huibao bacui*, 1914, vol1-2, no. 1-15, pp.587-593, p. 587.

from dozens of academic societies who favored the metric system.”[92]

Global Response to Chinese Metrication

The Qing reform did not trot far, as the dynasty came to its demise in 1911 along with its metrology. The preliminary preparations for transition happened in Beijing and Sichuan province but were bankrupted as the revolution started first in Sichuan coincidentally and spread to the whole realm.[93] Nevertheless, the torch was handed soon to the Republic of China. While Qing’s new metrology was characterized by its adherence to Chinese metrological heritage, in 1912, the Ministry of Industry and Commerce of the young republic devised a far more radical plan. It proposed to abandon traditional measures once and for all and legalize the metric system as the sole official metrology. The transition would be finished in 8 years. The Ministry justified it with a simple reason: Chinese measures were not scientifically grounded, whereas most nations took the metric system.[94] In other words, instead of taking practical advantages brought by unified metrology into consideration, like in the late Qing, the ideals of universalism and science characterized the Ministry’s decision to go metric.

In August, the proposal was submitted to the higher authority and distributed to other ministries for further discussion. While the details of the new metrology, such as nomenclature, had been debated, none of the central ministries expressed their opposition to abandoning traditional measures. Only the Ministry of Transportation uttered its doubt and suggested that

[92] Ibid., p. 588.
[93] Shi and Zheng, “Qingji huayi”, pp. 129-131.
[94] Gongshangbu gongwusi [The Department of Industrial Affairs, the Ministry of Industry and Commerce], *Gongshangbu duliangheng shuoming shu* [Introduction to the new metrology], Gongshangbu gongwusi, 1913, pp. 19-21.

traditional measures should be unified too and allowed for a short period of time to smooth the transition to the ultimate adaption of the metric system.[95] As a result, the final proposal extended the timespan of the coming reform from 8 years to 10 years. It also recognized the importance of gradual transition; governments would use new measures first, then among merchants and common people, who would have three years to prepare for the transition.[96]

However, the plan did not go through in the Chinese Congress. Most congress members cast their doubts on the metric system. It was suitable for learning physics yet did not conform to the needs of common people who did not express their opposition to long-standing traditional measures. Forcing them to give up old measures was not recommended at all.[97] The proposal was vetoed by 56 against 15. The Ministry of Industry and Commerce continued its efforts by sending officials to investigate metrological affairs in France and Japan since 1913. The Ministry also established a direct connection with Bureau International des Poids et Mesures, which happened to hold its fifth international conference in October. Chen Chengxiu (陈承修) and Zheng Liming (郑礼明) were sent to BIPM with the Ministry's proposal for new metrology and introductory materials for the former reform in late Qing.[98]

Chen Chengxiu received his education in a commercial school in Osaka, Japan. Chen was in a higher position than Zheng but soon left the cause of metrological unification later. However, Zheng Liming was an important figure in the Chinese metrological administration for several decades later

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95 ASIMHA: 03-46-016-01-005, "Jiaotong bu shuitie"[Opinions from the Ministry of Transportation], 13 August 1912.

96 ASIMHA: 03-46-016-01-007, "Gongshangbu gaige duliangheng nianxian mingcheng shuitie(fu tuixing banfa)"[Opinions from the Ministry of Industry and Commerce on the timespan and nomenclature of metrological reform (The procedure of promotion attached)], 14 September 1912.

97 "Beijing dian: canyi yuan shenyi xin duliangheng yian" [Telegram from Beijing: the congress reviewing new metrological proposal], in *Shenbao*, 30 October 1912.

98 ASIMHA: 03-46-016-01-013, "Faguo duliangheng gonghui kaihui jiansong duliangheng shuoming shu qing zhuanji you" [Transferring of introductory materials to French BIPM's conference], 4 September 1913.

to come. Born in 1882, he graduated from Foochow Shipbuilding Institution and trained as an electronic engineer at the University of Liege. Zheng was the chief of Beijing's national metrological Bureau until 1921. He continued to serve as a Deputy Ministry of Industry and Commerce in the KMT government and held a concurrent position as the chief of Nanjing's National Bureau of Weights and Measures since 1938.[99]

Zheng and Chen's appearance in Paris was an auspicious sign for the international metric Bureau. The conference regarded the presence of China as proof that "the metric system is in constant progress." China had already received great attention from BIPM before the 1913 visit. In 1907, under the request of the Qing government, the Bureau constructed the standards of length and mass in platinum-iridium. BIPM had set a special ceremony for the handover of standards, which was "full of symbolic grandeur." Though Qing did not take the metric system, BIPM still expressed its appreciation since traditional Chinese metrology was "almost entirely decimal." This time, Chen and Zheng introduced the progress of Beijing reform and that China had set a deadline of ten years to complete its gradual transition to the metric system. Their presence bore significant meaning in the eyes of BIPM since it represented a "new step": "the Chinese Republic, the youngest and the most populous in the world, has sent two officials to the International Bureau, whose presence is for us a sure guarantee of the adhesion of their great homeland to the metric system." BIPM allowed Chen and Zheng a few weeks at the Bureau, "studying the methods of metrological research."[100]

Chinese presence in the most influential international metrology conference and the message

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99 "Zhici: huanying zheng Langzhao xiansheng" [Speech on welcoming Mr. Zheng Langzhao], in *Duliangheng tongzhi*, 1940, no. 24, pp. 1-2.

100 BIPM, COMPTES RENDUS DES SÉANCES DE LA CINQUIÈME CONFÉRENCE GÉNÉRALE DES POIDS ET MESURES, RÉUNIE A PARIS EN 1913, p.14, 62

of China's metrication plan have greatly encouraged people in the British pro-metric camp, one of which was G. E. M. Johnson, the secretary of the Decimal Society. Johnson was the arch-enemy of George Moores. Bitter debates and contestations defined their relationship in the 1900s.[101] However, in the early 1910s, the metric camp was outgunned. While the chambers of commerce, municipalities, and many other public bodies were clamoring for the metric system in the 1860s and 1890s, Moores and BWMA successfully reduced the number to "half a dozen." Moores declared his triumph over Johnson and the Decimal Association. He even taunted his enemy in public media by asking, "why all this change of attitude?" And if Johnson had any difficulty in ascertaining the reason, he shall be pleased to help him.[102]

Johnson expressed his appreciation of the Chinese metrological legacy: "from time immemorial, decimal arithmetic and decimal coinage have been used in China."[103] He knew about the Chinese reform in late 1913. After both returned to Beijing in late 1913, Chen Chengxiu received an inquiry from *the Morning Post* in London about the metrological reform in China. Chen's replied in December that he understood that one of the obstacles to British metrication was because it was feared that the Chinese would not understand the metric measures". Chen assured English readers that "the meter and kilogram are not entirely unknown in China. Children learn the system in the schools, and the government uses it also in many departments." Rather than being a hindrance to trade with China, Chen believed that the metric measures would be an advantage in a few years to come. Chen ended his reply by saying that he hoped the English would introduce the metric system shortly. Johnson was much excited by the message and quoted Chen in his article in *the*

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101 For instance, a debate between the two happened during 1905 on *British Medical Journal*. A brief coverage of it sees please, *British Medical Journal,* 1905 Jan 21, p.168.
102 George Moores, "Weights and Measures" in *The Spectator*, Sep 16, 1911, p. 414.
103 G. E. M. Johnson, C*urrency Reform*, p. 5.

Journal of the Royal Society of Arts. He treated it as Chinese consent to metrication and a strong counterargument to the trade point made by the anti-metric camp.[104]

While Moores seemed to be silent in front of Johnson's new discovery, Samuel Dale responded from the U. S. He gave his long response a week later, in which he meticulously scrutinized and attacked Chen's viewpoints. He doubted Chen's words would bear any authenticity because if he did not study in Paris but "throughout the world," he would find that "there is but one efficient method of introducing the metric system, that is by force." Even if the metric system might force its way into China, it was not possible to "force out" other established systems of weights and measures. The result was confusion by adding the "incommensurable metric standards" to the existing Chinese system. Chen alleged that Chinese schools taught the metric system already. But Dale pointed out that American children had been "learning" the metric system for the past fifty years and "forgetting it as soon as they leave school." China would be the same. Since 1907, the Department of Commerce and Labor has collected thousands of Chinese cotton goods samples through special agents. All these samples were in English measures. Put school children and the Chinese government aside, Chinese merchants would not understand the metric system, as "their ideas of the weight, length, texture, value, and price of cotton goods are based on the British standards." The English system and English language were "so firmly established in the Orient" that Chinese authorities should conform "as far as possible to the prevailing British system." The result of forcing the metric system on the Chinese people would otherwise furnish an example of "the impotence of authority and the uniformity of confusion."[105] Johnson fought back a week later by pointing out that although the majority of the textile exports were still going to "non-metric

[104] G. E. M. Johnson, "The Metric System", in *Journal of the Royal Society of Arts*, Dec 19, 1913, p. 100.
[105] Samuel S Dale, "The Metric System" in *Journal of the Royal Society of Arts*, Jan 16, 1914, p. 180.

countries," "certain Oriental countries" would change the industry. While Dale alleged that Chinese merchants who import textiles would not "understand the meter," Johnson did not believe that "the intelligence of the Chinese merchants is inferior to that of the merchant in many other countries where the metric system has been successfully introduced."[106]

The debate also stirred up foreign communities in China, particularly merchants in Shanghai. Johnson continued to muse upon the significance of Chinese metrication in 1914 and pointed out to his readers in China that since "no country which has reformed its weights and measures has yet adopted the British tables," it was hardly to be wondered that China "entirely ignores our complicated units." In his view, the Chinese government "consulted the best experience of England and the Continent." He also appraised Chen and Zheng's visits to Europe, which he deemed also contributed to China's decision to go metric.[107]

While Chen and Zheng did play their parts, other players also shaped the Chinese decision of metrication at the time. In 1913, Zhang Jian (张謇), an influential industrialist, became the Minister of Agriculture and Commerce. Zhang had already urged the Qing court to follow Japan's example of unifying measures in 1901 when he began his modernization projects in Nantong, where he built textile factories, museums, and schools.[108] Zhang regarded metrological unification as the foundation for industrial development in China. As Zheng, Chen, and other delegates returned at the end of 1913, Zhang participated in a series of discussion sessions with them. Their new metrology proposal appeared on the desk of President Yuan Shikai in February. It still took the metric system as the goal; however, it also planned to legalize Qing's official treasury measures (营

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[106] G. E. M. Johnson, **"**The Metric System", in *Journal of the Royal Society of Arts*, Jan 23, 1914, p. 198.
[107] "Chinese Weights and Measures" in *The Shanghai Times*, Aug 12, 1914.
[108] "Zaixu Zhang jizhi dianzhuan jian bianfa pinyi" [Following installment of Zhang Jian's reform proposal], in *Shenbao*, 12 May 1901.

造尺, 库平) after they were calibrated and unified. The reason was to combine "the new theory in the world" and "national tradition." While there was no evidence suggesting that Zheng and Chen's involvement in the metric debate in Britain resulted in this change, Zheng Jian justified it with a clear reference to the U. S. and Britain: "If we follow the continental metrology like France and Germany, why did not the U. S. do the same? If we abandon traditions dating back to Tang and Han dynasties in order to become a civilizational nation, why did England not do the same?" As both nations did not give up their traditional measures, neither should China. Zhang prioritized metrological reform in his agenda. Despite the fact that the Ministry experienced a budget deficit at the time, Zhang managed to secure a ten-year loan of two million silver Yuan from American merchants. He also planned to hire a foreign metrological specialist to train Chinese inspectors. For Zhang, the deal was worthwhile in that China could quickly harvest the benefits of unified metrology within 2 or 3 years.[109]

The Beijing government summoned a reviewing committee for the new proposal. Yan Fu, one of the pivotal intellectuals of the time who translated many western concepts into Chinese, was sitting on the committee. According to Wu Chengluo, the chief of Nanjing's metrological administration, it was Yan who suggested putting the character "Gong" (公) as the prefix in front of traditional Chinese metrological nomenclature to denote the metric units.[110] In this case, the

[109] "Guihua duliangheng shuitie" [Opinions on metrological unification], 8 February 1914 and "Niding duliangheng zhiduu dagang cheng dazongtong" [The tentative proposal of metrological unification to the great president], in Li Minxun ed., *Zhangjian quanji* [Full collection of Zhang Jian's works], Shanghai: Shanghai cishu chubanshe, 2012, pp. 297-299, pp.299-300.

[110] Wu Chengluo, "Dulianghen biaozhun mincheng zhi kexue xitong" [The scientific system of standard terms of weight and measures], in *Eastern Miscellany* (1935), vol.32, no.3, p65. The detailed records of the meeting could not be identified. However, Zheng Liming related later in the 1930s, that Yan Fu intended to translate the metric terms phonetically or follow Japanese method to make new characters at first. He turned to character Gong later, for common people were accustomed to traditional terms. See, Zheng Liming, "Shijin gongzhi zhi bianli ji tuixing duliangheng zhi guanjian" [The convenience of decimal metrology and opinion of the promotion of new measures], in *Gongye biaozhun yu duliangheng*, 1935, vol.1, no. 11, pp. 3-7, p. 5.

"Gong" as a distinctive concept was heavily featured in Yan Fu's works. For example, Yan Fu resorted to the term "Gong Li"(公理), or "universal principles", when he translated Thomas H. Huxley's book *Evolution and Ethics*. For meter would be called Gong Chi, or universal Chi (公尺). According to Wu, Yan took the character from a Confucian canon, "The Conveyance of Rites" in *The Book of Rites* (礼记礼运篇), which contained the line that "when the great way prevails, the world is equally shared by all" (大道之行也，天下为公). In this regard, Gong carried a strong sense of universalism. Indeed, ever since the late Qing, the character "Gong" appeared in the Chinese translation of "metric system," or "Wang Guo Gong Zhi" (万国公制), literally meaning "the universal metrological system of ten thousand nations." Beijing Government also established the Gregorian Calendar as the official Calendar, which was called again, Gong Li (公历), or the universal Calendar. Yan's choice of words for the nomenclature of the metric system symbolized an accommodating strategy to the global norm and Chinese metrological tradition. On the other hand, it is ironic that Hebert Spencer was one of Yan's most important intellectual inspirations. Yan began to translate Spencer's 1873 book, *Principles of Sociology* into *Qunxue Siyan* (群学肆言) and also the famous social Darwinism slogan "survival for the fittest" into Chinese as "Shi Zhe Sheng Cun" (适者生存) in his earlier translation of Thomas H. Huxley's book *Evolution and Ethics*.[111]

The proposal was put into practice in 1915, as Beijing promulgated its metrological law, which

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Yan and other prominent thinkers at the time, such as Kang Youwei (康有为), "universal principles" was an overarching concept that science, liberty and democracy all felt within its contours. Instead of dancing closely to the evolutionist tune of Huxley, Yan brought a strong sense of morality to this term, in that the universal principles as embodiments of moral justice would triumph over sheer might in the international arena. See, Yan Fu, "Lunshuo: you qianquan wu gongli ciyu xingyu?" [Discussion: is it true that might would win over universal justice?] in *Tongxue bao*, 1906, vol. 1, no. 4, pp. 119-127. Also, Wang Hui, *Xiandai zhongguo sixiang de xingqi* [the rise of thoughts in modern China], Shanghai: Sanlian press, 2004, particularly vol.3 with the study on "worldview under universal principals" of Yan Fu. On the historical evolution of the idea "Gong", see Goukou Xiongsan, *Zhongguo de gong yu si* [China's Gong and Si], Shanghai: Sanlian Shudian, 2011.

Besides "Gong"s many volatile historical meanings, "Gong" also was tightly bounded with political authorities such as emperor or nation-state. For instance, "Gong Jia"(公家) could be the synonym of "government". It was this connotation that later caused discontent from scientists in the 1930s, which I shall turn to in my chapter 5.

[111] We do not have enough evidence to ascertain that Yan knew Spencer's metrological perspective. Yan began to translate Spencer's *Principles of Sociology* in the 1890s, and had it published in 1903 in Shanghai. In 1896, Hebert Spencer first published four letters of his opposition against metrication in the London newspaper, *The Times*. He published another 4 letters in 1899. These letters were collected and republished in his volume of essays, *Various Fragments* in 1914, when the discussion of the metric system happened in the Beijing government. Even though the two timelines did overlap, to the best of my knowledge, Yan left no recordings or commentaries on Spencer's metrological position. See, Vera, The social life of measures, p. 342.

simultaneously legalized Qing's official system and metric system. In 1915, Zheng Liming, for his experience of studying in BIPM, was charged by the Ministry to train 16 inspectors. They began to operate in Beijing, which had been appointed as an experimental zone for the reform.[112] The experiment did not trot too far since only Shanxi province temporarily responded to the call from the capital in the 1910s. Yunnan and Jiangsu provinces only followed in the late 1920s, when KMT's new metrological was going to replace Beijing's scheme soon in 1929.[113]

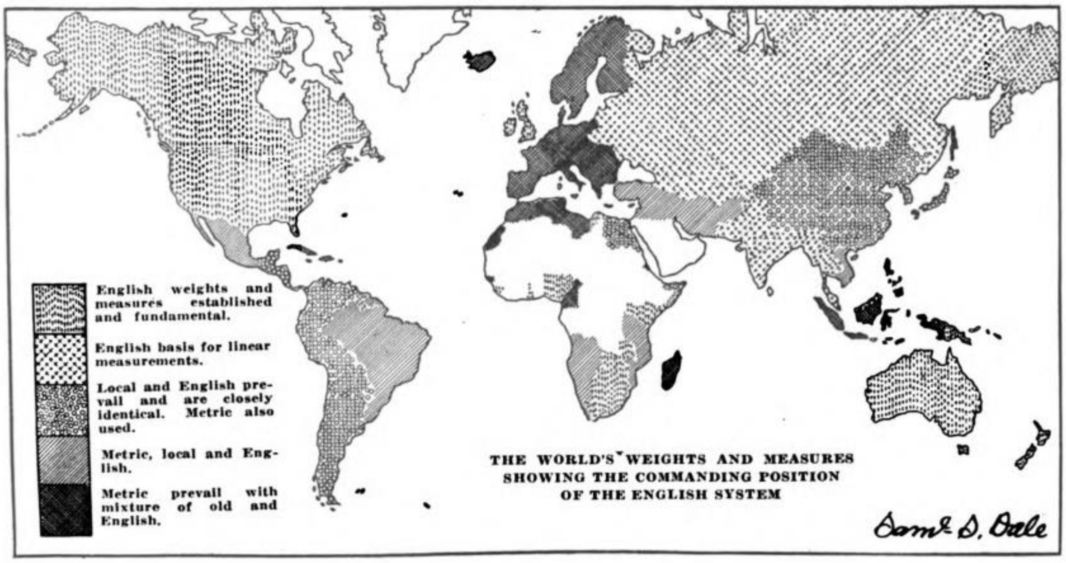
However, China's official metrication in 1915 had wider repercussions in the trans-Atlantic forum. For both sides in the debate, China was a major factor that could shape the general global metrological landscape. The major reason was China's vast population. Pro-metric camp meticulously recorded the number of metric nations and the total population as their major argument for global metrication. It was simple yet powerful proof of who was winning. Halsey, a central figure of the transatlantic anti-metric movement, was deeply vexed by this method. He criticized that the metric camp in Britain and the U. S. "simply added the figures for the population" of the countries who have passed "some kind of a metric law," without investigation of how the metric system was actually implemented."[114] Frederick Halsey rewrote *The Metric Fallacy* in 1920. Former contents about China such as the textile trade was replaced by a new evaluation that English measures were "well known" in "commercial" China. Samuel Dale added a new global map as "the only comprehensive, authentic exhibit of the weights and measures situation of the world as it exists today," which justified "the commanding position of the English system." China was in

112 "Mingling; Nongshang bu cheng tuixing quandu xinzhi qing xian zhiding jingshi wei shiban quyu zhuo ni jinxing banfa bing liantong biaozhun ji tuyang qingdan chengqing xunshi shixing wen bing piling" [Orders: Ministry of Agriculature and Commerce's appeal to appoint Beijing as experimental area for metrological reform, devise the method of promotion and send standards samples and pictorials], in *Zhengfu gongbao*, no. 1119, 20 June 1915, p. 15.

113 Shi Huijia "Minchu Beijing zhengfu", pp. 161-169.

114 Halsey and Dale, *The metric Fallacy,* p.4.

this map a place where "local and English prevail and are closely identical," albeit "Metric also used."[115]



Sam'l. S. Dale

THE WORLD'S WEIGHTS AND MEASURES, SHOWING THE COMMANDING POSITION OF THE ENGLISH SYSTEM.

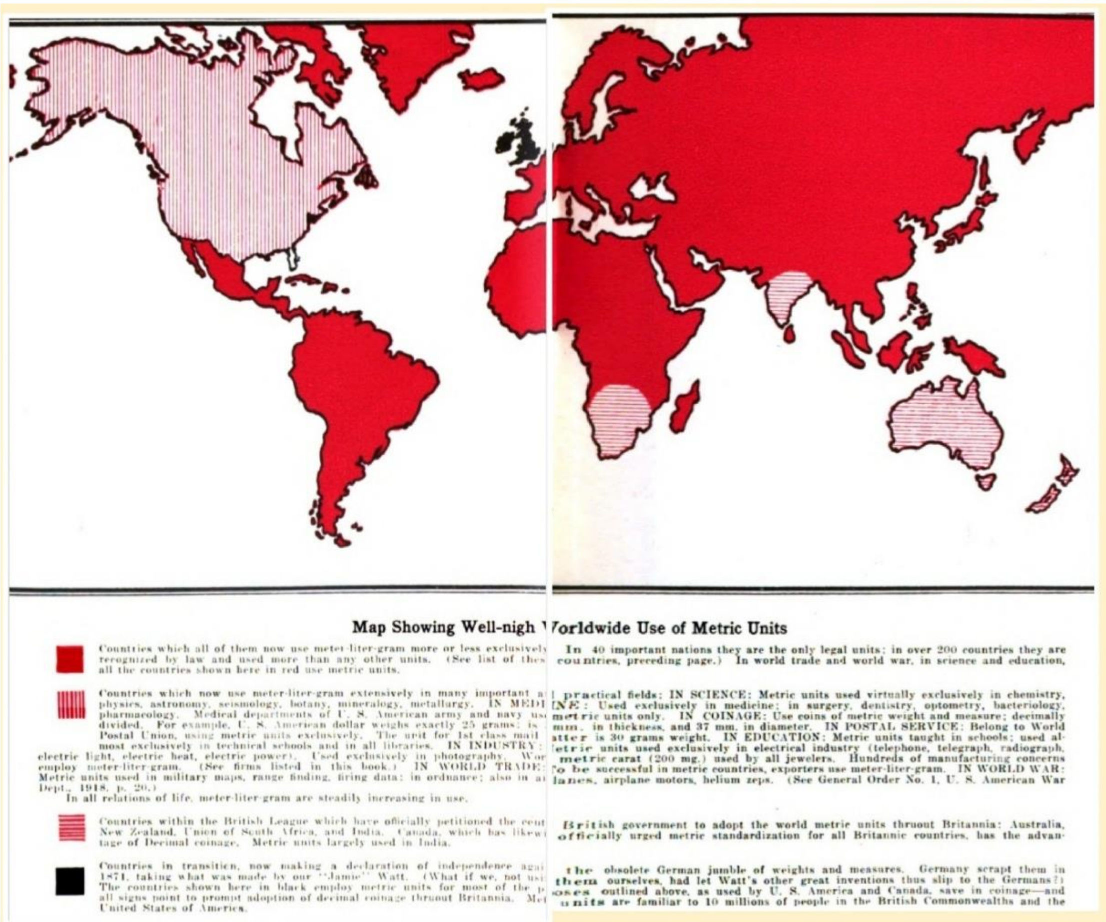
This map summarizes the results of investigations that have been in progress nearly twenty years. These investigations are unique of their kind, and this map is the only comprehensive authentic exhibit of the weights and measures situation of the world as it exists today. It is an answer to the assertion that the metric system is in universal use except in the United States and Great Britain.

Other the other hand, gaining populated areas into the metric world was one of the main concerns of the global pro-metric camp. For instance, BIPM in Paris relied on contributions from its members to sustain the operation, and the contributions were generally calculated by the population. However, it made the specific regulation that the normal contribution of its member state "may not be greater than 15% of the total endowment, whatever the population". The reason for this arrangement was to ensure that "China, India or both will want to join the Meter Convention," whose population "is greater than the total from those currently acceding states."[116] China's metrication in 1915 decidedly reshaped the global metrological balance. In this context,

[115] Frederick A. Halsey, *The Metric Fallacy: An Investigation of the Claims Made for the Metric System and Especially of the Claim that Its Adoption Is Necessary in the Interest of Export Trade*. 2ed edition. New York: The American Institute of Weights and Measures, 1920, p.157 and p. 185. For the map, see, p. 125.

[116] BIPM, COMPTES RENDUS DES SÉANCES DE LA SIXIÈME CONFÉRENCE GÉNÉRALE. DES POIDS ET MESURES, RÉUNIE A PARIS EN 1921, p.48.

the American pro-metric camp's interest in China began to rise. Aubrey Drury was an example. Drury was the most influential organizer of various pro-metric activities from 1920 to 1950 and a relentless worker for American metrication.[117] In 1922, he edited a book titled *World Metric Standardization*, with a copious volume of testimonies around the world that urged worldwide adoption of the metric units, including rich information about China that he got form various channels. He also provided a global map in this book, showcasing the victorious marching of global metrication, where China was categorized as a nation that used the metric system "more or less exclusively."[118]



[117] Vera, *The Social Life of Measreus*, p. 296.

[118] Aubrey Drury, ed., *World Metric Standardization: An Urgent Issue*, San Francisco: World Metric Standardization Council, 1922. The map is on pp.2-3.

As I will elaborate later, China, in fact, could not be qualified as a fully metric country since the Beijing reform was never effectively implemented. In this sense, Halsey and Dale's descriptions were closer to the true metrological status in China. Drury nevertheless wanted to strengthen the population argument. He wrote to Shi Zhaoji (施肇基), then the head of the Chinese delegation to the U. S., to ask about the actual status of the metric system in China. Shi replied in December 1921, giving him an affirmative answer that "the modern metric system is gradually coming into use" and that he was "thoroughly in sympathy with" the American metric camp and their vision of "general standardization of weights and measures throughout the world."[119] Drury regarded Shi's words as an official confirmation and was inspired by it to the extent that he called 1921 a "great Year for metrics" since he believed China, along with other countries, was already metric. Drury wrote, "China, with 400.000.000, has kept up the process by which it is gradually advancing to the metric units in merchandising and industry."[120] As I will show later, 1921 saw basically no major improvement in metrological unification in China, nor was the population number accurate. However, for Drury, the inclusion of China. He alleged that the global metric population had already outnumbered the non-metric population by at least 4 to 1. The Chinese population, which equaled approximately that of "the whole of continental Europe," would bring a final strike on the anti-metric camp. In this regard, he contended that "China **should** (original emphasis) be added."[121]

Samuel W. Stratton, the chief of America's National Bureau of Standards who had lent a helping hand to the late Qing reform, also noticed the progress of Chinese metrication. A physicist serving

[119] Ibid., p.188.
[120] Ibid., p. 528.
[121] Ibid., p. 36, p. 498.

as a professor at the University of Chicago, Stratton was an important player in American metrication since the 20th century. Stratton and Drury were members of the American Metrication Association, the most influential metric organization among scientific academia since its founding in 1916. The Association held its annual conference in Chicago on 29-30 December 1920. "A number of Chinese" attended the Chicago meeting. These Chinese told the Association that it would be more "helpful and successful" if Americans conducted business with China in terms of the metric system. They also briefed Americans about China's success in metrication in past years. For instance, "Chinese steel works at Pan Yang" (汉阳铁厂) produced rails in metric units. Likewise, the metric system laid out the project for reclaiming the flood districts along the Grand Canal. Stratton seemed to be impressed, as he emphasized the extended use of the metric system in the world was "enhanced by the fact that China, a country of 400.000.000 people, is now in the process of adapting the metric system[122]

All in all, China in the 1920s was no longer a member of the "metrological third world." Instead, it became a model for many in Britain and the United States. Isaac Taylor Headland (何德兰), an American missionary in China in the late 19th century, suggested to his people in the early 1920s that "the Christian world" must follow "the progressive spirit of China" in her courage to abandon tradition for "posterity."[123] In this sense, China's metrication was not only passively influenced by global metric expansion but also influenced the trans-Atlantic debate and decidedly shaped the global metrological landscape since the 1910s.

[122] Ibid., p. 312, p. 167.
[123] Ibid., pp. 246-247.

A Chinese System for the World?

While the Chinese government ruled out the British system and embraced the metric system, it was hardly the end of China's search for working metrology. Another important dimension was the efforts to restore and revive traditional Chinese metrology, which never ceased from the late Qing to the end of the 1930s.

Ye Zaiyang was an early example. Ye Zaiyang was a low-rank official in the late Qing. As a French teacher, he graduated from Foochow Shipbuilding Institution (福州船政学堂). The institute was China's first modern naval school, with teachers from France and Britain. Students were taught French, Math, the metric system, and also British measures (since they were dominant in naval navigation). In 1905, Ye wrote his proposal for new Chinese metrology in the form of a book, *Duliangheng xinyi* (度量衡新议). Ye visited Yan Fu in Shanghai and asked him for a short preface. As Ye's fellow county man and senior alumni of Foochow Shipbuilding Institution, Yan granted Ye's wish. Ye's book made his fame as a metrological expert in the late Qing when the court tried to launch its metrological reform. Ye was invited by Zai Zhen (载振), a modern-minded young prince, to participate in the New Policies reform. Yet Ye failed to make a bigger mark in Chinese metrological history, as he died soon in 1907.[124]

Ye recognized that science was an indispensable foundation for any working metrology in this world. Chinese metrology was supposed to be based on the length of several millet grains. "Millet was a plant," Ye explained, "its grain's plumpness and size easily changed in several centuries.

[124] Liu Zengqiang, Feng Lisheng, "Ye Zaiyang dui zhongxi duliangheng de yanjiu yu qingmo duliangheng de gaizhi: yi duliangheng xinyi wei zhongxin" [Ye Zaiyang's Study on Chinese and Western Weights and Measures and the Reform of Weights and Measures in the late Qing Dynasty: Focusing on His *Duliangheng xinyi*], in *Ziran kexue shi yanjiu*, 2018, vol. 37, no. 1, pp. 71-86.

Metrological errors are inevitable." On the other hand, Ye held that the metric system was far more stable than Chinese measures as it took a part of the meridian line as its base. However, the meridian line slightly changed its length due to the centrifugal force brought by Earth's rotation. Ye proposed to take the equator as the base for the new Chinese Chi, which equaled 1/129.600.000 of equatorial length. The weight and volume units were derived in a similar way to the metric system, as a Dou was cubic Chi and Jin was the weight of water in a cubic Cui. The whole system was also strictly decimal.[125]

Ye's new metrology marked the inauguration of efforts that aimed at making traditional Chinese measures scientific. To this end, Ye was not alone. Zeng Houzhang (曾厚章) was one of the first Chinese scientists who paid attention to the measure issue in the late Qing. Zeng became interested in measures when he taught in a school in his youth. He published his studies on measures in the late Qing, and in the late 1920s, when the discussion of measures reappeared again, Zeng republished his former studies. Very much like Ye, Zeng believed that there were some fundamental flaws in the metric system scientifically. He followed Ye's criticism of the meridian line's stability and contended the equator's superiority. In his view, Chinese scientists' former calibration of traditional measures, such as that of Li Shanlang (李善兰) and Ye, set a glorious example. For Zeng, Chinese scientists were entirely able to provide a solid scientific ground for traditional measures.

But what made Zeng's stance more special was his cultural stance on the issue. For him, the competition in the metrological arena since the late Qing was not merely "a problem of science or a competence for Chinese scientists" but also about the "pride of the Chinese nation and Chinese

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[125] Ye Zaiyang, *Duliangheng xinyi* [New discussion on metrology], 1905, no page marks.

civilization." In a great sarcastic tone, Zeng explained why he decided to republish his early work:

> "The reformers are likely to criticize not only the old system but, along with it, our good ways of tradition. The young people who love to talk about foreign affairs just mindlessly follow and regard these trivial opinions as guiding lines [...] To cure choking is acceptable, but abandoning eating for it is not. An ugly woman imitating a famous beauty is fine, but disfiguring her face is not. Taking the problematic western system as our way, we have already lost our independent spirit; to obliterate our traditional decrees, isn't it a shame for all Chinese people?"[126]

Despite their cultural stance, we shall not mistake these scientists as pure traditionalists, nor did they oppose the idea of science per se. Zeng and Ye had no problem applying scientific elements to their proposals. For them, science itself was not a clear-cut demarcation between China and the world, nor modern and traditional. Far from abandoning science for tradition, their core concern was to "scientize" the conventional measures in the competition of the metric system for China's metrological future. The followers of Ye and Zeng constantly emerged. However, some of them were far more ambitious than Ye, as they were not satisfied with giving a third choice to China but also to the world. The most representative one of this kind was Fei Delang (费德朗) or P. Vittrant.

Who was P. Vittrant? Current studies only pointed out that he was a dean of the physics department at Aurora University (震旦大学, Université L'Aurore)[127], a Catholic university located

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[126] Zeng, *Zhongwai duliangheng*, "Yuanqi" [The reason for writing], pp. 1-2.
[127] For Aurora University, its Catholic background, and its unique role as a French higher education flagship in China,

in the French concession in Shanghai, where he spent much of his life time. In fact, his real name was Michel Vittrant, and "P." was the abbreviation of "Père" (Father), as he was sent to Shanghai as a Jesuit missionary. It seemed that religious background was important for Vittrant's self-identification, as he published his studies of metrology in Chinese media in the 1920s under the name "P. Vittrant" (费德朗), which explained his mystery. P. Vittrant, or Michel Vittrant was born in 1882. Vittrant spent his scholastic years under the British flag. He received his training in science and theology first at St. Helier on the Island of Jersey and later at Hastings in England. [128] Vittrant set for China later and was at the Zi-Ka-Wei(徐家汇) scholasticate from 1915 to 1917. He then taught at Aurora University from 1917 to 1940 and was again attached to the scholasticate from 1940 to 1951. As CCP took it all over after 1949, the Jesuits closed the university and left continental China in 1951. Vittrant returned to France, taught physics at the École Sainte-Geneviève and passed away shortly after in 1953. Vittrant's Chinese experience defined the person. In a report Vittrant submitted to the Jesuit Order, which evaluated the biblical measures of *homers* and *omer* in 1953, the archivist marked above Vittrant's signature: "ex- 'Chinese.'"[129]

Indeed, if we look at Vittrant's proposal, it radiated a strong admiration towards Chinese historical metrology. Vittrant's interest in Chinese metrology began to grow during his Aurora years. In 1919, he published his nine pages proposal for new Chinese metrology in French, *Mesures Décimales* in Shanghai. [130] It was swiftly translated into Chinese and appeared in *Eastern*

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see, Steven Pieragastini, "A French University in China? The Forgotten History of Zhendan University (L'Universitél'Aurore, 震旦大學 Zhendan daxue)" in *Outre-Mers, Revue d'histoire* (No. 394-395, 1er semestre), pp. 85-103.

128 M. Vittrant, "A Note on the Unification of the Units of Measurements in the United States, the British Empire and in China", in *Bulletin of the American Association of Jesuit Scientists, Eastern Section,* March 1925, vol.2, no. 4, pp. 47-49, p. 47.

129 Vittrant's short biography and his report, see, Christian Bidard and Guido Erreygers (eds), *The Analysis of Linear Economic Systems: Father Maurice Potrons Pioneering Works*, Routledge, 2020, pp. 243-244. The report was titled: "[Report on] Le problème de lamanne des Hébreux" (The Hebrew Manna Problem).

130 Michel Vittrant, *Mesures Décimales*, Changhai: Imperimerie de l'Orphelinat de T'Ou-Sé-Wé, 1919.

Miscellany in 1921. It was safe to say that Vittrant appreciated traditional Chinese metrology more than many of his Chinese peers. He studied the ancient measures recorded in *Zhou li* (*Rites of the Zhou* 周礼), a Confucian canonical work dated back to the Warring States Period (5th to 3rd century BC). He started his proposal by penning down Chinese historical metrology as an "extremely perfect units-system." (极完美之单位制) because of its fundamentally decimal nature and its history of almost 30 centuries.

Vittrant kept traditional Chinese metrological nomenclature in his system and proposed to take 1/120.000.000 of the meridian line as the Chinese Chi (华尺), which was approximately 33.33956cm. In this way, Chi was also scientific since it derived from a natural fact like the metric system. The calculation of area and weight units followed the metric system approach as they were derived from a basic length unit. For instance, Fangcun (方寸) was a squared Chi(11.11dm²), and the basic volume unit was a cubic Chi(37.05dm³). In a similar vein, the basic weight unit, Zhidan (质单, or 质量单位, mass unit), followed the metric precedent, which was the weight of pure water in 4 degrees Celsius in a cubic Chi.

Vittrant's method was like Ye Zaiyang in that they more or less drew from the metric system more or less. But what made his new Chinese metrology novel was his decimalization of Chinese chronometry. The global time system that was commonly used with the metric system in the scientific application was not decimal since a day was divided into 24 hours and an hour into 60 minutes. Vittrant saw this as a flaw and an opportunity. He proposed new decimal chronometry. This Chinese chronometry divided a day into 12 "Chinese hours." (华时) Accordingly, "Chinese quarter" (华刻), "Chinese minute" (华分), and "Chinese second" (华秒) were in a decimal relationship.[131] This decimal time system, according to Vittrant, had a historical rationale:

> "Scholars among the nations felt the inconvenience of current time counting. Some suggested decimalizing time. This reforming approach will surely be easier to prevail in China since China only needs to return to its traditional ways. In ancient times, China had divided a day into 10 hours, before the system was altered in the Han dynasty, when a day was 12 hours, and each hour was eight quarters (刻) with the exemption that the first and the seventh quarters were of 10 quarters. This system was used till the 15th century, which explained its convenience."

Vittrant's observations of China's historical institutions of chronometry were not entirely correct. Indeed, the 12 hours system coexisted with Baike zhi, or 100 quarters system (百刻制) till Ming Dynasty. However, in the Ming dynasty, the first and the seventh quarters were of not ten quarters. Rather, each of the 12 hours was of 8 and 1/3 quarters, and the 1/3 quarter was called a "small quarter" (小刻).[132] Mateo Ricci was the first missionary to challenge the 100-quarters system since 100 quarters were not compatible with 12 hours because conversion between was a headache. Ricci crystalized this predicament as a mathematical question in his *Tongwen Suanzhi* (同文算指), the Chinese translation of Christopher Clavius's *Epitome Arithmeticae Practicae*: "a day in China is of 100 quarters but a day in the western is of 96 quarters. How many Chinese quarters equals 31 western quarters?"[133] Ricci suggested changing it to 96 quarters per day, which made every hour

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131 Fei Delang (P. Vittrant), "Lun zhongguo duliangheng zhi zhi danwei" [On China's Weights and Measures], in *Dongfang zazhi* [The Eastern Miscellany], 1921, vol. 18, no. 24, pp. 43-49, p. 45.

132 See also, Chen Jiujin, "Zhongguo gudai shizhi yanjiu jiqi huansuan" [Chinese historical chronometry and its conversion], in *Ziran kexue shi yanjiu*, 1982, vol.2, no.2, pp. 118-132, pp.122-126.

133 Li Zhizao and Mateo Ricci, *Tongwen Suanzhi Qian Bian* 《同文算指前编(下篇)》, Beijing: Zhonghua shuju, 1985,

even eight quarters. Johann Adam Schall von Bell (汤若望) reiterated Ricci's reformist idea in his bitter debate with dissenting Chinese astronomers such as Yang Xianguang (杨先光) in early Qing. In 1670, with the effort of Ferdinand Verbiest (南怀仁), Emperor Kangxi recognized 96 quarters as the official chronometry.[134]

Moreover, the transformation of time regimes was never an easy task in China or elsewhere. Rather, the habitus of temporality proved to be a constant historical issue that triggered much social turmoil in all echelons of society. Vittrant's new Chinese chronometry was identical to the French Revolutionary Calendar, which devised a ten-days week and divided a day into 12 hours, and an hour into 100 minutes as well. In France, the decimal time system was implemented along with the metric system and decimal currency by the revolutionary government but failed to persist after 1805 when Napoleon abolished it of the social turmoil it caused and the difficulty of maintaining a fixed circle of leap years with it[135]. In China, Gregorian Calendar was promulgated by the republican government in 1912). The debates hinged around the new Calendar, such as its cultural alienness, incompatibility to advice Chinese agricultural production cycle, and even its terminology never ceased for the succeeding several decades.[136] The same radical decimal calendar would most likely fail in China.

Besides time, Vittrant's emphasis on metrological tradition also stood out. Probably knowing that

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p.142

[134] Ma Weihua and Guan Zengjian, "Jiushiliu ke zhi zai zhongguo de queli" [Estalishment of the 96 Units of Chronometry China], in *Shanghai jiaotong daxue xuebao,* 2013, vol. 21, no.1, pp. 46-51. See also, Guan Zengjian, "Chuanjiaoshi dui zhongguo jiliang de gongxian" [Missionaries' Contributions to Chinese Metrology], in *Ziran kexue shi yanjiu*, 2003, vol. 22, supplementary issue, pp. 33-46, pp.38-42.

[135] A relatively short but comprehensive work on French and global experiments of decimal time, see, Hector Vera, "Decimal Time: Misadventures of a Revolutionary Idea, 1793-2008." *KronoScope: Journal for the Study of Time*, 2009, no. 9, pp. 29-48.

[136] An excellent history of Chinese time reform since the late Qing, see, Zhan Xiaobai, *Shijian de shehui wenhua shi: jindai zhongguo shijian zhidu yu guannian bianqian yanjiu* [A social and cultural history of time: a study on conceptual and institutional evolution of time in modern China], Beijing: shehuikexue wenxian chubanshe, 2013.

many would view his proposal as a critique against the spirit of the universalism of global metrication, Vittrant provided his reflection on the idea of “progressive evolution”:

> “Some of you might stand up and question me, that the implementation of the metric system was a global phenomenon […] and why China should be the sole exemption? The new Chinese metrology based on Chi has many benefits. Men should not take global uniformity as an excuse to hinder the progressive evolution of other people […] Chinese metrology was historically inherited, thus was difficult to obliterate but easy to reform and improve. The truth of global progress lays not within accepting things novel, but on the renewal of things old.”[137]

In other words, Vittrant fundamentally questioned the universality and singularity of the metric system as the answer to global metrological progress. Chinese metrology could also evolve into a scientific system by renewing the historical legacy as the foundation for further progress.

Length			Area		
Term	Chinese unit	Metric unit	Term	Chinese unit	Metric unit
引	100 尺	33.33956 m.	方引	10000 方尺	11.11527 ares
丈	10 尺	3.333956 m.	方丈	100 方尺	11.11527 ㎡
尺	1 尺	33.33956 cm.	方尺	1 方尺	11.11527 d ㎡
寸	0.1 尺	3.333956 cm.	方寸	0.01 方尺	11.11527 c ㎡

137 Fei Delang (P. Vittrant), “Lun zhongguo duliangheng zhi zhi danwei”, p.47.

分	0.01 尺	3.333956 mm.	方分	0.0001 方尺	11.11527 m ㎡
厘	0.001 尺	0.3333956 mm.			
毫	0.0001 尺	33.33956 mier.			
丝	0.00001 尺	3.333956 mier.			
忽	0.000001 尺	0.3333956 mier.			
杀	0.0000001 尺	3.3333956 angst.			
Weight			Time		
Term	Chinese unit	Metric unit	Term	Chinese unit	Metric unit
质单	1000 两	37.0568 kg.	华时	10000 华秒	7200 second
两	0.001 质单	37.0568 g.	华刻	1000 华秒	720 second
钱	0.1 两	3.70568 g.	华分	100 华秒	72 second
分	0.01 两	370.568 mg.	华秒	1 华秒	0.72 second
厘	0.001 两	37.0568 mg.			
毫	0.0001 两	3.70568 mg.			

This chart is based on Fei Delang (P. Vittrant), "Lun zhongguo duliangheng zhi zhi danwei" [On China's Weights and Measures], in *Dongfang zazhi* [The Eastern Miscellany], 1921, vol. 18, no. 24, pp. 43-49, pp. 48-49.

Vittrant did not fight alone. His idea of renewing Chinese metrology found many allies among Chinese scientists such as Liu Jinyu (刘晋钰). Liu was educated in France at Université Grenoble Alpes as an engineer. In the 1920s, he was Vittrant's colleague at Aurora University. According to Liu, Vittrant had constantly been musing upon the scientific weakness of the metric system and ways to improve it but failed to find the right angle to start. It was he who later introduced Chinese historical metrology to Vittrant. Vittrant was inspired by his conversation with Liu and took Chinese metrology as the base to form a "more superior system than the metric system."[138] In 1923, Liu's translation of Vittrant's new Chinese metrology was published in *Kexue* (科学), then the most influential scientific journal in China. The new article was titled "Rudimentary ideas about the Chinese metrological system." It was this article that brought wider interest from Chinese scientists.

The proposal of Liu's article was identical to that of Vittrant. However, Liu added a long introduction at the beginning, highlighting the metric system's scientific flaws, particularly in the field of electromagnetism. The meter was too large, and the second was too small and not decimal. According to Liu, these flaws contributed to the metric system's failure to cater to this field's needs, for it was not "systematically consistent." Since the second half of the 19th century, many derivatives of the metric system were developed for scientific applications. These derivative systems included System M. T. S. (Meter, Ton, Second) in engineering and System C. G. S. (centimeter, gram, second) in electromagnetism. However, the latter was particularly "inconvenience to use." Because electricity and magnetic power were mutually convertible, two different systems derived from system C. G. S. One was based on electromagnetics (System Electromagnetic C. G. S.), and the other on electrostatics (System Electrostatic C. G. S.). The units of both systems, while convertible too, were far remote in their scales. For instance, an Amber in the first system equals three billion electrostatic units. In 1881, European scientists tried to address this problem by setting an Ohm as one billion electrostatic units. However, the new system was still not good enough when it came to coefficients in equations. That was why Vittrant and Liu set

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[138] Liu Jinyu, Chen Jingyong, "Huayi duliangheng yijianshu (xu)" [Our opinion letter on metrological unification], in *Nonggongshang zhoukan*, 1928, no. 22, pp. 7-8, p. 8.

one-tenth of Ohm as the basic unit of electric resistance to solve the disparity of units. Decimal time also greatly facilitated the calculation in this field. Liu told his readers that a new clock for the Chinese time had already been produced by a Swiss watchmaker, Maison Paul Ditisheim, which was about to be shipped to China soon.[139]

The article on Kexue made Liu and Vittrant known to many Chinese scientists. One of them was Hu Gangfu (胡刚复). Sponsored by the Boxer Indemnity scholarship, Hu received his education as a physicist at Harvard. As one of the founding fathers of modern Chinese Physics, Hu was the teacher for most Chinese physicists in the 1920s. Hu appreciated Liu's emphasis on electromagnetic units in new metrology. He nevertheless gave his advice with reservation. The basic unit of length, defined by 1/120.000.000 of the meridian line, did not correlate strongly with new magnetic units. Hu suggested deriving all units of common use from electromagnetic units. In the meanwhile, Liu also exchanged his opinion with Chen Jingyong (陈儆庸), a colleague in Beijing. Chen studied in Belgium and was a veteran of Chinese metrological reform. He was a technocrat in the Qing court and served as the chief of an official measures factory for the Beijing Government.[140] Chen also expressed his appreciation for Liu and Vittrant's new metrology. Under the advice of Hu, both parties did their "calculation separately and came to the same conclusion." New metrology was invented.

Vittrant published some early results of this new proposal in an American Journal *Bulletin of the American Association of Jesuit Scientists* in 1925. In the beginning, the editor explained the reason for the article's publication. "The metric system comes to us from France, and it may seem

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139 Liu Jinyu, "Zhonguo danweizhi chuyi" [Rudimentary ideas about Chinese metrological system.], in *Kexue*, 1923, vol. 8, no.11, pp. 1119-1132, pp. 1120-1122, p. 1127, p. 1129.

140 *Dangdai zhongguo mingren lu* [Records of contemporary Chinese celebrities], Shanghai: Shanghai Liangyou tushu yingshu gongsi, 1931, p. 294.

strange that a Frenchman should propose other units." Vittrant's unusual stance not only caught the attention of the editor but also that it served as a reference to the rising cries for the metrication of the United States during the 1920s. As the editor witnessed, most students and teachers of science then were "quite convinced of the advantage of the metric system. Very many would like to see it adopted in this country. In fact, there is an association in this country whose main purpose is to further the adoption of the system in the United States." In this regard, the editor hoped that Vittrant's article might "start some discussion." [141]

Vittrant's article began by admitting that "The metric system is at present the best end most widely known system of units." However, Vittrant quoted the prevailing population argument that "it is not used in some of the largest countries, for example, the British Empire, China, and the United States, which comprise in all some 900,000,000 inhabitants. We can therefore say that half of the human race does not use this system". More importantly, Vittrant held that the metric system was not perfect". Moreover, Vittrant swiftly turned to question the universality of the metric system. The "prori reason" was it did not represent "progress" and the idea of "global unification," and "unification is only to be desired if it means progress that cannot be exceeded. Everything human, however, was capable of improvement. To seek unification at any cost would only "hinder progress." To prove the metric system was in much need of improvement. Vittrant contended that "the metric system has many defects which are well known to those who have occasion to make Measurements and computations in the various applications of science. As a result, various systems have been formed which are derived from the meter, and it is impossible to get along with one of them alone. Besides, the division of time is not according to a decimal

[141] M. Vittrant, "A Note on the Unification of the Units", p. 47.

system, nor does it fit in with the division of the circle." Vittrant then listed some of these competing systems, including System K. T. S. and system C. G. S. These systems revised the original metric system to better-suited scientific applications.[142]

Vittrant gave a precondition of a nation's adaption of the metric system: "a nation should therefore only adopt the metric system if its own units cannot be improved in such a way (like K. T. S. or C. G. S) as to constitute a system more perfect than the metric system. There are fewer disadvantages in improving something which is already in existence than in replacing it with something altogether different." He continued to justify his approach to find a better alternative in traditional metrology. "If we study the old units closely, we find they can form a system which is preferable to any other." Forementioned K. T. S. and C. G. S systems were not good enough to be "preferable to any other" since the units of the former were "too large" and those of the latter "too small." As a comparison, Vittrant viewed that "the foot, the ounce, the pound, and the bushel are quite well suited to ordinary human needs."[143]

Vittrant finally turned to China. Traditional Chinese metrology, much like that of the British, was also suited to daily use, and their actual values of units were similar. Better yet, Chinese measures were also scientific in that they "have the advantage of possessing decimal multiples and sub-multiples," which was in use "for more than 20 centuries". Vittrant stepped back on his former radical decimal Chinese time and agreed with a day divided into 24 hours instead of 12 Chinese hours a day, but he argued this minor change would also make it more compatible with the already globalized western time regime since in China, "the division of the day into twelve hours is still used to some extent in ordinary language and the European hour(24 hours) is called a little hour(小

[142] Ibid. pp. 47-48.
[143] Ibid. p. 48.

时).” After a short introduction of his units, Vittrant introduced his principles of ideal metrology. First, it shall “depart as little from the old units.” Second, it must keep the ordinary electrical units or at least their decimal multiples, “for the watt, the ohm, the volt, and the ampere are really international units.” Third, it must introduce “the decimal division in the measurement of time without interfering too much with popular usage.” Vittrant assured his readers that his new system followed such principles. His length unit was around 32. 68902cm, “in between the English feet and the Chinese” so that it did not depart from both too far. His basic unit of power equals 10 watts, larger and “rational and practical.” His time unit is fundamentally decimal, as an hour was ten quarters. Vittrant concluded at the end that “it can be seen that it is easy to establish a system of unit superior to all existing systems without changing too much the long-fixed habits of 900,000,000 people.” Vittrant proudly penned down the name of the new system at the end, which was titled the American-British-Chinese Decimal System (A. B. C. System).”[144]

Although this A. B. C. system did not make much of a splash in the western scientific circle since no feedback was given on the journal, the new system nevertheless marked an important transition. The ambition was remarkably amplified. From metrology solely for China to metrology that was also intended for the English metrological world, it provided an “improvement” of the metric system as an additional global metrological alternative. In the meanwhile, in China, this new metrology was again translated by Liu and published in *Kexue* in 1926, with but a different Chinese title, an “International metrological system”(国际单位制). Liu, in his article, elaborated on the scientific details of the system. Adopting the advice of Hu Gangfu, the new system was based on electromagnetic units, and the basic length unit was defined as 12.125 inches, around one

[144] Ibid., pp. 48-49.

traditional Chi (营造尺), so to facilitate its application in China, America, and Britain.[145] To "differentiate it from all other existent metrologies," Liu named the basic units "Righteous Chi"(正尺) and "Righteous Liang"(正两) since they were "correct and fair." After seeing the article, Hu Gangfu further christened it as "Système Homo" (原人制), for "it catered to the life's needs" of the entire human race.[146]

There were no traces that anyone, foreign or Chinese, outside of the small Chinese metrological experts' circle expressed their support for the ABC System. In 1928, when the rumor of Nanjing's forthcoming metrological reform was spreading in society, Liu Jinyu and Chen Jingyong republished the proposal in several magazines. Liu and Chen continued to market it as a revolutionary product o and a Chinese contribution to the world, but without an explicit label of the ABC System anymore. They acknowledged that the English system was not ideal for scientific applications and that the metric system was dominant worldwide. There was a piece of strong evidence that they might be aware of Drury's book since, at the beginning of their proposal, they laid down four categories of nations that followed the metric system, and the population and percentage were the same.[147] However, they contended with the same arguments that the metric system was not scientific enough for its inconsistency. On the other hand, "American and British people constantly expressed their dissatisfactions of English metrology." They did not succeed in the end because "they did not find a proper substitute." If Chinese people took Liu and Chen's system, "European and American people would follow since its convenience was affirmed." In this way, the starting point of global metrological unification would be the Republic of China. What a glory!" They continued to explain

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[145] Liu Jinyu, "Guoji danwei chuyi" [Rudimentary ideas about International metrological units], in *Kexue*,1926, vol. 11, no. 5, pp. 633-644, p. 636.

[146] Liu and Chen, "Huayi duliangheng yijianshu", p.8

[147] Liu Jinyu, Chen Jingyong, "Huayi duliangheng yijianshu (er)" [Our opinion letter on metrological unification], in *Nonggongshang zhoukan*, 1928, no. 19, pp. 1-2.

that the metric system was “a child of the revolution,” but it had already shown its flaws. Instead of stepping behind on the heels of others, China as a “nation of four hundred million,” shall “follow the tides of times, and seize this chance of revolution.”[148]

Conclusion

As I will cover in a more detailed way, Vittrant and Chen’s new metrology did not survive on the table of the Nanjing government in 1928. In 1929, the metric system was selected as the official metrology for China. However, disagreement never disappeared. Xu Yongchang (徐永昌), a general of the KMT army, criticized Chinese metrication secretly in his diary in 1934:

> “For nations with rich histories, such as China, Britain, and France, their metrologies must respect their own traditions. The most important thing is the metrological unification within respective national realms; the metrological synchronization with other nations is not necessary […] The government now requires people to follow western measures. It will lead to the obliteration of our metrological history […] French is a common language for diplomatic affairs, but I have not heard any nation abandon their own language for French. Should China be the first?”[149]

Indeed, China’s metrication was characterized by tensions between homogenizing global norms

[148] Liu and Chen, “Huayi duliangheng yijianshu”, p.8
[149] *Xu Yongchang Riji* [The diary of Xu Yongchang], 14 May 1934, Taibei: Academia Sinica, the Institute of Modern History, 1991, pp. 101-102.

and perseverant local metrological tradition. Far from a theological reading of the global adaption of the metric system, which foregrounded it as an inevitable tendency of history, the Chinese case was full of hesitations, contestations, and imaginations. European metrication before the 1870s led to the “making” of the Chinese metrological mess elaborated by a chorus of foreign and indigenous reformists. While pursuing a metrological “common language” was not questioned any longer, divergence emerged when determining which language or metrology it should be.

The competence of the British system was an indispensable dimension and reference to global metrication. British merchants displayed their persistent passion for shaping China’s metrological future in the late Qing, as much of their interests were hinged on China’s choice of measures. Despite the failure of making Chinese metrology English, this historical connection decidedly brought China into the trans-Atlantic debate. More importantly, the connections were reciprocal. As the most populous nation then, China’s decision to go metric was a result of global influence, but it also bore a global significance as it broke the balance of the metrological landscape around the world. Trans-Atlantic pro-metric camps were much excited by the information, to the extent that China seemed not to be a follower of metrological modernity but a new model to be followed.

However, we must not overestimate the significance of this change. For the pro-metric camp, China was more of a rhetorical weapon in their own domestic struggles. For the anti-metric camp, Chinese attachment to customary measures and English standards made her, at times, an ally in front of encroaching metrication. But this comradeship was overshadowed by the imperialist consideration of ensuring their commercial territory in China through measures. As for China, far from believing that the table had been turned around by the Beijing reform, Nanjing continued to place China in the 1930s at the bottom of the global hierarchy of metrological modernity since metrication was never fully implemented, public media lamented the backwardness of Chinese metrological situation by comparing China to those “advanced nations” in metrological unification, including Britain and the United States.

Many have attributed the victory of the metric system to the practical needs of the ever-tightening network of globalization, that “our world is too small for two systems.”[150] However, our world was once an arena of two confronting global metrological norms, and many, such as Michel Vittrant and Chen Jingyong, even dared to imagine three. Their proposal was, on the one hand, a passive response to global metrication in that they aimed at reviving Chinese customary measures. On the other, as they tried to market it as Système Homo for all human beings, their proposal meant an active gesture to offer a Chinese alternative to global metrology. It was also wrong to assume it was a baseless historical rhapsody. Chinese measures enjoyed a global position since Han Dynasty and were disseminated around Eastern Asian World. Even in the first half of the 20th century, they were continuously in use in Southeast Asia because of Chinese sojourning merchants’ dominant influence on local markets in the past several centuries.[151] While historians are customed to detect reasons for a given historical result, this rather theological approach of causality tends to “read the book backward” and cancel historical “ifs.” It should not limit our imagination, as it did not for Vittrant, Chen, and many others.

[150] Vera, *The Social Life of Measreus*, p. 420. This quote was originally on an American newspaper shortly after World War II. See, J. T. Johnson *Morning World-Herald (Omaha),* March 11, 1946.

[151] Por Heong Hong and Tan Miau Ing, "Contested Colonial Metrological Sovereignty: The Daching Riot and the Regulation of Weights and Measures in British Malaya", in *Modern Asian Studies*, January 2022, vol. 56, no. 1, pp. 407-426.

Chapter 2: Build a Nation-State via Measures: the Nanjing Reform (1928-1937)

Introduction

As KMT's North Expedition ended two decades of wars between warlords and its bloody breakup with the communists, on 1927 April 8th, a new republic government was announced to be established in Nanjing. Under the new regime, social order has been quickly restored, at least in the most industrial and wealthy provinces of southeast China. China has become relatively peaceful during 1928-1937 with a quick economic boom and more capable governance. As some argued, the ten years before the Japanese invasion was the "Golden Decade." It was in this context that the Nanjing regime came under the spotlight. The administration was renowned for its modernizing ambition. Metrication and unification of China's fragmented metrological landscape were but just one of the regime's broad constellations of modernizing endeavors ranging from water control projects, monetary system reform, and public hygiene to western-style urbanization and education. As Nanjing was the strongest motor behind these mega-modernizing projects, most of the current literature on reforms during the Nanjing decade took a common genre: a strong government-centered perspective and a Chinese nation-state narrative.[152]

Admittedly, a nation-state angle is an indispensable reality for our understanding of metrology.

[152] Just to give some exemplary and recent examples of this type of nation-state's "reform literature", see, Lloyd Eastman, *The Abortive Revolution: China under Nationalist Rule, 1927-1937*. Cambridge, Mass.: Harvard University Press, 1974; Lillian M. Li, *Fighting famine in North China: state, market, and environmental decline, 1690s-1990s*. Stanford: Stanford University Press, 2007; David A. Pietz, *Engineering the State: the Huai River and Reconstruction in Nationalist China, 1927–1937*, Routledge, 2018; Liu Wennan, *Jindai zhongguo de buxi zhiyan yudong yanjiu*[The anti-cigarette campaigns in modern China], Beijing: Shehui kexue wenxian chubanshe, 2015; Yang Xinmei, *Shengti zhi zheng: jindai zhongguo fan chanzu de lichen* [The contested body: the anti-footbinding movement in China], Beijing: Shehui kexue wenxian chubanshe, 2012; Duan Yan, Mingguo shiqi de bizhi gaige sixiang[The thoughts of Monetary system reforms in modern China], Beijing: Shehui kexue wenxian chubanshe, 2022.

In the current global literature on metrology, measures have always been related to the exclusive jurisdiction of the state. The European historical experience of pre-metric metrology was marked by bitter contestations between various cities, minor states, and municipalities. The right of metrological jurisdiction over measures, according to Kula, was a "fundamental attribute of sovereignty."[153] Moreover, as Bruce Curtis pointed out, maintaining uniform metrology itself was the process of state formation since "Putting things together and making them stay that way, furthermore, often is successful only through the exercise of state sovereignty. In this sense, the establishment of metrological systems after the late 18th century can be seen as a constitutive element of state formation."[154]Indeed, during the metric era, such processes of state-building via standardization were quite successful. The metric system helped to consolidate bureaucratic rule and summon an imagination of metrological homogeneity within the borders of new nation-states. In France, the establishment of the metric system was analogous to the narrative of building modern states. Metrological administration expanded as new bureaucratic apparatus gained its authority among the people.[155] In Italy, the making of the metric system as national metrology started in Sardinia in 1844 and was parallel to the making of Italy as a newborn nation-state.[156] Particularly in Germany, the narrative of nation-building triumphed the logic of regional specialty. Germany had already anchored Zollpfund (customs pound) as 500 grams in 1839. However, German scientists, such as the famed astronomer Friedrich Wilhelm Bessel kept being suspicious about the accuracy of the French metric system. The doubts about the metric system were largely

[153] Witold Kula, *Measures and Men*, Princeton University Press, 1986, pp.18-23.
[154] Bruce Curtis, "From the Moral Thermometer to Money: Metrological Reform in Pre-Confederation Canada", in *Social Studies of Science*, vol. 28, no.4, 1998, pp. 547-570, p.548.
[155] Ken Alder, "A Revolution to Measure: The Political Economy of the Metric System in France." In M. Norton Wise ed., *The values of precision*. Princeton: Princeton University Press, 1997, pp. 39-71, p.45.
[156] For more on pre-metric European metrology among the "republic of letters", see, Emanuele Lugli, *The Making of Measure and the Promise of Sameness*, Chicago: University of Chicago Press, 2019. On Italina metrication, see also, Emanuele Lugli, *Unità di misura: breve storia del metro in Italia*. Il mulino, 2014.

dispelled as the Reichstag of the North German Federation came into being in 1866 and took the metric system as the official metrology. According to Martin Geyer, it was "a means of national integration that could draw on a broad liberal consensus," particularly so as south German states hesitated to do the same despite public opinions leaning towards it.[157] Outside of Europe, the same process was witnessed. Mexico, for example, was the leading country of metrication in Latin America. The effort to introduce the metric system was launched there in 1857, while the metrication of Europe was ready to soar around the same time. In 1895, it became mandatory. The metric system and the consensus of the metrological situation in Mexico, according to Héctor Vera, gave modern states the leverage to fulfill some of their essential functions, one of which was enabling the state to "see" the actual economic and social conditions of the nation.[158]

It is not only a global fact that a nation-state possesses a unified national metrological system nowadays but also a Chinese political tradition that the unification of measures resembled the strength of the centralized state and the unity of Chinese polity. In Chinese historical mythology and antiquity, Huangdi(黄帝) invented classical metrology and other standards for the inception of Chinese civilization. Sage Kings continued the cause, such as Shu(舜), who was believed to unify various measures and musical temperaments among eastern tribes, thus laying the foundation of Chinese metrological culture. Qin Shihuang(秦始皇), the first Chinese emperor, abolished conflicted monetary units, measures, and road gauges from his conquered kingdoms. As a result,

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157 Martin H. Geyer, "One Language for the World: The Metric System, International Coinage, Gold Standard, and the Rise of Internationalism, 1850-1900", in Martin H. Geyer, Johannes Paulmann eds., *The Mechanics of Internationalism: Culture, Society, and Politics from the 1840s to the First World War*, Oxford: Oxford University Press, 2001, pp.55-92, pp. 65-67. For more on metrication of Europe in 19th century, see, Edward Franklin Cox, *A History of the Metric System of Weights and Measures, with the Emphasis on Campaigns for its Adoption in Great Britain and the United States Prior to 1914*, unpublished dissertation, University of Indiana, 1956, Ch. 5.

158 Héctor Vera, “Counting Measures: The Decimal Metric System, Metrological Census, and State Formation in Revolutionary Mexico, 1895–1940”, in *Histoire & mesure*, June 2017, vol. 32, no.1, pp. 121-140.

the first unified Chinese Qin Dynasty was born with China's first unified metrology.[159] It was no surprise that, for this symbolic potency of historical "unification of measures" (划一度量衡, or 同律度量衡), Nanjing in the 1930s also took it as a common slogan to evoke wide social sympathy and nation-state imagination towards a unified China, both metrologically and politically.

History doesn't repeat itself, but it often rhymes. Metrological unification in ancient times and the 1930s did rhyme with an apparent similarity. For any political entity, either that of a dynasty or of a nation-state, the unification of measures generally facilitated trade and taxation, stimulated a shared metrological culture and concurrently cosmological view, and strengthened the political influence of the ruling which in return framed, conditioned, and monopolized the measures. Indeed, these themes remained to be important in the 1930s. Following this "reform genre" of writing history during the Nanjing period, practitioners of Chinese historical metrology championed Nanjing as their main protagonist and nation-state narrative as their main plot. Their problematics clustered around a serious of themes such as metrological legislation, the metrological administrative apparatus, and a central government's metrological hegemony over local measures, all of which foregrounded the "unification of measures" and the state's monopoly of measures as the most important goal for this reform.[160]

However, there was a danger of pursuing the nation-state narrative too far. The "positive state" phenomenon, which highlighted the active role of the central bureaucratic apparatus and the efficiency of metrological administration in metrication around the globe, guided scholars to ignore

159 “岁二月，东巡守，至于岱宗，柴。望秩于山川，肆觐东后。协时月正日，同律度量衡。” See,《尚书·虞书·舜典》.See also, Wu Chengluo, *Zhongguo duliangheng shi* [History of Chinese Metrology], Shanghai: Shangwu yinshuguan, 1937, pp.114-124.

160 Just to give some examples, see, Fang Wei, *Mingguo Dulianghen Zhidu Gaige Yanjiu* [Research on Institutional Reform of Weights and Measures in the Republic of China], unpublished dissertation, Anhui University, 2017, also, Yi Ci Lo, *Measuring Up to Modernity: Metrological Reform in China, 1870s-1940s,* unpublished dissertation, University of California, Irvine, 2021.

the limitations of the state[161]. This chapter revisited the nation-state story of the Nanjing regime, with but a twist: instead of recognizing Nanjing as the sole player that mattered, I reconstructed the story by identifying the enemies of the state and those centrifugal forces within the Nanjing regime, whose motives and interests conflicted with "unification of measures." As articulated in Chapter 1, a global metrological duality shaped the metrological landscape internationally and in China domestically since the late 19th century. I argued that this duality continued to loom largely behind the governmental choice of China's metrological future, leading to the disagreement between cultural and metrological conservatives with Nanjing. I then pointed out that imperialism and warlordism, whose roles in metrology were long neglected by practitioners, proved to be other major forces challenging Nanjing's monopoly of metrological affairs. Moreover, thousands of metrological inspectors served as the social carriers of Nanjing's metrological reform in the 1930s. Using them as my lens, I contended that, far from concerted cooperation, this reform was full of tensions between Nanjing and local governments. Their resistance to the mega-modernizing project also provided an additional dimension that undermined Nanjing's claim of monopoly and command of metrological administration. Together, the dissenting voices and multifold structures of China's metrological landscape challenged the nation-state narrative that enshrined "unification of measures" as the only possible perspective and Nanjing as the sole arbiter of China's metrological affairs.

[161] More on "positive state" in metrication, see, Martin H. Geyer, "One Language for the World", pp.61-62.

Come up with a Plan

KMT paid special attention to measures. In 1912, when Sun Yat-sen visited Nanchang, local merchants advised him that measures were a dispensable part of the new republic, for metrological unification was the synonym of national unification: "a unified nation should have a unified metrology."[162] Later in 1924, when it was still a regional regime in Guangzhou, KMT had already planned to unify the measures first in Guangdong Province and then the whole of China. During the North March, the revolutionary army kept the unification of measures in its guiding line and promised it in every province it conquered.[163] In 1927, scientists and scientist groups raised their concerns on this issue in government meetings. Merchants and some local governments, such as in Shanghai, Anqing, and Shanxi, pleaded with the new central government to unify national measures. Their local markets suffered from concomitant conflicts of inaccurate measures during the war.[164] At the same time, articles discussing China's metrological future began to emerge in public media, urging Nanjing to learn from the failure of Beijing's reform and act quickly on this matter. One author commented on the former Beijing reform: "empty words could not get measures unified. The government merely held a piece of blank paper to flare."[165] Many

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162 "Zhuandian： Nanchang dian" [Special telegram from Nanchang city], in *Shenbao*, 27 October 1912.。

163 Gongshang bu quanguo duliangheng ju [National Bureau of Weights and Measures, the Ministry of Industry and Commerce], *Gongshang bu quanguo duliangheng ju duliangheng jianding renyuan yangchengsuo diyici baogaoshu* [First report of the Training Center for Inspectors of Weights and Measures], Nanjing: Zhonghua yinshua gongsi, 1930, "Yanjiang" [Speeches], p. 4.

164 Shiye bu gongye si[Industry department, the Ministry of Industry], *Huayi quanguo duliangheng biaozhun yanjiushu* [Studies on the national unification of measures], Nanjing: Zhonghua yingshua gongsi, 1931, p. 1; "Chen shengzhenfu chenqing huayi anqing shi duliangheng you" [Petition to the provincial government for the unification of measures in Anqing], in *Shizheng yuekan*, 1928, no.2, p. 5; "Zhuanchen huayi duliangeng zhidu" [Petition for the unification of measures] in *Shenbao*, 1928 May 4th.。

165 Sun Wenyu, "Zhonguo duliangheng wenti zhi yanjiu" [Studies on Chinese metrological problem] in *Jinlin daxue nonglinke nonglin congkan*, 1927, no. 40, pp.1-30, p. 28. Other examples, see, Shan Gong, "Gailiang nongye yu tongyi duliangheng zhidu" [The improvement of agriculture and the unification of measuers], in *Xinguangxi xunbao*, 1928, no.17, pp. 13-17. Chen Guiqing, "Tongyi woguo duliangheng chuyi" [Preliminary discussion on the unification of measures], in *Yinghang zhoubao*, 1927, vol.11, no. 48, pp. 23-28. "Huayi Shanghai duliangheng yijianshu" [Opinions on the unification of measures in Shanghai], in *Shenbao*, 1927 October 27th. Xin Mu, "Gaige ji tongyi

metrological reformists placed high expectations on Nanjing. As Wu later recalled, there was a unanimous agreement among elites that if the metrological unification could not be achieved by a more powerful and determined regime such as Nanjing, then it never will. [166] It was a historic albeit fleeting opportunity.

In April 1928, the Ministry of Industry and Commerce(工商部) was established in Nanjing. Less than half a year later, the revolutionary army seized Beijing and the national factory of measures and the prototype metric measures, which were handed over by Paris in late Qing. The ministry swiftly ordered the duplication of prototypes. In June 1929, French prototypes (termed as "No.1 new object" by Nanjing) and dozens of copies were shipped to Nanjing[167]. In the meanwhile, the ministry called for possible reform plans national-wide. More than ten proposed plans were collected. While each of them was different, they can be loosely grouped into two categories depending on their attitude toward the metric system.

zhongguo duliangheng wenti" [Reform and the unification of Chinese measures], in *Qinghua zhoukan*, 1927, vol. 27, no. 10, pp. 467-472. Liu Jinyu and Chen Jingyong, "Huayi duliangheng yijianshu" [Proposal for the unification of measures], in *Nonggongshang zhouka*, 1928, no. 19, pp.2-3.

166 Wu Chengluo, "Zhongguo lidai duliangheng zhidu zhi bianqian yu qi xingzhen shang zhi cuoshi" [The evolution of Chinese historical metrological institutions and their administration and policies], in *Gongye biaozhun yu duliangheng*, 1934, vol.1, no.2, pp. 15-20, p.19.

167 Gongshang bu quanguo duliangheng ju, *Gongshang bu quanguo duliangheng ju duliangheng jianding renyuan yangchengsuo diyici baogaoshu, "*Daoyan" [Preface], pp.1-5.

Shiye bu quanguo duliangheng ju [National Bureau of Weights and Measures, the Ministry of Industry], *Shiye bu quanguo duliangheng ju duliangheng jianding renyuan yanchengsuo dierci baogaoshu* [Second Report of the Training Center for Inspectors of Weights and Measures], Nanjing: Zhuonghua yinshua gufen youxian gongsi, 1931, p.14.

At this stage, Wu Chingluo (吴承洛), a slim chemist from southern China, began to step at the center of China's metrological future and later became a mastermind behind Nanjing's metrological reform. Wu was born in a small village in Fujian Province. In his early years, he was influenced by the "new learning" at the end of the Qing. Wu's father traveled to Shanghai and Beijing and brought back the books of Kang Youwei (康有为), who was renowned for his introduction of a wide range of western knowledge and his pivotal role in the failed reform in the years of the Guangxu Emperor. Wu left his hometown Pucheng (浦城), later for Shanghai to receive a better education. At the age of 20, he was admitted to Tsinghua University, one of the most elite universities at the time, with a major in Chemistry. Wu later got a master's degree from Lehigh University and Columbia University. He went back in 1920 to teach at several universities in Beijing.[168] In 1927, Cai Yuanpei(蔡元培) was appointed as the head of the Ministry of Education. Cai was particularly keen on absorbing scientists into his administration. Wu, who maintained a good relationship with Cai in earlier years, was invited to serve in the ministry as a secretary and joined the newly established Academia Sinica.[169] Wu started to urge the government to take the metric system when he served in the Ministry of Education in 1927.[170]

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[168] Zhou Shaozhi, "Wu Chengluo xiansheng shilue" [Short biography of Mr. Wu Chengluo] in *Pucheng wenshi ziliao* [Historical materials of Pucheng], Collection no. 4, 1984, pp. 17-24.

[169] For example, Cai once wrote a preface for Wu's book. See, Wu Jiandong, *Dangzhi kaocha ji* [The investigation of rule by party], Shanghai: Taidong tushuguan, 1928. Preface.

[170] Shiye bu gongye si[Industry department, the Ministry of Industry], *Huayi quanguo duliangheng biaozhun*

In 1928, Wu began to work for the ministry. Shortly before the meeting, in 1927, Wu traveled to the Philippines. While the original purpose was to investigate the colonial economy and market Chinese goods in southeast Asia, Wu nevertheless noticed that the Philippines did not take the American system but the metric one, even as an American colony. The colonial government was also preparing to re-measure its land with the metric system. Wu later that year went to Japan. Japan simultaneously legalized the metric system and Japanese traditional measures. The well-organized metrological administration apparatus, civil metrological organizations, professional metrological journals, and meticulous metrological investigations all impressed Wu so much that Wu admitted that Chinese reform had "drawn a lot of lessons from Japan."[171] In 1928, Wu was instructed by the ministry to draft a plan for the Chinese metrological system.

Wu and his ally Xu Shanxiang(徐善祥), a Yale doctor of chemistry and a technocrat of the Nanjing government, proposed a metric system combined with an auxiliary system. Like others in the metric camp, such as Gao Mengdan(高梦旦) and Ruan Zhiming(阮志明), they contended against the anti-metric camp mainly with a global discourse. They questioned the cultural parochialism of their opponents. Because in this world which was shared "universally" (大同), "if a good system exists, it should be taken," just like China had already followed the Gregorian calendar. Xenophobia shall not interfere with academic issues. They gave the example of Germany, where its recognition of the metric system did not affect its rising patriotism or (Nazism, for Nanjing tended to view it in a positive way). After all, "one should not take 'pride' in maintaining the so-called 'independence of measures' in the world." If such an attitude prevailed, it would most likely "hinder the

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yanjiushu [Studies on the national unification of measures], Nanjing: Zhonghua yingshua gongsi, 1931, pp. 1-3.

[171] Wu Chengluo, "Huayi quanguo duliangheng zhi huigu yu qianzhan" [The reflections and prospects of national unification of measures], in *Gongye biaozhun yu duliangheng*, 1937, vol. 3, no. 8, pp.1-24, p.18.

introduction of this global learning to China." Moreover, at least 49 nations had already adopted the metric system. In those "civilized nations," the metric system was mandatory for science textbooks, research instruments, or machines. The metric system was ideal and indispensable for "international communication" and global trade. On the other hand, it was troublesome to modernize conventional Chinese measures, which would not necessarily be better than the metric system nor accepted by other nations. It was more likely to add an extra piece to the already chaotic medley of measures for China. Instead of gradually transiting towards the metric system in the long term "to avoid future conflicts," it was better to act and implement the metric system thoroughly.[172]

However, the metric system was indeed too novel for daily use among ordinary people in a more practical sense. For example, the meter is far too long than Chi(尺), and the kilogram is too heavy compared to the traditional weight unit, Jin(斤). Wu and his colleagues proposed a certain "auxiliary system" (辅制, later 市用制, Market System) to the metric system. Beijing Government had experimented with a similar dual-track system but failed. The main reason was the lack of a simple numeric ratio between the two systems to ease the conversion.[173]

Instead of directly accepting a metric system based on the length of the meridian line, the anti-metric camp proposed to develop a new, scientific, and most importantly, Chinese metrology. For these people against the use of the metric system, the new China system should not only reflect the progressive meaning of science like the metric system but also pay due respect to the Chinese metrological tradition. Again, as mentioned in Chapter 1, they also justified their choice with an evaluation of the global metrological landscape, only in a different way. While indeed 49 nations

[172] Shiye bu gongye si, *Huayi quanguo duliangheng biaozhun yanjiushu,* pp. 13-15.
[173] Ibid., pp. 9-11.

legalized the metric system, at least 21 countries with vast populations (for example, China, the United States, and the British Empire) still recognized their traditional measures alongside the metric system. They believed blind worship of the metric system was misleading, particularly so as it won't fit China's local conditions: the meter was too long, and the kilogram was too heavy for common market use. Even bringing in an auxiliary market system wouldn't smooth the transition, for the use of an auxiliary market system also required basic knowledge of the metric system in the first place. Moreover, according to them, many western countries had considered reforming their standards but all failed. China could set a successful example for western countries by modernizing traditional measures and keeping its metrological sovereignty.[174] For example, Qian Li (钱理) recommended taking a hundred millionth of the round meridian line as the new Chinese Chi. The new Chi was 40.0034 cm, which approximated to traditional Chi. Not a surprise at all, standing in the center of the anti-metric camp stood were still Zeng Houzhang, Vittrant, and Liu Jinyu, who also proposed their ABC system to the ministry at the time.

In front of competing proposals, the ministry decided to summon a review committee to pick the best. However, this committee mainly consisted of scientists who presided over positions in the ministry. These technocrats, including Wu Chengluo, Xu Shanxiang(徐善祥), or Liu Yinfu (刘荫茀), happened to be the ones who advocated the metric system the most and also served in central metrological administration that was about to be established two years later. As a judge and player on the court simultaneously, the committee swiftly ruled out other possibilities. The British imperial system was the first to be dismissed, as its complexity was "long being criticized by people." Qian Li's proposal of new Chi based on a round meridian line was not essentially superior

[174] Ibid., pp. 15-17.

to the metric system, and P. Vittrant and Liu's ABC system based on electromagnetism was too "abstruse," requiring more studies and verification by other scientists. While their proposals were fundamentally scientific sound, they were nevertheless not universally recognized as a global norm. [175]

The committee ended up submitting three options to National Affairs Meeting for further discussion. The first option was to abolish other systems and solely promulgate the metric system. The second and third options suggested legalizing the metric system as the main system along with a temporary auxiliary system. This auxiliary system which kept a simple numeral ratio to the metric system and served as a mediator to familiarize common people with the metric system would be discarded when it finished its task. The second option was proposed mainly by Wu and his colleagues, also known later as the "one-two-three system": One Market Sheng (市升) equals one liter, two Market Jin (市斤) to one kilogram, and three Market Chi (市尺) to one meter. The third option was basically the same as the one-two-three system, with one minor difference: four Market Chi equals one meter. In other words, all these three options would ultimately force Nanjing to go metric. Having "Chinese" metrology was no longer an option.[176]

On 1928 June 28th, further discussion was held and participated by representatives from the Ministry of Industry and Commerce and the Ministry of Education. The dual-track system got past with no drama, but concerns were brought to the table on details of the assistant Market System. Zhu Kezhen (竺可桢), a renowned meteorologist representing the Ministry of Education, opposed the arrangement of three Chi equals to one meter, as Chi, under this circumstance 33.33cm, would not be exactly divided, which might cause troubles in daily use and manufacturing. A more serious

175 Shiye bu gongye si, *Huayi quanguo duliangheng biaozhun yanjiushu,* pp. 15-17.
176 Ibid., pp. 19-21.

questioning focused on the arrangement of Liang (两). While in Wu's plan, 10 Liang amounted to 1 Jin (斤), scholars doubted it to be suitable for China since the commonly used ratio was 16 to 1. Also, Jin and Liang were the most used units in commerce. For instance, Chinese traditional medicine employed a 16 to 1 ratio for Liang. When it came to the monetary system and international trade of precious metals, as paper bills were hardly universal in China in 1929, Liang was also the most common unit for silver and gold. The participants decided to solve the conflicts in an ensuing meeting. [177]

Wu submitted his studies on both issues at the second meeting in July. For one thing, Chi, around 33.33cm long, was close to the average length of China's various kinds of Chi, falling right in between the popular old official Chi in northern China and Suzhou Chi (苏尺) common in the south. For another, Liang and Jin must maintain a decimal relationship in consistency with other units in Market System.[178] The meeting finally approved Wu's plan. However, later discussion in the government restored the 1 to 16 ratio due to the consideration of convenient daily usage and traditional practice such as medicine, where the 1 to 16 ratio was adopted. For the ministry, Market System merely served as a tool of transition towards the metric system, and there thus was no need to keep it entirely decimal.[179]

In retrospect, Nanjing's discussion on China's metrological future was characterized by the rivaling views between following a global norm and maintaining Chinese tradition. Far from falling for an unchallengeable and enshrined scientific metric system, some Chinese scientists used science as their own weapon. On the other hand, it seemed that the metric system won in the end,

[177] Ibid., pp. 31-34.
[178] Ibid., pp. 50-59.
[179] Ibid., pp. 34-35.

with now more than 400 million people being newly included in a global standard. However, the duality of China & global tradition & science kept being a controversial topic. Like lingering *basso ostinato*, the discussion of keeping Chinese cultural elements within national measures will again draw reformers' and scientists' attention in 1935. But more pressing at this point, the Nanjing regime was about to step into a real-world Chinese metrological dilemma, deep water that had never been navigated before.

On February 26th, 1929, after a series of discussions within the Nanjing regime, the republic proclaimed its new metrological law that went into effect in 1930 on January 1st. This law legalized Wu's proposal with just minor changes.

Length		Weight		Volume	
Market System	Metric System	Market System	Metric System	Market System	Metric System
市厘(1/3mm)	公厘(1mm)	市毫(0.005)	公毫(0.01g)	市撮(0.001L)	公撮(0.001L)
市分(1/3cm)	公分(1cm)	市厘(0.05)	公厘(0.1g)	市勺(0.01L)	公勺(0.01L)
市寸(10/3cm)	公寸(10cm)	市分(0.5g)	公分(1g)	市合(0.1L)	公合(0.1L)
市尺(1/3m)	公尺(1m)	市钱(5g)	公钱(10g)	市升(1L)	公升(1L)
市丈(10/3m)	公丈(10m)	*市两(50g)	公两(100g)	市斗(10L)	公斗(10L)
市引(100/3m)	公引(100m)	市斤(500g)	公斤(1kg)	市石(100L)	公石(100L)
*市里(500m)	公里(1km)	市衡(5kg)	公衡(10kg)	市秉(1000L)	公秉(1000L)
		市担(50kg)	公担(100kg)		
		市吨(500kg)	公吨(1000kg)		
Exchange ratio: 1 to 3 *市里 did not follow the decimal		Exchange ratio: 1 to 2 *Such was only the plan. Despite a		Exchange ratio: 1 to 1	

rule to 市引 as 333.3m. For an easier exchange with metric kilometers, it was half a kilometer.	strong voice[180] within Nanjing that the decimal system shall be applied to market Jin and Liang, in the 1930s, what in actual use was 16 market Liang (31.25g) for one market Jin.	

Made based on the 1929 Republican Metrological Law, in Huang Xiaoxian, *Geguo Quandu* [International metrologies], Shanghai: Shangwu yinshu guan, 1930, pp. 120-126.

A closer examination of the 1929 metrological law along with its implementation regulations (度量衡法施行细则) issued on April 11th indicated the highlighted metrological monopoly of Nanjing. The law and affiliated regulations pinned down the metric system as the sole legal metrology in China and Nanjing as the arbiter who defined the accuracy of measures through a hierarchical system of distribution of prototypes. Nanjing possessed the most accurate set of metric measures in China since BIPM in Paris had sent a set of duplications of international prototype standards(原器), which were made of platinum-iridium alloy, the most stable artifact known to men then. Nanjing was supposed to make several copies of prototype measures and send them to provinces. Every five years, provincial prototypes must be inspected and assayed in accordance with Nanjing's prototype. Provincial governments shall also make their own copies from the prototypes that Nanjing had sent them. These copies were sent to local manufacturers

[180] Gao Mengdan, "Yian (ershi)" [Motion no. 20], in *Gongshang bu quanguo duliangheng huiyi huibian*[The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p.58.

for mass production[181]. Local governments were strictly forbidden to issue their own standards or manufacture non-compliant measures[182]. The law meticulously regulated the materials, physical dimensions, and shapes of measures to be produced. It even specified the extent to which a deviation or error of measure was allowed during production.[183]

Imperialism and Warlordism

Preparation of setting up a national network of metrological administration, the mission that Nanjing's predecessors had never fulfilled, soon followed. As a first step, the republic was supposed to set the general quarters of the reform, the National Bureau of Weights and Measures (全国度量衡局, hereafter NBWM), on the date 1930, January 1st. However, due to the lack of government funding caused by wars between Nanjing and northern warlords, NBWM was officially established in October 1930 in a small building belonging to the Ministry of Industry and Commerce.[184] The little setback boded further troubles: throughout the 1930s, deficiency of budget haunted the reform nationwide.

While the ink on the 1929 metrological law was barely dried out, the Ministry of Industry and Commerce quick summoned a committee to discuss the implementation of reform(度量衡推行委员会). The committee included representatives from various ministries but also the National

[181] Huang Xiaoxian, *Geguo Quandu* [Metrologies in various nations], Shanghai: Shangwuyinshuguan, 1930, pp.120-126.
[182] Gongshang bu [Ministry of Industry and Commerce], *Gongshang bu duliangheng tuixing weiyuanhui huiyi huibian* [Compilation of meeting materials of the meeting of the Metrological Reform Implementation Commission of the Ministry of Industry and Commerce], Nanjing: Zhonghua yinshua gongsi, 1930, pp. 60-62.
[183] "Duliangheng fa shixing xize" [Implementation regulations for the Metrological Law], in *Gongshang Banyue kan*,1929, vol.1, no. 9-12, pp. 8-24.
[184] "Quanguo duliangheng ju chengli" [The establishment of National Bureau of Weights and Measures], in *Gongshang banyue kan*, 1930, vol.2, no.24, p.1.

Federation of Chambers of Commerce(全国商会联合会). Particularly, the commission responsible for frontier matters in Tibet and Mongolia was also invited, which revealed the committee's increasing concern about China's metrological frontiers.[185]

In September 1929, depending on "transportation and economic development conditions," The committee planned to spend six years achieving national metrological unification. The plan consisted of six phases, and each stage would take one year. The reform would be held first in better-developed provinces and cities and, at the same time, forbid other regions to use new measures for metrological stability. Phase by phase, new standards would slowly spread to the whole realm till 1935. However, experts in the ministry (particularly Wu) advised shortening the entire process to 3 years and 3 phases, as they thought it was possible to start the reform in all provinces simultaneously, and the only difference was that it would take longer to get unification in remote regions than in developed provinces.[186] Against the strong optimism of Wu and his colleagues, the ministry realized it was almost impossible to finish the job within three years. It finally decided to go back to the six years plan, and the whole plan was divided into three two-year phases.[187] The committee divided the nation into three categories: Phase 1 provinces were coastal or provinces with major railways lines and waterways. Phase 2 provinces were "remoted areas," and Phase 3 were ethnic frontiers.[188]

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[185] Gongshang bu, *Gongshang bu duliangheng tuixing weiyuanhui huiyi huibian,* p.1.
[186] Ibid., pp. 37-48.
[187] Ibid., pp. 26-27.
[188] Gongshang bu quanguo duliangheng ju, *Gongshang bu quanguo duliangheng ju duliangheng jianding renyuan yangchengsuo diyici baogaoshu*, “Yanjiang” [Speeches], p.5.

"The procedural graph of national metrological unification," Shiye bu duliangheng ju [National Bureau of Weights and Measures], *Gaizheng quanguo haiguan duliangheng wenti* [Rectification of measures for Customs], Nanjing: Puliji zhihao yingshu chang, 1933, front page. The provinces marked red were phase one provinces, which were to be "primitively unified"(初步划一) in 1931. Phase 2 provinces marked green were unified in 1932, and phase 3 provinces marked yellow in 1933. All these three phases did not progress at the planned time. Phase 3 barely started even till 1937.[189]

It must be pointed out that while the three phases were alleged to be decided solely on the "economic conditions of provinces," it was rather apparent that politics was also a major

[189] The phase 1 provinces and cities were Jiangsu, Zhejiang, Anhui, Jiangxi, Hubei, Hunan, Fujian, Guangdong, Guangxi, Hebei, Henan, Shandong, Shanxi, Liaoning, Jilin, Heilongjiang, Nanjing, Shanghai, Qingdao, Beiping, Weihaiwei. The phase 2 provinces were Yunnan, Guizhou, Sichuan, Shaanxi, Gansu, Ningxia, Xinjiang, Rehe, Chahaer, Suiyuan. Phase 3 provinces and areas were Tibet, Mongolia, Qinghai, Xikang.

consideration of the plan. Warlordism was the major concern looming largely behind the geographical layout of metrology implementation. In the late 1920s and early 1930s, the political landscape of the republic was still plagued by warlordism, and the KMT regime was only a titular "national government." Most phase 1 provinces happened to be the provinces that the KMT regime had a somewhat firmer grip on, and phase 2 provinces were all in the hands of warlords who only pledged a dubious loyalty to Nanjing. Phase 3 provinces facing imperialist encroachment from the British and Russian drifted even further from the central government: Nanjing's influence was, at best symbolic in Outer Mongolia and Tibet. Recognizing the practical obstacles from a politically jig-sawed landscape, NBWM had no choice but to take a phase-to-phase approach. [190]However, this practical choice did not rule out the necessity to unify the whole realm of the republic metrologically if it was supposed to be national. Instead of warlords, only Nanjing had the sole decision on China's metrological future. In this sense, this reform also tried to establish a political symbolism that unifying national metrology was a prerequisite for a unified, modern nation. By the same token, metrological disunity presaged a weakness and a danger to the national entity. While nowadays, a unified national metrological system is taken for granted, the strong political symbolism of a nation-state's metrological unification was acutely felt in the 1930s. For example, the press and NBWM constantly compared the reform to the historical metrological unification during Qin, Han, or Tang Dynasties when China had been united and strong[191].

Indeed, for many warlords, standards and measures were political stakes to haggle with the central government. For instance, war broke out between Nanjing and Yan Xishan(闫锡山)in

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190 "Ge shengshi tuixing jinkuang" [Recent situation of promotion of measures], in *Duliangheng tongzhi*, 1932, no.3, pp. 5-7.

191 Just to give one example, Wu Chengluo, "Zhongguo lidai duliangheng zhidu zhi bianqian yu qi xingzhen shang zhi cuoshi", p.15

Shanxi(山西) and Feng Yuxiang(冯玉祥), who controlled Gansu and Shaanxi(陕西)then. During Yan and Feng's temporary control over Beijing, their army seized the national factory of measures under Yan's direct order. While Nanjing secured the factory quickly later, NBWM complained that Yan and Feng's provinces ignored its requirement for reform.[192] On the other hand, switching to new measures was a way to express political allegiance to Nanjing. In Sichuan, warlords competed for decades. Liu Xiang (刘湘)won the war with other warlords in the early 1930s due to Nanjing's support. He returned that favor by accepting Nanjing's appointment as Governor of Sichuan. In November 1934, Liu visited Chiang Kai-shek personally in Nanjing. Not coincidentally, Liu's inscription appeared in the official magazine of NBWM this year, in which he stated that "as the whole nation followed, we don't dare otherwise... I hereby wish the success of the reform and the endless benefits to come." [193] This was not merely a gesture. In 1934, a center to train future measure inspectors in Sichuan was also established in Chengdu. It also enabled Wu Chengluo to embark on his journey to investigate reform work in Sichuan, Yunnan, and Tibet in 1935. In other words, measures created an arena of metrological politics where separatism and nationalism were constantly wrestling.[194]

It shall not be mistaken that warlords were all natural opponents of this reform, even though the reform endangered their status. On the contrary, many local modernizing elites in warlords' campaigns were ardent about promoting new measures. That is the case even In the remote province of Ningxia, where the local branch was established as early as 1931, for the simple fact

[192] Yan did not hinder the production and the factory continued to follow Nanjing' order. The take-over was a political gesture. See, Gongshang bu quanguo duliangheng ju, *Gongshang bu quanguo duliangheng ju duliangheng jianding renyuan yangchengsuo diyici baogaoshu,* "Yanjiang" [Speeches], p. 5 and p. 7.

[193] Liu Xiang, "Inscirption", in *Gongyebiaozhun yu duliangheng* [Indutrial standardization and weights and measures], 1934, vol.1, no.3, front page.

[194] Wu Chengluo "Sichuan huayi duliangheng qiantu de zhanwang" [The prospect of Sichuan's unification of measures], in *Duliangheng tongzhi*, no. 25, pp.3-4.

that Wei Hongfa (魏宏发), one of the heads of warlord administration, was much interested in developing modern causes in their territory[195]. In Guangxi province, the reform was also remarkably advanced than in other provinces of phase 2, partially due to warlords' tolerance.[196]

Metrological monopoly against warlordism was only half of the story. Nanjing also felt a danger of encroaching metrological imperialism. In 1932, officials of NBWM noticed that Japan was prepared to unify the measures in Manchukuo, the Japanese puppet state in Manchuria, and cautioned it as a sign of Japan's "permanent occupation."[197] Ma Ling(马麟), governor of Qinghai Province, regarded foreign measures as a potential danger to national security. Ma witnessed that imperial power "took advantage of China's metrological weakness" in frontier areas such as Qinghai or Tibet, where ethnic minorities always felt cheated when dealing with the Han people and their measures. However, they trusted foreign banks and companies more due to their "fair and accurate measures." Ma dramatized the danger and urged the government to draw a lesson from history by comparing it to the fall of India, where the British East India Company won the trust of the local people and led them to the trap of total colonialization.[198]

A good window to reflect upon this metrological imperialism was the railways. As Wu Chengluo witnessed, China's disunity and lack of standardization were manifested most by language, transportation, and measures.[199] While the movement of creating a unified national language(国

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195 "Quanguo duliangheng xiaoxi" [National metrological messages] in *Dulinagheng tongzhi*, 1931, no.1, pp. 2-3. See also, Lu Renyong, "Ningxia sheng guomin zhengfu shoujie weiyuan, jiansheting tingzhang weihongfa", in *Ningxia shizhi*, 2010, no.5, pp. 16-19.

196 Being as the most influential political fraction since the 1920s, the so-called Xinguixi(新桂系) warlords, such as Li Zongren(李宗仁), Bai Chongxi(白崇禧), Huang Shaohong(黄绍竑) were particularly keen to promote modernizing projects in Guizhou province. For more information, see, Yang Nailiang, *Minguo shiqi xinguixi de Guangxi jingji jianshe yanjiu (1925-1945)* [The economic construction of New Guizhou Clan of Republic of China (1925-1945)], unpublished dissertation: Central China Normal University, 2001.

197 Bao Shaoming "Duliangheng de lishi ji huayi duliangheng de zhongyao" [The history of metrology and the importance of metrological unification] in *Jianshe zhoukan*, 1932, no.22, pp. 2.3, p.3.

198 Ma Lin, "Duiyu huayi duliangheng xinzhi zhi guanjian" [Limited outlook of the unification of measures] in *Gongye biaozhun yu duliangheng*, 1934, vol.1, no. 6, pp. 1-3.

199 Gongshang bu quanguo duliangheng ju, *Gongshang bu quanguo duliangheng ju duliangheng jianding renyuan*

语运动) and metrological reform were highly visible in the 1930s, not much attention was paid to transportation. As Karl Marx agreed, railways and other technological innovations tightened global connections and brought "the annihilation of time-space." While Marx was amazed by technological wonders which laid the essential infrastructures for expanding imperialism, he also pointed out "the compression of time-space." As we witnessed during the second half of the 19th century, railways became an "invincible force": in the fancy geopolitical name of "continentalism," yet in practice imperialism, railways helped to construct and stabilize colonial territories in Africa, the Middle East, and China.[200] Following this line of argument, Chinese historiography tended to view railways as an imperial tool that facilitated the economic invasion, which was constantly draining the blood of the Chinese nation. At the same time, railways were also the battlefield where the Chinese state strove to fence off foreign interference, even at the cost of economic loss since the Late Qing.[201]

Railway imperialism also contained a metrological side: gauge standards. Since Late Qing, industrialized imperial powers grappled with each other for the right to build railways in China. Whereas railways functioned as a tool of national and regional integration in other places around the globe, railways in China served the powers as a marker to divide the spoils, that is, the spheres of influence in China. One of the results of this imperial game was China's variegated gauge standards. First originated in England but later popularized worldwide, the International Standard Gauge (1435mm or 4 feet 8.5 inches) was then the most globalized standard. Most Chinese railways built since the Late Qing took this standard. Nanjing also recognized it as China's own standard

yangchengsuo diyici baogaoshu, "Yanjiang" [Speeches], p.7.

200 A good analysis on railways, continentalism, and territoriality, see, Charles S. Maier, *Once Within Borders: Territories of Power, Wealth, and Belonging since 1500*, Harvard University Press, 2016.

201 A good case study, see, Cheng Weirong, *Jindai dongbei tielu fushu di* [The dependent territories of railways in modern northeast area], in Shanghai: Shanghai shehui kexue yuan chubanshe, 2008.

gauge in the 1930s. However, there were also notable exceptions: the Chinese Eastern Railway, or Zhongdonglu (中东路) in Manchuria, ran with a wider Russian Gauge, which was 1524mm or 5 inches. Russian gauge enabled the Zhongdonglu to be connected to the Trans-Siberian Railway that linked Moscow, the European heart of this continents-straddling Empire, all the way to Vladivostok in the far East. It also connected Port-Artur, or Lushun(旅顺), the Russian concession in southern Manchuria.[202] Needless to say, conflicts between imperial powers arose: Japan seized the southern branch of Zhongdonglu(南满铁路, Southern Manchuria Railway) after its triumph in Russo-Japanese War in 1905. Engineers swiftly replaced the gauges in accord with Japanese standard, which was 1067mm or 3 feet 6 inches[203]. Another example was in Yunnan(云南), the southwest frontier where China had been under colonial geopolitical pressure from France since the 1860s. French standard gauge was exactly 1 meter wide. In 1910, Yunnan-Vietnam Railway(滇越铁路) was opened, which connected the provincial capital Kunming(昆明) and Haiphong of French Indochina. Extending standards on China's soil meant a promising upper hand in the imperial game, as a brochure published by a French railway company alleged that: " Besides Russia, France was the only European Country that is adjacent to China on land."[204]

It must be pointed out that the railway gauge was not a core issue for metrological reformers in the 1930s. Railway standards were within the jurisdiction of the Ministry of Railways instead of

[202] Karl E. M. Starns, *The Russian Railways and Imperial Intersections in the Russian Empire*, Thesis, University of Washington 2012, p. 33. Also, S. C. M Paine, "The Chinese Eastern Railway from the First Sino-Japanese War until the Russo–Japanese War." in Bruce A. Elleman and Stephken Kotkin ed., *Manchurian Railways and the Opening of China: An International History*, Routledge, 2015, pp.13–36, p.18.
[203] Shengyangshi dangan guan [Municipal archive of Shenyang] ed., *Huanggutun Shijian dangkan ziliao tuji* [Archival collections of pictures and materials about Huanggutun incident], Shenyang: Shenyang chubanshe, 2018, p. 20.
[204] Yu Jian, *Yunnan zhebian* [On the side of Yunnan], Kunming: Yunnan renmin chubanshe, 2019, p.346. Also, an older study with a special attention on railway gauge standards, see, Ma Jiqiao (Joseph Marchisio), Zhonguo tielu: jinrong yu waijiao (1860-1914) [Chinese railways: international finance and diplomacy], Beijing: Zhonguo tiedao chubanshe, 2009.

NBWM. The ministry had neither the resource nor the intention to unify the conflicted gauge standards, even though goods or passengers must be relocated to other carriages when passing through different rail gauges. However, with the reform marched into the 1930s, the Ministry of Railways ordered the distances between stations must be shown in metric terms on tickets and mileposts alongside the rails. All railway freight was to be measured in Kilograms.[205] However, a report in 1936 confirmed that railway stations continued to use English standards to measure cargo. While platform staffs were responsible for converting foreign measures of freight to Chinese measures for passengers, they seldom did so or did it in favor of passengers.[206] Indeed, while railways were at the center of industrialization and standardization of time, NBWM was keener to introduce industrial standards directly in factories instead of on rails. The imperialists managed to interfere with the gauge standards again in the 1930s. Quite the contrary, as Nanjing progressed remarkably by adding more than 3000 km to the national railway network, almost all the newly laid down rails followed International Standard Gauge.[207]

However, this is not to say that imperialism lost its influence or interest in Chinese railways. Foreign banks continue to provide essential financial support for Chinese railways, not to mention many railway professionals reside in high positions in governmental and private railway companies. Foreigners' passion for standards of rails was never gone. A French Commercial Attache in Indochina alleged in the 1920s that: "Nearly all the railroad systems in China have adopted the metric system except one built by the British from Peking-Tientsin-Mukden. The Franco-Belgium

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205 "Tielu shixing fading duliangheng banfa" [Regulations for the implementation of legal measures in railways], in *Tielu gongbao*, 1930, no.39, p.6. 9

206 "Shanghai Meiya zhichou chang zongjinli Cai Shengbai tiaocheng huayi duliangheng banfa an" [The general manager of Meiya silk factory's suggestions on the metrological unification], in Gongye biaozhu yu duliangheng, 1936, vol.3, no. 5, pp, 57-58.

207 Yang Gangyong, *Zhonguo jindai tielu shi* [Modern history of Chinese railways], Shanghai: Shanghai shudian chubanshe, 1997, p.109.

Railroad, the Peking-Hankow line, was unable to get connection for freight and material with the British railroad because the standards of measurements were not the same."[208]

This Frenchman as an ardent propagandist of the metric system was obviously not an expert on railways: most railways in China at the time adopted International Standard Gauge based on British measures. Peking-Hankow line (京汉线) connected smoothly with the line that went through Peking-Tientsin-Mookden (京奉线), both run with International Standard Gauge. His distortion of facts, inadvertently or not, revealed the ongoing competence of dual metrological globality for China's rails. The metrological imperialism of rails remained to be an indispensable backdrop for standardization issues since the 1920s. In this regard, the Frenchman would be further discouraged if he knew that the railways which did employ the metric system were under severe attacks during the 1930s. For example, in Yunnan, alarms were given by frontier experts such as Zhang Fengqi(张凤岐), who worried the imperialism carried by French railways would not only destabilize Yunnan alone but "when times come," further infiltrate Guizhou and Sichuan or even Tibet.[209]

But a more interesting case was in Shanxi(山西). Here, the metric gauge led to a conflict between Nanjing and the local warlord Yan Xishan(阎锡山). Shanxi's French metric gauge railways, such as the Zhengtai railway(正太路), and the inconvenience of trans-tracking were common in the 1920s and began to be criticized by NBWM.[210] In 1928, Yang rejected to use of the International Standard Gauge regulated by the Ministry of Railways, but the French metric gauge to build the Tongpu railway(同蒲铁路). There was a rumor that Yan deliberately used a narrower

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208 Aubrey Drury, *World Metric Standardisation: An Urgent Issue. A Volume of Testimony urging World-wide Adoption of the Metric Units of Weights and Measures—Meter-Liter-Gram.Compiled*, San Francisco: World Metric Standardisation Council, 1922, p.171.

209 Zhang Fengqi, "Xinan bianjiang wenti yu Yunnan" [The issue of westernsouth frontiers and Yunnan], in *Waijiao yuebao*, 1933, no.6, pp. 13-15. See also, Zhang Fengqi, "Xinan tielu wang zhi yanjiu", in *Shishi yuebao*, 1934, vol.11, no.2, pp.111-116.

210 Gongshang bu quanguo duliangheng ju, *Gongshang bu quanguo duliangheng ju duliangheng jianding renyuan yangchengsuo diyici baogaoshu*, "Yanjiang" [Speeches], p. 9.

rail gauge to keep Shanxi as an "independent kingdom" and rejected military and economic integration from Nanjing. On the other hand, evidence indicated that Yang's choice was also economical: the short gauge was cheaper and compatible with the extant metric gauge railways built by France since the late Qing. The interests of local society thus took priority over the standardization of the nation-state in the eyes of Shanxi's authority.[211] Another unverified theory pointed to the collaboration between Yan and French Imperialism: Yan had a huge deposit in a French bank which only allowed Yan to withdraw the money to purchase French goods.[212] In 1933, the debate on railway gauges came to an end. While firstly demanding a standard rail gauge, Nanjing could not force Yan's hand but accepted Yan's proposal in the end. It was certain that Yan won these conflicts of rail gauges for a simple reason, that local affairs of Shanxi were mainly decided by him instead of Nanjing.

Indeed, Nanjing did not have much control over the issue of standards on warlords' turf. Not coincidentally, Shanxi was also one of the most resolved provinces that rejected the NBWM's reform in the 1930s, as it had already unified its measures according to the order of the Beijing regime in 1919. In 1929, the Ministry of Industry and Commerce did notice the pre-unification situation of Shanxi when composing the complementation scheme. Exactly because of Shanxi's good record on metrological unification, NBWM expected the introduction of new measures would be rather smooth and swift. This was why Shanxi was enlisted among the first phase provinces.[213] Since 1933, NBWM has constantly urged Shanxi to switch to new measures. However, Shanxi

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211 Wang Mingxing, *Yan Xishan yu Shanxi zhaigui tielu* [Yan Xishan and Shanxi's short gauge railways] in *Zhonguo shehui jingji shi yanjiu*, 1997, no.4, pp.65-78.

212 Li Huasheng, "Shanxi jinnei xiuzhu zhaigui tielu de zhenxiang" [The truth of the construction of short gauge railways within the realm of Shanxi], in *Shanxi wenshi ziliao*, 1996, no.1, pp. 125-131, p.129. Another evidence also suggested that it was a German bank. See Yan Xishan tongzhi shanxi shishi [The historical materials of Yan Xishan's reign in Shanxi], Taiyuan: Shanxi renmin chubanshe, 1981.

213 Gongshang bu, *Gongshang bu duliangheng tuixing weiyuanhui huiyi huibian,* p.33.

rejected it by alleging that the metrological unification had already been achieved and that a sudden metrological change would bring much turmoil to local society.[214] The province only succumbed to Nanjing's unification scheme at the beginning of 1937, after Wu personally visited Shanxi in 1936 and finalized the plan with Shanxi's officials.[215]

In sum, warlordism and imperialism did impose some practical difficulties in setting up a national network of metrological administration, but these difficulties were not unexpected. In provinces where KMT had control, a working bureaucratic apparatus was plausible. A grand network began to form. Till the end of 1931, at least 17 phase-one provinces and major cities had their provincial headquarter. Local branches in counties were expected to be further established soon.[216] NBWM did experience some setbacks in providing adequate prototypes and measures for its branches, but the problem was mitigated after NBWM moved the national measure factory in Beijing (which was established by Beijing Government) to Nanjing.[217]

The networks continued to grow. As the reform was far from a planned consummation in 1935, NBWM drafted another six-year plan. The key point of this new plan was to establish more local branches to strengthen the apparatus of metrological administration.[218] These new efforts delivered some results: at least in those more developed provinces in the East, every county had its branch before the war put a temporary stop to the reform in 1937.

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[214] "Gongwen" [Official correspondence], in Shanxi shiye gongbao, 1933, no. 13, pp. 68-69; "Duliangheng faling" [metrological regulations] in *Gongye biaozhun yu duliangheng*, 1934, vol.1, no.2, pp. 89-90.
[215] "Zhiling" [Order], in *Shanxi shiye gongbao*, 1936, no. 296, p.18; Wu Chengluo, "Zhongguo duliangheng xinzhi jilishi shang zhi gengju" [The scientific and historical grounds for Chinese new metrological], in *Shanxi minzhong jiaoyu*, 1936, vol. 3, no. 5-6, pp. 7-9, p. 8; "Shanxi sheng duliangheng huayi chengxu" [The procedure of metrological unification in Shanxi province], in *Shanxi shengzheng gongbao*, 1937, no.15, pp.19-22.
[216] "Quanguo duliangheng xiaoxi" [National metrological messages] in *Dulinagheng tongzhi*, 1931, no.1, pp. 2-3.
[217] Chinese Second Historical Archive (hereafter, CSHA): 613-349, "Zhizao zhi jingguo qingxing ji jianglai banfa" [Overview of manufacturing and future plans].
[218] "Shiye bu quanguo duliangheng wancheng quanguo duliangheng huayi liunian jihua gangyao" [General contents of NBWM's plan of six years national unification of measures], in *Duliangheng tongzhi*, 1937, no. 21, pp. 13-15.

Province	Number of counties	Number of county and district branches
Jiangsu(江苏)	61	61
Zhejiang(浙江)	75	65
Shandong(山东)	108	108
Hebei(河北)	129	129
Jiangxi(江西)	83	83
Sichuan(四川)	148	127
Suiyuan(绥远)	16	16
Shaanxi(陕西)	92	28
Guangxi(广西)	94	94
Guangdong(广东)	97	
Fujian(福建)	69	77
Hunan(湖南)	75	75
Hubei(湖北)	69	77
Anhui(安徽)	63	63
Henan(河南)	103	114
Yunnan(云南)	110	1
Guizhou(贵州)	84	24
Chaha'er(察哈尔)	16	1
Gansu(甘肃)	66	1

Qinghai(青海)	16	1
Ningxia(宁夏)	10	10
Shanxi(山西)	105	
In total	1682	1147

Chart made based on "Quanguo duliangheng tuixing gongzuo gaikuang" [The overview of national metrological promotion works], in Biaozhun, 1947, no.6, pp. 11-19.

A Metrological Army

Throughout the 1930s, NBWM, the central brain of the reform, was a small and efficient institute. Under Wu Chengluo, the chief of the bureau, there were only three departments： the department of general affairs, the department of production, and the department of inspection. NBWM had two major functions for the forthcoming reform: the production department had a small factory that provided standard measures for its local branches, and the inspection department aimed to train inspectors across the nation[219]. Till 1934, there were only 40 members. Most of the staff were well-educated in related subjects of metrology, mechanics, and chemistry from universities in China, Germany, Japan, the United States, and Belgium. Some specialists from Beijing reform or who had experience in the police force were also recruited[220].

Obviously, the forthcoming job requires many professional and dedicated staffs. NBWM began to summon an army of metrological inspectors. NBWM placed the inspectors at of the reform's success: according to Wu's reflection, the Beijing reform failed because it emphasized solely the

219 "Gongshang bu duliangheng ju zuzhi tiaoli" [The organizational regulations of National Bureau of Weights and Measures, Ministry of Industry and Commerce], in *Xingzheng yuan gongbao*, 1929, no. 24, pp. 1-7.
220 CSHA: 422-522, "Shiye bu quanguo duliangheng ju zhiyuan yijiusansinian shangbannian kaoqinkaoji biao" [Charts of attendance and performance of NBWM employers in the first half of the year 1934].

manufacture of new measures instead of training enough professionals to enforce new measures.[221] Inspire by the Japanese example where a dedicated institute was erected for the training of inspectors in 1891, NBWM built a small elite school for students (实业部度量衡检定人员养成所).[222] At the beginning of 1930, several dozens of young students who had just freshly graduated from universities and high school had been handpicked by local governments and sent to Nanjing to receive basic training as metrological inspectors.

Warlordism once again hindered the recruiting. The communist riot in Changsha and wars in northern China temporarily cut off the Yangtze River and railways transportation. Many recruits could not arrive at Nanjing as scheduled.[223] Moreover, as officials in the ministry recounted, many provinces were suspicious of the real intention of Nanjing and refused to send trainees. Other provinces did select trainees but dared not to dispatch them on their way, for they did not fully know the local warlords' attitudes.[224] Nanjing planned to train more than 200 inspectors in the first session, yet only around 60 students showed up for the first class. On March 22nd, they got their certificates.[225] Nanjing had to clarify to provinces that inspectors were not spies. Instead of recruiting trainees by itself, Nanjing, in the spirit of "avoiding misunderstanding," allowed provincial governments to pick their own trainees.[226] Local governments responded positively: the number of recruits increased from 54 in the first session to 139 in the third session of 1931.[227]

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221 Shiye bu quanguo duliangheng ju, *Shiye bu quanguo duliangheng ju duliangheng jianding renyuan yanchengsuo dierci baogaoshu*, p. 125.
222 Gongshang bu quanguo duliangheng ju, *Gongshang bu quanguo duliangheng ju duliangheng jianding renyuan yangchengsuo diyici baogaoshu*, p.3.
223 Ibid., pp. 6-7.
224 Shiye bu quanguo duliangheng ju, *Shiye bu quanguo duliangheng ju duliangheng jianding renyuan yanchengsuo dierci baogaoshu*, p. 135.
225 "Huiwu jiyao" [Essential records of meetings], in *Duliangheng tongzhi*, 1931, no.1, pp.1-2.
226 Gongshang bu quanguo duliangheng ju, *Gongshang bu quanguo duliangheng ju duliangheng jianding renyuan yangchengsuo diyici baogaoshu,* "Yanjiang" [Speeches], p.18.
227 Shiye bu quanguo duliangheng ju, *Shiye bu quanguo duliangheng ju duliangheng jianding renyuan yanchengsuo dierci baogaoshu*, p.220.

However, Shanxi continued to be the most rebellious province, which refused to send recruits.[228]

From 1930, the training lasted till the outburst of the Japanese invasion in 1937. Each session of training lasted three months. Most of the students were in their early 20s.[229] Senior inspectors from Beijing reform, officials, and scientists, including Wu himself,[230] were responsible for the academic content. Wu invested much time and energy in training, as he personally compiled the textbooks and handouts, which were more than 500.000 characters in total[231]. The curriculum contained a wide range of subjects from KMT's ideology, Chinese, English, metrological law in China and industrial nations, history of Chinese metrology and industrial countries, accounting, theory of governmental administration, the practice of writing official correspondence and propaganda materials, modern metrology and metrologically related Math, Chemistry, Physics, and Mechanics, to field works of calibration and inspection of measures.[232]

To pass the final exams, students must show a good grasp of general science and modern metrology knowledge. Students should have a distinctive awareness of social affairs and a global perspective. They were asked questions such as "what is Fascism," what makes a nation," "my vision of modern China," "what is Lenin's 'New Economic Policy," or "describe the theory of Jean-Jacques Rousseau."[233] Most of the students managed to graduate, as they had received either

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[228] Ibid., Appendix, "Shiye bu quanguo duliangheng ju duliangheng jianding renyuan yangchengsuo geqi geshengshi biye renyuan renshu tongjibiao" [Statistics of graduates from the Training Center for Inspectors of Weights and Measures]

[229] Ibid., appendix, "Shiye bu quanguo duliangheng ju duliangheng jianding renyuan yangchengsuo geqi biye renyuan nianlin tongjibiao [Statistics of the age of graduates from the Training Center for Inspectors of Weights and Measures]. The average age of 248 graduates in the first three session was around 24.

[230] CSHA: 422-3456, "Cheng fu zhisuo zuzhijiandan jinfei wuke zunjie zaixin jinsuo" [Reply: "the bureau's simple organization and small budget should not be further reduced"].

[231] Gongshang bu quanguo duliangheng ju, *Gongshang bu quanguo duliangheng ju duliangheng jianding renyuan yangchengsuo diyici baogaoshu,* p.8.

[232] "Ju hanqing ge sheng shi zhuguan jiguan baosong duliangheng jianding ji zhizao xueyuan an" [The bureau called provincial administration for the recruiting of inspection and manufacture trainees], in *Biaozhun*, 1937, vol.3, no. 7, pp. 51-52.

[233] See for example, "Zalu" [Miscellany], in *Duliangheng tongzhi*, 1935, no. 15-16, pp. 39-45.

high school or college education before, which were scarce in the 1930s when the illiterate took up around 80 percent of the population.[234] Ethnicity and a sense of honor were other important aspects of the training. NBWM believed that inspectors were supposed to be respectable role models for society. In Europe, inspectors were directly nominated and appointed by Kings or ministers. Following the examples of European countries, students were required to make their oath of integrity in their graduation ceremonies.[235]

Nanjing expected its herd of inspectors to be responsive, responsible, and disciplined. Wu stated that "the management of students is military, and the lifestyle is also militarized."[236] The reason for this arrangement was that in front of the complicated and sometimes harsh conditions of future work, "the cultivation of spirits is important for the training of personnel...It is just like training soldiers. We must not only let them know how to do 'Stand at attention, 'Easy,' and 'Fire,' we also need them to respond to the order accurately."[237] Strong militarism continued to be a part of Wu's philosophy of administration. For instance, Chiang Kai-shek had once given ten commandments of righteous conduct and integrity to Lizhi Society (励志社), a semi-fascism

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[234] The literacy rate is debatable during Late Qing and Republican time. Rawski estimated that the male literacy in late Qing was around 30%-45%. Scholars such as Ge Zhaoguang challenged this result, his estimation is between 10%-20% percent. Since no solid and accurate national but only some provincial census data existed in 1930s，I here take the estimation of KMT's central propaganda department in 1929: about 80 percent of the whole population was illiterate. Respectively, the rate in the countryside was 90 percent, and 60 percent in urban settings. See, Evelyn Rawski, *Education and popular literacy in Ch'ing China*. University of Michigan Press, 1979, p.5; Ge Zhaoguang, "*Shixian tongshu* de yiwei" [The implications of *Shixian tongshu*] in *Dushu*, 1997, no.1, pp. 43-48, p. 47. "Zhuanzai" [Special publication], in *Tianjin tebieshi shizi yundong xuanchuan weiyuanhui huikan*, 1930, no.1, p. 15.

[235] "Yian(qishiba)" [Motion, no. 78], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p.146-147. Also, "Yian(bashiqi)" [Motion, no. 87], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p.155.

[236] Unfortunately, we do not know more details about the militarized training of inspectors in Nanjing. It was evidential that local branches did follow Wu's policy. For instance, Sichuan provincial branch alleged to give trainees "harsh military drills so to strengthen their spirit hard work" in 1936. See, Sichuan duliangheng jianding suo, *Sichuan duliangheng jiangdingsuo zhounian jinian kan* [The commemoration for the first anniversary of Sichuan provincial metrological insepction branch], Chengdu: Xinxin yingshua she, 1936, part 7 "training", p. 7.

[237] "Wu Chengluo zhaoji ge sheng duliangheng suozhang" [Wu Chengluo called upon the directors of provincial metrological inspection branches] in *Gongye biaozhu yu duliangheng*, 1937, vol. 3, no. 9, p.9.

organization in the KMT army that Kiang himself supervised. Wu hung these commandments on his office's wall in NBWM as a constant reminder for his comrades.[238] Chen Ling (陈嶙), a Northern Expedition veteran who served as chief of NBWM for a short time in 1931, shared his wartime experience with graduates that he once shared a piece of coarse black bread with a fellow soldier in the trench. Chen expected graduates to value the comradeship hardened by harsh ordeals and withstand the challenge of their forthcoming work, just like a soldier in the war.[239]

On 1932 April 6th, Wu invited all the newly trained inspectors to a tea party in the garden at his home and gave them his last words before the graduates left for their provincial branches. While tea and snacks were provided, the atmosphere was nevertheless intense. As their elder, teacher, and commanding officer, Wu urged them to bond as a fraternity, keep learning modern metrology and laws, publish their research if possible, and believe that they would "achieve a great cause." Specifically, Wu hoped that his students would remember the training and mind their conduct among people, so much so that students should avoid using words such as "pounds," "inches," "horsepower," and other "wrong terms" even in their daily conversations.[240] He continued asking his students to maintain a high metrological caution of accuracy and standards in daily life. Wu even asked inspectors to write on "standardized letter papers" in their private correspondence.[241]

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[238] These commandments read as follows: avoid being avaricious; bravery in front of death; avoid being ostentatious; avoid from pride; diligence; avoid gambling and prostitution; avoid smoking; avoid alcohol; avoid borrowing money; honesty. See, Shiye bu quanguo duliangheng ju [National Bureau of Weights and Measures, the Ministry of Industry], *Duliangheng jianding renyuan yangcheng suo biye tongxue lu* [Alumni of the Training Center for Inspectors of Weights and Measures], Nanjing: Shengying shuju, 1936, p24.

[239] Gongshang bu quanguo duliangheng ju, *Gongshang bu quanguo duliangheng ju duliangheng jianding renyuan yangchengsuo diyici baogaoshu,* p. 21.

[240] "Benhui liujing huiyuan lianhuan chahua jizya" [Essential records of tea-party with members in the national capital], in *Duliangheng tongzhi*, 1932, no. 2, pp. 2-4.

[241] Wu Chengluo, "Sichuan huayi duliangheng qiantu de zhanwang" [Prospects of metrological unification in Sichuan province], in *Duliangheng tongzhi*, 1941, no. 25, pp. 3-4.

The picture taken at the tea-party. In *Duliangheng tongzhi*, no.2, 1932. Front page

It is tough to evaluate how well the students have received their training. As we will see later, NBWM discovered the corruption of inspectors occasionally. However, for some inspectors, their own vision for a new China did echo that of Nanjing. An inspector wrote to his friend before he set out for training in Nanjing. To answer his friend's doubt about the importance of measures and the necessity of his choice, he replied with radiant optimism about the metrological reform. He wrote that "every social institution will always be replaced by something new when coming to the edge of a breakdown. This new social institution will always be superior to the old one."[242] And needless to say, he regarded himself as one of those lucky chosen few to facilitate this significant historical change.

However, this optimism would most likely be quenched when these inspectors returned to their home provinces. The number of Nanjing's elite army was far from enough. In NBWM's original plan,

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[242] Da Jiang, “Wei jieshi duliangheng xinzhi yu xunlian jiandingyuan de yiyi da H jun shu” [A letter that explains the purposes of inspector training and metrological unification to Mr. H], in *Duliangheng tongzhi*, 1935, no. 12, pp. 32-34.

inspectors were divided into three categories. First-class inspectors were ones with a college education, and each province would have several as the heads of provincial and urban branches of the bureau. The second class with high school education will be assistant to first lass inspectors. Both would lead third-class inspectors who were with junior high school education or a primary school education. Third-class inspectors would be sent to take care of branches at the county level.

The problem was that Nanjing mainly trained first and second-class inspectors; the training of third-class inspectors oversaw provincial governments and will be taught by first and second-class inspectors at the site. Nanjing estimated that five first-class and ten second-class inspectors were the bottom lines for each province, which meant 315 first-class and 630 second-class in total.[243] In 1930, the number of first and second-class inspectors was 214, of which 67 were first-class. In provinces of phase one, the number was barely enough. The lack of second and third-class inspectors was more pressing, for the provincial-trained third-class inspectors were extremely slow. Without much choice, Nanjing had to assign two or three counties for each local metrological branch, which usually had one inspector;[244] even so, the number of inspectors needed was more than 800. Even though Nanjing sped up its training, the gap continued to exist throughout the 1930s.[245]

To better understand the situation, let's take Jiangsu Province as an example, one of the core provinces of KMT where the grasp of Nanjing was rather firmer. In the year 1931, Jiangsu had 61 counties, with a population of 32.194.000. The average population of each county was around

243 Gongshang bu quanguo duliangheng ju, *Gongshang bu quanguo duliangheng ju duliangheng jianding renyuan yangchengsuo diyici baogaoshu,* p.3.
244 "Yian(wu)" [Motion, no. 5], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p. 28.
245 "Quanguo duliangheng jianding renyuan yangchengsuo xiaoxi" [Messages from National training center for metrological inspectors], in *Duliangheng tongzhi*, 1931, no.1, pp. 3-4.

520.000. In other words, an inspector who had been assigned to Jiangsu must consider the problems of promoting new measures among one and a half million people in three counties.[246]

NBWM later established the Weights and Measures Society of China (hereafter WMSC) to strengthen the connection of inspectors, for they were operating in different provinces with great distances. On June 1st, 1930, WMSC was founded in Nanjing, shortly after the first patch of inspectors graduated. They all automatically attained membership, alongside Wu Chengluo and other technocrats and government officials outside NBWM. As an elite group, the initial number of members was only 69. Though the number increased to several hundred, the membership remained inspectors and governmental personnel. However, scientists with government positions seldom joined WMSC, nor did people from other social backgrounds.

In other words, WMSC was a civil face of NBWM. It lacked a more comprehensive social representation of Chinese society, which, as I will showcase in chapter 4, weakened the stance of NBWM when criticism came from other social spheres. It also was reflected by the society's to-do list: among many missions that it was assigned at its birth, only one was related to propagating new measures among common people, that is, to publish some popular books on metrology, which also did not deliver satisfactorily later.[247] Among the activities of WMSC throughout the 1930s, the most successful was its publication of the Journal *Duliangheng tongzhi* (度量衡同志, *Weights & Measures Companion*). Again, this journal was mainly and subscribed to, and contributed and funded by inspectors. Its content ranges from metrological papers, Wu and other leading officials' comments on socially heated issues, inspectors' reports, poems, stories related to metrology,

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246 See the number in *Shenbao Nianjian* [The yearbook of Shenbao], 1934, Shanghai: Shenbao nianijian she, p. 83.
247 “Zhonguo duliangheng xuehui qishi” [Notice of Weights and Measures Society of China], in *Duliangheng tongzhi*, 1932, no.3, p.8.。

administration issues, etc.

However, against NBWM and Wu's will, the society nor the journal glued the brotherhood of inspectors tightly enough. Even the journal sometimes had trouble collecting enough membership dues from the inspectors to print the journal. WMSC must assign specific inspectors in the provinces to urge the submission of the fees.[248] Distance hindered communication between Nanjing and its members in remote regions within the society. Wu sometimes needed to travel to distant provinces to get first-hand information. For example, Wu once told members in Guangxi province that NBWM felt very hard to know the local situation but did not express it publicly for the sake of the NBWM's image. He then encouraged members in Guangxi to reach out more often: WMSC was even happy to know information such as which member recently fell in love or who had a child and got married.[249]

Nanjing aimed to train well-educated, honest young men with a passion for changing China. However, when these inspectors marched deeper into the woods of local societies, they soon found out that they were caught between Nanjing and local governments, the befuddling margin that would make their routine work a tough mission.

Between Nanjing and Local Governments

A good inspector was expected to start his branch in local societies. One must possess adequate metrological knowledge to monitor the production of measures, calibrate measures, and inspect

248 "Zhonguo duliangheng xuehui qishi san ze" [Three notices of Weights and Measures Society of China], in *Duliangheng tongzhi*, 1931, no.1, p.8.
249 "Huiwu jiyao" [Essential records of meetings], in *Duliangheng tongzhi*, 1935, no. 13, pp. 14-24, p. 20.

the proper usage of measures. One also needed social skills, as much of the work would not be conducted in quiet laboratories but also in the bustling urban market and harsh rural settings where they needed to persuade peasants who had the faintest ideas about the metric system. A good inspector was expected to follow a standardized process to start his branch in local societies. In a word, inspectors were the minor antennas of NBWM to touch China's vast lands. On the other hand, the local situation was extremely complicated and diverse, particularly at the county level. As someone witnessed, the success of reform at this level almost exclusively depended on the support of local governments.[250] However, most counties did not show enough enthusiasm to say the lease. An extreme case was from Hebei province, where 81 out of the total 130 counties did not even bother sending representatives to receive copies of standard measures, despite the provincial government's repeated requirements.[251] Liu Shihuang(刘世煌), who served as the head of Nanjing and Hunan provincial branches in the 1930s, provided his diagnosis of the local dilemma. For Liu, the reasons were at least three-folded: organization, budget, and personnel.[252]

Liu's observation accurately grasped some institutional flaws of this reform. Nanjing wove a national network of metrological administration through inspectors who directly carried out the orders from NBWM. On the other hand, the local metrological branches were established not by Nanjing but by provincial and county governments. The Provincial Department of Construction(省建设厅) and Section of Construction (建设科) at the county level supervised their work. In other words, inspectors answered to two masters: Nanjing and local governments. These dual

[250] For example, in Dongtai(东谭) county of Jiangsu province, with the help of the county government, the rural area was very close to unification even in early 1935. See, "Baogao" [Reports], in *Duliangheng tongzhi*, 1935, no. 13, pp. 12-14, p.13.

[251] "Yian(wushiliu)" [Motion, no. 56], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p.129-130.

[252] Liu Shihuang, "Jinhou huayi duliangheng zhi shangque" [Deliberation of the unification of measures in the future], in *Duliangheng tongzhi*, 1944, no. 28, pp. 3-4.

commanding chains naturally made the distribution of the budget a headache, which constituted Liu's second piece of the puzzle. In most cases, NBWM did not provide any financial support for its local branches; local governments did. As early as the 1930s, local governments had already pleaded.[253] Facing this demand, Nanjing only agreed to add limited "temporary" budgets to local governments in 1930. Nanjing's promise to address the lack of found was only lip service, as the burden was still laid upon local governments. Nanjing urged them to give more local budgets to metrological branches and balance routine inspections, equipment, and personnel expenses.[254]

In the 1930s, local governments' fiscal avenues continued to increase, but the growing income did not meet the expanding expenditure for ambitious modernizing courses required by the central government.[255] Only a small amount from annual budgets was allocated to metrological affairs. In the early 1930s, provincial metrological budgets varied from three to four thousand Yuan. A big county got around 500 yuan and the small one around 200.[256] Worse still, the fiscal reform in 1931

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[253] At least 5 motions were given to NBWM in the 1930 national metrological meeting. Just to give some examples, the plead from Hebei province which suggested the local expense of metrological work be partially covered by Nanjing, see, "Yian(wushiba)" [Motion no. 58], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p.131. Or the suggestion that put the budgets of local branches directly under the central Ministry of Finance, see, "Yian(wushiyi)" [Motion no. 51], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p. 120. Other motion suggested the establishment of local commissioners of budgets from the Ministry of Finance, or regularly allocating money from local governemnts industrial development budge (实业费), see, "Yian(jiushiba)" [Motion, no. 98], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p.170; "Yian(jiushijiu)" [Motion, no. 99], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p.172.

[254] "Tongji" [Statistics], in *Gongshang bu quanguo duliangheng huiyi huibian*, Nanjing: shiye bu, 1931, p. 6.

[255] A more detail discussion, see, Prasenjit Duara, "State Involution: A Study of Local Finances in North China, 1911-1935", in *Comparative Studies in Society and History*, 1987 Jan., vol. 29, no.1, pp. 132-161.

[256] "Yian(jiushiba)" [Motion, no. 98], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p.170.

rearranged the distribution of tax income between the central government and local governments, which cost local governments a sum. For example, the Lijin system (厘金), which had been the backbone of local fiscal avenues since the Late Qing, was abolished by Nanjing. In many places, local governments had to issue more governmental and public bonds to balance out the fiscal deficit.[257] The result was that most county governments experienced a shortage of money, for whom metrological reform was a task imposed by Nanjing, a trivial and expensive matter at best. County governments shunned away from lending financial support to inspectors. An extreme example was from Fuyang (阜阳) county, where inspectors had to resort to NBWM for a pair of equipment that the county government deemed too expensive. It was even more common for local branches to cancel regular inspection patrols in markets, for no money was given from local governments. When counties did receive money for metrological work from provincial governments, they tended to appropriate it for other causes, which they viewed as more worthwhile.[258]

However, we shall not dismiss the uncooperative attitude of county governments as simply disobedience. Rather, their grudge sometimes came from solid fiscal grounds. Let's take Guizhou province, "the model province of southeast China" in the eyes of NBWM,[259] as an example. In 1934, when the region launched its first three branches, the total cost was 379 Yuan. At first glance, the expense was reasonable. In big counties and regular-sized cities, the expense of opening a local metrological branch, with all the one-time cost of office place and necessary equipment, ranged

[257] Ke Weiming, *Yingye shui yu minguo shiqi de shuishou xiandai hua (1927-1949)* [Business Tax and Tax Modernization in Republican Time (1927-1949)], unpublished dissertation: Fudan University, 2013, pp. 43-46.
[258] "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangheng tongzhi*, 1934, no. 9, pp. 3-18, p.7.
[259] "Huiwu jiyao" [Essential records of meetings], in *Duliangheng tongzhi*, 1935, no. 13, pp. 14-24, p. 22.

from 100 to 300 Yuan, while in smaller-sized counties, the amount was only from 50 to 150 Yuan.[260] However, counties in Guizhou soon found the branches to be a black hole that was constantly burning money. Particularly so were the inspectors' wages, which amounted to more than 300 Yuan every month. To keep things running, counties with branches had to reduce inspectors' legal salaries by 40 percent.[261] As far as money was concerned, the reform also brought practical difficulty to taxation. Changed measures meant a changed rate of taxation. Before 1934 when the Ministry of Finance in Nanjing completely agreed to new measures,[262] county governments collected taxation with their regional measures. They were reluctant to accept new measures. In Fuping(阜平) county, the tax office refused to change the former procedure according to new measures, especially for tobacco and wine, which were the primary source of local revenue. In Zhejiang province, tax offices also refused to cooperate, as they directly answered to the Ministry of Finance instead of NBWM or its local branch.[263]

The problems of organization and budget contributed to the last piece of Liu's puzzle, personnel. Local branches reported that they were constantly short of hands, which became more visible after 1935 when the reform began infiltrating the rural area. Even in the republic's capital, the Nanjing local branch had to borrow inspectors from NBWM for work in the city's suburban villages.[264] The lack of inspectors, particularly third-class inspectors, prevented the reform from further development in rural areas. Provinces started to train their third-class inspectors as early as 1931

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260 "Jianding fensuo kaiban ji jingchang fei zuidi yusuan an" [Proposal for the minimum budget of opening new inspection branches], in *Gongye biaozhun yu duliangheng*, 1935, vol.2, no.6, pp. 57-61, p.57.
261 "Guizhou sheng ge xian duliangheng jianding fengsuo kaibanfei yusuanshu" [Budget plans for the opening of county inspection branches in Guizhou province], in *Gongye biaozhun yu duliangheng*, 1934, vol. 2, no. 1, pp. 99-100, p. 99.
262 "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangheng tongzhi*, 1933, no. 7, pp. 2-5, p. 5.
263 Ibid., p.4; also, "Duliangheng xingzheng xiaoxi" [Metrological administration messages], in *Duliangheng tongzhi*, 1932, no. 4, pp. 3-6, p.5.
264 "Baogao" [Reports], in *Duliangheng tongzhi*, 1936, no. 19, pp. 11-13, p.13.

to meet the gap in personnel at the local level. These inspectors were only required to have a middle school diploma but needed to pay their own tuition fees and accommodation. These conditions were not attractive: most provinces reported that they did not recruit enough students.[265]

Local governments were not ardent enough to train inspectors. Anhui provincial government trained 49 third-class inspectors for more than 60 counties. As the number already met the minimum standards of NBWM (one inspector for three counties), Anhui did not further its effort throughout the 1930s for budget shortfalls.[266] Only Henan and Hebei provinces have trained a substantial number of inspectors. Till September 1934, Hebei province had 293 inspectors staffed in every county.[267] The situation was similar in Henan, where a local branch had at least one third-class inspector, even in a small county. NBWM encouraged other provinces to follow the heels of Henan, yet no evidence showed that this advice had any repercussions at all.[268]

Another problem came from Nanjing's attitude. Nanjing only trained 557 inspectors till the end of 1936, mostly elite inspectors of first and second classes. The real backbone of the army of inspectors was 2120 third-class inspectors trained locally.[269] However, despite those third-class inspectors taking up most of the crew, they did not receive due attention from NBWM. For example, most of the third-class inspectors were not even enlisted as members of WMSC.[270] Nanjing's

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[265] "Duliangheng xingzheng xiaoxi" [Metrological administration messages], in *Duliangheng tongzhi*, 1932, no. 4, pp. 3-6, p.6; also, "Jiangxi sheng duliangheng jiandingsuo fushe duliangheng jianding renyuan xunlianban zhaokao banfa" [The recruiting regulations for Jianxi provincial metrological inspection branch's training center], in *Jiangxi sheng zhengfu gongbao*, 1932, no. 20, pp. 18-19.
[266] "Difang duliangheng xingzheng xiaoxi" [Local metrological administration messages], in *Duliangheng tongzhi*, 1933, no. 6, pp.9-19, p.9; also, Liu Yiyan, "Dui duliangheng jianding renyuan xunlianban biye xuesheng xunhua" [Exhortations to the graduates of metrological inspector training class], in *Jianshe zhoukan*, 1932, no.13, pp.1-2.
[267] "Fulu" [Appendix], in *Duliangheng tongzhi*, 1934, no. 11, pp.12-15.
[268] "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangheng tongzhi*, 1934, no. 8, pp. 2-11, p. 2.
[269] Wu Chengluo, "Huayi quanguo duliangheng zhi huigu yu qianzhan" [The reflections and prospects of national unification of measures], in *Gongye biaozhun yu duliangheng*, 1937, vol. 3, no. 8, pp.1-24, p.11.
[270] "Huiwu jiyao" [Essential records of meetings], in *Duliangheng tongzhi*, 1934, no. 11, pp. 17- 25, p18. In 1934,

failure to establish a more direct channel with the lower echelon of the inspector army took a toll: it was not entirely uncommon that these locally trained inspectors sometimes did not obey their commanding inspectors from Nanjing.[271]

Gloomy career perspectives for local inspectors also worsened the situation. The third-class inspectors were mostly under the age of 20 years. Unlike first or second-class inspectors, they dueled on the lowest level of metrological administration, did not receive sophisticated training from NBWM but from local branches, and thus lacked the channel of moving up in the administration. Even if they got promoted for outstanding work, the time for them to reach first class would be at least 16 years, and many inspectors thus chose to resign, which worsened in return the shortage of hands for local branches.[272]

It was by these conditions that an inspector's work was defined. Working as an inspector in a county was not a pleasant or rewarding experience at all. To start with, third-class inspectors faced a constant financial struggle. In Nanjing, Wu Chengluo himself received a paycheck of 240 yuan per month, which sufficed affluent and decent life. Third-class inspectors in NBWM were paid 30-40 Yuan.[273] While salaries of third-class inspectors in local branches were supposedly at the same level as that in Nanjing[274], wage arrears happened far too often. For example, In Hubei province, inspectors complained that they did not get paid for months, whereas the job became more arduous as they marched into rural areas. [275] To assuage the financial suffering of the inspectors,

the total number of the members of the society was 433, while third-class inspectors were more than 1.600.

[271] Ibid., p. 22.

[272] "Ge shengshi duliangheng jiangdingsuo zhuren tanhuahui jilu" [Records of inspection branch directors' meeting] in *Gongye biaozhun yu duliangheng*, 1937, vol.4, no.1-6, pp.5-33, p.28.

[273] CSHA: 422-522, "Shiye bu quanguo duliangheng ju zhiyuan yijiusansinian shangbannian kaoqinkaoji biao" [Charts of attendance and performance of NBWM employers in the first half of the year 1934].

[274] For instance, in Hubei, the salary for a third-class inspector was 40 Yuan in 1930. See, "Hubei sheng duliangheng jiandingsuo shijiu niandu kaibanfei zhifu yusuanshu" [Hubei provincial metrological inspection branch's budget plan in 1930], in *Hubei jianshe yuekan*, 1930, vol.2, no. 7, pp. 285-286.

[275] "Baogao" [Reports], in *Duliangheng tongzhi*, 1935, no. 13, pp. 12-14, p.12.

in 1933, Nanjing ordered local governments that the wage of inspectors must meet the minimum standard of local civil servants[276]. However, counties did not necessarily follow the policy. Salaries of inspectors were not listed as a "separate budget item" but remained in the vague category of "administration expense." Nanjing's order was simply ignored.[277] Other counties did set a separate budget for metrological work, yet the sum was smaller than Nanjing required and was barely enough to maintain the current inspection, let alone extend and improve it.[278]

Besides poor salaries, a heavy workload also added to inspectors' agony, a common phenomenon in many understaffed local branches. For example, In Nanchang(南昌), the capital city of Jiangxi province, two inspectors were responsible for patrolling the whole city "day and night," and they needed to check more than ten streets every day. However, illegal measures continued to come out despite their toil. The inspectors described their job as "picking up a grain of rice on the street each and every time while someone else was pouring a bag of rice around the city." [279]

Finally, many inspectors did not adjust to the content of their work in local societies well. The typical working routine of an inspector included calibration and inspection of measures sent from manufacturers, patrolling on streets to detect violations of law in stores, and holding scheduled inspections in markets. These forementioned tasks could be categorized into two kinds that were radically different in nature: while calibration demanded academic and professional metrological knowledge, inspection on the streets, markets, and the countryside was tedious and required

276 “Baogao” [Reports], in *Duliangheng tongzhi*, 1936, no. 19, pp. 11-13, p.12.
277 “Ge shengshi duliangheng jiangdingsuo zhuren tanhuahui jilu”, p. 26.
278 Chen Benzhong, “Woguo duliangheng jianding renyuan zhi diwei” [The status of our nation’ metrological inspectors] in *Duliangheng tongzhi*, 1937, no. 22, pp.2-5, p.5.
279 Long Jiachang, “Duliangheng yi gongzao qiu tongyi” [The unification of measures through governmental manufacture] in *Duliangheng tongzhi*, 1937, no. 21, pp.2-4, p. 3.

"social skills with people." Apparently, the inspectors did not deliver remarkably for the latter, as Chen Gongbo (陈公博), the minister of industry and commerce, criticized them for being too "westernized" and failing to cope with local society.[280] For instance, the head inspector of the Jiangxi provincial branch reported that his inspectors, although "academically professed," were not suited for work in the countryside. He recommended appointing dedicated patrolling personnel to liberate professional inspectors from such street work. NBWM did not take the advice simply for the fact that neither NBWM nor local branches had enough resources, as the number of such patrolmen needed by calculation would be twice the number of inspectors.[281]

As a result, tensions between inspectors and local governments were witnessed in many places. From the perspective of local governments, many provinces along the Yangtze River reported that their inspectors "lacked the characters to gain trust among people." Their behavior was "childish that disobedience of orders happened" along with "willful attack on people of higher positions." [282] A natural development was that inspectors were marginalized within local governments. In Jiangxi province, inspectors reported with great frustration that their colleagues from other government departments gave them insulting nicknames, "Cheng Dou Chi" (秤斗尺). Moreover, local governments there regarded measures as a trivial issue. They denied inspectors' demands to purchase inspection equipment and did not offer help when inspections were held. Violators of metrological law did not get punished accordingly. Worse still, local governments supervised and evaluated their work annually so that inspectors did not dare to voice their

280 Shiye bu quanguo duliangheng ju, *Duliangheng jianding renyuan yangcheng suo biye tongxue lu*, p.5.
281 Zhou Zanming, "Duliangheng jianding jiguan lin she jianchayuan zhi shangque" [the discussion of recruiting extra inspectors for inspection administration], in *Duliangheng tongzhi*, 1936, no.20, pp.2-4.
282 "Huiwu jiyao(yi)" [Essential records of meetings (part one)], in *Duliangheng tongzhi,* 1936, no.19, pp. 14-19, p.17.

dissatisfaction. Many inspectors quit without a proper goodbye.[283]

The uncooperative attitude of their colleagues in other governmental branches was a real-life fact for local inspectors. Let's see a more detailed case. Huang was the inspector in Leshan county(乐山) of Sichuan province. On September 4th, 1937, Huang inspected 11 local salt stores and found that 9 of them did not use proper measures. However, the store owners refused to give up their measures because the local salt administration disseminated them. Huang then visited Li Shaoting(李少庭), the chief of the salt affair office. Li sided with the merchants, alleging that the measures were correct. As Li had an anti-smuggling team under his command, Li even shouted and scolded Huang, threatening to detain Huang into custody should he insist on confiscating the measures.[284]

NBWM indeed tried to deal with the issue by employing its political influence in the central government. While local governments did not answer NBWM directly, they could not ignore orders directly from upper authorities. NBWM resorted to Executive Yuan, and since 1933 first in Jiangsu Province and later in other KMT-controlled provinces, the success of metrological unification was included in the annual evaluation of county governments.[285] However, the result was hardly satisfactory. While some local leaders were punished, no evidence showed that it altered the tides. Due to Nanjing's relatively weak political grip, it is not a surprising fact that some local governments tried to shut down metrological branches. For example, in Henan Province, the provincial financial committee tried to reduce the number of inspectors and the scale of the local metrological branch.

283 Long Jiachang, “Duliangheng yi gongzao qiu tongyi”, p. 2.

284 Sichuan Provincial Archive: “Sichuan sheng dujiansuo diwuqu fengsuo qushu wei shangren bu fucong jiancha gaihuan duliahengqi dian” [the telegraph from the fifth district of provincial metrological branch on the issue of the disobedience of merchants and their refusal to change measures], Ming 126-01-0854, pp. 9-10.

285 “Zhongyang duliangheng xingzheng xiaoxi” [Central metrological administration messages], in *Duliangheng tongzhi*, 1933, no.7, pp.2-5.

Even with the strong protest from the inspectors, half of the inspectors were forced to leave, and for the rest, their salaries were also cut to half, which was directly against Nanjing's order.[286] In Fujian and Hunan provinces, the provincial governments also intended to shut down the metrological branches directly.[287]

NBWM knew the local situation as the heads of local branches were regularly summoned to Nanjing. However, it did not or could not provide any solid and meaningful solutions to the difficult equation. For example, when asked for a solution to the disobedience of common people and the struggle of inspectors, Wu told his inspectors that the method was very simple: to be "Cheng." Wu used a Confucian term, "Cheng" (诚, loosely translated as "sincerity") here: inspectors should treat people with sincerity to gain their favor. "Cheng" meant that, on the one hand, "we should have an attitude of an educator. If one or two times is not enough, teach them for the third and fourth time". On the other, Wu hoped that "Cheng" would give inspectors a "religious" appeal. Inspectors should not persuade them with government orders or laws, but through "Cheng" to gain the love and trust of ordinary people so that when the familiar people saw inspectors, it was like "children saw their loving mothers."[288] It is very doubtful that inspectors' moral preaching would lead to any improvement for the work without further financial and institutional supports from NBWM or local governments. NBWM had no choice but decided in 1937 to retrain all locally based inspectors in Nanjing, as they proved to be inadequate in conducting the work satisfactorily.[289] The plan was never implemented, as the war with Japan led to the fall of Nanjing, which forced NBWM to move

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[286] "Ge shengshi duliangheng jiangdingsuo zhuren tanhuahui jilu", p.16.
[287] "Fujian gaizu shengxian jianding jiguan an" [The case of re-organization of Fujiang province's provincial and county metrological administration] in *Gongye biaozhun yu duliangheng*, 1934, vol.1, no. 1, pp. 100-101, p.101.
[288] "Ge shengshi duliangheng jiangdingsuo zhuren tanhuahui jilu", p.10.
[289] Wu Chengluo, "Huayi quanguo duliangheng zhi huigu yu qianzhan (xu)" [The reflections and prospects of national unification of measures(follow)], in *Gongye biaozhun yu duliangheng*, 1937, vol. 3, no. 9, pp. 4-11, p.7.

to Chongqing in 1938.

Conclusion

It was not entirely uncommon that the Nanjing regime aimed for long in many modernizing reforms but only came short in practice. William Kirby has termed this seemingly inevitable historical outcome that haunted Nanjing's various modernizing projects as the fate of "an "embryonic developmental state."[290]

For current literature on the reform, the Nanjing regime seemed to be a major hand in pushing the metric measures, which downplayed the importance of dissidents against Nanjing's monopoly of China's metrological future. There is no denying that the metrological reform in the 1930s was a nation-state enterprise. Nanjing's metrological scheming aimed at solidifying the sole monopoly of the KMT regime for metrological affairs. To achieve the goal, Nanjing established its control of the standard copies, justified its jurisdiction by legislation, and carefully trained its inspectors as carriers to spread its message of shaping the Chinese future through measures.

However, it is wrong to assume that the central government in Nanjing was the only significant political player in this process. The first part of the chapter lent support and evidence to the endeavor to disenchant the nation-state narrative. Much like I demonstrated in Chapter 1, Chinese elites did not understand the reform in a narrow nation-state term; their evaluation of the global metrological landscape remained a strong rationale for China's metric turn. Adding to the picture,

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[290] William Kirby, "Engineering China: Birth of the Developmental State, 1928-37," in Wen-hsin Yeh ed., *Becoming Chinese: Passages to Modernity and Beyond, 1900-1950*, Berkeley: University of California Press, 2000, pp. 137-160, p.152.

the disobedience of warlords and invested interests of international imperial powers in the railway system. They represented realms that Nanjing could not influence, which decidedly defined the metrication of modern China as an arena of constant political contestations. These enemies of the Chinese state weakened the assumptions that the unification of measures was within Nanjing's exclusive jurisdiction. Last but least, unlike most other nations, where the introduction of metrication accompanied a successful expansion of bureaucratic authority, the Chinese experience signified the incompetence of Nanjing in commanding its subordinate local governments. As I will demonstrate in the next chapter, this bureaucratic shortcoming again prevented Nanjing from influencing the metrological practice in broader society, particularly in the countryside. Although the actors mentioned above failed to halt the metrication march of Nanjing, they questioned Nanjing's monopoly of metrological authority and indicated the limitation of a metrological nation-state and the narrative that the metrological reform was a success story.

Chapter 3：Towards a Metricized China: Abortive Visions and its Global Entanglements

Introduction

Sociologist Li Jinghan(李景汉), who led various social surveys in the 1920s and 1930s Beijing, made the statement that Chinese people were careless or "so-so" people(马马虎虎之人民) who made China as a careless or "so-so" nation(马马虎虎之国家). Li exemplified his point with the myth of China's population:

> "When I entered primary school, the geographic textbook that I read alleged the population of China was 400.000.000[...]As time went by, the number remained when I graduated from high school[...]Several years later, when I finished college, I picked up the textbook of my nephews, and China's population was still 400.000.000. When I returned to China from my study abroad, the number still did not change a bit[...]Experts from customs said the population was more than four hundred and fifty million. The post office claimed four hundred and ninety. An English statistician estimated no more than three hundred million, and a German scholar calculated the number to be only two hundred and thirty million based on China's salt consumption."

Li concluded that the issue of population indicated an urging problem for China, which he described as "all under heaven is obscure."(天下模模糊糊)[291]

[291] Li Jinghan, "Shehui diaocha zai jinri zhongguo zhi xuyao" [the necessity of social surveys in current China], in *Qinhua zhoukan*, 1932, vol.38, no.7-8, pp1-8, pp.1-2.

While this obscurity troubled Li deeply, it is essential to note that this yearning for accuracy was not only a response to the modernizing tasks faced by the Chinese elite but also was informed by the rising global trend of "accurate state." Trained as a sociologist in America, Li's concerns reflected a worldwide change of perspectives on imagining social reality from the beginning of the 20th century. As cutting-edge mathematical approaches integrated into sociology, numerical descriptions of social reality became essential to reconstruct sociological "facts." Li advocated the governance of accuracy, the kind that Theodore M. Porter once called a deep "trust in numbers." Contrary to pre-modern statecraft, modern nation-states displayed a strong belief in accurate data, which was the most important, if not the sole rationale for policymaking.[292] This global shift of political thoughts also reached the Nanjing Regime in the 1930s, when the regime conducted numeral albeit failed censuses and other sociological surveys nationwide.

It was in this context that metrology came under the spotlight. Apparently, if sociality was to be quantified numerically, "by which measure" became an urgent issue. Metrological unification and standardization were much in line with modern sociologists' calling for this governance of accuracy. As Wu Chengluo revealed in 1935, the major purposes of the reform were "to establish the trust among people, to keep the accuracy of statistics, and to lay the foundation of science."[293] In the eyes of NBWM, obscurity and concomitantly dis-uniform measures and other standards of Chinese society came hand in hand, which begged complete standardization.

Recent global historiography of China began to lay more weight on local societies' global entanglements, and neglected individuals who did not enjoy much global mobility yet were still in

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[292] Theodore M. Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*, New Jersey: Princeton University Press, 2020. On statistics and making of modern nation state, see, Silvana Patriarca, *Numbers and Nationhood: Writing Statistics in Nineteenth Century Italy*, London: Cambridge University Press, 1996.
[293] Wuchengluo, Wu Chengluo, "Tongyi zhonguo duliangheng gongzuo zhi jingguo ji weilai zhi jihua" [The overview of works for unification of measures and plans in the future], in *Zhonguo shiye*, 1935, vol.1, no.2, pp.215-237, p.217.

"an encounter zone between manifold global and local structures."[294] From "China in global history" to "global history within China," many in Chinese academic settings have presaged a local turn of global historiography.[295] The Nanjing decade particularly was characterized by its embracing of global norms as the Chinese state was drawing from western historical experience for China's own self-strengthening.[296] At the same time, we should not assume that China completely imitated a global norm or model — if such a thing existed at all. The wave of global norms normally reached the shores of different places without a clearly identified model but merely vague outlines. This "chain transfer" effect of global norms, argued by Jörg Feuchter, indicated distortion, mutation, disputes, and hybridity as global norms traveled through actual and figurative networks doted by variegated national entities and social groups with conflicted and, at times, contradictory views of imagined global landscape.[297] As Heiner Roetz further pointed out, "if cross-border influences did not fall on receptive 'internal' ground, they would remain futile."[298] In other words, not only did the global impose or force upon the local, but also the local enabled the global at times. The global expansion of the metric system and accurate state must thus be

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[294] Dominic Sachsenmaier, *Global Entanglements of a Man Who Never Traveled: A Seventeenth Century Chinese Christian and His Conflicted Worlds*, New York: Columbia University Press, 2018, p. 10. See also, Henrietta Harrison, *The Missionary's Curse and Other Tales from a Chinese Catholic Village*, Berkeley: University of California Press, 2013; Stefan Berger, ed., Writing the Nation: A Global Perspective, Houndmills: Palgrave Macmillan, 2007; Walter D. Mignolo, *Local Histories/Global Designs: Coloniality, Subaltern Knowledges, and Border Thinking*, Princeton: Princeton University Press, 2012; Natalie Zemon Davis, "Decentering History: Local Stories and Cultural Crossings in a Global World", in History and Theory, 2011 May, vol. 50, no. 2, pp. 188-202.

[295] Recent discussion on "global history in China" from Chinese scholars, see, Zhang Xupeng, "Quanqiushi yu mingzu xushi: zhongguo tese de quanqiushi heyi keneng" [Global History and National Narrative: The Possibility of a Global History with Chinese Characteristics], in *Lishi yanjiu*, 2020, no.1, pp.155-173. Hu Cheng, "Guanyu zhongguo shijiao de quanqiushi zhi sikao: yi ruogan gainian gongju wei zhongxin" [Global History in Chinese Perspectives: Rethinking Several Conceptual Tools], in *Shilin*, 2022, no.2, pp. 158-168.

[296] A good overview piece, see, William C. Kirby, "The Internationalization of China", in *China Quarterly*, 1997 Jun., no. 150, pp. 433-458; also, Dominic Sachsenmaier, *Twentieth Century China: A Global History,* forthcoming.

[297] Jörg Feuchter, "Cultural transfer in dispute: an introduction", in Jörg Feuchter, Friedhelm Hoffmann, and Bee Yun ed., *Cultural Transfers in Dispute: Representations in Asia, Europe and the Arab World since the Middle Ages*, Frankfurt-on-Main, New York: Campus, 2011, pp.14-37.

[298] Heiner Roetz, "Transfer in Dispute: The Case of China", pp. 262-281, in Jörg Feuchter, Friedhelm Hoffmann, and Bee Yun ed., *Cultural Transfers in Dispute: Representations in Asia, Europe and the Arab World since the Middle Ages*, Frankfurt-on-Main, New York: Campus, 2011.

situated and understood in the local context of China.

To what extent, then, in what form and in what context was Nanjing's metrological reform local or global? As was mentioned in the former chapter, current literature on Nanjing reform tended to emphasize the unification of measures as a political inroad to strengthen the actual political authority of Nanjing, in metrological administration specific and the political symbolism of metrological sovereignty in general. While this perspective did help reveal political concerns of the Chinese nation-state behind the reform, it was less productive to follow this understanding too far as it narrowed the motives of the reform as a jurisdictional issue. Admittedly, Nanjing strove to gain a legal monopoly on measures to gain political authority against the challenges of political fractions and imperialism; then what? To what ends did this monopoly serve if Nanjing succeeded? Were there other concerns and motives besides the political one? As I will showcase in this chapter, metrology was regarded as a panacea for China's various problems in the 1930s. NBWM got involved with several social and economic projects that aimed to standardize Chinese industry, answer to the agricultural crisis, and even discipline the masses by imbuing a sense of accuracy and cultivating a culture of accuracy. All these efforts were entangled and connected to the global model of accurate state and other global trends, such as international industrial standardization and the global circulation of modern sociological knowledge. I argued that NBWM's visions were not confined to metrology and its political implications per se. Measures channeled a desire to go towards an all-rounded, metricized nation-state exemplified by the industrialized world north.

A New Way to Look, New Way to Rule: The Agricultural Crisis in the 1930s

Since the 1920s, the flood of foreign corps into the Chinese market and the economic turmoil brought by wars of warlords have devastated the agricultural economy. In 1925, mass media began to draw public attention to this so-call "agricultural crisis"(农业危机) and peasants' suffering. Public media tended to pin the crisis of agriculture down to metrological disorder in the countryside.[299] It was the same time when western-trained agricultural economists and sociologists conducted many agricultural investigations either within or outside governments, such as John Lossing Buck, an American agricultural economist at the University of Nanking, or Chen Hansheng (陈翰笙) from the Sociology Institute of Academia Sinica.[300] In these investigations, the problem of standards and measures and their implications on Chinese agriculture emerged. Sun Wenyu(孙文郁), a leading Chinese agricultural economist who worked with John Buck in the 1920s and 1930s and became Buck's successor as the dean of the Department of Agriculture economy later, wrote a long article in 1927 on China's metrological issue. In this article, Sun gave heartily support for the upcoming metrological reform of Nanjing and pointed out related metrological matters pending to be addressed in agriculture: the exploitation of peasants by the merchants' maneuvering of measures, the chaotic situation of inconsistent measures used for crops trade, and particularly, the difficulty to measure arable land and taxation accordingly.[301] Chen Hansheng, a German-trained historian who later on secretively studied agricultural economy and served as a spy for Intercom, also found and addressed the issue of inconsistent measures for land in his

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[299] For example, Shan Gong, "Gailiang nongye yu tongyi duliangheng zhidu" [The improvement of agriculture and the unification of measuers], in *Xinguangxi xunbao*, 1928, no.17, pp. 13-17.
[300] For John Buck and other American agricultural economists at the time, see, Randall Tross, *The Stubborn Earth: American Agriculturalists on Chinese Soil, 1898–1937*. Berkeley: University of California Press, 1986, Ch. 7.
[301] Sun Wenyu, "Zhonguo duliangheng wenti zhi yanjiu" [Studies on Chinese metrological problem] in *Jinlin daxue nonglinke nonglin congkan*, 1927, no. 40, pp.1-30, pp.20-27.

reports based on investigations in Wuxi(无锡), where more than a hundred variants of a typical measure Mu(亩) for rice paddies existed.[302]

We should not be surprised that agricultural professionals paid specific attention to measures. As Tong Lam pointed out, western sociology experienced a "numeric turn" at the turn of the 20th century: acute numeric statistics became the sole credible source to describe social facts.[303] This "passion for facts" was also manifested in China's agricultural investigations of the 1920s and 1930s, implemented by mainly western-trained sociologists and their students. Accurate, numeric, and "objective" descriptions of social facts were only possible with an accordingly correct and unified set of measures that Nanjing tried to promote. In turn, real social facts also facilitated the efficient policymaking of the state.

This interdependent relationship between a technocrat state and social science led NBWM and agricultural experts to become potential allies. Wu also noticed the ongoing discussion at the time, and agricultural investigation reports by Chinese economists began to appear in the official magazines of NBWM and WMSC. Being a chemist himself, Wu nevertheless recognized the importance of social science. He noted in a later article that "speaking of the social sciences, Statistics is the foundation for these social investigations...and without accurate numbers, the study of statistics is not possible." It was thus essential to re-measure arable lands nationwide, for the state's statistics were, at best, "estimation."[304]

How exactly did inaccurately measured land afflict peasants? Zou Fang(邹枋), an economist

[302] Guoli Zhongyang yanjiuyuan shehui kexue yanjiusuo shehuixue zu [social science group of social science institute, Academia Sinica], "Zhongguo nongcun jingji yanjiu zhi faren" [The beginning of Chinese agricultural economy studies] in *Nongye zhoubao*, 1930, no. 46, pp.16-19, and no. 47, pp.18-21.

[303] Tong Lam, *A Passion for Facts: Social Surveys and the Construction of the Chinese Nation-State, 1900–1949*, University of California Press, 2011.

[304] Wu Chengluo, "Duliangheng xingzhi tuixing fangfa yu quanguo huayi shikuang" [The method to promote the new measures and the reality of national unification], in Duliangheng tongzhi, 1937, no.22, pp.8-12, p.9.

who participated in Chen Hansheng's investigations, described "the numeric problem" in his article published in NBWM's magazine. The standard measure for land area, Mu, varied drastically even within the realm of a province. In Hubei, for example, the biggest Mu was larger by two times than the smallest. Mu varied according to various factors. Drylands, paddy fields, flat lands, and marginal grasslands on the slope were all measured by different Mu. More importantly, the diversity of Mu made it difficult for taxation. Since Ming and Qing Dynasties, local governments relied on mapped brochures, or Yulin Tuce (鱼鳞图册, Fish Scale Atlas) to determine tax. The brochures with data on individual land pieces' shape, acreage, and quality remained the main taxation documents for local governments even in the 1920s and 1930s. However, Zou noted that many brochures were lost due to wars and lack of funding. Some brochures fell into the hands of the people, who later served local governments as professional tax collectors for their monopoly of land and tax information. "Tax extortion on peasants" followed. The situation sometimes even worsened to the state that, as Zou noted, some county magistrates burnt these brochures on purpose to hide traces of corruption or make it easier for arbitrary taxation.[305]

When ill-measured lands combined with ill-measured taxes, the natural result was that the actual crops paid as taxes by peasants were far more than it was supposed to be. Thus, the time for collecting enough tax was usually prolonged. Local governments punished peasants who delayed taxation by increasing the rate. Xu even noted that, in Liuan County of Anhui Province, police officers who oversaw tax collecting hired their own crew. Around 90 police officers, with a bunch of 4 to 5 hundred, were stationed in peasants' homes and only left after the taxes were paid

305 Zou Fang "Yanjiu zhongguo tianfu de jige kunandian: tianmu danwei butong" [Some difficulties to study China's land taxation: the differentiation of land measures], in *Gongye biaozhun yu duliangheng*, 1935, vol.2, no.1, pp.4-6, pp.4-5.

off. Their living expense during the stationing time was also to be covered by peasants. [306]

Local governments, police, and semi-governmental experts on measures held land brochures. These groups of actors in Zou's record functioned as representatives of a state that exploited and predated the rural population. The image here coincided with Prasenjit Duara's "entrepreneurial brokerage" or "state brokerage," which stood against "protective brokerage," the group consisted of local elites that represented and protected the interests of the rural population.[307] On the other hand, NBWM proposed a different vision of the state, a state through functioning measures cured the agricultural crisis. It served as the protector for peasants against the exploitation of cunning merchants and rural predators.

Finally, the lack of fair measures and, in a broader sense, the lack of standardization did not only cause a social and economic crisis in the countryside but came with ramifications in the urban scenario and industrial sector. Take rice as an example: Chinese rice did not feed Chinese mouths. In big cities, customers were inclined to purchase rice from Vietnam or Thailand. The lower price of imported rice was a reason; another reason was their standards. These foreign rice kinds were cultivated, graded, and then sold based on a series of standards. Their color, luster, and plumpness were more likely to gain the favor of the urban population. No such standards existed in China in the 1930s. Quite the contrary, Chinese rice failed to enter some big urban domestic markets for not being engineered for the liking of urban pallets. In Hunan Province, peasants had to burn unmarketable rice, the fruits of hard labor. It is ironic, particularly so for China, a famine-trodden nation in the 1930s. Cotton was another example. A huge amount of cotton was imported annually

[306] Ibid., p.6.

[307] Prasenjit Duara, *Culture, Power, and the State: Rural North China, 1900-1942,* Stanford University Press, 1991, Ch. 2.

to feed the textile industry, then the most dominant industry in China. The cultivation of foreign cotton was carefully engineered to meet the industrial requirements on the fiber's length, luster, and resilience, whereas domestic cotton failed to meet. Many peasants even soaked cotton in water or mixed dirt in cotton to increase the weight of their products on sale. The textile industry had little trust, if not none, in domestic cotton, and the domestic market was flooded by foreign cotton.[308]

As articulated earlier, NBWM was well aware of the metrological situation in rural society. Particularly in 1934, preliminary urban unification was achieved, and many local inspectors expanded their work to more rural settings and sent tons of reports back to Nanjing. Wu recognized the urgency of addressing the measure problem in rural areas through first-hand experience. During the new year of 1934, Wu went out to check local branches' work and found out that most villages along the railways had not unified their measures for grain trade.[309] It was also common knowledge that the reforms in rural and urban settings were somewhat disjointed and disconnected: urban businessmen traded urban dwellers with new measures but bought from peasants who did not have a clue about metrological reform with the old illegal measures.[310]

Wu presented his assessment of the agricultural crisis later in 1934, which echoed the viewpoints of sociologists and economists at the time. The most urgent issue at hand, opined Wu, was the fraud: peasants were stripped off by cunning merchants who used inconsistent measures,

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308 Wu Chengluo, "Gongye biaozhun" [Industrial standards] in *Gongye biaozhun yu duliangheng*, 1936, vol.3, no.5, pp.3-19, p.18; see also, Shiye bu quanguo duliangheng ju [National Bureau of Weights and Measures, the Ministry of Industry], *Shiye bu quanguo duliangheng ju duliangheng jianding renyuan yanchengsuo dierci baogaoshu* [Second report of the Training Center for Inspectors of Weights and Measures], Nanjing: Zhuonghua yinshua gufen youxian gongsi, 1931, p.102.

309 "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], 1934, no.9, pp.3-18, p.5.

310 "Te zai: Jia" [Special publication: Home], in *Duliangheng tongzhi*, 1934, no. 10, pp.6-10, p.8.

which sometimes caused more damage to rural households than stiff taxes. When dealing with rural grass-root credit institutes such as pawnshops, peasants also suffered financially without accurate measures to value their yields.[311] Wu's observation was accurate enough. As I will detail in the next chapter, fraud during commercial transactions was basically unchecked in the countryside. For instance, In Wuxi, silk merchants purchased dried-out cocoons from peasants. The merchants tampered with the hanging weights of their steelyards, which would add at least 10 percent more for every Dou in measuring.[312] In Songjiang, rice traders also removed wooden paddles at the bottom of their barrels to increase the unity capacity.[313]

Wu's plan to restore rural society was a systematic standardization of agricultural life through accurate measures. Like his peer economist and sociologists, Wu thought that arable land should be re-measured, first and foremost. Wu argued that arable land was measured with inconsistent standards and taxed based on not only its dimensions but also its location, fertility, the approximation to irrigation, etc. Whether the tax was collected in a monetary or a natural form, only accurate measures enabled the correct and fair calculation of taxes. Also, metrological frauds would end if peasants knew the proper measures to detect them. More roads should connect urban markets, and the distance between would be measured carefully to facilitate the transportation of agricultural products better. The hygiene and health of the rural population would benefit from standardization if peasants had "standardized meals" served with accurately

[311] Wu Chengluo, "Fuxing nongcun shen zhong yige zhongyao wenti" [An important issue for the revitalization of the countryside], in *Duliangheng tongzhi*, 1934, no.11, pp.1-3.

[312] "Chajin jianshang siyong dacheng" [Forbiding the illigeal usage of big steelyards], in *Jiangsu shengzhengfu gongbao*, 1930, no. 553, pp.19-20.

[313] Huang Zaojing, "Songjiang mihang qingkuang" [The situation of rice stores in Songjiang], in *Songjiang wenshi*, vol.4, 1983, pp. 13-18.

measuring utensils.[314] Fertilizer would be applied in an accurate quantity. Peasants would also be educated to measure the land independently and learn to irrigate it with the correct amount of water.[315]

Not only a metricized agriculture but a metricized, modern agricultural life. Wu's vision revealed NBWM's ambition to stretch its tentacles to standardize the vast population of Chinese peasants. However, it is disappointing when we look at the actual standardization of agriculture. In all fairness, the land problem entered the state's agenda, as the KMT government attempted to address this issue at the beginning of its foundation. In 1928, Nanjing started to prepare the national-wide land re-measuring, and new Land Law was enacted in 1930. Nanjing first tried to map all arable lands in its controlled provinces, only to find it impossible to ascertain each household's actual land acreage. In Henan Province alone, a complete re-measuring demanded more than 5 to 6 thousand dedicated surveyors, and annually 5.2 million Yuan. Due to a significant lack of personnel and funds, central and local governments had no way but to order individual households to report to governments the areas of their lands mandatorily. However, nobody could guarantee the accuracy of the collected data as there were not enough surveyors to verify each report. Worse still, even this endeavor has failed, as many peasants did not report it. Besides Jiangsu Province, no provinces have completed land re-measuring, and the program was in de facto stagnation through the 1930s.[316]

NBWM made no significant moves to participate in the land reform. Neither the political

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314 Wu Chengluo, "Fuxing nongcun shen zhong yige zhongyao wenti", pp. 3-6.

315 Wu Chengluo, "Huayi duliangheng heyi neng xiezhu shengchan" [How does the unification of measures facilitate the production], in *Duliangheng tongzhi*, 1935, no. 14, pp.2-6.

316 Chen Yuhua, *Jiangsu sheng tudi zhengli yanjiu: 1928-1936* [Research on the land checking in Jiangsu province: 1928-1936], unpublished dissertation, East China Normal University, 2008, Ch. 1.

jurisdiction nor resources to lead the endeavor were in the hands of NBWM. On the local level, only the metrological branch in Hebei Province tried to investigate the possibility of land re-measuring in 1933, under the instruction of NBWM.[317] No report was submitted afterward, so the small endeavor seemed to have no repercussions. Ironically, the land re-measuring program did not even follow NBWM's new measures: in 1935, after five years of the reform, NBWM had to urge the Ministry of Industry to use legal metrology in land re-measuring.[318] In retrospect, even if NBWM's plan had been implemented thoroughly, it was doubtful that it would have made any significant difference. Many historians have argued that the 1930s agricultural crisis was a combination of state evolution, a social disorder brought by the unchecked local elite, and economic turmoil characterized by price diving of domestic markets but triggered by the global economic crisis. Moreover, this crisis was exaggerated by many Marxist economists then: even though the rural social crisis was very much real and witnessed in northern China, in the Jiangnan area, the rural society was generally not severely affected.[319] However, NBWM's involvement displayed a tendency to address social problems by problematizing them in a metrological way. In other words, by "metricizing" various social realms, NBWM managed to engage with social topics and other social actors that exceeded far beyond metrology per se. We shall see this method again as NBWM's ambition jumped from agriculture to industry.

[317] "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangheng tongzhi*, 1933, no.6, pp.2-9, p.9.

[318] "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangheng tongzhi*, 1934, no.9, pp.3-18, p.3.

[319] A good reflection of the scholarship on agricultural crisis, see, Ma Junya, "Yong jiao biaoshu: ershi shiji ersanshi niandai zhongguo xiangcun weiji de linglei xushi" [Expressing with the Feet:The Alternative Narratives of Rural Crisis in the 1920s and 1930s China], in *Wenshizhe,* 2016, no.5, pp.53-58, p.166.

Dancing to the Global Trend: Industrial Standardization

Since the launch of the self-strengthening movement in the late Qing, industrialization was always an indispensable piece in the puzzle of building a modern China. After WWI, followed by Liang Qichao's lament for the bankruptcy of European materialistic civilization and industrial capital, industrialization began to appear suspicious as the basis for China's revitalization. Starting from 1924, whether to "rebuild China on the basis of agriculture or industrialization"(以农立国以工立国) provoked a heated debate within the intellectual circle. Influential scholars such as Liang Shumin(梁漱溟) expressed their concern about social diseases that industrialization could bring to modern China, such as polarization or a rising unemployment rate.[320] However, the majority of intellectuals and the Nanjing regime were still much for industrialization as the only plausible way to revitalize China, despite its many downsides. In the 1930s, China's industrial booming in the 1930s and the excitement brought by the prospect of an industrial China further fueled this industrial mentality. For example, an industrial organization wrote to NBWM, stating that "the future of China is in the hands of engineers": bankers lent more funds to the industrial sector. Young students aspired to a factory career instead of being a bureaucrat in governments. Academics, with their expertise, got involved with industrial production as well. Apostles of industrialization at the time declared that an "industrial culture" began to rise to the extent that some compared 1930s China to Europe on the eve of the industrial revolution centuries ago.

It was in this context that NBWM manifested a much stronger passion for standardizing the industrial sector of China, particularly so when compared with its half-hearted interest in the

[320] For a good evaluation of this debate, see Luo Rongqü, *Cong xihua dao xiandaihua*[From westernization to modernization], 2008, Hefei: Huangshan shushe, the fourth collection.

metrication of agriculture. Again, Wu Chengluo came to the center of the play for his role in NBWM, for he was one of the most experienced experts in industry development. Far preceding the metrological reform set off in the 1930s, Wu had already done a serious "industrial investigation"(实业调查), meticulously compiled economic data from the eve of Qing's collapse to the 1920s, and published several monographs based on his research.[321] In 1929, as a member of the Chinese industrial ministry delegate, Wu traveled to the Philippines to market Chinese industrial goods. Even as a colony, the Philippines' industrial progress impressed and worried him. Wu concluded it was ever-more pressing to turn China from an agricultural country into an industrial one if China wished to survive as a sovereign nation in the 20th century.[322] Later, in 1932, Wu became the director of Nanjing's Central Industrial Experimental Institute(中央工业试验所所长), which was China's most significant industrial research institute in the 1930s. Wu also launched a popular industrial magazine, *Industrial Center*（工业中心）. While the title has already given away the main content, according to Wu's preface for the magazine, it was a "popular monthly magazine with many illustrations devoted to the development of industries."[323]

For NBWM and Wu, "the man of standards," industrial standards became the natural handle to open the door to industrialization. Industrial standards were in the blueprint of NBWM at the beginning of the reform. In the early 1930s, NBWM ordered its inspectors to investigate industrial

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321 These works include: *Diaocha nongzhi zhilue* 调查农产志略 [The records of investigation of agricultural], *Diaocha geye zhilue* 调查各业志略 [The records of investigation of various industries], and *Diaocha kuangye zhilue* 调查矿冶志略 [The records of investigation of mining and metallurgy], in Liu Jingzao, *Qingchao xu wenxian tongkao* 清朝续文献通考, vol. 385, 386, and 390. Also, Wu Chengluo, *Jinshi zhongguo shiye tongzhi* [General records of Chinese industries nowadays], Shanghai: Shangwu yinshuguan, 1929.

322 Wu Chengluo, *Feilübin gongshangye kaocha ji* [The investigation of the Philippines' industry and commerce], Nanjing: Zhonghua shuju, 1929, p.2.

323 Front page, in *Gongye zhongxin*, 1932, vol. 1, no.1.

standards alongside market standards.[324] Chen Gongbo(陈公博), then the minister of industry and commerce, held that a unified metrological system and industrial standardization were two major tasks as China marched toward becoming an industrial nation.[325] In 1931, Industrial Standards Committee (工业标准委员会) was summoned under the direct request of the ministry, with Wu as its director general. Though an independent committee, it functioned as a part of NBWM.[326]

More importantly, NBWM's devotion to industrial standards was a production of the bureau's evaluation of global economic reality. The waves of the second industrial revolution in the 1860s came to a height after the great war, which nurtured new economic sectors and a new notion of industrial development. The global "industrial rationalization movement"(产业合理化运动) became a public topic in the 1920s in major Chinese media like *East Miscellany.* As an economic theory, it emphasizes the cooperation of different production parties and a rational balance of supply and demand to achieve greater economic efficiency. The term "industrial rationalization" was mostly used in Europe. Particularly in Germany, "Industrielle Rationalisierung" was one of the foci among Weimar Republic's numeral "rationalizing projects" after the great war.[327]

The global industrial rationalization movement after the great war was firstly inspired by the American economist Frederick Winslow Taylor and his "scientific management" theory. This theory, later crystalized as Taylorism, emphasized synthesized workflows and the interchangeability of

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324 "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangheng tongzhi*, 1932, no.4, pp.3-6, p.6.

325 Chen Gongbo, "Fakan ci" [Foreword for the journal], in *Gongye biaozhun yu duliangheng*, 1934, vol.1, no.1, pp.1-3, p.1.

326 "Gongye biaozhun weiyuanhui zuzhi chengli jingguo ji qi jianzhang" [The establishment of Industrial Standards Committee and its general regulations], in *Gongye biaozhun yu duliangheng*, 1934, vol.1, no.1, pp77-79.

327 See An old but extensive study on the rationalization movement in Weimar Germany, see, Robert A. Brady, *The Rationalization Movement in German Industry. A Study in the Evolution of Economic Planning* (Berkeley: University of California Press, 1933. See also, J. Ronald Shearer, "Talking about Efficiency: Politics and the Industrial Rationalization Movement in the Weimar Republic", in *Central European History*, vol. 28, no. 4, December 1995, pp. 483-506.

product parts to increase productivity and economic efficiency. It also valued the standardization of materials, tools, and production procedures to eliminate waste. In other words, standardization was central to rationalization. Taylorism's globalization accelerated after the great war. As Germany tried to rise from the ruins of the war and its ensuing economic hardship, the German state brought in American money to stimulate investment, together with Amecian economic thought and policy that reshaped the ruined industry. In the 1930s, standardized production procedures characterized economic fields such as electrical or automotive industries in the United States and Germany, both the epitomes of this trend in the eyes of the Chinese. As one of the most enshrined and global-circulated economic thoughts since the early 20th century, Taylorism was widely accepted by China's economist circle from the 1920s to the 1940s. [328]

NBWM later termed this trend of industrial standardization as the "scientization of industries"(产业科学化). Members of NBWM drew a historical lesson that intensifying industrial standardization paved the pathway towards post-war economic restoration for Germany specifically and Europe generally. Laying in front of NBWM were facts from Ford Motor Company's success in America, Where the country's magnificent industrial prowess (in the highly integrated and monopolized forms such as a trust or a syndicate) was crystallized by its experts who specialized in quality control and production standards.[329] Chinese also witnessed the "industrial rationalization" movement marching beyond Europe but to the Soviet Union and Japan. Despite Lenin's decrying of Taylorism as "man's enslavement by the machine" or a " scientific system of sweating " before the revolution, he and Stalin also adopted scientific management later in five-

[328] For example, Yang Chunfang, “Chanye helihua yundong” [Industrial rationalization movement], in *Dongfang zazhi* [The Eastern Miscellany], 1930, vol. 27, no. 23, pp.11-26.

[329] Lü Xiangwen, “Du liangheng gongye biaozhum ji guomin jingji” [metrological industrial standards and national economy], in *Gongye biaozhun yu duliangheng*, 1935, vol.1, no.11, pp.1-2.

year plans.[330] Japan's intensive industrial standardization after WWI also caught the attention of NBWM.[331] For instance, the textile industry, one of the most vital fields in China, used English measures and machines from the U.S., Japan, and England. China had more spinning factories than Japan, but without industrial standards, Chinese products failed to compete with Japan. People were warned that industrial nations imposed grand pressure and competition on China if she wanted to secure her own domestic and global markets. By "scientization of industries" or implementing industrial standards, industrial yields will be maximized with the lowest material costs possible.[332]

However, industrial standardization did not necessarily dictate the use of the metric system. Indeed, it seemed that the metric system was more suitable to be the metrological base for industrial standardization as metric units were more systematic than English measures in that the relationships between the units were strictly decimal. The conversion between them was coherent and consistent. However, in the United States, the most important motherland of industrial standardization and scientific management, the process was characterized by the enshrinement of English measures in the industrial sector. Since the 1860s, accomplished industrialists and engineers began to use inch-based standards to unify national industrial production. This endeavor resulted in a complex standardized network of "inch industries" that produced uniform, interchangeable parts and practices defined solely by inches and feet. In other words, it was not the interchangeable decimal measures like the metric system but the interchangeable and

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330 On Lenin and his evaluation of Taylorism, see, Zenovia A. Sochor, "Soviet Taylorism Revisited", in *Soviet Studies,* Vol. 33, No. 2 (Apr. 1981), pp. 246-264.

331 Liu Yinfu, "Fakanci(zhier)" [The second foreword for the journal], in *Gongye biaozhun yu duliangheng*, 1934, vol.1, no.2, pp.1-2.

332 "Te Zai" [Special publication], in *Duliangheng tongzhi*, 1934, no.9, pp. 1-3, p.3.

standardized parts of machinery that marked the American method toward industrial standardization. British measures established the systematic dominance in machine tools and metalwork industries, particularly that a pipe, a coil of wire, or even the screw threads followed inches instead of meters.[333]

Adding to this somewhat troubled history in the eyes of the metric adherents was the fact that people who influenced this development of scientific management and industrial standardization most happened to be the major figures of vehement anti-metric campaigns in the United States. The country was extremely close to going metric in the late 19th century and early 20th century. However, the dream of a metricized America was undermined by leading technological minds, who viewed the change to the metric system as too costly and a threat to the established metrology and the already standardized industrial sector, which they took much effort to build and much pride in. Among the rank of the anti-metric camp were Henry Towne, who first theorized the idea of scientific management, Frederick Halsey and Samuel Dale, two pivotal anti-metric leaders in the global arena who were mentioned in the beginning chapter, and even Frederick Winslow Taylor himself, the front face of scientific management and industrial standardization. As the president of the American Society of Mechanical Engineers, the most influential anti-metric organization since 1880, Taylor played a critical role in defeating the metric system in the 1900s when he appeared in front the congress with his testimony, which added a lethal strike to kill the metric bill of 1906.[334] European experience of industrial standardization enshrined the base of the metric system, while

[333] Stephen Mihm, "Inching toward Modernity: Industrial Standards and the Fate of the Metric System in the United States", in *Business History Review*, vol. 96, Issue. 1: Standards and the Global Economy, Spring 2022, pp. 47-76, pp. 53-55.

[334] Ibid., p.57, pp. 62-73. See also, Hector Vera, "Breaking Global Standards: The Anti-Metric Crusade of American Engineers," in David Pretel and Lino Camprubi eds., *Technology and Globalisation: Networks of Experts in World History*, London: Palgrave Macmillan, 2018, pp. 189–215.

the United States, the leading country in the global industrial standardization movement, built its economy with parochial, outdated metrology. The reality endangered the intimate linkage made by Chinese elites between metrological reform and Chinese industrialization. The treatment of this conflicting and ironic message was to ignore it. Among the concerted lobbying for industrial standardization from supporters or NBWM on public media, not a single piece has tried to explain, or even mentioned the fact, although some loudest voices were from Chinese professionals who trained in America as engineers and by no means were they unaware of the situation. NBWM's interest in industrial standards continued to grow. In 1934, NBWM launched its second official magazine, *Gongye biaozhun yu duliangheng* [Industrial Standards and weights & Measures]（工业标准与度量衡）. Straightforwardly, industrial standardization was put before weights and measures.

Front page of issue no.1 of *Gongye biaozhun yu duliangheng*. The cartoon, which appeared in every issue, depicted a climbing man on the right side with a heavy bag, looking at another man on the top of the hill without a load on his shoulders. The title reads: "standardization and simplification is the mother of success." The lines above the climbing man and man on top read respectively: "before standardization, cumbersome" and "after standardization, convenient."[335]

The second lesson that NBWM concluded from the global wave of industrial rationalization was that the metrological institutes in industrial nations played a central role. Germany had its first standardization institute in 1887, and Normenausschuss der Deutschen Industrie began to function in 1917 to lead industrial standardization. The United States Bureau of Standards was founded in 1901 and later became the mastermind of the country's metrication efforts and industrial standardization. Japan established its national institute for both standardization and metrological unification in 1921. In Russia, the National Committee of Standardization began to function in 1923. The founding dates of these institutes were clearly listed in an article on *Gongye biaozhun yu duliangheng*, and the author ended by urging the introduction of industrial standardization in China. With a worrisome tone, the author stated that it has been "more than three decades since

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335 Please note that the publisher was "National Bureau of Standards" instead NBWM. NBWM submitted a petition to the Ministry of Industry in 1934, hoping to expand its jurisdiction on all standards instead of measures alone. The purpose of this change, according to NBWM, was to enable Chinese products to compete with imported products in domestic market. See, "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangheng tongzhi*, 1934, no.9, pp. 3-18, p.5. As a matter of fact, Nanjing's National Bureau of Standards (中央标准局) was founded only in March, 1947, more than a decade later, and was merged by the industrial standards committee and NBWM. The purpose of this arrangement was most likely to set NBWM equal among its global peers whose jurisdiction covered standards in general, instead of merely measures and weights. The magazine itself was also distributed to standardization organizations in other nations, thus an English catalogue of contents was provided in every issue. See, Zhongyang biaozhun ju [National Bureau of Standards], *Zhongyang biaozhun ju gaikuang mulu* [The overview of the National Bureau of Standards].Nanjing： Zhongyang biaozhun ju, 1947, pp.1-3.

America had its institute for standardization...more than a decade since Japan had its own."[336] The feeling of lagging and the urge to integrate China into this global trend was evident in the discussion at the time. While NBWM led the metrological reform, which mainly targeted the unification of measures in urban markets, the bureau nevertheless wished to expand the reform from the narrow definition of "weights and measures" to "standardization" in a broader sense, just like its peers around the globe.

It shall not surprise us that NBWM planned China's metrological future with a distinctive global awareness. NBWM was not alone in its endeavor toward metrological modernity. On the contrary, NBWM has communicated with various international standardization organizations on multiple levels. NBWM kept an official correspondence with the International Bureau of Weights and Measures (*Bureau International des Poids et Mesures*, hereafter BIPM), the global headquarters of world metrication. In the 1920s, besides the metric system, BIPM began to include industrial measures under its jurisdiction. The chief of BIPM, Charles Édouard Guillaume, a Nobel Prize Laureate and Swiss physicist, kept an official correspondence with NBWM. Many of Guillaume's papers were also translated and regularly appeared in the official magazines of NBWM. In one of these translated articles, Guillaume applauded the metrological reform in China. He assessed the metrological unification of "big countries in the Far East" as a sign of the global triumph of the metric system.[337]

Guillaume invited China to participate in BIPM several times. NBWM also answered with interest.

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[336] "Shijie geguo gongye biaozhunhua zhi gaikuang" [The overview of international industrial standardization], in *Gongye biaozhun yu duliangheng*, 1935, vol.2, no.1, pp. 7-23, p.7.

[337] Wei Lian, "Zuijin shijie geguo guanyu duliangheng falu shang zhi xin fazhan" [Recent development of international metrological legislation], in *Gongye biaozhun yu duliangheng*, 1935, vol.1, no. 4, pp7-19, p.9 and p.19.

In the 1931 National Metrological Meeting already, NBWM considered contacting BIPM. The reason was that BPIM's standard copies of the metric system were sent to China two decades ago, and they needed recalibration or to be replaced.[338] In 1935, Wu Chengluo included the membership of BIPM as one of the major tasks to be achieved along with industrial standardization in the bureau's working agenda. NBWM hoped to receive BIPM's direct help with manufacturing scientific and industrial measures. Since BIPM held the international prototypes of the metric system, NBWM also hoped to acquire a new set of prototype copies to improve the accuracy of the measures manufactured in China.[339] However, BIPM's membership fee was calculated by the population of its member nation. For China, the sum was more than 120.000 Yuan per year, a sum that was hard to afford. While Guillaume agreed to reduce the membership fee for China under the plea of NBWM, it seemed that the negotiation yielded no result.[340]

Standardization institute around the globe also wove their own professional networks. Meetings of standardization institutes were summoned in London in 1921 and Zurich in 1923. In 1926, The International Federation of the National Standardizing Associations (ISA) began to function in London, the first international organization dedicated to industrial standardization. While the original members only included 14 industrial countries, ISA also sent a letter to invite China for future membership.[341]

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338 "Yian(bashiba)" [Motion, no. 88], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p.157.

339 Wu Chengluo, "Tongyi zhonguo duliangheng gongzuo zhi jingguo ji weilai zhi jihua" [The overview of works for unification of measures and plans in the future], in *Zhonguo shiye*, 1935, vol.1, no.2, pp.215-237, p. 235.

340 BIPM's membership fee was calculated by the population of its member nation. For China, the sum was more than 120.000 Yuan per year. See, "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangheng tongzhi*, 1934, no. 9, pp.3-18, p.15.

341 "Shijie geguo gongye biaozhunhua zhi gaikuang" [The overview of international industrial standardization], in *Gongye biaozhun yu duliangheng*, 1935, vol.2, no.1, pp. 7-23, p23. These industrial countries of ISA were Belgium, Germany, France, Great Britain, the Netherlands, Italy, Japan, Canada, Norway, Austria, Sweden, Switzerland,

Gathering foreign metrological information was laid with heavyweight by NBWM. Even Wang Jingwei(汪精卫) was once invited to translate materials for NBWM for his fluent French.[342] Adding to the ties with major global standardization organizations, China had regular connections with dozens of nations individually in the 1930s. Exchanging standardization publications was a common way of communication between standardization institutes worldwide. NBWM maintained such exchange regularly with Japan, the U.S., and all major industrial countries in Europe. It also got in touch with standardization administrators in the world South, such as Cuba, Peru, Brazil, Colombia, Bolivia, and Mexico, via publication exchange. In other words, a giant web to facilitate information exchange was already in good form in the 1930s. Till the end of 1933, NBWM has collected more than 3000 kinds of publications from this network. [343]

What impressed NBWM most through this information exchange was the economic benefits brought by industrial standardization. Follows were the numbers that NBWM constantly quoted: in Moscow, the standardized paper industry alone saved more than 100.000 rupees annually. In England, the standardization of the railway system saved 6 million pounds. In the United States, the National Bureau of Standards estimated that industrial standardization helped save 289.1 million dollars every year in the industrial sector. In the Czech Republic, 750.000 korunas were gained by applying standardized wheels in the automobile industry. The most impressive data came from Germany, where the money saved by standardization amounted to 15 percent of its national annual income.[344]

Czechoslovakia, and the United States.

[342] "Benhui liujing huiyuan lianhuan chahuahui jiyao" [Brief on the tea-party of members in the capital city], in *Duliangheng tongzhi*, 1932, no. 2, p. 4.

[343] "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangheng tongzhi*, vol.10, pp.11-24, p.24.

[344] Wu Chengluo, "Huayi duliangheng duiyu guomin jingji jianshe zhi shimin" [The commitment of the unification

NBWM gathered from the global industrial landscape the importance of industrial standardization. Besides capital, labor, or technology, standards became a shortcut to China's national industrialization. Based on this understanding, the Soviet Union's successful industrialization and Germany's economic recovery received special attention from NBWM, as both rose quickly out of the ruins of the great war. Many believed that the rising international status of the Soviet Union in the 1930s was attributed mostly to its industrialization and growing economic weight.[345] This fact encouraged many Chinese and NBWM. Under the order of NBWM, many Soviet Propaganda materials about standardization, including Stalin's speeches and slogans in factories, were translated and distributed among inspectors "for their reference."[346] Wu Chengluo even found the Soviet Union's planned economy and five-year plans attractive enough. The planned economy was for him similar to Sun Yat-sen's economic blueprint for future China, and the Xunzheng(训政, period of political tutelage) period from 1931 to 1937 was the Chinese five-year plan. Whether a correct evaluation of the soviet economy or a far-fetched comparison, Wu saw the vital role of standardization in economic strengthening for less developed countries such as China. The Soviet Union abolished old measures for the metric system in 1918 and began to plan its first five-year plan in 1921. Since the metrological unification was still underway, the Soviets postponed the five-year plan by a year in 1922. The lesson learned from the Soviet Union was that suitable measures were the prerequisite for any meaningful economic goals.[347]

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of measures on the construction of national economy] in *Gongye biaozhun yu duliangheng*, 1936, vol.3, no.2, pp.3-10, p.7; Yang Boqiao, "Gongye biaozhunhua" [Industrial standardization], in *Gongye biaozhun yu duliangheng*, 1936, vol.2, no. 7, pp.1-3, p.3.

345 Ibid, p. 18.

346 "Biaoyu" [Slogans], in *Duliangheng tongzhi*, 1936, no. 18, pp. 19-25.

347 Wu Chengluo, "Zhonguo jingji jianshe jihua zhi shishi yu sulian shishi jihua jingji zhi fengxi bijiao" [The implementation of Chinese economic plan and its analysis and comparison with the Soviet Union's implementation

Besides the Soviet Union, Germany was another country that received special attention from NBWM.[348] Germany had its first standardization institute Physikalisch-Technische Reichsanstalt as early as 1867. Industrial standardization was launched during WW1 to spare raw materials for military industries. But the process continued and helped Germany rise from the ruins of war quickly.[349] Moreover, Germany was also the country that successfully "metricized" its economy. After the great war, the Weimar government focused on gathering and keeping an unprecedented amount of standardized data (mostly in metric form). The accurate information on the balance of payments, unemployment, prices, and national income facilitated a more precise administration of the economy with the help of developing mathematical techniques employed in econometric and macro-economics[350]. On the other hand, the German industrial circle's interest in China continued to grow. In 1930, eager to open the Chinese market for the struggling German economy at the end of the 1920s, Germany sent an industrial delegation to China. The commission, consisting of leading figures from Krupp and other major industrial tycoons, visited major cities in China from March to May, investigated the possibility of future investment, and offered its advice of industrial planning and development advice to the Chinese government. In 1931, on a mutual agreement between this delegation and the Chinese government, the Chinese Studies Society (China Studien Gesellschaft) was founded to pursue the prospect of economic cooperation and

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of planned economy] in *Gongye biaozhun yu duliangheng*, 1936, vol.3, no. 2, pp.1-9, p.8. For a general history of the metric system in the Soviet Union, see, V. I. Kiparenko, "The development of soviet metrology on the basis of the metric system", in *Measurement Techniques,* 1975, vol. 18, pp. 490–494.

348 Lü Xiangwen, "Huayi duliangheng, yu biaozhunhua zhi guanxi" [The relationship between the unification of measures and standardization], in *Gongye biaozhun yu duliangheng*, 1936, vol.2, no. 10, pp.4-7, p.4.

349 David Cahan, *An Institute for an Empire: The Physikalisch-Technische Reichsanstalt, 1871-1918,* New York: Cambridge University Press, 1989. See also, Thomas Wölker, *Entstehung und Entwicklung des Deutschen Normenausschusses 1917 bis 1925,* Beuth: Publishing DIN, 1993.

350 Adam Tooze, *Statistics and German state, 1900-1945: the making of modern economic knowledge*, Cambridge: Cambridge university press, 2001, pp.4-11.

further investment in China.[351] Liu Yingfu(刘荫茀), then one of the heads of the Industry Department of the Ministry of Industry and Commerce(实业部工业司), got to know the German standardization movement from his communication with the delegation. Liu wrote later in great admiration that in Germany, "every industry followed its standard." The paper industry standards alone were simplified from 40 kinds to 3 kinds, saving a considerable sum for the nation. The German consul in Nanjing also visited NBWM and offered to provide several thousand pieces of German industrial standards as a reference for China's standardization in the future.[352]

Again, like the abortive land re-measuring scheme, we have not seen much evidence that industrial standards were implemented in the production process. NBWM had already poured its resources into urban metrological unification. At least in 1936, a report from a Shanghai entrepreneur confirmed that most big companies and Shanghai's major industry, the textile industry continued to use foreign measures.[353] In 1936, the ministry prepared to merge NBWM and Industrial Standards Committee into a new National Bureau of Standards, but the war made the merging only come to reality as late as 1947.[354] NBWM planned to standardize all realms of the industrial sector, from fertilizer, cars, and metalwork, to the size of socks, bricks, and cigarettes. However, the only significant and finished job before 1937 was the purchase of foreign documents

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351 Zhu Xie, "Deguo shiye lianhehui touzi zhongguo zhi jihua jiqi piping" [German industrial cooperation association's plan of investment in China and its critique], in *Dongfang zazhi* [The Eastern Miscellany], 1931, vol.28, no.12, pp.9-15, p.9.

352 Liu Yinfu, "Fakanci(zhier)" [The second foreword for the journal], in Gongye biaozhun yu duliangheng, 1934, vol.1, no.2, pp.1-2, p.1.

353 "Shanghai Meiya zhichou chang zongjinli Cai Shengbai tiaocheng huayi duliangheng banfa an" [The general manager of Meiya silk factory's suggestions on the metrological unification], in *Gongye biaozhu yu duliangheng*, 1936, vol.3, no. 5, pp. 57-58.

354 Wu Chengluo, "Huayi quanguo duliangheng zhi huigu yu qianzhan (xu)" [The reflections and prospects of national unification of measures(follow)], in *Gongye biaozhun yu duliangheng*, 1937, vol. 3, no. 9, pp. 4-11, p.8; "Quanguo duliangheng tuixing gongzuo gaikuang" [The overview of national metrological work], in *Biaozhun,* 1947, vol.6, pp.11-19.

of industrial standards and their systematic translation. Germany and the Soviet Union were two major sources of these documents. Nanjing purchased more than 9000 pieces of industrial standards from Germany and 8898 from the Soviet Union. Till 1937, NBWM translated 3253 pieces of documents, among which 1131 were from Germany and 1030 were from the Soviet Union. NBWM aimed to compose a bibliography of Chinese industrial standards based on these imported documents. This work was not delivered remarkably. Till the beginning of 1937, Nanjing only produced 111 Chinese industrial standards. Aspired by the German example, which standardized paper industry save considerable governmental expense, most of these officially recognized standards were of the paper industry, besides several mechanical engineering standards. No evidence suggested that these new standards were implemented, and a standardized and industrialized China thus existed at this time only in the blueprint of NBWM. [355]

A Culture of Accuracy: National Characteristics and the New Life Movement.

In 1930, Yang Dongchun(杨东莼) published his study of global industrial standardization on *Eastern Miscellany.* In a chorus of almost unanimous endorsements on industrial standardization in the 1930s, Yang's voice was somewhat dissonant, for his article pointed out some potential negative outcomes brought by standardization. Yang feared a "mechanization of human life" as an inevitable ramification of standardization. He gave examples that in the U.S., neckties always came with the same pattern and color, and all men's wardrobes had the same shirts with arrow-shaped

[355] Wu Chengluo, “Huayi quanguo duliangheng zhi huigu yu qianzhan” [The reflections and prospects of national unification of measures], in *Gongye biaozhun yu duliangheng*, 1937, vol. 3, no. 8, pp.1-24, p.19.

collars from the same company.[356] "The standardization of human life is a result of standardized products [...] While it is economically rational, the mundanity of life is concomitantly reinforced".[357]

Being a historian and one of the early Marxists in China, Yang warned about the risk of alienation of human existence brought about by industrial capitalism. Yang acutely detected a sense of dullness and mundanity of life or the demise of diversity in the face of radical standardization of the material world. Gu Yuxiu（顾毓秀）, an MIT-trained scientist, witnessed in the U.S. that the standardization of the physical world was an irresistible tendency: "even beds, tables, chairs to lamps all follow some their own standards."

For many, the linkage between the standardization of the material world and the standardization of social mentality meant a new challenge that could shake the traditional way of understanding life's reality. For others, it provided a perfect shortcut to instill the brand-new social-psychological agenda of an industrialized nation-state. Xu Shanxiang, Wu's dear ally in the proposal discussion in 1929, and a member of NBWM, described the "standardization man" (in his term) when he studied in the U. S. According to Xu, Americans were industrialized and standardized; much like ticking clock, "they get up at 6'o clock, eat breakfast at half past 6, and go to work at 7'o clock. There are standards even for how long the distance should one walk or how many letters should one type".[358]

Indeed, since the 19th century, processes of state-building via standardization have been quite successful in consolidating bureaucratic rule. As James Scott warned, this state rule also construed

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356 Interestingly, this arrow shaped collar was a fashion trend for men's shirts in the U. S. between the 1900s to the 1930s. Formerly, rounded collar was preferred. In the early 1920s, Cluett, Peabody & Co. of Troy, New York, began manufacturing their shirts with attached collars in response to consumer demand and became the most successful company in the U.S. at that time. Arrow collar was a symbol of American masculinity, and the company called its consumers "The Arrow Collar Man", or "Arrow Man". See, Carole Turbin. "Fashioning the American Man: The Arrow Collar Man, 1907–1931", in *Gender & History*, November 2002, vol. 14, no. 3, pp. 470–491.

357 Yang Dongchun, "Chanye helihua" [Industrial rationalization], in *Dongfang zazhi* [The Eastern Miscellany], 1930, vol.27, no. 7, pp. 37-43, p.43.

358 Gongshang bu quanguo duliangheng ju, *Gongshang bu quanguo duliangheng ju duliangheng jianding renyuan yangchengsuo diyici baogaoshu*, p8.

its subjects as "standardized citizens" who were "uniform in their needs and even interchangeable." [359] There was no wonder that NBWM's ambition did not stop at the physical world as it later tried to "metricize" the mind of Chinese people. By educating people about the metric system, NBWM wished the new measures to facilitate everyday life and instill a sense of accuracy in China's vast population. This process would hopefully cultivate a new species of citizens, or "standardization men." Li Fangxun(李方训), a young professor of chemistry teaching in Nanjing who was invited to lecture inspectors, offered a good explanation of the logic lying behind this somewhat bizarre mental engineering mission in his speech. Li argued that:

> "To carefully compare the cultural difference between western countries and China, it is about having the spirit of science or not. Modern science came to birth in the west instead of China. The reason is that while western people possess the spirit of science, we Chinese people do not. The Empire State Building in New York is the highest construction in the world[...]stretching more than a hundred floors, yet it is extremely solid, and never have we heard of the danger of its collapse. On the other hand, Chinese buildings are one or two floors in most cases. Many buildings have already collapsed before construction is finished. To scrutinize the reason for that[...]Western people value accuracy, while we Chinese people are careless and have the habit of 'almost.'" (差不多之习惯).

[359] James Scott, S*eeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*. New Haven: Yale University Press, 1998, p.346.

The reform was not merely an administration project but also a metrological revolution targeted at the human mind. Li told inspectors that "besides the unification of measures, another mission for us is to train our people to possess the epistemic tools and cultivate the mentality that adherent to accuracy and correctness. The common people will not only measure things but will know to measure them accurately, weigh them, and gauge them accurately. Only then can we say we fulfill our duty."[360] Li's view that western civilization was scientific and Chinese civilization was spiritual was then commonly shared by many Chinese intellectuals such as Hu Shi[361]. Moreover, the debate of "national character" undoubtedly influenced Li's observation. By attributing individual characters to shared nationhood, Chinese elites tried to identify national characters since the Late Qing period and offered their diagnosis of social problems.[362]

We must not assume that this critique of Chinese characters was something new in the 1920s. Weights and measures, the spirit of accuracy, and Chinese characteristics, these interwoven discourses, had long served foreigners since the late 19th century to caricaturize China as a metrological other. Arthur Henderson Smith, an American missionary who spent most of his lifetime in China, published his *Chinese Characteristics* in 1894. This book was the collection of his articles published in Shanghai's English newspaper, *North China Daily News.* In the book, he alleged that disregard for time and accuracy was essential in Chinese characters. Smith first attacked the lack of unified measure units as the root of the character of inaccuracy. While the impression of Chinese in western eyes was "that of uniformity," Chinese weights and measures particularly

360 Li Fangxun, "Cong changrongzhong tandao kexuejingsheng" [From length, volume, weight, to the spirit of science], in *Kexue de Zhongguo,* 1934, vol.3, no.3, pp. 603-605.
361 See for example, "Two Wings of One Bird: A Chinese Attitude Toward Eastern and Western Civilizations", in *Pacific Affairs,* Vol. 1, No. 1, May 1928, pp. 1-8.
362 For a provoking discussion on the national character debate, see, Lung-Kee Sun, *The Chinese National Character: From Nationhood to Individuality.* Armonk, NY: M. E. Sharpe Incorporated, 2002.

betrayed it:

> "The existence of a double standard of any kind, which is often so keen an annoyance to an Occidental, is an equally keen joy to the Chinese. Two kinds of cash, two kinds of weights, two kinds of measures, these seem to him natural and normal, and by no means open to objection."[363]

Smith continued to enumerate discrepancies in Chi, Liang, Li, and other units in China among different industries and areas. Built on this observation, Smith furthered his arguments that the lack of a consistent and accurate system of units resulted in a culture of inaccuracy. For instance, ascertaining the distance of a trip, either by road or on the river, with a Chinese seemed to be impossible: "the distance from A to B is not necessarily the same as the distance from B to A![...]We could name a section of one of the most important highways in China, which from north to south is 183 *li,* while from south to north it is 190 *li*". Smith believed his observation was confirmed by other foreigners who traveled in China and "holds true no matter how often you travel it or how carefully the tally is kept!". He concluded that "the regulation of standards is a thing which each individual undertakes for himself."[364] Moreover, Chinese people counted carelessly, as they preferred "tens," "hundreds" and "thousands" over precise counting with exactitude. This "habit of reckoning by 'tens'" led to the situation where "a few people are 'ten or twenty,' a 'few tens,' or perhaps 'ever so many tens,' and a strictly accurate numeration is one the rarest of experiences in

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[363] Arthur H. Smith, Chinese Charateristics, New York, Chicago, Toronto: Fleming H. Revell Company, 1894, pp. 48-49.

[364] Ibid., pp. 51-53.

China."[365]

Smith's *Chinese Characteristics* was one of the most-read books about China in the early 20th century. In the coming decades, it continued to draw a lot of attention among Chinese intellectuals. For example, Lu Xun(鲁迅), the lionized novelist who was known for his critiques of Chinese "deep-rooted bad characters"(劣根性), noticed Smith's book via Japanese translation in his youth. Lu Xun opined that this book, while containing "many misunderstandings," could nevertheless stimulate introspection among Chinese people and therefore constantly urged to publish it in Chinese.[366] Li Jinghan, the sociologist who questioned the Chinese population's accuracy, read the book's Japanese version. He was deeply troubled by it, writing comments to refute Smith. However, he gradually accepted Smith's arguments when he revisited them as a student in the United States. Li knew Smith personally when they both worked for a rural survey in Beijing, and Smith's criticism of the Chinese disregard for accuracy and discrepancies in metrology coincided with Li's own observations of Chinese peasants.[367] Li's colleague at Tsinghua University, sociologist Pan Guangdan (潘光旦), also appreciated Smith's book and translated 15 chapters (out of all 27) from 1933 to 1935 and published these in 1937 in his own studies on national character.[368]

Chinese intellectuals, bureaucrats, and metrological reformists completely embraced Smith's evaluation of Chinese character. One of the most influential cases was from Hu Shi. In 1924, Hu Shi created the character of Chabuduo xiansheng, (Mr. Almost 差不多先生). This character was the crystallization of Chinese nationalistic characteristics of inaccuracy and imprecision. Mr. Almost

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[365] Ibid., p.54.

[366] More on Lu Xun and Arthur Smith, see, Lydia H. Liu, *Translingual Practice: Literature, National Culture, and Translated Modernity—China, 1900-1937*, Stanford: Stanford University Press, 1995, pp. 51-60.

[367] Pan Guangdan, *Mingzu texing yu mingzu weisheng* [National characters and national Eugenics], Shanghai: Shangwu yinshuguan, 1935. See, “Li Jinghan's preface”, pp. 5-6, p. 16.

[368] Ibid., Pan Guangdan, “Author's preface”, pp.1-5.

was the specimen of ordinary Chinese that one could find "everywhere in China," who had eyes but could not see clearly, had ears but could not listen clearly. He got a normal-sized brain with a bad memory and shallow thoughts. He mistook red sugar for white sugar, Shanxi province for Shaanxi province, a thousand for ten, 30 minutes for 32 minutes, and Doctor Wang(汪医生) for Doctor Wang(王医生). "Almost" was his trademark, to the extent that even in his dying bed, he said living was "almost the same" as death. Hu Shi ended his short fiction by labeling the average Chinese as Mr. Almost and China "a nation of the lazy" (懒人国).[369]

Moreover, Smith's example of miscalculating distance was widely used by foreign and Chinese metrological reformists. Charles Keyser Edmunds, an American physicist who served as the president of Lingnan University(岭南大学) in Canton, published his studies on science among the Chinese. Edmunds followed Smith's arguments almost word by word, stating that in China, "the distance between two points A and B[...] depends not merely on the geometrical factor". The "spirit of inaccuracy was predominant in common affairs" and "in weights and measures, where most needed for scientific progress."[370] Based on this reiteration of Chinese character, which established the Chinese disregard of accuracy as a discursive truth, educating the people about the metric system became a perfect chance to help Chinese people eliminate this habit of "almost" and cultivate the spirit of accuracy. An official of Nanjing's KMT headquarters alleged that "among all the necessary national characters, the most lacking one is accuracy. Take the calculation of the distance from A to B as an example: some said 15 Li, some 10 Li, and others 20 Li. The discrepancy of 5 or 10 Li seems not to be a big deal." He then drew from his experience that party and

[369] Hu Shi, "Chabuduo xiansheng zhuan xuanlu" [Selected recordings of Mr. Almost], in *Xinghua*, 1924, vol. 21, no. 26, pp. 24-25.

[370] C. K. Edmunds, *Science among the Chinese: Some Aspects of the Chinese Conception of the Universe as Compared with Modern Scientific Knowledge*, Shanghai: reprinted from the "*North China Daily News*", July 1911, pp. 20-24.

governmental meetings were never on time since most participants were late, sometimes for more than two hours. However, he was surprised and impressed by the fact that NBWM's meetings began on time as scheduled.[371]

To eradicate the despicable character of inaccuracy among people, NBWM tended to use a populist approach and emphasized the participation of commoners. The bureau tried to embed new measures in every aspect of common people's life to make them "metric literate." The unification of the monetary system was a part of Nanjing's agenda, which NBWM found a potential starting point. In 1930, Gao Mengdan suggested standardizing silver coins of one Yuan as 20 grams heavy and 3.33cm in its diameter. Much like in France, where a 1 Franc coin weighed 5 grams, such Coins could serve as convenient instruments for common people because 50 pieces of such coins weighed a kilogram and three coins inline a decimeter long.[372] NBWM swiftly forwarded this advice to the Ministry of Finance. Later, NBWM officially proposed the standardization of coinage to the ministry. NBWM suggested that the coin of 1 Chinese Yuan should have a diameter of 4 centimeters. While there was no sign that the Ministry of Finance took this advice, proposals continued to be discussed within NBWM throughout the 1930s.[373]

Children's metrological education was another example. After all, if NBWM wished to metricize the minds of the next generations, starting as early as possible would be better. Many stories about

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[371] Shiye bu quanguo duliangheng ju, *Shiye bu quanguo duliangheng ju duliangheng jianding renyuan yanchengsuo dierci baogaoshu*, pp. 147-149.

[372] Gao Mengdan, "Yian (shijiu), fulu: yi huobi tuijing duliangheng" [Motion no. 19, appendix: use currency to promote new measures], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", pp. 50-58, p. 50.

[373] Gao Mengdan and Zheng liming, "Tuijin duliangheng yu huayibizhi" [Promoting measures and the unification of monetary system] in *Gongyebiaozhun yu duliangheng*, 1935, vol. 2, no. 3, pp. 1-2. Also, "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangheng tongzhi*, 1933, no.5, pp.2-9, p.5; Wu Chengluo, "Ruhe yingyong yingbi wei dulinagheng biaozhun" [how to use coins as metrological standards], in *Gongyebiaozhun yu duliangheng,* 1936, vol.3, no.6, pp.1-9. "Huiwu jiyao" [Essential records of meetings], in *Duliangheng tongzhi*, 1935, no. 15-16, pp.37-39, p.37.

measures and accuracy appeared in textbooks, such as the famous story "Cao Chong Cheng Xiang"(曹冲称象), in which Cao Chong(曹冲), a young son of Cao Cao(曹操), managed to weigh an elephant with boats and stones.[374] NBWM urged publishing houses to compose auxiliary textbooks for pupils, including the origin of the metric systems and basic maths to convert different measures.[375] Ding Wenyuan(丁文渊), a German-trained scientist at Tongji University, gave further suggestions to NBWM that a complete metrological education for students included measure conversion, land measuring techniques, and basic scientific equipment such as barometer and thermometer. They were also supposed to keep a weather log recording the average humidity, temperature, and barometric pressure every school day.[376]

It is under this background that NBWM saw a great opportunity to merge metrological unification and the "New Life Movement"(新生活运动, hereafter NLM)[377]. Jiang Kai-shek personally launched the movement, which advocated a "new life" among citizens. Guided by Confucian virtues, Christianity, and modern doctrines, the movement took a highly populist method and gave 95 specific rules covering all aspects of an individual's life, such as "do not gamble," "go to bed and wake up early," "keep household clean," or "do not raise voice in a dining table." In retrospect, NLM's radical ambition to interfere and discipline everyday life with sich protocols tasted much like, as Frederic Wakeman put it, a "Confucian Fascism."[378] Also, due to the resentment it invited from common people and KMT's lack of social mobilization, this movement

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374 "Fulu" [Appendix], in *Duliangheng tongzhi*, 1935, no. 13, pp.31-34.

375 "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangheng tongzhi*, 1933, no. 5, pp2-9, p3.

376 "Ertong duliangheng wenti" [the issue of measures for Children], in *Duliangheng tongzhi*, 1936, no. 18, pp2-5,

377 On the new life movement, see for example, R. Keith Schoppa, *The Revolution and Its Past*, New York: Pearson Prentic Hall, 2006, pp. 208–209.

378 Frederic Wakeman Jr., "A Revisionist View of the Nanjing Decade: Confucian Fascism." In *The China Quarterly* vol.150, no.2(June 1997), pp. 395–432.

proved to be fruitless or a "sloganized Confucianism" at best.[379]

Although NLM did not receive much enthusiastic support from intellectuals, Wu nevertheless shared the new life movement's vision of "a standardized life."[380] He wrote an editorial essay for his inspectors on NBWM's official magazines in 1935. Based on a short historical review of how China lost its "national confidence" from her defeats in front of imperial powers, Wu pointed out that one of the most devastating results of this defeat was the moral degeneracy of society. Wu claimed unified measures encouraged fraud among common people and dishonest transactions in markets, which hurt the morality of the Chinese nation. In this sense, Wu saw a great opportunity to combine metrological reform with NLM, as unified measures would help restore the lost values and ethics: "like a respected person kept his/her attire neat and tidy, so did a nation its metrology."[381] Wu held the movement as the "right medication for the disease." Even though the new life movement was informed by modern and western ideas such as public hygiene or Christianity, Wu as an American-trained scientist, opined in his final remarks that there was nothing novel about the theory of NLM, but an effort to revitalize "indigenous Chinese culture" to revoke lost morality among Chinese people.

Putting aside Wu's cultural conservatism that later characterized his conflicts with scientists, Wu did not come to this conclusion by fawning at Jiang or simply dancing with the popular political winds. He saw some real opportunities. Much like the movement, metrological reform also launched a war within the human mind. Much like the movement, metrological reform also demanded instilling a sense of accuracy into the real-life routine of common people. And much like

[379] Lloyd Eastman, *The Abortive Revolution: China under Nationalist Rule, 1927-1937*. Cambridge, Mass.: Harvard University Press, 1974, p. 67.
[380] Wu Chengluo, "Xinzhi duliangheng" [New measures], in *Yuebao,* 1937, vol.1, no.1, pp. 19-25.
[381] "Shixing Xinshenghuo yu huayi duliangheng" [Implementation of the new life and the unification of measures], in *Duliangheng tongzh*i, 1934, no. 10, pp.1-3.

Jiang, Wu also mused upon the necessity of social discipline. For example, Wu theorized the necessity of standardization in an advanced and industrial country with a bleak Social Darwinism. He claimed that generally, "as the society evolves, the strong dominate the weak, and the wise oppress the fool. Human beings become ever more sophisticated as well as ever more hypocritical".[382] If industrial countries in Europe use measures to discipline society, so should China.

In 1935, NBWM's sub-organization, the Weights and Measures Society of China, joined the movement, and under the society's invitation, on September 30th, 1935, Wu gave a speech on Central National Radio about merging metrological reform and NLM. Nanjing's new life movement promoting association(新生活运动促进协会) also sent its members to join the Weights and Measures Society of China in return.[383] NBWM even managed to put "using new measures" to NLM's doctrine list.[384] He Zhonghan(贺衷寒), Jiang's student and then the leader of Blue Shirts Society, an ultra-nationalist clan that followed the mode of Italian and German fascist organizations, published his piece in NBWM's magazine in 1935, which pondered upon the possibility to strengthen his even more radical version of fascism through the unification of measures to promote "a sense of loyalty and shame" among ordinary people.[385] Again, like the cases in industry and agriculture, NBWM's rather ardent participation in the new life movement left no meaningful results. The reason was simple enough that the new life movement itself was not a success. Local

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[382] "Te Zai" [Special publication], in *Duliangheng tongzhi*, 1934, no.9, pp. 1-3, p.1.

[383] "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangheng tongzhi*, 1934, no. 10, pp.11-24, p.17.

[384] Gesheng lixing xinshenghuo banfa ximu Zhong jiatian shixing duliangheng xinzhi yixiang an [The case of adding an entry of using new measures into regulations of the New Life Movement], in *Gongye biaozhun yu duliangheng*, 1936, vol. 3, no. 5, p. 53.

[385] He Zhonghan, "Liyilianchi zhi shehuixue de renshi jiqi yu duliangheng biaozhun zhi guanxi" [The sociological understanding of Liyilianchi and its relationship with the metrological standards], in *Zhongguo geming*, 1934, vol.4, no.5-6, pp.18-21.

governments turned out to be half-hearted. Even members of NBWM had to admit at the end of 1936 that, after two years, the New Life Movement still did not attract enough followers.[386]

Conclusion

Historian Ray Huang(黄仁宇) once ascribed the failure of the traditional Chinese state to the lack of "mathematical management" (数目字管理), which in his terms, denoted impersonal and bureaucratic thinking of statecraft which championed the principles of Mathematics and Statistics based on accurate data to achieve efficient governance. Huang criticized the Ming dynasty for its fiscal and canal system management disorder in this line of thought.[387] Ming was bound to collapse without accurate administration, whereas European states went through the rise of capitalism characterized by protecting private properties and effective fiscal management.[388] Needless to say, Huang's emphasis on the mathematical management of statecraft was tainted with an evident Weberian hue that valued the rationality of rigid Bürokratie. Scholars such as Ge Zhaoguang questioned Huang's Eurocentric understanding of historical China.[389] However, we should not easily dismiss Huang's viewpoint, for historians and their history studies were fundamentally the products of history itself. As a young officer in the KMT army in the 1930s, Huang

[386] Wang Zhenqin, "Xinyu erzhounain duiyu duzheng zhi yingxiang" [the impact of two years New Life Movement on metrological administration], in *Duliangheng tongzhi*, 1936, no. 18, p.5.
[387] On taxation and land survey of Ming Dynasty, see, Ray Huang, *1587, a Year of No Significance: The Ming Dynasty in Decline,* New Haven: Yale University Press, 1981, pp. 61-63, pp. 143-144. For the malfunctioning of canal transportation and fiscal management, see Ray Huang, *The Grand Canal during the Ming Dynasty*, 1368-1644, unplished dissertation, the university of Michigan, 1964, ch. 5 and 6.
[388] Huang Renyu, *Zibenzhuyi yu ershiyi shiji*[Capitalism and the 21st century], Beijing: Sanlian shudian, 1997, pp.31-32.
[389] Ge Zhaoguang, "Huanghe yijiu rao qingshan" [The huang river still revolves around the green mountains] in *Dushu*, no. 12, 2003, pp. 77-86.

witnessed the chaotic military management and ruined local communities with his eyes, which laid an intellectual foundation for his evaluation of the Nanjing regime as a failed state without functioning bureaucratic management.[390]

Importantly, Huang's idea of building China as an accurately managed state was widely shared by contemporaries in the 1930s and technocrats of the nationalist government. By no means was Nanjing in the 1930s a modern state with efficient and accurate governance. This fact stimulated Chinese elites to look globally. Like Prasenjit Duara once criticized a strong and sometimes linear view of nation-making and nation-building narratives in which the nation-state was the only narrator of its own history, which tended to put itself as the major protagonist,[391] I contended in this chapter that a global history awareness of nation-state history, or to be more precise, re-situating the metrological reform in its global context and identify the connections with its global counterparts, could help produce new themes and shed light to the specialty of the reform.

Although Nanjing's reform only harvested moderate success in urban markets and provincial capitals, Nanjing's visions went far beyond confiscating illegal measures or fining street peddlers who violated the law. Behind the unification of measures were ambitious standardization programs by metricizing China's agricultural, industrial, and social psychological spheres. These programs aimed to answer the aggravating social and economic crisis in 1930s China. At the same time, these programs were also profoundly informed by various global trends, such as the sociological turn of statecraft, the global industrial movement, NBWM's close connections with its international peers,

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390 For Huang's historical reflection on the demise of Nanjing regime, see, Ray Huang, *China: A Macro History*, New York: M. E. Sharpe, 1988, pp. 265-295; Huang Renyu, *Cong dalishi de jiaodu du jiangjieshi riji* [The interpretation of Chiang Kai-shek's diary from the perspective of macro hsitory], Beijing: Jiuzhou chubanshe, 2011, pp. 12-13 and pp.177-178.

391 Prasenjit Duara, *Rescuing History from the Nation: Questioning Narratives of Modern China*, Chicago; London: University of Chicago Press, 1995.

and the transnational stigmatization of Chinese characters. These global connections shaped the motives and visions of the reform and forced Chinese reformists to imagine a global model of the metricized state in the Chinese context. In this sense, the Nanjing reform must be placed in a global backdrop that surpasses the myopic nation-state narrative, which was dominant in Chinese metrological history. I propose that a complete understanding of metrological history in China must simultaneously be understood within local and global contexts. The major reason for the ignorance of global ties of the metrological past was that these global-inspired projects of metrological reform did not produce any significant fruitions during the Nanjing decade. I called these projects "visions", but these abortive visions did not completely lose without further historical reverberations, as industrial standardization, a cultural appreciation of accuracy or even scientific management of agriculture are no longer dreams, but part of modern life experience in China.

Chapter 4: Between the State and Society: Local Response to the Reform

Introduction

In early June 1934, the Ministry of Industry received an unusual guest. On the eve of Nanjing's scorching summer, a man was standing outside with a tin container and two jars of soy sauce in his hands. His name was Lin Yun(林允), a soy sauce guild leader from a small county called Minhou(闽侯) in Fujian Province. He must be desperate, as the ministry was his last hope of justice. Back in his hometown, fellow soy sauce merchants were waiting for the result of this visit, with their very livelihood hinged on it.

Lin had a case to argue. Earlier in the year, NBWM ordered a universal change of new volume measures for liquid goods and a ban on the usage of weight units. This "volume for liquid" policy, perhaps natural and reasonable enough in the eyes of many, changed his business**.** Traditionally, the dealers in his county sold soy sauce by weight. Soy sauce was weighed first by Jin and Liang in containers made of lead, tin, porcelain, or in some cases, bamboo. For only weight units were used in transactions, the volume of containers, regardless of their shapes or materials, did not affect the price. However, the provincial metrological branch followed Nanjing's order in 1934 and banned old containers. Inspectors were dispatched to stores and confiscated old containers worth more than seven hundred Yuan. The dealers had no choice but to follow and purchase new tin containers. But the problem became tricky since the quality of soy sauce was judged by its weight instead volume. Better soy sauce contained more percentage of salt and thus was heavier. The local metrological branch issued one-liter containers to dealers, yet soy sauce in these containers weighed 10 to 20 percent heavier than one kilogram. Dealers must secretly remeasure soy sauce by weight with their old measures, rendering new containers useless.

Lin went on his way to protest when the provincial metrological branch refused to change its policy despite repeated petitions. Lin asked the ministry to examine the tin container and soy sauce he had brought. The ministry acknowledged the mistake and later instructed Fujian to allow the sale of soy sauce by weight. The case gained national attention later, as it was published in a magazine by NBWM.[392] Lin's case must draw a lot of sympathy from all over the country. Many of Lin's peers, such as wine and sesame oil dealers in Beijing, were facing the same dilemma. Thanks to Lin's effort and ensuing immunity applied to other liquids, it was no longer necessary to travel to Nanjing.[393]

Lin's action, heroic might it be, was just one of the ripples that the 1930s reform caused, and sauce soy was not that a bizarre case. NBWM made a genuine effort within its ability to push the reform to all corners of the room and all walks of life. Besides ordinary economic spheres, MBWM even mandated that, for example, billboards and signboards should also conform to the metric and new Chinese measures.[394] Water buckets of public wells were replaced in Hubei and Beijing.[395] Traffic signs must be in metric units.[396] Printing backplanes, bookcases, and bookshelves were

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392 "Jiangyuan ye shoumai jiangyou keyong xinheng jianyi an" [the motion to allow soy sauce sale by weight], in *Gongye biaozhun yu duliangheng*, 1934, vol.1, no. 4, pp. 122-123.

393 Beijing Municipal Archive (hereafter BMA): J002-007-00109 "Beiping shi duliangheng jianding suo yaoqiu ge shanghao xunjiang yeti liangqi gaihuan xinzhi de gonghan" [Beijing metrological branch's official correspondence to merchants on swiftly changing the liquid measures], pp.14-15, 52-53, 55-56.

394 Shanghai Municipal Archive (hereafter, SMA): Q5-3-3120, "Shanghaishi gongyongju guangyu guiding guanggaomianji dulaingheng biaozhunzhi danwei banfa an" [Shanghai's department of public affair's regulation on the metrological standards of advertising boards] 1931, pp.7-8.

395 BMA: J002-007-00156, *Beipingshi duliangheng jianding suo sanzhounian jiniankan* [Third Anniversary Memorial Journal of Beijing's Metrological Branch], 1935, p.32.

396 BMA: J002-007-00156, *Beipingshi duliangheng jianding suo sanzhounian jiniankan* [Third Anniversary Memorial Journal of Beijing's Metrological Branch], 1935, p.32.

required to follow new measures.[397] Children's sports games were ordered to switch.[398] The range of things regulated was constantly widened that, later on, even corpses must be compulsorily measured with legal measures in autopsy.[399]

Although NBWM alleged that ordinary people would accept the metric system finally as it was a convenient aid to everyday life, the actual history suggested quite the contrary. As detailed lengthily in this chapter, a rich body of historical evidence, including newspapers, archival records, magazines, and anthropological reports, demonstrated that it was the common people who fiercely rejected the imposition of new measures based on their own sets of rationales that were far different from the state. One must ask, what were the motives behind their resistance if many resisted the reform like Lin? What was the local strategy for this great change that touched many spheres of society? How did Nanjing mobilize society, and why did this effort fail?

Current studies did not provide a satisfactory explanation. Local responses to the reform were not the main concern, as most concentrated on the state's role as the "influencer." In those studies that did pay attention to common people and local response, either their focus was confined to one region and city, or they merely treated local communities as the passive "influenced."[400] It was understandable since the "reform" was led by the state with its historical evidence written by

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397 "Shuban shuxiang shujia ying gaiyong xinzhi duliangheng" [printing backplanes, bookcases and bookshelves shall all use new measures] in *Gongye biaozhun yu duliangheng*, 1934, vol.1, no. 6, pp. 95-96.

398 "Ertong tili jingsai caiyong xinzhi duliangheng" [New measures were taken by children's sports games], in *Gongye biaozhun yu duliangheng*, 1934, vol.1, no. 6, pp. 89-91

399 SMA, Q181-1-582, "Sifa xinzhengbu xunlin" [Orders from legal administration], 11 August 1934, pp.2-4.

400 There is a new, increasing body of literature of Chinese metrological history striving to alter such landscape. Some good studies though came out recently. Zheng Chengling challenged this approach and noticed the participation of local chambers of commerce in many cities during the metrological reform. See, Zheng Chenglin and Shi Huijia, "Nanjing guomin zhengfu duliangheng gaizhi zhongde shanghui canyu" [The Participation of Chambers of Commerce in the Unification of Weights and Measures under the Nanjing Nationalist Government], in *Lishi yanjiu*, 2017, no.4, pp. 95-112. Most recent studies also shifted their focus to the reform in rural settings, for example, Xie Rui, *Sichuan sheng tongyi xinzhi duliangheng yanjiu* [Research on the New Unified System of weights and measures in Sichuan Province (1935-1946): Centering on the First Administrative Supervision Zone], unpublished Master thesis, Sichuan Normal University, 2022.

the state, which practitioners relied much upon. Also, the myopic lens of a sole state narrator led to the problem that the governmental recordings were highly identical in various locations, either in cosmopolitan Shanghai or in rural Sichuan. This also explained the geographic strategy of current studies, which confined their scope to one location. More importantly, By treating the 1930s reform as a state enterprise alone instead of simultaneously a social project which shook long-standing metrological habitus for a constellation of social groups, this approach led to the fallacy where historical details of local societies got lost from "the state's narrow frame of reference," as James Scott put it.[401]

In this chapter, I proposed a different narrating strategy. Instead of categorizing local responses by their locations, I viewed them as different social groups which resisted or cooperated, with different motives, means, and strategies in their own contexts. The state and its role in mobilization were simultaneously juxtaposed as a condition for their choice-making. This method would, hopefully, bypass "the state as the protagonist" and "location as a container" genre in former studies. Therefore, this chapter's main aim was to demonstrate the complicated and nuanced responses of various social groups in general local scenarios. The first part traced the strategy of NBWM's local mobilization projects and the response of urban merchants and commercial organizations. Their collaboration and resistance indicated how widely routine urban commercial order was changed in the reform. The second part gave a historical "deep-description" of the metrological conflict among Shanghai's rice traders, where the state's role was limited by the local community's commercial traditions and thus failed to become the sole arbiter of metrological affairs. The third part shifted to those less mobilized players and institutions, such as

[401] James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*, Yale University Press, 2008, p.13.

policemen, Baojia, and Yahang in the countryside, where the state failed to influence the metrological landscapes. Therefore, the administration of metrological affairs was largely laid in the hands of rural society on its own. This chapter ended with an analysis of how common people, such as small measure makers or housewives, phrased an "art of not being governed" by finding cleavages and vacancies in state control. Long-standing and stubborn metrological habitus, in the eyes of the state, persevered in the stormy times of the reform with creative means and motives.

Merchants and Chambers of Commerce

Shortly after the promulgation of metrological law in January 1930, local metrological branches were established in major cities. The plan was quite optimistic: most regions in phase one would only take one year to achieve Chubu huayi, or "primitive metrological unification"(初步划一) at the end of 1930. By the instructions of NBWM, Nanjing planned a standardized sequence of workflow that must be applied national-wide identically. The unification process was as follows. A local branch was set up first. An investigation into the usage of old measures was conducted simultaneously. Propaganda works ensued to promote public awareness of the reform. Local governments and civil organizations such as chambers of commerce and guilds were informed about coordinating the efforts. Manufacturers of measures were organized through the introducing of an official registration system. Manufacturers who did not register with the government were not allowed for business. Local branches then began to forbid manufacturers from producing old and illegal measures. Instead, inspectors taught manufacturers how to build new measures and remold old ones. Every piece of measurement must be sent to the local branch first for inspectors' examination before being sold and used in the markets. Selling old ones or new ones without beforehand examination was also forbidden. At the same time, other merchants and common storeowners were instructed not to deal with illegal measures. The strategy of MBWM was two-folded on both ends of supply and need. On the one hand, persuading the population out of old measures and forbidding their usage among merchants would reduce the need for old measures in markets. On the other, the increasing supply of new measures would fill the gap. [402]

Since it was impossible for NBWM to monitor every piece of measurement circulating in markets, Nanjing devised a marking system. Freshly manufactured measures must go through metrological examinations. After their accuracy was confirmed, they would get marked and then be allowed for sale. Inspectors marked old measures with the inscription "销" (Xiao, destroy) and confiscated them directly. New measures that grew inaccurate by use and needed calibration were marked "否" (Fou, denial) and went into recalibration. And for legal and accurate measures, the inscription "合" (He, compliance) or "同" (Tong, uniformity) was engraved. "Primitive unification" would be announced when at least most stores followed new measures. The second stage was "complete unification"(完全划一) when illegal measures were thoroughly irradicated in society. To achieve this goal, local branches would hold inspecting patrols by sending inspectors to the thresholds of stores in markets as often as possible. NBWM did not specify what would come after complete unification; what's certain was that no region ever announced "complete unification" in the 1930s. The tours would continue to be held as regular work to maintain complete unification before the market system fulfilled its transitional purpose and the whole nation switched to the metric system.

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[402] Shiye bu quanguo duliangheng ju [National Bureau of Weights and Measures, the Ministry of Industry], *Quanguo duliangheng huayi gaikuang* [Overview of National unification of measures], Nanjing: Guomin shuju, 1933, pp. 24-26.

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"Henan sheng jianding suo yi pie" [A glimpse on Henan provincial metrological branch], in *Gongye biaozhun yu duliangheng*, 1935, vol.1, no. 11, no page mark.

While the plan seemed to be well-thought and rosy, the actual progress cast doubt on it. For the investigation of measures alone, no branch gave a concrete report about exactly how many measures needed to be replaced in markets. Limited manpower only allowed investigations that merely counted the number of measures, and this result alone was frustrating enough. Take Shanghai as an example. Among 63 different kinds of trades and industries in the city, measures employed came from Japan, Britain, America, France, etc. Beijing Government's semi-new measures introduced 20 years ago were also in use. Measures varied from shop to shop, guild to

[403] Ibid. Also, the inscriptions were different from place to place. Sometimes marks indicating the county of local branches, province and examination time were also added to better the management within the realm of a county. Also, the letter "同", according to Wu, came from three phrases: Sun Yat-sen's "World commonwealth" (世界大同) and a classical quote of Su Xun (苏洵), "from the government and then follows the world" (资之官而后天下同), and Sage Emperor Shun(舜)'s deed to "calibrate weights and measures according to musical tones". (同律度量衡) see, Wu Chengluo, "Zhongguo lidai duliangheng zhidu zhi bianqian yu qi xingzhen shang zhi cuoshi" [The evolution of Chinese historical metrological institutions and their administration and policies], in *Gongye biaozhun yu duliangheng*, 1934, vol.1, no.2, pp. 15-20, p.19.

guild, and market to market. For example, the typical length measure, Chi(尺), ranged from 30.5cm to 38.1cm, so as volume measures. Even in near-by counties to Shanghai, such as Jingshan(金山), Songjiang(松江), Chongmin(崇明), and Jiading(嘉定), measures varied, as inspectors counted at least 16 different types of weight units.[404] The task was daunting for Shanghai's metrological branch, which in 1930 was a small institute with 15 inspectors[405] in a city with a population approaching three million in 1931.[406] The same dire situation happened in other branches forcing NBWM to grant another year to achieve primitive unification.[407]

A rather successful work conducted at the time was propaganda. For a reform touching the daily life of common people, it had been laid with a heavy weight by Nanjing. Many NBWM officials had mused upon the possibilities of mobilizing more social resources by devising a wide range of propaganda projects for the masses: metrological dramas in theatres, fireworks festivals, propaganda teams on bicycles, itinerant musical bands, torch parades at night, or even national and regional memorial days for metrological unification. Most of these ideas failed at the stage of mere proposals since NBWM explained that neither funds nor personnel existed for this wide range of activities.[408] The actual scope of propaganda works was far narrower than discussed, and the location was confined to cities and county towns. The most basic methods were posters and

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404 Liao Xiaobo, Huo Ming: "Minguo shanghai duzheng shimo" [Brief history of Shanghai's metrological reform], in *Chongqing shifan daxue xuebao*, 2015, no.4, pp.56-62, p57.

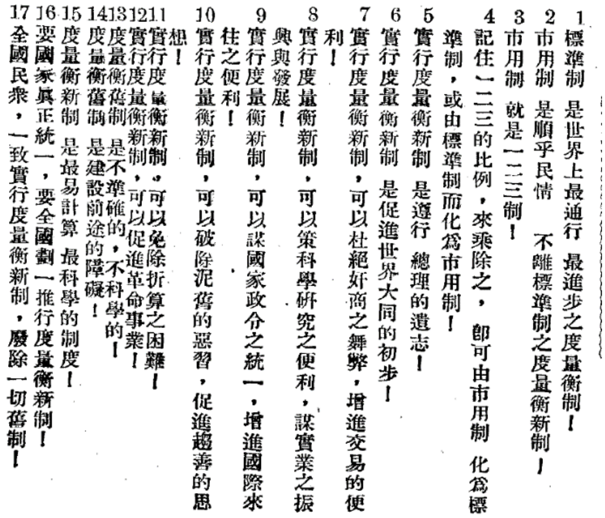
405 In Shanghai, the number of inspectors grew from 15 to 20 after 1933, see, "Benshi tuixing xinzhi duliangheng" [Shanghai is promoting new measures], in *Shenbao*, 14, June 1931. Also, See, Shiye bu quanguo duliangheng ju [National Bureau of Weights and Measures, the Ministry of Industry], *Duliangheng jianding renyuan yangcheng suo biye tongxue lu* [Alumni of the Training Center for Inspectors of Weights and Measures], Nanjing: Shengying shuju, 1936, p.124.

406 Gongbuju huawenchu [Chinese interpretation institute of SMC], *Gongbuju nianbao* [Annual report of SMC], 1931, p.133.

407 Shanghaishi shehuiju [Shanghai Bureau of Social affairs], "Shanghaishi shehuiju yewu baogao" [reports of the bureau of social affairs], 1930, no.4-5, p.17.

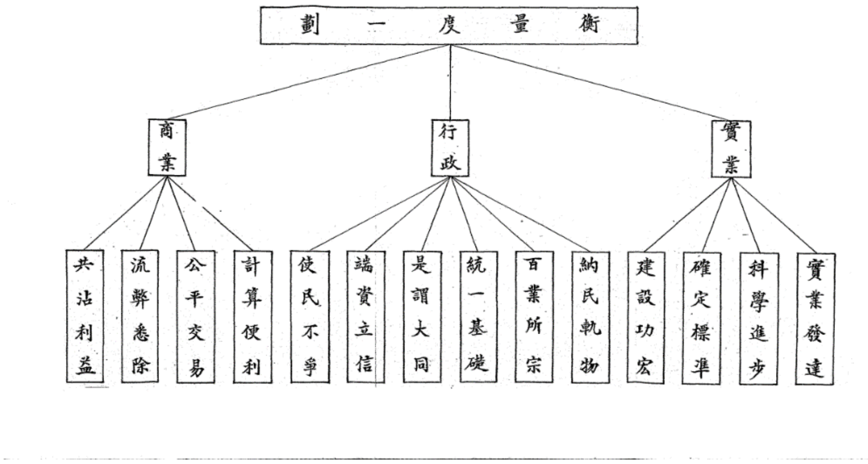
408 "Yian (ershisan)" [Motion no. 23], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p. 65.

leaflets. The contents of posters were fed by NBWM, normally lines of one-sentence slogans ending with exclamation marks. Simple diagrams were also common to showcase the goals of the reform.



1 標準制 是世界上最通行 最進步之度量衡制！
2 市用制 是順乎民情 不離標準制之度量衡新制！
3 市用制 就是一二三制！
4 記住一二三的比例，來乘除之，即可由市用制 化爲標準制，或由標準制而化爲市用制！
5 實行度量衡新制 是遵行 總理的遺志！
6 實行度量衡新制 是促進世界大同的初步！
7 實行度量衡新制，可以杜絕奸商之舞弊，增進交易的便利！
8 實行度量衡新制，可以策科學研究之便利，謀實業之振興與發展！
9 實行度量衡新制，可以謀國家政令之統一，增進國際來往之便利！
10 實行度量衡新制，可以破除泥舊的惡習，促進趨善的思想！
11 實行度量衡新制，可以免除折算之困難！
12 實行度量衡新制，可以促進革命事業！
13 度量衡舊制 是不準確的，不科學的！
14 度量衡舊制 是建設前途的障礙！
15 度量衡新制 是最易計算 最科學的制度！
16 要國家眞正統一，要全國劃一推行度量衡新制！
17 全國民衆，一致實行度量衡新制，廢除一切舊制！

"Huayi quanguo duliangheng xuanchuan biaoyu" [Propaganda posters of national metrological unification], in Jiangsu shengzhengfu gongbao, 1931, no. 826, p.21.



Beijing Municipal Archive: J002-007-00156, *Beipingshi duliangheng jianding suo sanzhounian jiniankan* [Third Anniversary Memorial Journal of Beijing's Metrological Branch], 1935, p.39.

Other channels have also been employed. In Shanghai, inspectors traveled to 54 schools and delivered speeches on the reform to more than twenty thousand audiences. Radio periodically invited inspectors to explain new measures. Speech sessions were held by civil organizations such as the local Self-governing Committee (地方自治委员会).[409] Shenbao also interviewed the chief inspector, who introduced the metrological reform briefly and alleged that his inspectors had already been working extra hours to finish their job.[410] In Jiangxi province, educational films on metrology were played in schools.[411] In Hubei province, one-month speech sessions were arranged at night from 7 pm to 9 pm when people finished their day's work.[412]

Particularly, burning down the illegal measures in front of the public was a popular way in many places to raise awareness of the reform and manifest the commitment and capacity of the state. For example, in 1935 Beijing, more than 2000 pieces of old measures were burnt to ashes in front of the Gate of Heavenly Peace(天安门), supervised by government officials, inspectors, and police officers. Beijing's report to NBWM claimed that the fire and smoke created a scene that attracted many citizens.[413]

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409 Shanghaishi shehuiju, "shanghaishi shehuiju yewu baogao", pp. 31-33. Liao and Huo, "Minguo shanghai", p. 59.
410 "Benshi tuixing xinzhi duliangheng".
411 For example, the propaganda campaign in Jiangxi province, see, "Baogao" [Reports] in *Duliangheng tongzhi*, 1935, no. 13, pp. 12-14, p13.
412 "Yian(shi)" [Motion no. 10], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p.38.
413 "Beipingshi duliangheng jianding suo ershisan nian xinzheng baogao" [The adminsitration report from Beijing metrological branch in 1934], in *Duliangheng tongzhi*, 1935, no. 15-16, pp.11-20, p15. Besides Beijing, Fujian, Hubei, and other places also held a burning event. See, "Fujian sheng jianshe ting fenhui moshou zhi duliangheng qingxing" [The scene of Fujiang provincial construction hall buring confiscated old measures], in *Gongye biaozhun yu duliangheng*, 1935, vol.1, no. 12, no page mark. For Hubei, see, "Hubei puxi xian juxing diyici jiuqi dafenghui qingxing" [The scene of Puxi county of Hubei province holding the first burning convention] in *Gongye biaozhun yu duliangheng*, 1935, vol.2 no. 4, no page mark.

“Beipingshi fenhui duliangheng jiuqi qingxing” [The scene of Beijing burning old measures], in *Gongye biaozhun yu duliangheng*, 1935, vol.1, no. 9, no page mark.

NBWM officials were quite aware that the coming reform required mobilizing broader social forces. Even for preparatory investigation work, as an official of NBWN acknowledged, it was “not entirely possible to have several inspectors of a local county branch to investigate a population of several hundred thousand.” At the same time, NBWM turned down the proposal to mobilize a wide range of civil organizations in local societies to “voluntarily” report their use of measures, as the bureau doubted the authenticity of data via this channel.[414]

Chambers of commerce (商会) were one of the few exceptions that were mobilized. The closed collaborations between local metrological branches and chambers of commerce characterized the

[414] “Yian(sishiyi)” [Motion, no. 41], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part “motions”, pp. 91-92.

reform in cities. As highly organized representatives of commercial interests, chambers of commerce could directly pass along governmental orders to their many member guilds (同业公会). Since the beginning of the 1930s, Nanjing required merchants to compulsorily register under guilds and guilds under their regional chambers of commerce. This chain of command covered most of the urban economic activities and proved to be effective. Particularly after 1929, with Nanjing's new law on commercial organizations, many local governments ordered a reorganization of the chambers(改组), thus increasing their political grips on merchants. On the other hand, chambers also maintained their independence. The tradition of "gentry-merchants" (绅商) made them prone to protect the interest of merchants and broader society. Chambers of commerce also served as intermediaries for merchants to negotiate with the state, particularly in conflicts of interest.[415]

Chambers of commerce made up for the lack of personnel in local metrological branches. Besides making their members report their usage of measures (shape, type, measuring capacity), their roles were evident in facilitating propaganda. For example, in Shanghai, the metrological branch summoned local measures manufacturers to attend a short-term series of lectures to inform all its members about the forthcoming reform. In June 1930, above 20 representatives gathered in the morning to hear a 2-hour talk covering themes such as a brief introduction to the metric system, new metrological law, engineering of new measures, and how to remold the old measures into the new.[416] The changed metrology demanded adjusted prices, and local

415 *Zhu Ying, Shangmin yundong yanjiu(1924-1930)* [Studies on commercial citizen movement], Beijing: Beijing University Press, 2011, particularly chapter 7 and 8; Fang Weiguo: "Jindai shanghai tongye gonghui yu zongshanghui, shishanghui zhiguanxi" [Relation of Associations and General Chamber of Commerce or Chamber of Commerce in Shanghai], in *Shanghai jingji yanjiu,* 2014, no.3 pp.79-88; Xu Dingxin, "Cong shengshang shidai zouxiang qiyejia shidai; jindaihua Jincheng zhong de Shanghai zongshanghui" [From gentry-merchants to entrepreneurs: Shanghai's general chamber of commerce in the process of modernization], in *Jindaishi yanjiu*, 1991, no.4. pp39-68; Ma Min, *Guangshang zhijian* [Between merchants and officials], Tianjin: Tianjing renmin chubanshe, 1995.

416 Liao and Huo, "Minguo shanghai duzheng shimo", p59.

metrological branches did not always do this independently. Chambers of commerce were often tasked with informing new pricing by posting a poster in local markets.[417] As to producing new measures, chambers of commerce were also essential because local metrological branches were prohibited from manufacturing measures. In Shanghai, a factory was sponsored together by the local chamber of commerce to rapidly increase the number of new measures. It also helped the local branch monitor illegal measures circulating among its member guilds and merchants.[418]

In general, local chambers were very responsive to demands from the state. On the other side, the local metrological administration also wished to maintain good cooperation, sometimes by paining it as a friendship. In Beijing, for example, a so-called Metrological Assistant Association (度量衡协助会) was formed, where inspectors met local merchants monthly, hearing their complaints and clearing the "misunderstandings."[419] Indeed, misinformation happened in many regions at the time. In Xiamen, the local chamber of commerce mistook the market system for the metric system at the beginning.[420] In Siming (思明) city of Zhejiang province, inspectors began to check measures before the new measures were disseminated by the chamber, which caused complaints in local markets.[421]

Around the end of 1931, most local chambers and guilds switched their measures or pledged

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417 Academia Sinica, Insitute of Modern History Archive (hereafter, ASIMHA): 17-22-107-04, "Beiping shizhengfu xingzheng gongzuo zong baogaoshu" [The general report of Beiping Municpal government's metrological administration]; also, see "Difang duliangheng xingzheng xiaoxi" [Local metrological administration messages] in Duliangheng tongzhi, 1934, no. 10, pp.19-27, pp.21-23.

418 Shanghaishi duliranghengju[Shanghai Municipal Bureau of Weights and Measures], *Shanghaishi gongyong duliangheng huayi chengxu*[Procedures of Shanghai Metrological Unification], Shanghai: Shanghaishi duliranghengju, 1935;"Diaocha"[Surveys], in *Duliangehng tongzhi*, 1937, no. 22, p.7; SMA: Letter from Bureau of Social affairs to Shanghai General Chamber of Commerce, Q173-36-68, pp.41-44.

419 BMA: J002-007-00156, *Beipingshi duliangheng jianding suo sanzhounian jiniankan* [Third Anniversary Memorial Journal of Beijing's Metrological Branch], 1935, p.34.

420 Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangehng tongzhi*, 1933, no.7, pp.2-5, p.2.

421 Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangehng tongzhi*, 1933, no. 6, pp. 2-9, p.7.

to do so soon. Major cities such as Shanghai and Nanjing announced their "primitive unification." The job left was "complete unification." However, there was a long way from "preliminary unification" to the second phase, "complete unification" (完全划一). In retrospect, a preliminary unification was far from satisfaction. Many guilds merely made empty promises but took a "wait and see" attitude.[422] In Shanghai, two years after the announcement of primitive unification, in 1933, patrols in the Chinese city revealed a continuous use of old measures. Three hundred sixty-four pieces of legal measures were confiscated from 343 shops in the southern city; the number was 200 for 192 in Zhabei(闸北), the northern city; 59 to 62 in the east, and 53 to 53 in the west. The number indicated that at least one illegal measure appeared in every shop inspected.[423]

The reasons for individual merchants' non-cooperation, despite the pressure from local metrological branches and chambers of commerce, were highly complicated and diversified. Chambers and guilds did not command all corners of the commercial sector. Beijing reported that it was a common phenomenon that most disobedient merchants and stores were outside any merchant organization.[424] More importantly, the metrological change severely undermined the usual commercial order, thus inviting resistance from a wide range of businesses and causing delays in unification.

To start with, sudden political interference in commerce disturbed the "tempo and pace" of commercial operations. In Shanghai, merchants used old measures in book-keeping, and traditionally the accounts of the former year were settled at the end of January in the next year. However, the local metrological branch required a universal transition to new measures by the end

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[422] "Tongye gonghui xiaoxi" [Messages from Guilds], in *Shenbao*, 20 July 1931.
[423] "Tongji" [Statistics], in *Duliangheng tongzhi,* 1936, no. 6, pp. 18-19.
[424] ASIMHA: 17-22-107-04, "Beiping shizhengfu xingzheng gongzuo zong baogaoshu" [The general report of Beiping Municpal government's metrological administration].

of 1931 to meet the deadline of Nanjing. Since a sudden change of measures would mean a complete recalculation of current accounts, the local chamber of commerce sided with its members and pleaded for a delay. Shanghai agreed to postpone the deadline to January 1932. With the Battle of Shanghai out-bursting on January 28th, 1932, the settlement of accounts did not finish on time. Merchants again deplored a delay as the business did not recover quickly after the war. The final transition of booking-keeping only happened in June 1932.[425]

Moreover, space was another vital dimension. Spatial desynchronization of unification among different regions gave merchants reasons to resist the reform. Many silver stores found it unreasonable to switch new measures as their peers in other cities did not do so[426]. More importantly, the desynchronization endangered the supply chain. While it was not surprising that the same measure varied drastically from place to place, the interconnectedness of trans-regional long-distance trades hindered the quick adoption of new measures. Take Shanghai's timber trade as an example. The timbers were mainly from remote hinterlands such as Guangxi(广西), Hunan(湖南), and Hubei(湖北). Many local timber guilds coordinated this transportation. In 1932, merchants engaged in the timber trade in Shanghai asked for a meeting summoned with their peers in other provinces to coordinate the usage of new measures. But the other regions did not respond enthusiastically. The meeting happened only a year later, as they alleged it took time to get all representatives to travel from the hinterland.[427] However, the discussion concluded that using new measures was a mission impossible. The metrological reform did not touch the rural area where workers cut the woods by old standards. Timbers were valued by their girth and length: the

425 SMA, S474-2-17, letter from SGCC to MBWM (8, July 1932), pp29-31.
426 Zheng and Shi, "Nanjing guomin zhengfu", p. 102.
427 SMA, S145-1-62, Correspondence from timber guild in Zhengjiang to Shanghai timber guild (29, June 1933), pp. 16-19.

bigger, the better. As the new measures were smaller than the old, merchants must trim the wood they bought to conform to the smaller new measures, thus affecting the selling prices.[428] The representative from the inland port Zhenjiang(镇江) was extremely against new measures. As Zhenjiang transshipped the majority of timbers to Shanghai, his guild would suffer the most.[429] Only late in 1936 did most timber guilds apply new measures in Jiangsu province, and merchants in Zhenjiang finally agreed to cooperate.[430] In Shanghai, spatial desynchronization led to more commercial tension than in other regions. Exactly because Shanghai took the lead in the metrological transition, merchants in Shanghai suffered a great loss of business. For instance, Silk merchants in Shanghai reported that their peers in Hangzhou(杭州) secretly used an old custom measure, Haichi (海尺). Since it was longer than the new (35.5cm to 33.3cm) but still at the same price, many Shanghai customers would rather travel to Hangzhou for a better deal for several days.[431]

Many merchants of closed-related trades were not comfortable with being the first to bear the shock. Even within one business of one region, desynchronization happened. The guild of medicine, for example, was not able to switch as doctors refused to buy medicine weighed with new measures since it did not tally with traditional medicine scripts and, as they alleged, the change of measures might very well result in "a loss of life." The medicine union also, in return, used doctors' uncooperative attitude as an excuse to delay the switching.[432] The silk dealer in Shanghai had already switched to the new market Chi in early 1934. However, chengyi stores (成

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428 SMA, S145-1-62, Letter from Yancheng timber guild to Shanghai timber guild (1932, exact time unknow), p. 13.
429 SMA, S145-1-62, Correspondence, pp. 16-19.
430 SMA, S145-1-62, letter from Shanghai timber guild to MBWM (8, January 1936), p.70.
431 SMA, S230-1-158, letter from Shanghai silk guild to Hangzhou silk guild (13, March 1934), pp. 13-16.
432 "Guoyao gonghui zhiwei jilu", *Shenbao*, 20 September 1932. Also, "Guoyaoye dingqi shixing duliangheng xinzhi", *Shenbao*, 6 November 1932.

衣店), the stores which sold ready-made clothing and tailored clothing, still used traditional measure, Cai Chi, (tailor Chi 裁尺), which was slightly longer than market Chi. A Shanghai newspaper report gave a vivid description of the petite conflict that this discrepancy between the two Chi caused：

> "A customer wanted to purchase silk fabric to make a cloth. The tailor of chengyi stores told him that one Zhang and four Chi of silk fabric (in tailor Chi) were needed. The customer then purchased one Zhang and four Chi of silk fabric (in market Chi) from a silk store. On hearing from the tailor that the fabric was shorter than expected, the customer felt cheated and went back to the silk store for compensation. The store had to agree with his demand for fear of causing more trouble."[433]

Indeed, as showcased in this report, the fear of business loss was the major reason for merchants' resistance, particularly for petite businesses, which relied on "small margins and quick capital turnovers."[434] The customers were neither aware of, costumed to, nor trusted the new measures as they were smaller than the old. It was a shared phenomenon in big commercial cities that experienced customers more often suspected of fraud instead of minding the metrological change. For instance, the cloth shops in Tianjin turned to new measures, and the price per new Chi has revised downward accordingly. But when they sold to "peasants from the remote countryside," the customers still asked to deal with old measures. As a result, stores either refused a deal or

[433] "Xinwenzhi ying xiezhu xuanchuan duliangheng xinzhi" [Newspapers shall facilitate to propagate the new metrology] in *Gongye biaozhun yu duliangheng*, 1934, vol.1, no.2, pp. 91-93, p. 92.
[434] Gong, "Duliangheng zhi wojian" [My opinions on measures], *Xiaoribao*, 20 February 1936.

swallowed the loss brought by a lower price.[435]

The practical inconveniences, in return, contributed to merchants' opposition to the state's interference in metrological affairs. For instance, silk merchants in Shanghai were much against the inspection fees by bluntly calling it an "exploitation" in the newspaper. Experiencing fierce competition from Japanese smuggled silk in 1934, the merchants partially ascribed their business downturn to the mandatory use of new measures as the government disturbed their business instead of offering a helping hand. The merchants claimed that the common bamboo rulers formerly cost only 1 to 2 cents of silver Yuan. The government forced them to purchase inspected rulers at 8 cents. They suspected that the price difference went into the government's pocket in the name of inspection fees. The newspaper report seemed to reflect the concerns of many, as it forced not Shanghai's local branch but NBWM to answer directly. NBWM explained that the inspection fees were only half a cent, which was also a worthy deal for the merchants since the rulers were much more accurate after inspection. Besides clarifying the misinformation, NBWM later advocated for the public media to side with the state and facilitated the propaganda of the new metrological policy instead of sabotaging it.

In a nutshell, it was safe to say that the unification in cities was not as advanced as NBWM alleged and projected. Merchants, in many cases, offered metrological authorities lip service. In early 1933, NBWM received a report from two measures factories in Jiangsu and Zhejiang provinces, the core regions of the Nanjing regime where the reform had been enforced most carefully. The report lamented that their legal and brand-new measures were stocked in warehouses because no buyers were interested. These two factories pleaded with NBWM to

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435 Zheng and Shi, "Nanjing Guomin zhengfu", pp. 101-103.

promote the reform quicker so their products could find a market.[436] Another appeal in late 1936, 7 years after the reform, was in a similar vein. The appeal, from an owner of a silk factory in Shanghai, witnessed that majority of merchants had not honestly followed new measures. Much to his appointment, merchants who responded to the state's call were laughed at by those who did not. He then asked NBWM for more strict regulations.[437]

Corruption of Hu

Merchants were not necessarily against a metrological change. Rather, many of them welcomed the potential economic prospect brought by an accurate measuring system. Earlier in 1928, when KMT's Northern Expedition destabilized the markets, inaccurate measures had become one of the main concerns of merchants. For instance, Shanghai's guilds of tea, vegetable, fruit, and rice had pleaded for governmental intervention to calibrate measures, and better yet, they asked for a new set of official standards. The city government responded by conducting a small-scale metrological inspection in the markets, but only to find the task was too hard to finish in a short time.

On the other hand, their loyalty to metrological reform became less secure once the influence of the state endangered their commercial interests. This part gave a detailed case that happened in Shanghai. It was the fiercest conflict that broke out in China's most important economic center, attracted national attention, resulted in a month-long strike, almost endangered the food supply, and thus was worthy of special attention. It provided an in-road to see the role of deeply rooted

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[436] Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangehng tongzhi*, no. 5, 1933, pp. 2-9, p. 3

[437] "Shanghai Meiya zhichou chang zongjinli Cai Shengbai tiaocheng huayi duliangheng banfa an" [The general manager of Meiya silk factory's suggestions on the metrological unification], in *Gongye biaozhu yu duliangheng*, 1936, vol.3, no. 5, pp. 57-58.

metrological tradition and vested interest in agitating commercial conflicts of the 1930s and how the state managed them.

In 1931, Shanghai's Municipal Bureau of Weights and Measures (hereafter SMBWM) ordered the Guild of Beans and Rice(豆米公会) to participate in the reform. The guild agreed to switch but demanded to manufacture new measures on its own because their shapes were unique. The guild also claimed they had already collected support from more than seven hundred rice dealers and shops. At first, SMBWM denied their demand. Granting guilds the right to produce measures was not a usual practice. SMBWM did not fully trust the guild would be honest enough, and the proposal might hide some "fraudulent schemes." However, after the Battle of Shanghai, SMBWM wished to speed up the reform and reluctantly accepted this arrangement in July 1932 but insisted on sending inspectors to monitor the production.[438]

In retrospect, the guild had sufficient reasons to deserve special treatment. Their measures, as they claimed, were indeed special. Historically, they used Hai Hu (海斛) to measure. Hu was a typical unit of volume for rice and other grains, such as beans and millet. The measure varied from time and space. Typically, one Hu equals five Dou(斗). According to an investigation of SMBWM, in the 1930s, one Hai Hu equaled 59.15 liters. Specifically, as its name indicated, Hai Hu was used to mainly measure grains transported by the sea, as compared to Cao Hu (漕斛) for the rice transported via the Great Canal. Hai Hu was even employed in Amur River, north-east of China, for soybeans trade to Shanghai prospered since the Late Qing.[439] As the new measure system made

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[438] SMA: S398-1-37, Correspondence between Shanghai rice shops' association and SMBWM & BSA, pp.4-6, p. 17, pp. 26-27.

[439] Wang Tao and Li Yushang, "Minguo shiqi fengtian diqu duliangheng kao" [Weights andMeasures of the Mukden Area in the Republican Period], in *Shanghai jiaotong daxue xuebao*, 2011,no.3, pp. 56-63, p. 62; See also, Li Bozhong, "Shijiu shiji chuqi songjiang diqu de duliangheng ji zhesuan biaozhun" [The Weights and Measures and the Conversion Criteria in Songjiang District in the Early 19th Century], in *Zhongguo zhengfa daxue xuebao*, 2017, no.2, pp. 60-65, p. 62. Guandong Dan(关东石) was directly correlated with Hai Hu (海斛), the ratio was approximately 1

a Dou 10 liters, SMBWM required the new Hu to be 50 liters exactly. Merchants protested that the difference between 50 and 59.15 liters was too big. To avoid turmoil in trade, SMBWM temporarily allowed merchants to manufacture and apply 60-litre Hu (六斗市斛) in February 1932.[440]

Local merchants, however, did not receive the new measures very well. In February 1933, the office of the rice guild received a threatening letter. The letter, alleged by the owner of a small rice shop, Hengxing(恒兴), revealed the difficulties that a small dealer faced. After collecting new Hu from the guild, the owner, in shock, found that the new measures were way smaller than the old ones. An essential part of his profit came from the inaccuracy of measures: he bought rice with measures bigger than it should be and sold too with measures smaller than it should be. This maneuvering of the disparity of measures, or in his words, "eating between measures" (吃升合), was critical for the survival of his rice shop. This practice was also common for other businesses, particularly so when the market was gloomy or the taxation was heavy. However, trading with smaller and more accurate new measures deprived him of this profit, thus endangering his livelihood.[441]

What angered the writer further was that: small dealers like him had difficulties coping with the new Hu, whereas big merchants who held the guild's leadership had the stomach to digest the temporary loss brought by the reform. The writer suspected that the guild either had received bribes from"guest merchants," the rice sellers coming to Shanghai, or those big merchants wished to crush small businesses to gain their monopoly in the market. "If you lot do not let me eat[...], then I have to do inconvenience to you within my capacity," the writer threatened so and sketched

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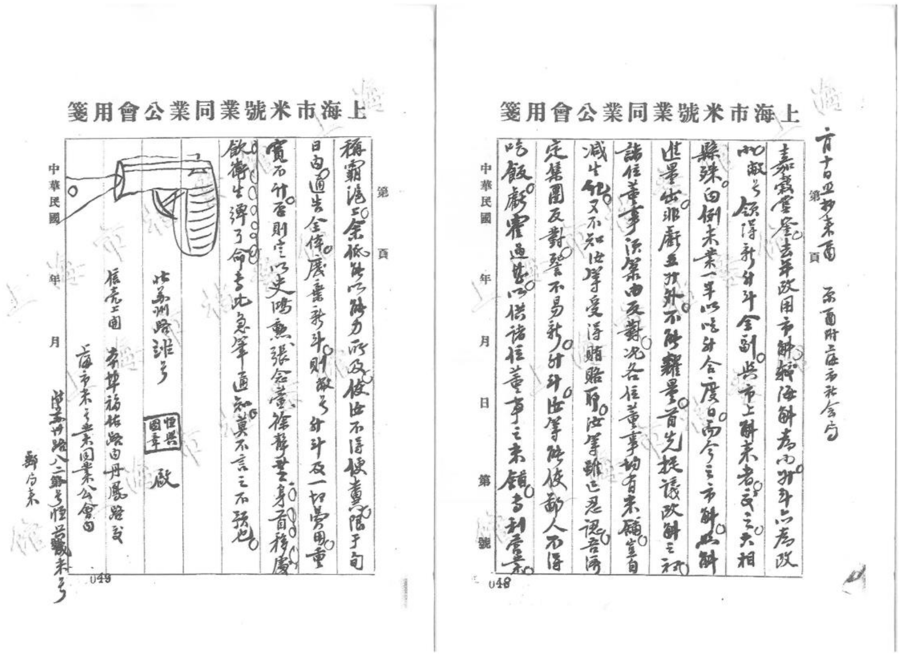
[440] "Nanbei mishihang liangxihuiyi ji" [The records of the joint conferment of north and south rice markets], *Shenbao*, 19 February 1933.

[441] Gong, "Duliangheng zhi wojian".

a firing pistol at the end of his letter: "[...] I will kill you, members of the guild board, and commit suicide with a bullet at the end."[442]


上海市米號業同業公會用箋

上海市米號業同業公會用箋

Copy of the original letter by the rice shops guild. Courtesy of Shanghai Municipal (SMA: S398-1-37, pp.61-62)

Shocked by the letter, the guild swiftly reported to SMBWM. The guild visited the address given in the letter and investigated among its member merchants the owner's identity. Local police also participated in the investigation under the request of SMBWM, only to conclude that the address and the name were fake. Nevertheless, SMBWM asked the police to crush any suspicious activities of this nature and asked the guild to clarify the policy further to its members.[443]

Fake as the letter was, the tension between sellers outside Shanghai and local buyers, as the writer alluded, was not only real but later ignited an even bigger conflict by introducing new measures. In the 1930s, the majority of rice was transported to Shanghai by "guest merchants" (客商) from Zhejiang(浙江), Jiangsu(江苏), and also rice markets in Anhui(安徽), Jiangxi(江西), and

442 SMA, S398-1-37, letter from rice shops guild to BSA, 10 February 1933, pp. 57-62.
443 SMA: S398-1-37, Shanghai rice guild to BSA, February 1933 (exact date unknown), p. 65.

Hubei(湖北). Other supplies came from India, Vietnam, and Thailand.[444] Before being bought by local merchants, the rice would be measured at the docks by measuring agencies hired by the local merchants. After the measuring, workers employed by the agencies delivered the rice with their wheelbarrows to the doors of rice shops.

The measuring process was supposed to be accurate and fair for both parties. Like many other trades in Shanghai, before the reform, the right to calibrate and manufacture rice measures traditionally belonged to the guild itself. At the beginning of every season, Shanghai's rice guild as a buyer was joined by the union of guest rice merchants (运米客商联益会) to check the accuracy of measures. Measuring agencies (斛司), a semi-governmental broker institute, would check and calibrate measure samples from both parties.[445]

However, the so-called "corruptions of Hu" (斛弊) emerged in actual business. As an unspoken rule, for every Hu, extra rice was spared intentionally by measuring agencies. This "over-spilled rice" would go to buyers' pockets, which enabled them to gain additional margins. However, how much rice would spill over became a constant dispute between buyers and sellers. When the extra rice was too much, a "heavy Hu" (重斛) appeared, and guest sellers faced loss; and vice versa, local buyers, suffered from "light Hu" (轻斛). Even for a correct, "even Hu" (平斛), a small portion of rice was also to be spared as agreed by both parties, which enabled rice shops to gain an extra profit as the threatening letter suggested.[446]

The professionals hired by measuring agencies titled Hu Shi (斛师), "Masters of Hu," determined

[444] Shehui jingji diaochasuo [Social and Economic Survey Institute] eds., *Shanghai minshi diaocha* [Surveys on Shanghai's Civil Affairs], 1935, p. 5.
[445] "Qianzuo liangri xiaji jiaohu" [Summer calibration of Hu in past two days], in *Shenbao*, 28, June 1931.
[446] Ma Jun, *Guomindang zaihu liangzheng de yanmian ji houguo* [The evolution and consequences of Guomindang's rice policy in Shanghai], Shanghai: Shanghai guji chubanshe, 2006, pp. 91; "Benshi humi jiufen jiejue" [The dispute of measuring rice was solved], in *Shenbao*, 12 May 1933.

the results of light or heavy Hu. These masters were worthy of their reputation, only in a notorious way. With their "hand techniques of measuring rice" (斛米手术), they could easily and secretly affect the accuracy of measuring. We do not have many details about these techniques, but a Shenbao journalist once sneaked into the agencies in the late 1920s and offered us a glace of the "swinging of Hu" (甩斛): masters used large, wicker-made scoops to pour the rice into a wooden barrel that was of one Hu volume. When the rice was about to fill two-third of the barrel, masters would raise their scoops and swing with strength. The density and weight of rice would consequently rise. Each Hu thus gained more weight by 1 or 2 English pounds.[447] These corruptions were not only recognized by both parties but also semi-institutionalized. Since local merchants hired the agencies, guest merchants, for fear of unfair treatment, had to give bribes almost compulsorily to the masters in the name of "liquor money" (斛酒).[448]

Secondly, the fact that rice was measured by volume instead of weight also complicated the situation. Many guest merchants took advantage of it by exposing their rice to the sun before docking their ships, thus increasing the volume of rice. Local buyers would ask for cold rice to be measured as a counterstrategy.[449] On the other hand, the quality of rice was judged by its weight and density. The same volume of different kinds of rice did not weigh identically. For example, one Hu of rice from Pudong(浦东), which was of low quality, weighed only 103 English pounds, whereas rice of superior quality could be as much as 105 pounds.[450] Buyers tended to weigh their goods before distribution to examine the quality level and determine the price. It was not seldom for local

447 "Mihu zhongliang zhi shidi kaocha" [Field investigation of corruptions in rice measuring], in *Shenbao*, 15 February 1928.
448 "Hubei humi gongren yin fandui quxiao jiuzi bashi" [The northern measures workers led a strike against the cancelling of liquor money], in *Shenbao*, 8 April 1934.
449 "Nanbang mishang gonghui lianxihui" [Messages from southern rice merchants union], in *Shenbao*, 28 March 1933; Ma Jun, *Guomindang zaihu liangzheng,* p.93, footnote no.3.
450 "Miye Zhenghu wenti" [The issue of measure dispute in rice trade], in *Shenbao*, 10 February 1928.

buyers to find out that the weight was considerably lower than it was supposed to be because guest sellers had added sand, rice husks, and water to the rice to increase the weight.[451]

Admittedly, the corruptions of measures were common among other trades when one stepped into China's metrological universe. Shanghai merchants used a soft bamboo ruler(围蔑) to measure the circumference of timbers. They used thin rulers to buy and thick ones to sell.[452] Such corruption in the rice trade was a common phenomenon in other places. For instance, Jiangxi rice dealers sometimes added thin wooden plates to their containers to sell. Sometimes they poured a thin layer of hot rosin at the bottom of containers. They covered it with another layer of rice dusks when it cooled down.[453] Customers could hardly detect the difference.

However, these practices brought about fierce conflicts more often in Shanghai, particularly in the rice trade. Guest merchants knew that they were cheated. In 1932, Shanghai Credit Rating Institute(上海征信所) investigated the rice trade. Their report suggested that big measures were prevalent in the northern rice market to attract local rice buyers. Though already knowing it would cost them by dealing with big measures, the guest merchants had no choice but eagerly sell at an unfair price, for the wild tides of the Huangpu River made a long time anchoring dangerous.[454] The prevailing corruption of Hu seriously plagued the relationship between guests and local merchants, and minor conflicts around heavy and light Hu already erupted occasionally in 1928 and 1932.[455] From 1932 onward, the situation for guest merchants was even worse. The harvest of rice and

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451 Ibid. Also, "Mike huaiyi fangshi miliang chanshui" [Rice merchants suspected water was added to rice], in *Shenbao*, 13 October 1926; "Qudi miliang chanshui banfa".

452 SMA: S145-1-62, letter from SMBWM to Shanghai timber guild, 15 July 1936, pp. 81-84.

453 Gong xuesui, "Huayi xinzhi duliangheng de zhongyaoxin" [Importance of metrological unification], in *Gongye biaozhun yu duliangheng*, 1934, vol.1, no. 5, pp. 1-2.

454 Zhang Xiaochuan, *Jindai shanghai zhabei jumin shehui shenghuo* [Life of Zhabei residents in modern Shanghai] Shanghai: Shanghai cishu chubanshe, 2009, pp. 107-108.

455 "Hunan mihang hushi yu keshang chongtu ji" [Dispute between Hunan rice store and guest merchants], in *Shenbao,* 9 October 1932; "Shehuiju zuori gongkai yanhu" [Bureau of social affairs held an open measure inspection yesterday], in *Shenbao*, 1 December 1932.

increased imports of American rice led to ample supply, low prices, and a buyers' market.[456]

Therefore, guest merchants saw an excellent opportunity to solve this long-standing problem with local merchants when the reform came to their docks. Their union pleaded to SMBWM to replace the scoops with a more accurate funnel, reducing the influence of masters of measures to ensure fairer measuring. Meanwhile, on February 10th, 1933, the union began a strike by ceasing their transportation of rice to Shanghai. Shanghai's rice guild prepared to negotiate with guest merchants, but Shanghai's rice shops considered this gesture of compromise a betrayal of local commercial interests. The guild found it hard to curb the rage of its members, and the hostility escalated quickly. Local merchants sent out leaflets among themselves and concerted a boycott against guest merchants' strikes.[457] As the negotiation entered a deadlock, guest merchants later blocked the ports with their ships to intercept any attempt to unload rice.[458]

On March 1st, SMBWM summoned the union of guest merchants and local merchants' guild, together with representatives of measuring agencies.[459] SMBWM gave two solutions: either SMBWM calibrated the measures, supervised the process of measures, and compared the accuracy of both funnels and scoops, or it changed the measures altogether by switching from volume to weight. While merchants of Shanghai agreed with the usage of weight for measuring, guest merchants thought it was only advantageous for local merchants on the ground that their rice was bought with volumes from farmers but dried out and lost weight in transportation. Measuring by

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456 Shanghai shehui kexueyuan jingji yanjiusuo, eds., *Shanghai jiefang qianhou wujia ziliao huibian* [Collection of historical materials of prices before and after the liberation of Shanghai], Shanghai: Shanghai renmin chubanshe, 1958, pp.128-133; Yin Fei eds., *Shanghai liangshi zhi* [History of grains in Shanghai], Shanghai:Shanghai shehui chubanshe, 1995, p.23.

457 SMA: S398-1-37, leaflet, between January to February 1932, exact time, unknown, p. 70.

458 "Mike xuangao bayun" [Guest merchants announced a strike], in *Shenbao*, 21 February 1933; "Miye fengchao kuoda" [Dispute in rice trade expaneded], in *Shenbao*, 7 March 1933.

459 "Zhendang zuoyi mike bayunan"[Party meeting discussed the strike of guest merchants yesterday], in *Shenbao*, 2 March 1933.

weight was thus a cunning scheme from local merchants.[460]

As the strike continued for almost a month into March, local merchants reported that their rice storage was about to exhaust, which endangered the food supply for the whole city. The situation needed a quick solution, and SMBWM wielded its iron fist, ordering guest merchants to restore transportation immediately on the 11th. At the same time, SMBWM tried to placate them by holding an open test of measures joined by both sides. The final solution was that the SMBWM dropped the motion of measuring by weight and promised guest merchants that a recalibration of the volume measure would happen shortly. SMBWM also approved the usage of funnels as requested by guest merchants, and local merchants had one month to prepare for the change.[461] However, the exposed corruption within measuring agencies did not change afterward. SMBWM only gave more rigid regulations on agencies in May and increased the penalties for heavy or light Hu. Moreover, it even gave tacit consent to the necessity of sparing extra rice under the condition that overspilled rice was from 0.4 to 0.9 liter for every 50 liters.[462]

In retrospect, the existence of this metrological corruption was a rational and natural outcome of China's vast commercial network. As Wang Chunfang pointed out, the same measure unit tended to be larger in major commercial cities than it was in the place of production. For instance, an investigation in the 1930s proved that the Hu was 3-5 percent smaller in Wuhu(芜湖), the major rice trade center, than it was in Nanling(南岭), a small town near the grain-producing area. The discrepancy of measures compensated for potential loss in hazardous long-distance transportation

[460] "Zhendang jiguan zuori jianyan liangmi qi" [Party administration examined the rice measures yesterday] , in *Shenbao*, 4 March 1933.
[461] "Zhenghu fengchao jieju"; "Humi jiufen jiejue banfa shangwei gongbu" [The final solution for the rice measuring dispute is still pending], in *Shenbao*, 12 March 1933.
[462] "Benshi humi jiufen".

and enabled rice dealers to offset operating expenses.[463] However, it also caused continuous conflicts among traders, remarkably so when the metrological regime drastically changed. In the eyes of the state, the secret commercial know-how evaded the expansion of metrological supervision. Yet Nanjing in the 1930s did not possess enough authority or resources to eradicate this tradition from its roots, nor could it suppress direct conflicts when the commercial circle could not absorb a change of measures. Therefore, SMBWM only took an eclectic stance to appease both sides, which pointed to the limitation of the state's ability to influence the metrological habitus of social groups.

Limited Mobilization: Police, Peasants, Yahang and Baojia

As Nanjing's new measures went deeper into cities and marched to the wider countryside after 1934, this part shifted the focus from urban merchants, a highly mobilized social group in the reform, to those less visibly mobilized actors and social spheres, such as the police force, peasants, Yahang(牙行), and Baojia(保甲), etc. While not extensively studied, the involvement of these actors served as a "feeler" to understand the reform's level of infiltration and mobilization, revealing some fallacies of Nanjing's mobilizing strategy and vacancies in Nanjing's metrological administration.

NBWM understood the importance of the police force, and as early as 1932, NBWM managed to get the promise from the Ministry of Internal Affairs(内务部) that the police force

[463] Wang Chunfang, "Shichang cengji yu 'rongliang tidu': yi jindai anhui migu shichang jiliang wenti wei li" [Market Levels and the "Capacity Gradient": Measurement Issues in the Rice and Millet Markets of Early Modern Anhui], in *Zhongguo shehui kexue*, 2011, no. 3, pp. 206-224.

would cooperate with the inspection. [464] Partially to gain support from local governments and police forces, Nanjing ordered that the fine for metrological misdeeds be divided among local police departments, metrological branches, and local governments. Inspectors and accompanied police officers were rewarded with a smaller part of the fine. The state encouraged citizens to report violations of metrological law. In some places, part of the fine was given to informants.[465] In other places, the total fine sum was transferred to the police force alone to ensure their support.[466]

However, this small amount of income was hardly an adequate encouragement. The police force did not regard the extra work of metrological inspection as their duty and constantly shunned away from the call of local branches by simply giving all sorts of excuses. For instance, in Hankou, police officers refused to lend a helping hand to inspectors, as they alleged that they were already occupied with other daily routines. The local metrological branch had to mobilize workers from a small measure factory to help with inspections in markets.[467] Sometimes, the police force did not even bother to find an excuse. In Yixin county(宜兴), the local branch complaint that it had to cancel the scheduled inspections with the police force, as officers did not show up when the market patrolling started.[468]

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464 "Dulaingheng xingzheng xiaoxi" [Metrological adaministratio messages], in *Duliangheng tongzhi*, 1932, no. 4, pp. 3-6, p. 4.

465 For example, such arrangement for informants was established in Sichuan Jiangxi and Fujian. Also, the distribution ratio of fine varied slightly in different areas. In Jiangxi, 40 percent was given to the police, 30 to metrological administration, and 30 to inspectors, police officers and informants. The rate in Jiangxi was 60 percent to local governments and 30 to related personnel. "Faling: Jiangxi sheng jiancha duliangheng ju fajin chufen banfa" [The regulation of fine on metrological inspection in Jiangxi province], in *Gongye biaozhun yu duliangheng*, 1935, vol.1, no. 7 pp.82-83; "Fagui: Fujian sheng geshixian chuzhi weifa fanmai huo xingshi duliangheng ju fajing banfa" [The regulations of Fujian province on the fining of illegal use and sale of measures], in *Fujian shengzhengfu gongbao,* 1936, no. 642, pp. 1-2. Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangehng tongzhi*, 1934, no. 8, pp. 2-11, p. 7.

466 "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangehng tongzhi*, 1933, no. 5, pp. 2-9, p. 7.

467 "Te zai: Hankou yidi" [[Special publication: Hankou], in *Duliangheng tongzhi*, 1934, no. 8, pp. 13-16, p. 13.

468 "Zalu" [miscellany], in *Duliangheng tongzhi*, 1937, no. 22, pp. 24-29, p. 25.

There were well-grounded reasons for this reluctance to cooperate. Henan police gave a detailed explanation. First, a metrological inspection was a "specific inspection"(特种检查). The police must undergo heavy paperwork to get special permission from the local governments to participate. Second, the area of a single inspection patrolling tour sometimes overlapped the jurisdiction areas of several police officers. All these officers were required to present at the same time, which proved to be a waste of the police force. Moreover, as the report of the Henan provincial branch confirmed, the local policemen did not possess enough metrological knowledge and failed to appreciate the importance of metrological work. As the Henan provincial branch suggested, a possible solution was to train two full-time "metrological policemen," but local police stations rejected the motion for their lack of personnel.[469] The only exception was in Wu County(吴县) in Jiangsu province, where a short report claimed two specialized and dedicated policemen like Henan desired appeared.[470]

Seldom did we find successful mobilization and intensive involvement of the police force. But the reform went quicker in limited areas where local branches maintained closed ties with the police force. For example, in Guangxi province, police officers were summoned to receive basic training in metrological knowledge. As the provincial branch reported, it delivered an impressive boost for the reform when the police officers returned to their own counties.[471]

The most impressive case was in Beijing. One of the historical lessons from the former Beijing reform was the essential role of the police force in cities. The Beijing police force was the main carrier of the reform since the number of well-trained inspectors was far from adequate then.

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469 "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangehng tongzhi*, 1934, no. 9, pp. 3-18, p. 18; also"Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangehng tongzhi*, 1934, no. 10, pp. 11-24, p.18.

470 "Baogao" [reports], in *Duliangehng tongzhi*, 1935, no. 12, pp.24-27, p. 26.

471 "Baogao" [reports], in *Duliangehng tongzhi*, 1937, no. 21, pp. 6-13, pp. 11-12.

Police officers investigated the usage of old measures, kept routine inspections in markets, and even served as deputies for the municipal metrological administration. The cooperation of the police force led to moderate success of metrological unification there in the 1910s.[472] Nanjing admitted that police officers in Beijing were well-equipped with adequate metrological knowledge and inspection experience due to this historical legacy.[473] When the new municipal metrological branch began to operate in 1930, the Beijing police force showed great enthusiasm. A police training center for metrology was set up, and the local metrological branch sent sample measures, copies of laws and regulations, and metrological textbooks to police stations.[474]

The buttress of the Beijing police force in daily work enabled the local branch to touch wider corners of society. Take propaganda as an example. In 1931, the Beijing metrological branch conducted only 48 times of propaganda missions, and the scope of work was limited to handing out leaflets or posting banners. Since 1932, the police force has participated intensively in this work. Accompanied by police officers, inspectors found their way to the narrow valleys of the city. They posted the charts of adjusted prices "from door to door" and delivered speeches at crowded crossroads. The gathering places or urban life, such as cinemas and other entertainment venues, received special attention. Since most of the population in the 1930s were illiterate, many Beijing citizens visited the Public Newspaper Locations(民众阅读处)， an institute widely set in the 1930s, where they could read on the newspapers billboards or alternatively listen to the contents being

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472 "Mingling; Nongshang bu cheng tuixing quandu xinzhi qing xian zhiding jingshi wei shiban quyu zhuo ni jinxing banfa bing liantong biaozhun ji tuyang qingdan chengqing xunshi shixing you" [Orders: Ministry of Agriculture and Commerce's appeal to appoint Beijing as experimental area for metrological reform, devise the method of promotion and send standards samples and pictorials], in *Zhengfu gongbao*, no. 1117, 17 June 1915, p. 6.

473 "Yian(sishiyi)" [Motion, no. 41], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p. 91.

474 BMA: J002-007-00156, *Beipingshi duliangheng jianding suo sanzhounian jiniankan* [Third Anniversary Memorial Journal of Beijing's Metrological Branch], 1935, p.31.

read by others. “Oral propaganda”（口头宣传）with police officers happened periodically in such locations. [475]

The Beijing police engaged in the reform deeper than its peers in other regions. For instance, standard sets of new measures were deposited in major police stations and the ones near markets so that citizens could directly go to the police station to settle their metrological conflicts with the help and supervision of police officers.[476] With the police force shouldering a big share of the burden in the downtown area, Beijing’s local metrological branch even established several sub-branches in the suburbs after 1933, a rare case that did not usually happen in other major cities.[477]

The second less mobilized sphere of the reform was the countryside. In the plan of NBWM, rural areas were not in priority. Rural inspections began after the preliminary unification was secured in urban areas. Reports from Beijing approved that the constant and regular inspections in the city’s rural vicinity were impossible due to its lack of resources.[478] However, the close social and economic urban-rural ties produced an unexpected result: the lagging of reform in the countryside held back and endangered the hard-earned “preliminary unification” in cities.

In Qingdao, the unification in its urban area was relatively smooth, whereas peasants from its rural region did not comply with the government at all. As peasants could not be forbidden to come downtown, inspectors always found illegal measures in the hands of peasants. They resisted the confiscation immediately and asked to return their measures “without any fear.” Even though inspectors explained the new measures to them many times and notified the heads of their villages, the situation did not improve.[479] In 1935, some peasants even went into a certain kind of guerrilla

[475] Ibid., p.41.
[476] Ibid., p.34.
[477] Ibid., p.33.
[478] “Beipingshi duliangheng jianding suo ershisan nian xinzheng baogao”, p.11.
[479] “Fulu” [Appendix], in *Duliangheng tongzhi*, 1935, no. 14, pp. 13-16, p. 14.

warfare with the government. Four inspections were organized in Qingdao that year. Inspectors usually announced the coming of inspections and informed the storeowners of the time and area of inspections. For the first three inspections, peasants in markets somehow got notified beforehand and fled away. The inspectors had no choice but changed their strategy. They did not set a fixed location for the last inspection. Instead, teams of inspectors patrolled randomly, "sometime in the countryside, sometimes on the streets, sometimes in the periodic rural markets, and sometimes in the food markets." The report claimed that "this was exactly like a guerrilla war, and it yielded great results," as this approach uncovered more illegal measures.[480]

Indeed, numerous feedbacks from local inspectors in rural settings registered peasants' resistance and highly diversified reasons behind it. For instance, propaganda works did not normally reach the countryside, and peasants had no clue of the coming reform. This was the case in remote provinces such as Guangxi, where resistance happened when peasants were asked to buy new measures and more so when their old measures were confiscated.[481] Sometimes the job was outsourced into the wrong hands. In Fujian province, where county branches were not widely set, new measures were allowed to be carried and sold by salesmen hired by metrological branches. These salesmen were not professionally trained and sometimes sold the measures by force, which caused a "common aversion" among people.[482] Sometimes the distrust came because of the short temper of inspectors. In Guangdong province, it was reported that most inspectors "lack the characters." While not specified in detail, the report admitted that inspectors' "methods" were

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[480] Ibid., pp. 15-16.

[481] "Te zai: Jia" [Special publication: Home], in *Duliangheng tongzhi*, 1934, no. 10, pp.6-10, p.7.

[482] "Fujian gaizu shengxian jianding jiguan an" [Fu jian reorganized its provincial and county branches] in Gongye biaozhun yu duliangheng, 1934, vol.1, no.1, pp. 100-101, p. 101. Also, Chen Benzhong, "Woguo duliangheng jianding renyuan zhi diwei" [The status of our nation' metrological inspectors] in *Duliangheng tongzhi*, 1937, no. 22, pp.2-5, p. 5

sometimes too harsh, which easily solicited resistance from people. This report concluded that inspectors should pay special attention to their behaviors in rural areas.[483]

But most importantly, new measures were of no use to peasants. While NBWM alleged the new measures could protect peasants from cunning and predatory merchants, the actual situation suggested otherwise. Sellers and buyers in rural markets were reluctant to use new measures, as they may cause commercial disorder and add the expense to commercial transactions. For instance, in Wuwei County(无为县) of Anhui Province, the local metrological branch ordered taxing rice with new measures in the autumn of 1935. However, poor peasants refused to switch, fearing that the change may cause more fraud as they were unfamiliar with the new measures. Rice merchants also avoided new measures, for they might invite conflicts with the peasants. Moreover, since the new measures were significantly smaller than the old, peasants must pay ten percent more to the rice porters, who refused to cut the price for carrying each Dou of rice. [484]

The predicament of reform pointed to a fatal fallacy of Nanjing's mobilizing strategy. Nanjing failed to mobilize the basic rural political apparatus, Baojia(保甲), and Yahang(牙行), the most important metrological player in the countryside.

Without the support of local governments, the metrological administration in the 1930s hardly infiltrated the lower echelons of rural societies. Atomized political agencies were essential in this infiltration process when a reform aimed at changing the social behavior of common people in daily scenarios. One good index for analysis was the involvement of Baojia(保甲), the tentacles of governmental apparatus at the county level. While it could be dated back to as early as Song

[483] "Huiwu jiyao(yi)" [Essential records of meetings (part one)], in *Duliangheng tongzhi,* 1936, no.19, pp. 14-19, p.18.
[484] "Wei gaiyong xinzhi duliangheng hu zu quangao quanxian yezhe yu dianhu wen" [To related commercial practitioners and tenants on the thorough transition to new measures for metrological unification], in *Duliangheng tongzhi*, 1935, no. 15-16, pp. 35-36.

Dynasty, the Baojia system(保甲制) was revitalized by Nanjing in 1932. First in Jiangxi Province as a counterstrategy to CCP's infiltration of rural society, it later expanded to other KMT core provinces such as Jiangsu and Zhejiang.

The Baojia system wove a grand network of social control in the countryside in the 1930s. Normally, ten individual households form a Bao(保), and ten Bao form a Jia(甲). A larger village could be of several Jia. Governmental orders were passed along from Xiang(乡) to Baojia. Despite its utmost importance, we have not seen much evidence that NBWM utilized the Baojia system to instill the vast agricultural regions. However, only in counties where local governments displayed an apparent concern for metrological affairs we witnessed limited involvement and mobilization of Baojia. In Fuyang(阜阳) county of Anhui province, the heads of Bao accompanied inspectors for inspection and propaganda works in villages.[485] From 1936 to 1937, there were slightly more cases. In the villages near Hankou(汉口), Bao and Jia's heads helped distribute propaganda materials and accompanied inspectors to give speeches in village schools.[486] Only occasionally, mobilization targeted Baojia directly, as in Fujian and Guangxi in 1937, where metrological branches offered the training classes to the heads of Bao.[487]

More detailed cases indicated that their support was half-hearted at best in areas where the Baojia system indeed got involved. For example, in Qijiang (綦江) county of Sichuan province in 1937, an inspector accompanied by police officers detected that Gao Yinchu, a local storeowner, had hidden illegal measures. The police officer then showed Gao a fine ticket, which Gao took and reaped into pieces. Gao's father also came later with four other people to beat the inspector and

485 "Baogao" [Reports], in *Duliangheng tongzhi*, 1935, no. 13, pp. 12-14, p. 14.
486 "Gedi huiyuan zhongyao baogao" [Important reports from local members], in *Duliangheng tongzhi*, 1937, no. 22, pp. 12-19, p. 15.
487 Lin Guifan, "Gei tongzhimen de henian xin" [New year letter to comrades], in *Duliangheng tongzhi*, 1937, no. 21, pp34-36; "Baogao" [Reports], in *Duliangheng tongzhi*, 1937, no. 21, pp. 6-13, pp.11-12.

police officers. As Gao's father shouted on the streets for more help, more people joined with sticks in their hands. The police officers were heavily injured, but the inspector managed to find his way into the office of the local Baojia. Gao, with his lot, chased after the inspector and threw their straw saddles into the office, threatening that they would break in and kill the inspector. The inspector asked Mr. Cai, the chief of the Baojia office, to stop this crime. However, Cai took no action but only smiled at the inspector. As more police officers later arrested Gao, Cai begged the inspector to spare Gao and suggested paying the inspector 100 Yuan as a bribe. Cai was blamed later for his dereliction of duty.[488]

Seldom did the resistance against new measures result in violence. In this case, common people's antipathy to the metrological inspection radiated as pedestrians answered swiftly to the calls of Gao and his father. But more interesting was the attitude and role of the local chief of Baojia. While Mr. Cai's inaction in the face of this audacious crime should be punished in the eyes of the state, he also provided certain protection for the local community, as he did not stop Gao and later tried to settle the case by bribing the inspector.

The other major metrological actor in rural areas was Yahang(牙行). The role of Yahang evolved through history, but as Nanjing defined it in the 1930s, they were "brokers engaging agency trade and managing metrological affairs for both parties in commercial transitions." Yahang brokers, sometimes carrying with themselves conversion tables of measures, were fluent in different local measures. This role was essential in rural markets to make trans-regional trade possible.[489] During Ming and Qing, Yahang was a highly lucrative business, particularly when rigid supervision from

488 "Xujiang zuai duzheng baozhang bei xianfu shouya" [The Bao chief in Xujiang county was arrested for his hinderance of metrological reform], in *Guomin gongbao*, 19 January 1937. Requoted from, Xie Rui, *Sichuan sheng tongyi xinzhi duliangheng yanjiu*, pp.75-76.

489 Zhang Yantai, *Minguo shiqi huabei yashang yanjiu* [The Study of Yahang in North China], unpublished dissertation, Heibei Normal University, 2012, p.17, p. 105.

the state was missing. It was also a sphere where metrological conflicts occurred.[490] However, an interesting historical phenomenon was that the conflicts filed to the state during the republican times were significantly fewer than that in Ming and Qing dynasties. This was not to say that Yahang brokers suddenly became honest businessmen. Rather, that meant Beijing and Nanjing governments failed to monitor metrological conduct in rural markets, whereas Qing and Ming courts managed to impose an effective official quota system for taxation and registration of Yahang brokers(官牙制) and check their measures every season.[491] As a comparison, local governments sent police officers to calibrate the measures of Yahang, at the frequency of merely once a year.[492]

The missing of state supervision resulted in metrological corruption and a confined metrological world regulated by unspoken rules among brokers. In Zunhua county (遵化) of Hebei province, Doucheng Yahang(斗秤牙行) assisted transactions of grains between peasants and merchants. Like their peers in cities, Yahang brokers took a cut of 1 percent of volume as commissions, along with extra grains that they secretly spared during the measuring. These grains, called gezi (鸽子), or "pigeons" in local slang, flew directly into the pockets of Yahang brokers. To fence off the supervision of the state and keep trade secrets, brokers also developed their own jargon. For instance, numbers from one to ten were coded with characters(由中人工大王主并羊非). The

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490 A ghastful story of Late Qing suggested exemplified how lucrative the business of Yahang was: "In Beijing there are two people, Jia, and Yi, fighting for the monopoly of Yahang business. Their case has been taken to the court yet could not be settled for years. At last, they sent representatives to each other, and said: 'Let us place a large pot in room, boiling oil within, and stand our families on side. Who dares to throw his son into the pot would get the monopoly profit.' Jia's son was barely 5 years old. He was thrown into the pot, making Jia the winner. Jia kept the dried-out corpse of his son in an idol niche at home. Later, when others came to contend for the monopoly, Jia would point to the niche and say: 'My family get the monopoly because of this sacrifice. Should one wish it, one must do the same too.' The contenders were all shocked and fled." See, "Jingren zheng yahang tiao" [Entry of Beijing people's fighting for Yahang], in Xu Ke, *Qing bai lei chao,* 1916.

491 Zhang, *Minguo shiqi huabei yashang yanjiu*. For the observation on decreasing cases of metrological misdeeds in republican times, see p.367.

492 Wang and Li, "Minguo shiqi fengtian diqu duliangheng kao", p. 6.

system functioned by counting the number of stroke ends protruding from the main body of a character. For example, 由 with one end on the top denoted number one. And 中, with two ends on top and bottom, was number two. The principle went for the rest.[493]

Beijing's government attempted to address the problem. In 1920, it gave specific orders to provinces, which prioritized inspection of Yahang's old measures as a major task to speed up metrological unification. Provinces never executed the order.[494] In the 1930s, Zheng Liming, who had visited BIPM in the 1910s and served Beijing in its reform, and now was the Deputy Minister of Industry and Commerce, urged NBWM to tackle the issue. In 1930, he notified NBWM that Yahang was increasing in number, and its rampant expansion aggravated peasants' suffering. The situation, according to Zheng, was even "worse than in late Qing."[495] In 1931 again, Zheng again addressed newly graduated inspectors to pay great attention to Yahang's grip on measures in agricultural settings such as Northwest China, even though the reform had not expanded there yet.[496] However, no evidence suggested that Nanjing leveled any supervision of Yahang. This served as a sharp contrast to the successful experience of Shanxi province during the Beijing reform, where civil organizations at the village level facilitated unification in the countryside. Yahang in Shanxi also received direct orders to report on their usage of their measures. Local governments carefully calculated taxation changes and the number of needed new measures, making sure that

493 Tianhui, "Jiushehui zunhua xian de doucheng yahang" [Doucheng Yahang of Zunhua county in the old society], in Yuan Wenru et al., eds., *Zunhua wenshi ziliao daquan(shang)* [Collection of Historical Materials in Zunhua County], 2013, pp. 409-411.

494 "Tongyi duliangheng de xiansheng" [The premises for metrological unification], in *Shenbao*, 17 December 1920.

495 *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931, p. 10.

496 Shiye bu quanguo duliangheng ju [National Bureau of Weights and Measures, the Ministry of Industry], *Shiye bu quanguo duliangheng ju duliangheng jianding renyuan yanchengsuo dierci baogaoshu* [Second report of the Training Center for Inspectors of Weights and Measures], Nanjing: Zhuonghua yinshua gufen youxian gongsi, 1931, p. 127.

Yahang corruption would not be triggered by new measures.[497]

In a nutshell, Nanjing's bitter failure in the countryside was in contradistinction to its relative success in mobilizing merchants and police. It substantiated the warning made by an NBWM official in 1930: if new measures could not penetrate local societies, the most likely result would be that in Guangdong province during 1926-1927, where KMT's rudimentary efforts on metrological unification were but a slogan.[498]

The Art of not Being Governed

As this chapter has already partially answered, the question next was why the reform invited wide resistance from all kinds of social groups, particularly common people. The most direct reason was that they simply did not know. Soldiers were a good example. In many heavily garrisoned cities such as Wuhan and Beijing, they were sent to purchase provisions and caused conflicts in markets.[499] Soldiers were reported to interfere with the confiscation of their old measures, and in some cases, they beat anyone who dealt them with new measures for mistaking the shrinking measures as frauds.[500] Propaganda works, while being emphasized by NBWM, had its limit. Living in a highly confined environment, soldiers were not well briefed by their commanding officers on the metrological change.[501] But more important was the resistance, or "complaints" in a more

[497] "Gongwen" [Official correspondence], in *Zhengfu gongbao*, no. 1456, 4 March 1920, p.14.
[498] "Yian(sishiyi)" [Motion, no. 41], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p. 91.
[499] "Difang duliangheng tuixing xiaoxi" [Messages of local metrological promotion], in *Duliangheng tongzhi*, 1933, no. 6, pp. 9-19, p. 17.
[500] "Duliangheng xingzheng xiaoxi" [Messages of metrological administration], in *Duliangheng tongzhi*, 1932, no. 4 pp3-6, p. 6.
[501] Beijing Municipal Archive: J002-007-00156, *Beipingshi duliangheng jianding suo sanzhounian jiniankan* [Third Anniversary Memorial Journal of Beijing's Metrological Branch], 1935, p.32.

covered and nuanced way, of the social groups who chose not to comply with the state despite their knowledge of the coming metrological change. This kind of resistance, despicable in the eyes of the state, was well-grounded in some cases.

First, Nanjing's policy was sometimes being put into practice in a harsher way in local scenarios. For instance, the old measures of Chinese traditional medicine were allowed to be practiced. However, this information apparently was not widely known to local inspectors. In Beijing, inspectors confiscated the traditional medical steelyards of a medicine store, even when the owner explained the official exemption to them. As a result, the store owner seemed to be irritated and scolded inspectors in a loud voice and filed his protest via Beijing medical guild. However, the Beijing metrological branch refused to return the measures because it only granted medical stores a "delay" to switch measures instead of full immunity as Nanjing allowed.[502]

Second, the misbehavior of inspectors sometimes invited criticism and resistance, which happened more often in rural settings and at the county level. For instance, Mi Boheng(糜博衡), a third-class inspector in Qu county(渠县) of Sichuan province, was accused by local merchants of secretly running a measure factory despite Nanjing strictly forbidding inspectors to engage in the sale and production of measures. Xinxing(新兴) and Sanze(三则) were two major measure factories in Qu county. Mi invested in the Xinxing factory in his wife's name in 1936, and Xinxing promised to give 2 cents commission for every measure Mi inspected. To help Xinxing gain the upper hand in the competence with Sanze, Mi blocked the sale of Sanze's products by refusing to inspect them, while the measures of Xinxing flooded the market without inspection at all. The

[502] Beijing Municipal Archive: "Beiping shi jingcha ju dier qushu guanyu dulaingheng jiandiguo an fagui chengfa hongda yaopu de cheng" [The report form the second district branch of Beijing police bereau about Beijing metrological branch"s punishment of Hongda medicine store] J181-021-19621, p. 2.

owner of Sanze brought the case to the magistrate in 1937. Under the direct order of the county government, Mi began to inspect measures from Sanze, but deliberately hindered the process by sending all of them back as he alleged these measures were not accurate and needed further calibration. Mi was only removed from his position in 1938 under the constant protests of local merchants.[503]

Third, the state, with its bureaucratic rationality, ignored the practical difficulties that a sudden metrological change might incur, such as in the case of soy sauce. The inconvenience caused by inspection and new measures was an important reason for civil resistance. It was safe to say that the scope of inspection sometimes was unnecessarily expanded. For example, the materials for liquid containers were highly diverse in the 1930s. Restaurants sometimes even used bamboo joints as cups.[504] In Changshu county(常熟), wine cups and kettles were ordered to be replaced. For wine shops and restaurants, purchasing new cups was expensive but also unnecessary because customers did not really care. Even the local administration admitted this point, but the policy continued to be carried on.[505] In other cases, thoughtless administration even endangered the very livelihood of people. In 1934, Beijing stipulated the standard water measure, Dan(担), as 50 kilograms. The decision was based on the experience in Wuhan, where the modern water supply system allowed such big units. However, one Dan in Beijing was 10 American gallons which were approximately 38 kilograms. The new Dan, 12 kilograms heavier, literally added the burden on the shoulders of water tankers. Carrying a pole with two water buckets on their shoulders, water

[503] Sichuan Provincial Archive: Ming 126-01-0868 "Quxian xianfu chengbao banli tuixing duzheng zhiyuan kuangzhi wubi qianxianzhang fuyan fuzheng qingxing" [The report of corruption absence of metrological clerks and former magistrate's inaction in promoting metrological reform], pp. 16-23.
[504] Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangehng tongzhi*, 1933, no. 6, pp. 2-9, p8.
[505] "Jiuhu zaidian zuowei jiliang qiju ze ying shou jiangding bing zhengshou jiandingfei an" [Wine kettles in stores should receive inspections and be levied with inspection fee, domestic use could be spared], in *Gongye biaozhun yu duliangheng*, 1937, vol.3, no. 7, pp.65-66.

tankers "started to work at sunrise, only to rest at sunset." Each water tanker supplied around 40 to 50 households, and their average daily workload was 200 Dan. Since the resident refused to pay more for each Dan according to its increased weight, the already-impoverished water tankers suffered a further loss of monthly income.[506]

All these reasons explained the motives of their resistance but not the means of their resistance. An indispensable understanding of civil resistance would include social mechanisms that enabled common people to utter a different voice. As James Scott, social resistance was sometimes "by design," as many cultural and social mechanisms were maintained to discourage states from limiting the freedom of society in the first place.[507] Indeed, the dealing habits of Chinese customers, conditions of measure-making, or even the very shape of a steelyard conditioned the Chinese way to fence off metrological control from the state. By finding opportunities in blind spots of supervision and loopholes in laws, "this art of not being governed" enabled many social groups to fly under the radar of NBWM. This part showcased how small measures manufacturers and common households learned to evade the control of the state and conducted their everyday resistance that the metrological administration stigmatized.

The most successful social group of this kind was measure makers. Despite the efforts of NBWM made in the commercial sector, measure-making was not a highly organized or visible business before 1930. Like their fellow petite commercial peers such as Tofu makers, small-measure makers

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506 BMA：J002-007-00109, "Beiping shi duliangheng jianding suo yaoqiu ge shanghao xunjiang yeti liangqi gaihuan xinzhi de gonghan" [Beijing metrological branch's official correspondence to merchants on swiftly changing the liquid measures], pp.78-82. NBWM later "temporarily" agreed to change the water Dan to 30 kilograms in Beijing. "Beiping liangshui biaozhun qingyi sanshi gongjin wei yidan zhanyu zhaozhun an" [Approval of Beijing's 30-kilogram water Dan], in *Gongye biaozhun yu duliangheng*, 1934, vol.1, no.5, p.127.

507 James C. Scott, *The Art of Not Being Governed: An Anarchist History of Upland Southeast Asia*, New Haven & London: Yale University Press, 2009, pp. 8-9.

were often outside of any commercial organization.[508] At the beginning of the reform, NBWM set a registration system to increase its control of measure-making. When measure makers were caught forgery, the metrological administration would revoke their registered status, and local branches would stop inspecting and stamping their products. However, there were always ways to avoid such punishment. It was not uncommon that the offender successfully registered again with a different name and company title.[509] Some producers registered in one county and sold legal measures there but opened a branch store in another county and continued selling old measures. Their unlawful activities were not always uncovered.[510]

Another problem with this system was that it did not cover peddlers who made a living by manufacturing and selling measures. They wielded a big influence in everyday metrological life since their mobility enabled them to infiltrate the local society and deliver measures directly to the thresholds of residents. In Hubei, peddlers who sold measures by literally "knocking up doors" could not afford the registration fee and stamp tax which were 6 Yuan.[511] The exclusion of peddlers led to the fact that most of them continued to sell old measures which they manufactured domestically.[512] Worse still, many workers measures factories who lost their jobs also turned to peddlers. In Shanghai, their number was "in the hundreds." While the local metrological branch tried to persuade them to join measure guilds and threatened them with punishment, none of them followed the advice.[513]

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508 "Gongwen" [Official correspondence], in *Zhongyang xunlianbu gongbao*, 1931, no. 7, p.8.
509 "Jieshi nantong xian zhengfu qingshi guanfanchuli deng yiyi" [Explanation to Nantong County government's 15 inquiries on recidivists and so on], in *Gongye biaozhun yu duliangheng*, 1936, vol. 2, no. 11, pp. 111-114.
510 Ibid.
511 Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangehng tongzhi*, 1934, no. 9, pp. 3-18, p3.
512 NBWM asked big measure factories to sell new measures to peddlers at half price. Though no feedbacks on effectiveness of this policy. "Beipingshi duliangheng jianding suo ershisan nian xinzheng baogao", p14
513 "Ju cheng shiye bu" [Bureau's report to the Ministry of Industry], in *Gongye biaozhun yu duliangheng*, 1935, vol.1, no. 11, pp. 79-80,

The inspection fee also pushed peddlers further from the state. MBWM ordered that every legal piece of measurement must go through inspection and get marked. The strict quality control set a bar for hawkers, for their products were unlikely to pass the examination, but also, it was difficult for them to afford the fees of examination charged by MBWM. The examination fee was only symbolic, particular for small measures. On average, each measure was charged approximately 15 cents.[514] However, considering the quantity of production and the expense of examination fees, even some bigger manufacturers still found it unbearable and risked forgery.[515]On the other hand, avoiding inspection fees gave their products an edge in market competition. The low price of their illegal measures, sometimes at 20 to 40 cents, gained customers' favor.[516]

An important sign indicating the failing governmental supervision of measure makers was a rampant wave of forgery at the time. Cases were reported from north to south. For example, Daxing(大兴) county discovered unfinished components of measures circulating in its area. These measure parts were already with official marks of inspection on them. Since metrological administration only inspected and marked completed products, these marks were most likely to be counterfeit.[517] In Wu county(吴县), manufacturers illegally marked their products without sending them to the local branch for inspection, as marking a measure was not complicated at all.[518] In Beijing, local measure stores also forged the official marker and stamped those returned measures that failed the inspection. This misdeed was difficult to detect, as counterfeit measures

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514 From 1932 October to February 1933, MBWM examined 64753 pieces of measures, and collected fees of 1019.93 Yuan. "Tongji" [Statistics], in *Duliangheng tongzhi*, 1933, no.6, pp.18-19. Also, SMA: S398-1-37, MBWM's regulation on examination fee and standards of procedure, pp. 50-51.

515 SMA: S398-1-37, correspondence between Shanghai rice shop guild and BSA, MBWM, and SGCC, p. 48; also, SMA: Q173-36-68, letter from BSA to SGCC, 2 Feburary, 1934, pp.41-44.

516 "Ling anhui sheng xiuningxian jianding fensuo" [Orders for Xiuning county branch in Anhui province], in *Gongye biaozhun yu duliangheng*, 1934 vol. 1, no. 3, p. 92.

517 "Beipingshi duliangheng jianding suo ershisan nian xinzheng baogao", p.16.

518 "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangheng tongzhi*, 1934, no. 9, pp. 3-18, p. 6.

were mixed with approved and stamped measures sent to the metrological branch in the same patch.[519]

While these actions effectively bypassed the porous registration system and official inspection, the very shape of Chinese measures and their production process also granted measure makers unique advantages in this game of cat and mouse. For historical metrology, instruments and techniques are indispensable dimensions. Take the most typical measure, steelyards, as an example. As a traditional instrument employing the basic principle of leverage, a Chinese steelyard normally consisted of a beam with a hanging weight on one end and a hook or a pan on the other, with a pivotal handle in between. A typical steelyard got 16 marks of stars on the beam(十六星秤), with each denoting one Liang. Depending on its size, it had a weighing capacity ranging from thousands of Jin to less than a Liang. The latter, known as Dengzi(戥子), was common for measuring valuables such as medicine or silver and, in some cases, opium and heroin.[520]

We did not have enough evidence to suggest how steelyard makers ensured that their products were accurate, given unreliable materials and casual production. An anthropological study conducted in Beijing and Changsha(长沙) during the 1990s, the dying day of steelyards, provided us with an in-road. According to an interviewed maker, knowledge of scale construction was passed on from master to master. Master and apprentice were always related, so it was a family tradition. There were no mnemonics for learning and memorizing the technique of building scales. Nothing

[519] BMA: J002-007-00156, *Beipingshi duliangheng jianding suo sanzhounian jiniankan* [Third Anniversary Memorial Journal of Beijing's Metrological Branch], 1935, p. 30.
[520] Chen Chuanling, *Minguo zhongyuan duliangheng jianzhi* [Brief Metrological History in Zhongyuan fo the Republic of China], Beijing: zhongguo zhijian chubanshe, 2012, p. 156

was written down, either. Everything, including all the numbers, had to be memorized by heart.[521] In other folklore records, steelyard makers had their own vague codes of ethics, where a short of one Liang on a steelyard meant a one-year reduction in the lifespan of the maker. The last three star markers also represented Fu (福 fortune), Lu (禄 prosperity), and Shou (寿 longevity) (福禄寿) of the maker. The maker would not achieve these life goals should his steelyard be inaccurate.[522]

NBWM's statistics in the 1930s could partially verify these records. Most measure makers were small producers. Despite NBWM establishing several larger factories in major cities to assuage the shortage of new measures at the beginning of the 1930s, the basic situation of measure-making did not change much. Statistics of measures manufacturers in Chengdu and its vicinity in 1936 gave us a closer picture of the business. 73 out of 80 were old-fashioned handicraft workshops, with no appliance of electric-drive machinery. Most of them hired less than ten workers, and one manufacturer in Chongqing(崇庆) county was a "one-man shop." Around 60 percent could manufacture all three types of measures (volume, length, weight), managed the production of one or two types, and the rest five were qualified only to repair jobs. The level of output, productivity, and quality of their products were not hard to imagine.[523]

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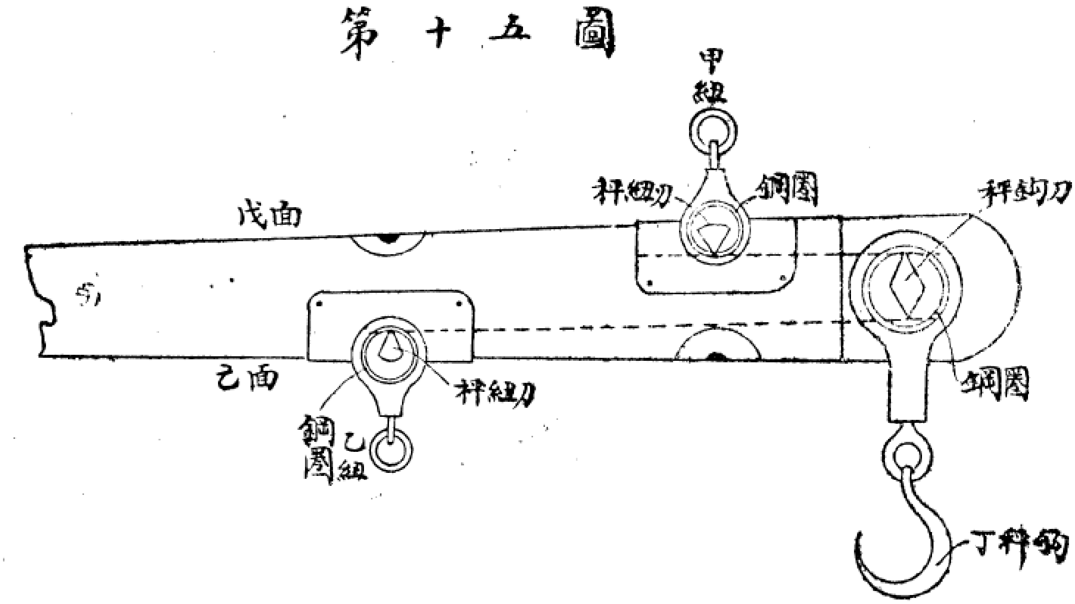
521 Jürgen Renn and Matthias Schemmel, *Waagen und Wissen in China: Bericht einer Forschungsreise*. Max-Planck-Institut fur Wissenschaftsgeschichte, Preprint no. 136, Berlin, 2000, p. 24.

522 Zhang Baichun et al., Zhongguo chuantong gon gji quanji [Full research on traditional Chinese crafts], Zhengzhou:daxiang chubanshe, 2006, p. 223.

523 Sichuan sheng duliangheng jianding suo [Sichuan provincial metrological branch], Sichuan sheng duliangheng jiandingsuo diyi zhounian jiniankan [The first anniversary memorial journal of Sichuan provincial metrological branch], 1936, "Tuixing gaiyao" [General situation of promotion], pp. 36-40.



Duliangheng qiju zhizaofa ji gaizaofa [The methods to produce and remold measures], Nanjing: Gongshangbu, 1930, p. 19.

Nanjing found it hard to regulate the highly informal production of steelyards. In Henan, some small steelyard makers only produced beams as they lacked the necessary metal forging equipment. The making of hanging weights was normally outsourced to local blacksmiths. Since the latter was not categorized as "metrological manufacturers" by law and registered accordingly, the standardization of steelyards production was but a pipe dream.[524] NBWM indeed forbade some shapes of traditional steelyards such as the double-pivots double-scales steelyards (双纽双面杆秤).[525] This type of steelyard had two sets of pivots and their respective scale readings on the beam, which enabled them to measure one Jin in sixteen Liang or twenty Liang on a single steelyard. However, it gave the fraud ample opportunity. In frontier areas such as Mongolia, it was common for itinerant merchants from inland provinces to buy with bigger Liang from herders and

[524] ASIMHA：17-22-100-05, "Jieshi zhuanying zhizao chengchui shangdian shifou yiying dengji"[Explanation on the registration of hanging weights makers]

[525] Chen Chuanling, *Minguo zhongyuan duliangheng jianzhi*, pp. 154-156.

sell their goods with small Liang.[526]

Even though NBWM distributed manuscripts to measures makers as early as 1930, which contained pictorial guidance and detailed methods to remold and produce standard steelyards, illegal steelyards still prevailed throughout the 1930s.[527] Therefore, the basic image of steelyards makers in the eyes of the state was extremely negative. They were viewed as one of the major reasons for China's metrological chaos. As an inspector witnessed in 1931:

> "Those steelyard makers do not abide by a constant standard of production. The size of steelyards is not determined by the makers, nor do they follow certain codes of their business. Rather, the size is determined by the liking of customers. Steelyard makers care only about sales and profits. Did they ever care about fairness and honesty? That is why we see all shapes of steelyards in the market, no matter how oddly off they are."[528]

Nevertheless, this observation also indicated that customers were in much need of these steelyards. "Oddly off," inaccurate, and illegal as they might be, they were suited to the actual commercial scenarios.

These inaccurate measures, such as steelyards, helped to cultivate a special dealing habitus that sustained autonomous metrological practices that shored off the state's influence. Indeed, even though NBWM could command stores through direct administrative orders or with the help

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526 "Yian(sanshisi)" [Motion no. 34], in *Gongshang bu quanguo duliangheng huiyi huibian* [The Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p. 80.

527 *Duliangheng qiju zhizaofa ji gaizaofa* [The methods to produce and remold measures], Nanjing: Gongshangbu, 1930.

528 Jiang Guangze, "Duliangheng jianding zatan" [Miscellaneous comments on the metrological inspection], in *Zhonguo jianshe*, 1931, vol.4, no. 6, pp.37-46, p.40.

of guilds and local chambers of commerce, there were also private sectors in cities that the state could not penetrate. Markets and cloth stores were two constant headaches for NBWM. In Nanjing in early 1934, the cloth stores continued to use fabric in old Chi, even silk stores in the area had already switched to new Chi. The fabric was most likely from customers who gave it to the store to make a cloth.[529] NBWM also well understood that a crowded market provided the best cover for metrological misdeeds. Inspectors in Nanjing conducted several unannounced investigations. Peddlers and vegetable dealers in markets were caught in surprise, with more than 2000 pieces of illegal steelyards being confiscated and broken at the site in front of them.[530]

Although Nanjing had painted itself a positive image in that it helped solve disorder in markets, the disturbance from the state sometimes still incurred anger. As a journalist described a scene of confiscating illegal measures in Shanghai's market in the 1930s vividly:

> "The official suggested the dealer in the market use a new weight and confiscated his old one. Then deep anger carved across his face. After the old measure was taken away, he immediately turned his head to a man standing aside who sold measures and said, "sell me a measure." "Which kind of measure?" the man asked. The dealer then replied, "still old ones!" And his voice was full of stubbornness and anger. This anger could never be explained by the suffering of material loss but must be connected to the stubborn love for traditional things. [531]

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[529] "Difang duliangheng xingzheng xiaoxi" [Messages of local metrological administration], in *Duliangheng tongzhi*, 1934, no. 9, pp. 19-27, p.19.
[530] Ibid., p.21.
[531] "Lao cheng lun" [On old steelyards], in *Duliangheng tongzhi*, 1940, no. 24, p. 11.

Even as late as 1937, NBWM was still struggling to eradicate old measures in cloth stores and markets. It gave specific guidelines to its local branches national-wide, in which NBWM meticulously regulated how often inspectors shall patrol markets, the method to explain NBWM's policy to store owners, and timespan of each inspection, and the necessity to report the situation to local branches on time and periodically. As Nanjing noticed, the reason for the lagging unification in these two venues was that common Chinese households possessed their own steelyards for the visits to markets and rulers for cloth stores as essential daily items. These house measures were often in old Chi and Liang. NBWM had no way to force common people to submit these illegal measures but pressed its branches to speed up the expansion of new measures in the market and cloth stores so that, hopefully, these illegal measures would become useless and disappear.[532]

The metrological disorder was directly linked to the commercial habitus of customers in cloth stores and markets. For instance, adding measures to gain the favor of customers was the common commercial strategy. In Beijing, cloth stores and coal stores put out advertisement banners on market opening days, claiming to add ten percent more in length or weight to attract more customers. (老秤加一，老尺加一).[533] The same happened in Shanghai's cloth stores.[534] This phenomenon was affirmed by the aforementioned anthropological investigation in the 1990s. A woman selling tea on a Peking market explained her old-fashioned steelyard to investigators, that

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532 "Xunling: zhun shiye bu quanguo duliangheng ju han wei chedi huayi caichang hengqi ji chengyi dian duqi fengbie niding banfa" [Orders: recognition of NBWM's regulations for complete unification in vegetable markets and chengyi stores], in *Anhui sheng zhengfu gongbao*, 1937, no. 814, pp. 16-18.

533 BMA: J002-007-00156, *Beipingshi duliangheng jianding suo sanzhounian jiniankan* [Third Anniversary Memorial Journal of Beijing's Metrological Branch], 1935, p. 30.

534 "Shanghai Meiya zhichou chang zongjinli Cai Shengbai tiaocheng huayi duliangheng banfa an" [The general manager of Meiya silk factory's suggestions on the metrological unification], in *Gongye biaozhu yu duliangheng*, 1936, vol.3, no. 5, pp. 57-58.

in dealings, the steelyard "was not equilibrated, but that a slight but noticeable sinking of the load was decisive. One had to weigh in favor of the customer".[535]

In other words, measures did matter but measuring accurately did not. The metrological accuracy of things, while it is a common modern experience of everyday economic life, was rather flexible in the 1930s. Instead of the state, the Chinese dealers and customers themselves held the divine power of accuracy. Xia Yan(夏衍), a drama writer in Shanghai, vividly described a scene of such negotiations of measures in his stage drama *Shanghai wuyan xia* (*Under the Eaves of Shanghai,*上海屋檐下)：

> Mrs. Zhao: Take it or leave it! (Walking into the room and holding her vegetable baskets)
>
> Vegetable hawker (Counting the coins in his hand, extremely upset): Even though, as you said, two and a half coins for one Liang(两), you are still short of three coins. Together with the basket, it weighs one Jin(斤) and two Liang, and the basket is 7 Liang.
>
> Mrs. Zhao (Throwing water oats on the ground and then weighing her empty basket with her own scale): I say the basket is eight and a half Liang.
>
> Vegetable hawker (stepping forward to see the reads of her scale): Ah ah, ah, you see.
>
> Mrs. Zhao (Pretending to finish weighing and walking inside the door): Take it or leave it!
>
> Vegetable hawker: All right, all right, two more coins would be fine.

535 Jürgen Renn and Matthias Schemmel, *Waagen und Wissen in China*, p. 7.

Mrs. Zhao (turning back to search her pocket, faking hesitation, and giving two coins to the Vegetable hawker. When the hawker is about to leave, swiftly fetching another water oat from his bamboo basket): One more of these then!

Vegetable hawker: This cannot do!

Mrs. Zhao (shutting the door and holding it with A-Xiang, her maid): Not a forthright hawker! (Talking to herself) It has been raining for almost half a month, and I could not afford a water oat.

Vegetable hawker(pushing the door several times and giving up.)[536]

This play was written in 1937 when the reform went into its 7th year. No traces of the state was there in this metrological dispute. Though Xia's story was staged in the context of Shanghai's distinctive residence compound, Shikumen(石库门), the scene was not too far from an actual market situation. As shown in the drama, measures and other factors, such as bad weather, constantly changed the price of goods and shaped negotiations between both parties in everyday economic life.

The last aspect that enabled the resistance of common people was the metrological law. By this law, manufacturing, selling, and using illegal measures would face imprisonment for up to two years or a fine ranging from 300 to 1000 Yuan, depending on the severity of impeachment.[537] In reality, however, the punishment was not implemented accordingly. Hebei expressed its doubts concerning the punishment of measure makers. An offender of metrological could be punished by

536 Xia Yan, *Shanghai wuyan xia* [*Under the Eaves of Shanghai*], Beijing: Beijing xiju chubanshe, 1981, pp.4-6.

537 "Te zai" [Special publication], in *Duliangheng tongzhi*, 1934, no. 11, pp. 6-9, p. 6.

imprisonment or receive a mild “administrative penalty” such as an official caution from the police or a small amount fine. Local courts had the final say but tended to give metrological cases light sentences.[538] In some provinces, because the local courts did not severely penalize the impeachment of metrological laws, habitual offenders dared to continue their usage of illegal measures.[539]

Nanjing was aware of this problem. In 1934, NBWM ordered local branches to report law cases, particularly those sentenced as “not guilty,” since it found out that light sentences were a common phenomenon across the nation.[540] However, there were well-grounded reasons for the legal system’s reservations about penalizing metrological violations. The conviction of metrological crime was a demanding task. An offender could only be convicted when one was spotted the actual usage of old measures in transactions. The offender sometimes made an excuse that the old measures were kept as antiques or for art collection. Some shop owners blamed the employees for bringing in illegal measures.[541] Moreover, evidence was hard to secure in a lawsuit. In Xiangxiang county（湘乡）of Hunan province, a local merchant Yuan accused another merchant Wang, of purportedly damaging legal measures. Yuan alleged that Wang had cut Yuan’s Dou around the rim to reduce the volume of rice that Wang was supposed to pay Yuan as the land rent. This Dou, according to the accuser, was inspected by the government and accurate in the first place. However, the court examined the measure and found this Dou did not have an official stamp. Neither was it possible to verify that Wang had manipulated the Dou since it was a worn-out piece

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538 Zhongyang duliangheng xingzheng xiaoxi” [Central metrological administration messages], in *Duliangheng tongzhi*, 1933, no. 5 pp. 2-9, p. 4.
539 “Henan shengbao” [Report of Henan province], in *Gongye biaozhun yu duliangheng*, 1935, no. 9, p. 107.
540 Zhongyang duliangheng xingzheng xiaoxi” [Central metrological administration messages], in *Duliangheng tongzhi*, 1934, no. 8, pp. 2-11, p. 8.
541 “Jieshi nantong xian zhengfu” pp. 111-114.

bearing several damages already. The court had decided to suspend the case and issued an acquittal when Yuan appealed the case again. [542]

Moreover, a case in Beijing suggested that even when hard evidence was presented, metrological violations were not always the priority of the court and accused accordingly. Li, an accountant of a local coal shop, was indicted by his customer, Mr. Hao, of selling with shorter weight. Hao alleged that he had detected the crime as he weighed the supposedly 100 Market Jin coals by himself with his own measures, and the result was 97 Jin. Moreover, Hao also witnessed that Li weighed the coal with bigger, traditional, yet illegal Coal Jin (斛煤斤) when Li purchased coals from others. Suspecting being cheated by Li, Hao submitted the case to the court. The oddity of the case was that both sides' measures turned out to be illegal, as the ensuing investigation of the Beijing metrological branch indicated that Hao's own measure was also inaccurate, bearing no inspection marks. The court sentenced a civil reconciliation, with no penalty on both side for their violations of metrological law.[543]

The metrological law also enabled common people to maintain their habitus, as it did not hold domestic possession and usage of illegal measures culpable.[544] In Beijing, inspectors reported that they were not allowed to confiscate ordinary customers' illegal measures outside of markets. Persuasion and advice" were the only move they took.[545] No evidence showed that inspectors and the police checked with common households for illegal measures. However, inspectors reported

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[542] Xu Deli, Minguo shiqi weizao zhi feng yanjiu: yi hunan weili [The Research on Forgery in the Republic of China: Hunan Province as the Case], Beijing: Renmin chubanshe, 2015, p.219.

[543] BMA: J181-020-19570, "Beipingshi gonganju guanyu zhun duliangheng jiandingsuo taishanquan meihang suo cheng jiufeng de xunling" [The order from the Beiping police on Beijing metrological branch's report about the incident of Taishanquan coal store], pp.10-15.

[544] "Duliangheng fagui" [Regulations of metrology] in *Fujiangsheng zhengfu gongbao*, 1935, no. 499. See entries no. 11, 16, 17, pp. 53-63, pp. 62-63.

[545] ASIMHA: 17-22-107-04, "Beiping shizhengfu xingzheng gongzuo zong baogaoshu" [The general report of Beiping Municpal government's metrological administration].

that it was quite common for a family to hide illegal measures. In Shanghai, official alleged that housewives who failed to appreciate the importance of metrological affairs was responsible for the problem, and husbands' supervision was much needed as the solution. The possibility of including measure investigation as part of residence registration was a way to address the issue. Another solution was to advocate for housewives to give up their old measures voluntarily through propaganda works. But no evidence suggests these plans were implemented.[546]

Conclusion

Witold Kula, in his classic study on European metrology, pointed out how measures meant for common people at dusk of the Middle Ages:

> Measure is intimately connected with man and the things he values above all others: land, food, and drink. It metes out to him what his destiny has failed to afford him in abundance. Sometimes fate will give him a full measure, but often, it will be a short one. Measure is not a convention but a value. It is never neutral: it is good or bad; or rather, there are countless bad measures, and only one, the one "of old," that is just, and "true," and "good."[547]

History sometimes is a portal of surprising synchronicity. The confusion, frustration, and indignation a Chinese might have during the 1930s were similar to what a European farmer would

546 "Te zai: Jia", p.8.
547 Witold Kula, *Men and Measures*, Princeton: Princeton University Press, 1986, p. 17.

experience in the 16th century. Metrological reform in the 1930s sent a mixed message to local societies, eliciting diversified responses. Measures were for governments to rule, merchants to compete, common people to facilitate their daily lives, and others to suffer and avoid. Each of these actors understood and coped with their different contexts.

No major social change could be accomplished by unilateral imposition from the state. The reform tested Nanjing's ability to mobilize social recourses in this regard. In cities, NBWM paid particular attention to propaganda works and harvested moderate success by securing the cooperation of chambers of commerce. However, it also invited complaints from individual merchants whose normal commercial routine was much disturbed. NBWM's control of commercial actors, therefore, was limited. Moreover, the commercial metrological universe of China was characterized by vested metrological interests. Either a tradition or corruption, it came under the light when the state stretched its hands. However, for others, the state's interference was an opportunity to get the upper hand in commercial competition. As the case of Shanghai's rice conflict showcased, metrological conflicts between local and guest merchants continued to happen in a rather dramatic way. Traditional metrological practices and vested interests were challenged but did not disappear. The state failed to contain the conflicts but only served as a negotiator instead of an absolute metrological authority in the end, which again testified to the state's limitation in controlling metrological affairs.

Policemen and Baojia represented actors and spheres where Nanjing failed to mobilize and got control. Compared to the quicker progress of unification in the cities, the rural areas throughout the 1930s were under the de facto metrological administration of Yahang instead of Nanjing. In this regard, autonomic administration of metrological affairs was the synonym for the autonomy of the capital Society. But for many others, the reform shaped their everyday life and endangered their livelihood. Nanjing's reform illegalized many long-standing metrological tradition habitus. This transition of "metrologies to metrology" invited creative resistance from measure makers, who managed to find their own niche in the cleavages and loopholes of state control, such as mandatory registration and regular inspection. The situation was similar for other social groups: peddlers on the streets, housewives, vegetable dealers in markets, etc. They all devised their own strategies to cope with the reform. Sometimes, even the very shape of a shabby steelyard gave them a way to avoid state control. Indeed, metrological instruments defined metrological habitus and vice versa. The symbiotic relationship between buyers and sellers facilitated social resistance and perseverance of illegal measures. Deals based on metrological negotiations instead of metrological accuracy continued to happen. For them, the reform was less a progressive project of metrological modernity but rather an intrusion into their metrological life, and they tried as they could to maintain the usual way.

Social resistance was a historical fact, but it did not cancel the historical significance of the reform. It was difficult to give a final judgment on the reform or to answer the simple "success or failure" question. While it had indeed met resistance in the 1930s, the metric system that Nanjing intended to enforce was inherited as a legacy by PRC and is followed by most Chinese people nowadays. Seldom if not never, have we heard any Chinese complaining about the measures. However, one lesson we could draw from the 1930s reform was how the dichotomy of the state and society was balanced and tested. Ever since the late Qing, deeply embedded in the mind of Chinese reformists was the conviction of changing society by (and through) the state(以国家变社会). This mindset loomed largely behind much of modern Chinese history and was the ultimate rationale for justifying an expansionist state encroaching on the social sphere. Therefore, Nanjing's metrological reform, which was an inch deep, not a mile wide, provided us with a valuable historical reflection on the limitation of state power and its imposition on society.

Chapter 5: Between the state and Science: the 1935 Debate

Introduction

In the early 1950s, Jawaharlal Nehru, then the Indian prime minister, found himself in an annoying situation. Like China, the young nationalist state was facing historical metrological chaos. British measures dominated trades, while locally used units varied drastically. Some were inherited form ancient Hindu metrology, and others were of Persian, Hebrew, or Chinese origins. There was no surprise that India decided to go metric to unify the nation metrologically, as most of the new-born nation-states had done. After all, many Indians, including Nehru himself, believed that India was the true motherland of the metric system for her time-honored decimal metrology and invention of the zero symbols. However, the rising tides of Indian nationalism burnt Nehru's fingers. A debate happened around a minor but sensitive issue: proper terminology for the metric system. Despite the official governmental position to retain the international terms of meter, liter or gram for their ease to pronunce, many others contended to use the Sanskrit terms. For Nehru, linguistic nationalism strode his nerves, for the debate earlier about making Hindi or English a national language had bitterly divided the Indian political landscape in 1947. Nehru managed a balance in the end: he conceded the usage of traditional terms, "Naya paisa," for the decimal currency, but the international terminology for the metric units.[548] More importantly, the Indian government's insistence on adapting the original metric nomenclature was based on its global survey, which

[548] Aashish Velkar, "Rethinking Metrology, Nationalism and Development in India, 1833–1956", in *Past & Present*, May 2018, vol. 239, no. 1, pp. 143–179, p.143, 150, 171. For more information of linguistic nationalism, see, Robert D. King, *Nehru and the Language Politics of India*, London: Oxford University Press, 1997.

concluded that all nations followed those original terms, with two exceptions: Japan and China.[549] While the Indian debate was confined within the administration circle, Nehru probably did not know that a similar debate on metric terminology had happened in China two decades ago, but on a far greater scale.

As it may surprise modern readership, the nomenclature was not a minor issue in Chinese metrological reform or other regions. Writing the metric units and pronouncing them became one of the core issues of global metrication. Why did nomenclature matter? An easy assumption would be that the metric units' terms had a distinctive cultural hue as most of them shared the Graeco-Latin linguistics foundation,[550] so they must be made sense again in drastically different culture settings. Even in France, the new nomenclature of the metric system was highly contested at the beginning. Napoleon had no choice but to tolerate customary nomenclature simultaneously. Many European nations also used customary nomenclature to denote the metric units at the early stage of metrication; however, these efforts to localize terminology often failed.[551] While a Latin alphabet existed in most European nations, things were more complicated in those more "alien" cultures. As an ideogrammic language, Chinese is not based on an alphabet. This fact made the adoption of the original metric terms via phonetic translation highly contested, particularly so since these translated terms, often in many characters, were too lengthy and bizarre, which defied not only many basic rules of the Chinese tradition of writing metrological units but also did not conform to customary nomenclature.

The second aspect that made the Chinese debate on metric nomenclature unique in the global

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549 Ibid., p. 171.

550 The Romanized Homeric Greek terms were Litron, Metron, and Gramma.

551 Edward F. Cox, *A History of the Metric System of Weights and Measures, with Emphasis on Campaigns for its Adoption in Great Britain, and in the United States prior to 1914*, unpublished dissertation, Indiana University, 1957, p. 140. For a general depiction of the metric expansion in late 19th century, see Ch. 4.

metrication process was the role played by Chinese scientists. Indeed, scientists around the globe were always at the heart of introducing the metric system to their respective local societies. Emanuele Luigi showed that European scientists were the earliest pioneers advocating universal metrology. Variegated measures in the pre-metric era hindered communication within the continental community of scientists. They were forced to attach additional documents about measures and units they used in their parcels sent to their colleagues.[552] The intensification of collaboration between scientists, particularly in France and Britain, prompted French scientists to be one of the chief lobbyists for standardization in the late eighteenth and early nineteenth centuries.[553] Moreover, scientific rationality canceled the legitimacy of measuring the physical world by the length of the elbow of a certain king, or in the Chinese case, the length of several millet grains placed end to end. Rather, nature itself shall be the criteria, which was unchangeable and scientific truth. This strong enlightenment ideal decidedly forced French scientists to define the metric system as the "universal" measure, which was "for all people and for all time."[554] Scientists also led in enforcing the metric system around the globe. Scientists in north America and Britain were the backbone of resisting the trans-Atlantic anti-metric movement. In Russia, Dmitri Ivanovich Mendeleev, the noble prize laureate of chemistry, was appointed as the scientific curator of the Depot of Weights and Measures in 1892 and strove for the metrication of the Empire to his

[552] For the pre-metric scientists circle in Europe, see, Emanuele Luigli, *The Making of Measure and the Promise of Sameness,* Chicago: University of Chicago Press, 2019, Ch.2.
[553] Ken Adler, *The Measure of All Things: The Seven-Year Odyssey and Hidden Error that Transformed the World*, New York: The Free Press, 2002, p. 2.
[554] On the enlightenment and metrology, see, J. L. Heilbron, "The Measure of Enlightenment," in Tore Frängsmyr, J. L. Heilbron, and Robin E. Rider eds., *The Quantifying Spirit in the 18th Century*, Berkeley: University of California Press, 1990, pp. 207–242. For the historical transition of European scientific community from "the republic of letters" to "Global Science" in the 18th and 19th centuries, see, Ken Alder, "Scientific Conventions: International Assemblies and Technical Standards from the Republic of Letters to Global Science", in Biagioli, Mario, and Jessica Riskin (eds), *Nature Engaged: Science in Practice from the Renaissance to the Present*, New York: Palgrave Macmillan, 2012, pp. 19-39.

death.[555]

Chinese scientists shared the same ideal with their international peers since they were all members of globe science as a transnational epistemic community. While metrology is a "social construction," this chapter concentrated on the society of scientists, a community that shared much globality yet came in different motives that must be situated in their specific national and cultural settings.[556] It seemed that Chinese scientists were natural allies to Nanjing's metrological reformists. In 1929, a strange story titled "A Famous French Scholar" came out in the official magazine of NBWM that identified the importance of science in the reform:

> "The metric system was a world-renowned French scholar. [...] The government had invited him to our land in 1915 so that our people got the chance to learn his theory. However, only several Chinese scholars got to know him when he first came, and most people looked at him with an indifferent attitude. The French scholar led a lonely life for more than a decade."[557]

The story came to a twist later, as the Nanjing regime launched its reform and helped the scholar to disseminate his theory. The scholar was excited since he received a warm welcome in the cities he traveled to. In distinctive rhetoric of impersonation, this story was a generalization of the ongoing metrological reform. Not a governmental official but a "scholar," the author's choice of

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555 Nathan M. Brooks, "Mendeleev and metrology." In *Ambix*, 1998, vol. 45, no. 2, pp. 116-128. Also, Michael D. Gordin, "Measure of All the Russias: Metrology and Governance in the Russian Empire", in *Kritika: Explorations in Russian and Eurasian History*, 2003, vol. 4, no. 4, pp. 783-815.

556 On "social construction" and metrology, see: Joseph O'Connell, "Metrology: The Creation of Universality by the Circulation of Particulars", in *Social Studies of Scienc*e, 1993, vol. 23, no.1, pp. 129-173, p .130.

557 Yanting, "Wenyi: yiwei zhuming de faguo xuezhe" [literature and arts: a famous French scholar], in *Duliangheng tongzhi,* 1936, no. 18, pp. 18-19.

protagonist pointed out that the element of science loomed largely behind the metric system. While we cannot identify the author because of the pseudonym, he/she was reasonably an inspector in remote areas, as the story ended by stating that the author hoped the French scholar could travel to his\her own "frontier province." There was no explanation on how the then stumbling reform could march there, nor why people suddenly accepted the metric system. Nevertheless, this story acutely gave out the rationale held by Chinese metrological reformists in the 1920s. Science was believed to possess an inherent beauty, and the acceptance of the metric system seemed an easy task if the common people had been enlightened enough to understand.

There was no surprise that Chinese metrological reformists appreciated the value of science. We witnessed the marriage of nation-state and science in the Nanjing regime, which was largely a technocrat regime, for it relied heavily on the expertise of many scientists such as Wu Chengluo. In return, scientists who had the state as the main patron to provide protection and resources also saw themselves go through intensive institutionalization and nationalization.[558] Ever since the New Culture Movement, the recognition of the value of the scientific spirit built strong scientism in Chinese society and an ever-firmer belief that science could be the solution to China's countless social problems on the road towards a modern nation. [559]

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[558] A general view of nation and science in China, see, Benjamin Elman, *A Cultural History of Modern Science in China. New Histories of Science, Technology, and Medicine.* Cambridge, MA: Harvard University Press, 2006. Recent literature paid a particular attention on the correlation between natural science and social science and nation-building, see for example, Yung-chen Chiang, *Social Engineering, and the Social Sciences in China, 1919–1949*. Cambridge: Cambridge University Press, 2001; David Pietz, *Engineering the State: The Huai River and Reconstruction in Nationalist China, 1927–37*, New York: Routledge, 2017; Tong Lam, *Passion for facts: Social Surveys and the Construction of the Chinese Nation-State, 1900–1949,* California: University of California Press, 2011.

[559] However, the historical belief that science as a perfect representation of enlightenment and rationality has been challenged by many. As pointed out by Bruno Latour's "black box theory" and his study on laboratory science, the production of scientific knowledge is the process that transfers weak rhetoric, random outcomes and controversial statement into scientific knowledge which is safely secured in a "black box" guarded by professionalism. Non-scientific factors such as local politics and social networks also played an indispensable role in the process. Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society*, Cambridge MA: Harvard University Press, 1987; also, Bruno Latour, Steve Woolgar, *Laboratory life: the construction of scientific facts,* Princeton New Jersey: Princeton University Press, 1986. In recent years, many began to talk about "colonization of science" in non-western settings, see, Gyan Prakash, *Another Reason: Science and the Imagination of Modern India*.

However, by no means was this marriage free of friction. While around the globe, scientists were the main pushers of the metric system and tended to side with the governments that promoted the metrication of nations, it was the scientists who stood against the government in the Chinese case. In other words, the so-call "scientists as pioneers" narrative of metrological reform in Europe and North America did not fully portray the ambiguous stance Chinese scientists took in the 1930s.[560] Their opposition was not to the introduction of the metric system per se but to how the metric units shall be written and pronounced. From 1934 on, the debate reached a climax in 1935 and appeared on major public media such as *Eastern Miscellany* and caused fierce conflicts among central governmental branches. Most of the literature on Nanjing reform either ignored the debate or narrowed it as merely a fuss in the small circle of scientists.[561] However, Yi Ci Lo lucidly pointed out that scientists fundamentally challenged Nanjing's monopoly on metrology. While other social groups uttered their opposition by simple disobedience or plain violence, only scientists managed to directly question the "scientificity"(科学性) of NBWM's nomenclature, thus shaking the credibility of the claim that Nanjing had only a "scientific" system of weights and measures.[562]

I reconstructed the history of the debate in this chapter. I traced the evolvements of governmental efforts to find workable terms for the metric system, the making of metrological

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Princeton: Princeton University Press, 1999. Particularly on China, see Fa-ti Fan, *British Naturalists in Qing China: Science, Empire, and Cultural Encounter. Cambridge, MA: Harvard University Press, 2004*; Laura Hostetler, *Qing Colonial Enterprise: Ethnography and Cartography in Early Modern China,* Chicago: University of Chicago Press, 2001.

560 To give some examples, Simon Schaffer, "Metrology, metrication, and Victorian values", in Bernard Lightman ed., *Victorian science in context*, Chicago: Chicago University Press, 1997, pp. 438-467, p.440; Henri Moreau, "The Genesis of the Metric System and the Work of the International Bureau of Weights and Measures", in *Journal of Chemical Education*, January 1953, vol. 30, no.1, pp. 3-20.

561 Just to give one examples, Fang wei, *Mingguo Dulianghen Zhidu Gaige Yanjiu* [Research on Institutional Reform of Weights and Measures in the Republic of China], unpublished dissertation, Anhui University, 2017. More recent studies noticed the interaction of scientists and the wider society during the debate, see, Fang Yili, Zhu linghui, "Shehui yu kexue zhijian: ershi shiji sanshi niandai duliangheng yiming lunzhan zhi shiqing, shizhi, yu shixiao" [From Socialized Science to Scientific Society: on the Name and Nature of the Translated Names of Measuring System in the 1930s], in *Ziran bianzhengfa yanjiu*, 2022, vol. 38, no.7, pp. 108-115.

562 Yi Ci Lo, *Measuring Up to Modernity: Metrological Reform in China, 1870s-1940s*, unpublished dissertation, University of California, Irvine, 2021, particularly Ch.3.

nomenclature as a problem for Chinese students in the United States in the early 20th century, and their early conflicts of scientific and governmental terms. It demonstrated how pursuing a modern Chinese scientific language became an enterprise for both the Chinese state and scientists. The second part revisited the debate and major points made by both parties in 1934 and 1935. The last part sought to resituate the debate in the context where differentiated stances towards science and Chinese culture defined the debate. I contended that the roots of the debate were not entirely on nomenclature per se and metrology alone. While NBWM defined the cause of metricizing China as a governmental reform, scientists felt the unscientific nomenclature of NBWM was an entrenchment to their autonomy and the true spirit of science. I argued at the end that behind the question of who had the final say in China's metrological future was the question of who possessed the power to define a cultural understanding of "science" in a broader sense.

Language as a Problem

One would be extremely bewildered when trying to pronounce or write the term "meter" in 1930s China. Before the Nanjing reform, there were three general ways to deal with foreign metrological nomenclatures. The first was the Japanese nomenclature for the metric system, which created new and specific characters. Japan participated in the international metric convention in 1886, and in 1891, the metric system as part of the official metrological system was legalized by the Meiji regime, together with traditional Japanese measures. There were two systems to denote metric units. The metric units could be phonetically translated via the hiragana system(ひらがな). Meter, by this way, was メートル (Mētoru), which also was pronounced quite like that in French.

To write it easily, however, the Japanese selected existent Chinese characters and made-up characters which did not exist in the Chinese writing system but consisted of some radicals in an ideogramic fashion. Thus meter was 米 and millimeter 粍. It was supposed to be a temporary solution for the Japanese: out of 27 metric terms, the Japanese government only provided 13 such terms. The latter kind of nomenclature found a market in the late Qing in China. At the end of the 19th century, China was exposed to multiple influences from the powers as a metrological glocal space. Japanese terms for the metric system entered China via many students who studied in Japan and a copious body of translation works. Chinese scholars completed the system by adding another 14 new characters[563]. These so-called "abbreviated terms of Japanese translated Chinese characters"(日译汉字略名) have been widely used in various industries with Japanese sponsorship, Japanese concessions in treaty ports and colonies, such as Shanghai or Taiwan. Particularly, it was quite common in the textbooks that had been translated from Japanese at the turn of the 19th century.[564]

[563] Quanguo duliangheng ju (NBWM), "Fading duliangheng biaozhunzhi danwei dingyi yu mingcheng queli zhi yuanyou" [Legal terms of measure and its reasons of establishment], In *Gongye biaozhun yu duliangheng*, 1935, vol.1, no.8, pp. 16-17.

[564] Cheng Huixian, *Zhangliang taiwan: rizhishidai duliangheng zhiduhua zhi licheng* [Measure Taiwan: the institutionalization of Japanese measures in Taiwan], Taiwan: Daoxiang Press, 2014, Ch. 2.

		Japanese terms (new created Chinese characters)
	kilometre	粁
	hectometre	N
	decametre	N
length	metre	米
	decimetre	N
	centimetre	糎
	millimetre	粍
	kilogramme	瓩
	hectogramme	
	decagramme	
mass	gramme	瓦
	decigramme	
	centigramme	
	milligramme	瓱
	kilolitre	竏
	hectolitre	竡
	decalitre	
volume	litre	立
	decilitre	竕
	centilitre	
	millilitre	竓

While one could explain this phenomenon through the lens of “translated modernity” or understand it against the background of the so-called “triangular matrix of concepts in Eastern Asia,” Chinese had solutions on their own.[565] The first solution was translating by meaning. In 1877, American missionaries had already translated “meter” as “fa chi” (法尺) and “liter” as “fa bang”(法磅), meaning “French Chi” and “French pound.” British “foot” and “pound,” on the other hand translated directly to Chi and Liang, despite the fact that these units are not equal numerically;[566]

565 See for example, Lydia Liu, *Translingual Practice: Literature, National Culture, and Translated Modernity-China 1900-1937.* Stanford: Stanford University Press, 1995. And also, Sun Jiang, Cheng Liwei eds., *Yazhou gainianshi jikan (dier ji)* [Collection of Studies on Asian Conceptual History, Vol.2], Shanghai: Sanlian chubanshe, 2013, especially “introduction”.

566 See the entry of meter and example of foot, Justus Doolittle, *Vocabulary and Handbook of Chinese Language*, Foochow: Rozario, Marcal, and Company, 1872, p. 190 and p. 644.

in other cases, they were translated as “Ying Chi” (英尺, British Chi) or “Ying Bang” (英磅, British pound). Combining foreign measures and traditional Chinese terms was common in the late Qing, as also the case of “ri Chi”(日尺, Japanese Chi) or “e chi” (俄尺, Russian Chi)[567]. What was more common, secondly, was to phonetically translate metric terms and spelling into corresponding Chinese characters with similar sounds. The term meter, for example, could be “mida”(密达) based on English pronunciation, “mitu”(米突) based on Japanese pronunciation, or “maidang”(迈当) based on French pronunciation. This system was widely used in fields exposed to foreign influence in the late Qing. For the post system, which adopted the metric system early in the Late Qing, “gelanmu”(格兰姆 or gram) was commonly employed. In China’s western-trained army, “mida” became the term for artillery. This way of translation was not entirely uncommon in the late 19th century when a lot of “things modern” has firstly been brought to China: the telephone, for example, has been translated as “telüfeng”(特律风), sofa as in “shafa”(沙发), microphone as in “maikefeng”(麦克风).

The Qing government never gave the metric system an official nomenclature. However, the situation changed in 1913 when the new republic’s Ministry of Industry and Commerce(工商部) set out to deal with the issue. Nomenclature was an issue heatedly debated within the Beijing government. The ministry first proposed a plan based on the Japanese method and Qieyinfa(切音法), an approach advocated by language reformers since the Late Qing. The metric units were written by radicals from two characters. For length units, the characters 度 and 个,十,百,千, were taken. Accordingly, meter, decameter, hectometer, and kilometer were written as 庅, 庁, 庴, and 序. As for pronunciation, Qieyin approach merged the two characters into one in a similar

[567] Quanguo duliangheng ju, “Fading duliangheng”, p. 16.

vein, and pronounced by the initial(声母) of the first combined with the final(韵母)of the latter. In this way, meter, decameter, hectometer, and kilometer were sounded respectively as de, di, dai, and dian. [568] The Ministry of Army uttered their disagreement. For convenience in military use and to follow the "way of world unification," it proposed to pronounce and write original metric terms.[569] The Ministry of Education stood on the other spectrum, arguing that new nomenclature should respect tradition. Foreign pronunciations and the Japanese method were unacceptable, whereas traditional terms must be inherited.[570]

The final plan took much of the advice from the Ministry of Education. It was decided that the official nomenclature for the metric system shall follow a simple rule: to add the character "Xin"(新), meaning "new," as a prefix to traditional terms. Traditional terms such as Jin, Chi, and Sheng were kept in the new nomenclature since the common people would not understand the phonetic translation of foreign terms.[571] However, this design was vetoed by congress as many congress members doubted the necessity of adapting the metric system.[572] As the new Ministry of Agriculture and Commerce began functioning in 1914, the metrological reform committee under the ministry took over the former nomenclature. It kept the traditional terms as a part of the new nomenclature but added a minor change. Instead of Xin, the committee picked the character "Gong"(公, universal) as the prefix. The new nomenclature became legalized in 1915 with the Metrological Law(权度法).

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568 "Gongshangbu duliangheng xinzhi shuomingshu" [Introduction of the new weights and measures from the Ministry of Industry and Commerce], Beijing: Gongshangbu gongwusi, 1913, pp. 18-20.

569 Academia Sinica, Institute of Modern History Archive: 03-46-016-01-005, "Lujunbu shuitie" [Opinion from the Ministry of Army].

570 Academia Sinica, Institute of Modern History Archive: 03-46-016-01-005, "Jiaoyubu shuitie" [Opinion from the Ministry of Education].

571 Wen Changbin, "Mingguo guanyu guoji quandu wenti de taolun" [Discussion on terms of international measures in republic China], in *Zhonguo Jiliang*, 2014, no.7, pp.41-44, 81.

572 "Gongwen" [Official Correspondence], in *Zhengfu gongbao*, no. 630, 7 February 1914, p. 14.

As articulately in the first chapter, Yan Fu was the one who pinned "Gong" down to the first official nomenclature as he deeply appreciated the ideal of internationalism behind the character. As a matter of fact, Yan Fu was a veteran in translating scientific nomenclature. In 1909, Qing's Ministry of Education(学部) established Biandìng mingci guan, the Institute for Compiling and Editing Nomenclature (编订名词馆). The small institute was the first dedicated and specialized apparatus in the central government for translating foreign scientific nomenclature. [573] Its further ambition was to unify the chaotic terminological world of China, then particularly flooded by those Japanese-translated terms, and to compile Chinese dictionaries for all western disciplines. [574] Yan Fu was appointed as the institute's general editor, with many talented scholars then served under him, such as Wang Guowei(王国维). Many manuscripts were produced, covering a wide range of western learnings such as Logic, Botany, Math, Geography, Psychology, Philosophy, and so on. Since many of these manuscripts were lost, we are unsure whether the metric terms were discussed. However, Yan's experience in this institute and his fame in translating western learning was a factor that put him a pivotal figure in the meeting in 1914.[575]

In 1927, when Nanjing began to draft its law on measures, Nanjing Government found no need

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[573] Zhang Zhidong (张之洞) was the major force behind the establishment of this institute. As an influential official who gained his fame by passionately introducing western learning, Zhang came to lead the Ministry of Education in 1907. However, before he came to Beijing, Zhang had already noticed the importance of a unified nomenclature, as he found similar institute in Hubei Province where he served as the governor for many years. See, Peng Leiting, "Zhang Zhidong yu biandìng mingci guan" [Zhang Zhidong and the Institute for Compiling and Editing Nomenclature], in *Hubei daxue xuebao,* 2010, vol. 37, no.1, pp. 97-102.

[574] It was somewhat related to Yan's dissatisfaction of Japanese terms and his complicated attitude towards Japanese Learning or Eastern Learning, see, Huang Kexu, "Xin mingci zhi zhan: qingmo Yan Fu yiyu yu hezhi hanyu de jingsai" [The War of Neologisms: The Competition between the Newly Translated Terms Invented by Yan Fu and by the Japanese in the Late Qing], in *Zhongyang yanjiu yuan jingdai shi yanjiu suo jikan*, 2008, no. 62, pp. 1-42. Also, He Siyuan, "Yan Fu de dongxue guan yu qingmo tongyi yiming yundong" [Yen Fu's View on Dong Xue and the Attempt of Unifying Translated Terms in Late Ch'ing], in *Beijing shehui kexue*, 2015, no. 8, pp. 36-45.

[575] To what extent did Yan Fu get involved in the translation is still an on-going debate in China. For example, Zhang Shizhao(章士钊) related later in 1918 that Yan did not pay much attention or participate the work intensively. See, Wang Liang, "Xuebu bianyi mingci guan shiqi de Yan Fu he Wang Guowei" [Yan Fu and Wang Guowei in the Institute for Compiling and Editing Nomenclature], in *Zhonguo dianji yu wenhua*, 2014, no. 4, pp.143-147. However, many of Yan's manuscripts discovered in recent years suggested otherwise, see, Huang Xingtao, "Xin faxian Yan Fu shoupi 'biandìng mingci guan' yibu yuangaoben" [New discovery of Yanfu's one manuscript of the Institute for Compiling and Editing Nomenclature], in *Guangming ribao*, Fubrurary 2nd 2013.

to change the 1915 nomenclature but inherited them intact. The decision was based on two reasons. First, the terms have been in use since 1915. It was inappropriate to suddenly change them. Things were best kept as they were to avoid confusion among people. Second, the 1915 metrological law should only be altered if it was necessary for legislative concern. In February 1928, when the law on weights and measures was issued after one and half years' preparation, the terms became official and were spread further by NBWM.[576]

While Nanjing's avoidance of changes so as to carry out the reform swiftly is understandable, it is worth noting that the 1915 nomenclature was born into a rather unfriendly environment. From 1915 to 1927, China was a nation plagued by political turmoil. Among its many challenges, measures did not come out as an immediate priority for Beijing Government which had neither national wide political authority nor a well-fledged institution dedicated to reinforcing their measures. The result was that the governmental nomenclature before the 1930s was quite limited in its influence. For example, although Beijing's Ministry of Education ordered textbooks to be consistent in using governmental terminology, textbooks remained to teach the metric system in Japanese terms or terms from scientists, depending on their publishers. Some regions indeed used the metric system already before the 1930s, yet not necessarily in Beijing's official terms. For example, even as late as the early 1930s, in China's southeast provinces such as Yunnan, where for their adjacency with French colonies, the metric system had infiltrated in the late 19th century, "Fa Chi"(法尺), or "Yang Chi"(洋尺) remained to be used among common people there.[577]

576 Shiyebu Gongyesi, *Huayi Duliangheng Biaozhun Yanjiushu* [A study on metroligcal unification], Nanjing: Zhonghua Yingshu Gongsi, 1931, pp. 11-13. Also, "Duliangheng xinzhi gedanwei mingchen caiyong zhi qingkuang" [The situation of terms of measures in various sphere], in *Gongye biaozhun yu dulianghen*, 1935, vol.1, no.15, pp. 18-30.

577 Quanguo duliangheng ju, *Sanshinian lai guoren duiyu duliangheng biaozhun zhi mingcheng fenqi zhi qingjin* [An overview of people's disagreement on the standard terms of measures], 1935, p. 17.

		1914 Beijing proposal	1915 Beijing plan; 1928 nanjing plan
length	kilometre	新里	公里
	hectometre	新引	公引
	decametre	新丈	公丈
	metre	新尺	公尺
	decimetre	新寸	公寸
	centimetre	新分	公分
	millimetre	新厘	公厘
mass	kilogramme	新斤	公斤
	hectogramme	新两	公两
	decagramme	新钱	公钱
	gramme	新分	公分
	decigramme	新厘	公厘
	centigramme	新毫	公毫
	milligramme	新丝	公丝
volume	kilolitre	新秉	公秉
	hectolitre	新石	公石
	decalitre	新斗	公斗
	litre	新升	公升
	decilitre	新合	公合
	centilitre	新毫	公毫
	millilitre	新撮	公撮

It is also incorrect to assume that the state had the only saying here. Chinese scientists had a history of translating western science. The English missionary John Fryer (傅兰雅) collaborated with Chinese scholar Xu Shou(徐寿) to translate chemical terminology for Jiangnan Arsenal in the late 19th century. However, this effort did not extend to the metric system.[578] Scientific terms as an urgent issue for nation-states were problematized first by Chinese students in the United States. In the late 19th and early 20th centuries, the Chinese students' community did not have a standard Chinese language to communicate with besides various dialects, and English became the lingua franca. For instance, Chinese student associations had to take English as the working language for

[578] James Reardon-Anderson, *The Study of Change: Chemistry in China, 1840-1949* (Cambridge: Cambridge University Press, 1991), pp. 29-52. Also, Wang Shuhuai, "Qingmo fanyi mingci de tongyi wenti" [The unification of translated terms in late Qing], in *Zhongyang yanjiuyuan jindaishi yanjiusuo jikan*, 1969, no. 1, pp. 47-83.

their summer summits and other annual events. At the same time, domestic efforts to build a unified national language for all citizens since the late Qing, later on, known as the National Language Movement (国语运动), also caught the attention of oversea students. It was in this context that language became an inroad to Chinese nationalism. Chinese students passionately debated questions such as romanticizing the Chinese writing system or replacing classic Chinese with vernacular Chinese. In many ways, the debate inspired figures such as Hu Shi and laid many foundations for Baihuawen yundong, (the vernacular movement 白话文运动) and the so-called "literature revolution."[579]

Most Chinese students in the United States were in science and technology. The translation and the necessity of a unified system of scientific terminology naturally became the topic among the students. For instance, Hou Debang (侯德榜), who later became a leading scientist in applied chemistry, pointed out the fact that for the simple term "meter," three different translations existed.[580] The necessity to unify the translation of scientific nomenclature was acknowledged unanimously, and the cries for an organization to coordinate this effort also appeared.[581] Zou Bingwen(邹秉文), then a student at Cornell University who later became the founding father of Chinese Plant Pathology, argued that the cause of nomenclature unification should not be bestowed upon the government and the failure of Qing's nomenclature institute was the perfect

579 Ji Jianqing, "Liumei xuesheng weirao yuyan gaige de taolun yu shijian ji wenxue geming de fasheng" [The debate and practice of language reform among Chinese students in the United States and the birth of literature revolution], in *Wenyi zhengming*, 2020, no. 9, pp. 39-49. On the language debate, see, Elisabeth Kaske, *The Politics of Language in Chinese Education, 1895-1919,* Leiden: Brill, 2008, pp. 421-442. For general depiction of Chinese students in the United States during the 1900s and 1910s, see, Weili Ye, *Seeking Modernity in China's Name: Chinese Students in the United States, 1900-1927,* Stanford: Stanford University Press, 2001, Ch.1.

580 Hou Debang, "Huayi mingci chuyi" [Discussion on the unification of nomenclatre], in *Liumei xuesheng jibao,March 1915,* vol.2, no.1, p. 31.

581 Zhang Yizhi, "Chuangli guojia xuehui chuli" [Discussion on the establishment of national scientific association] in *Liumei xuesheng jibao,* March 1915, vol.2, no.1, p. 28.

proof. Rather, scientists must lead the cause since scientific nomenclature was fundamentally a scientific issue. Zou gave the example of Latin terms of Phytology which were penned by the Botanical Society of America solely in 1894. In a nutshell, the government should take responsibility for financing scientific missions and leave the rest to scientists.[582]

The vision swiftly became a reality with the founding of the Science Society of China (SSC).[583] First established at Cornell University in 1914, SSC was mainly constituted of young science students in the United States. Partially informed by the American science model, where scientific academics were highly organized and influential in politics, SSC was not merely a scientific organization but rather intended to cast a big shadow on China's March to a modern nation, which was best summarized in their slogan, "save China through science"(科学救国)[584]. SSC held the translation of scientific terminology as its major task in 1915. In 1916, it painted out this vision in a more concrete term: among the nine tasks which were "paramount to science development" in China, the third among which was to "systematically translate and formulate modern scientific nomenclatures in Chinese."[585] Much in line with Zou's argument, SSC held itself as the leader of this effort instead of the Chinese government. In 1916, Nomenclature Committee(名词讨论会) was set as a branch of the SSC.[586]

The first clash between the nomenclature of the Beijing government and scientists came soon

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582 Zou Binwen, "Kexue yu kexueshe" [Science and Science Society of China], in *Liumei xuesheng jibao,*December 1915, vol.2, no.4, pp. 36-37.

583 On the history of Science Society of China, see Jia Sheng, *The Origins of the Science Society of China, 1914-1937*, unpublished Ph.D. dissertation, Cornell University 1995; an old yet still important work, see Peter Buck*, American Science and Modern China*, Cambridge University Press. A more recent work, see Zhang Jian, *Kexue shetuan zai jingdaizhongguo de mingyun: yi zhongguokexueshe wei zhongxin* [The fate of scientific sociaty in modern China: a study centered on Chinese Society of Science]*,* Jinan: Shandong jiaoyu chubanshe, 2005.

584 Zuoyue Wang, "Saving China through Science: The Science Society of China, Scientific Nationalism, and Civil Society in Republican China", in *Osiris*, 2002, vol. 17, no.1, pp. 291-322.

585 "Li Yan" [Introduction], in *Kexue*, January 1915, vol.1, no.1, p.2. For these nine missions, see, "Zhongguo kexueshe zongzhang" [the constitution of SSC], in *Kexue*, January 1916, vol.2, no.1, pp. 1-5.

586 "Mingci taolun hui yuanqi" [The origin of the nomenclature committee], in *Kexue*, July 1916, vol.2 no. 7, p. 823.

enough. Earlier in 1915, the first issue of SSC's Journal, *Science,* was published in Shanghai, and criticism of Beijing's 1915 metrological laws appeared immediately. Students questioned whether the Beijing government intended to possess "the spirit of science" since customary measures were still kept alongside the metric system. They required abolishing customary measures once and for all, which saved the trouble of transiting old measures to metric measures. The students were further unsatisfied with the governmental nomenclature of the metric system because it was neither consistent nor systematic. The prefix, neither Xin nor Gong, did not reflect the mathematical relationship between units like "deci-," "milli-," or "centi-" in the metric system. Instead, they proposed the combination of the phonetic translation of the "meter," "liter," and "gram" with numeric characters such as "qian"(千, thousand) and "bai" (百, hundred) to suggest the mathematical relationship.[587] This new system, as they alleged, was more applicable in pure science.

SSC's 1915 nomenclature has been widely used in the scientific circle and became the prototype for other nomenclature proposals from scientists. The principle of combining phonetically translated terms such as Mi and decimal prefixes remained to be influential for the next two decades to come. But more importantly, this scientific nomenclature of the metric system brought Chinese scientists and scientific organizations into a troubled relationship with the state, characterized by cooperation but more often conflicts. Scientists took much pride in their own nomenclature, which served as a symbol of scientific autonomy and a common language for the community of scientists. Indeed, as Ren Hongjuan(任鸿隽), the first president of SSC, related decades later, the unification of scientific nomenclatures was one of the society's greatest

[587] "Quandu xinming shangque" [Opinions on new terms of measures] in *Kexue*, February 1915, vol.1, no.2, pp. 123-129.

contributions to China. [588] Wang Hui keenly pointed out that SSC's effort on nomenclatures, along with the introduction of western punctuations in the Chinese writing system and the promotion of vernacular Chinese, indicated an inauguration of "scientific discourse"(科学的话语) and ironing of professional "scientific community"(科学共同体).[589]

We witnessed scientists get involved deeper in the politics of nomenclatures, and SSC became dominant in this process. In 1918, The Ministry of Education also noticed the disunity of scientific terminology for earlier complaints presented from a meeting of chancellors from middle schools. The Nomenclature Reviewing Committee (名词审查委员会) was summoned to edit scientific terms. This committee, first established in 1916, was a semi-official organization formed mainly by scientists and scientific groups and funded by the Beijing government. In 1918, the Ministry of Education sent manuscripts left by Qing's nomenclature institute to Peking University for discussion as preparation for further terminological unification. Cai Yuanpei (蔡元培), then the university's chancellor, distributed those manuscripts. In 1919, with SSC becoming a committee member, it commissioned SSC to edit physical terminology, including the metric terms. [590]

SSC gave another set of terms that was distinctively different from governmental plans. SSC believed that to fully demonstrate the decimal principle of the metric system, new characters must be made. In SSC's 1915 plan, 1 kilometer writes as "qian mi" (千米, or kilometer). While in French, prefixes existed as part of one-word terms to show the mathematical relationship between terms, in Chinese, "qian mi" was constituted of two characters. SSC considered it too redundant. Instead,

[588] Ren Hongjuan, "Zhongguo kexueshe sheshi jianshu" [Brief decription of the history of Science Society of China], in Kexue jiuguo zhi meng: Ren Hongjuan wencun, Shanghai: Shanghai keji jiaoyu chubanshe, 2002, p. 741.
[589] Wanghui, Xiandai zhongguo sixiang de xingqi [the rise of thoughts in modern China], Beijing: Sanlian shudian, 2008, pp. 1134-1145.
[590] On the Terminology Reviewing Committee, see, Zhang Daqing, "Zhongguo jingdai de kexue minci shengcha huodong, 1915-1927" [The activities of nomenclature reviewing in modern China], in *Ziran bianzhengfa tongxun* (1996), vol. 18, no. 5, pp. 46-52. See also, Huang Xingtao, "Xin faxian".

SSC argued that most textbooks have already taught variations of Japanese terms, which used one character for each unit. Despite the fact that these characters did not exist in classical Chinese, they were nonetheless unified and concise. After being officially recognized by the Ministry of Education later, with terms formerly legalized in 1915, this new plan coexisted as one of two official terms of metric systems before 1927.[591]

Significantly, the pattern of collaboration of the state and civil scientific groups in this terminology of 1919 marked the rising influence of scientists in nomenclature affairs. With their expertise, Scientists were indispensable in science-related issues. Scientific terminology kept being one of the central tasks of SSC when dozens of sub-societies based on disciplines set out to edit their own term books in the 1920s. As SSC continued its work, it also rose from a small student society into a giant network of modern science, so much so that almost all established scientists were either holding formal membership or in the contact list of the society. This could be understood by the sheer quantity of its members. While in 1914, it had only 33 members, the number almost doubled in the coming year. In 1924, 648 scholars from not only natural science but also social science were registered as members. Before 1934, the total amount increased to 1286, including 38 elite members from humanities, such as Hu Shi(胡适).[592]

If all former disagreements starting in the 1910s laid the seeds for the 1935 debate, the intensive institutionalization of scientists after 1927 gave this disagreement an official channel. One of the core figures of this transition was Cai Yuanpei(蔡元培)[593]. Cai was one of the directors

591 Xu Shanxiang, Wu Chengluo, "Quandu mingchen wenti zhi taolun" [The discussion on the metrological nomenclature], in *Shangye zazhi*, 1928, vol.3, no. 9, pp.1-8. Also, Wu Miao, "Xianxing jiliang danwei mingchen yuanliu kao" [The history of current metrological nomenclature], in *Zhonguo jiliang*, 2014, no. 11, pp.61-64.

592 Ren Hongjuan, "Zhongguo kexueshe sheshi jianshu" [Brief introduction on SSC's history], in *Wenshi ziliao xuanji*, vol.15, Tianjin: Wenshi ziliao chubanshe, 1988, p.4; Ren Hongjun, "Zhongguo kexueshe de guoqu yu jianglai" [the past and future of SSC], in *Kexue,* January 1923, vol.8, no.1, pp. 1-9.

593 Cai Yuanpei (1868-1940) has alsways been an ardent supporter of SSC since its birth. As a gratitude to his help

of SSC's supervising board since 1922. In 1927, Cai was appointed as one of six education committee members in the Nanjing government and, later on, the Council of Universities(大学院). Cai was ardent in recruiting SSC members, as Wu Chengluo and other SSC members stepped into politics in 1927 under Cai's invitation. Members of the SSC came to reside in key positions in the Nanjing regime. For example, when Academia Sinica, the newly established national institute of scientific studies, summoned its first regular meeting on 19 June 1928, almost all members were in SSC. SSC presence was so prominent in Academia Sinica that among ten sub-institutes of Academia Sinica, nine directors were SSC members.[594]

Cai paid a particular focus on terminology. He did not hesitate to place much weight on the issue of building a scientific China. As Cai argued in one article, the reason for the lack of science in China was:

> "[…] those scientific books were written in western languages, thus could not circulate wide and last long in China. Science is the learning of one person, but not the learning of the whole nation. Just like borrowing something from others, we must return it after some time;

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of fund raising and member recruiting, Cai was the first "special member"(特殊社员) of SSC，the title given to people who had special contribution to Science despite the fact that Cai himself was no scientist. In a way, Cai's unique experience granted him the role as a channel between Nanjing Regime and SSC. One the one hand, Cai was deeply involved in the revolution against Qing court, as member of Tongmenghui, the revolutionary party that Sun Yat-sen found. In 1912, when Sun fund organized provisional revolutionary government, Cai was appointed as the ministry of education. Sun continued to serve shortly in Beijing Government, and befriended influential members of KMT later such as Wang Jingwei. His impressive revolutionist past was matched by his respected status within academia. In 1892, Cai was recognized as Jinshi, the top grade in imperial examination. During 1916-1927, Cai resided the position of Chancellor of Beijing University. It is partially under his efforts that the university came to be the most prestigious one in modern China. His fame helped the development of SSC via his recruiting of established scholars and fund raising. Zhangjian, "Cai Yuanpei yu Zhonguo kexue she" [Cai Yuanpei and Science Society of China], in *Shilin*, 2000, no.2, pp. 56-70.

594 Sheng Xiaoyun, "Jindai Zhongguo lishi dabianju zhong de ziyouzhuyi zhishi fenzi: yi kexueshe tongren qunti wei zhongxin de kaocha" [Liberal intellectuals in the historical transition of modern China: a study centered on SSC members], in *"ziyou zhuyi yu jindai zhongguo (1840-1949)" xueshu yaotaohui lunwenji,* pp. 304-321, p.1. Meeting papers published online, see http://jds.cssn.cn/ztsjk/hylw/201605/t20160506_3331430.shtml. Visited on 1 March 2020.

although we can possess it for a moment, it does not belong to our nation."[595]

Cai's diagnosis, which attributed China's lack of science to the problem of terminology and language, was not isolated but must be related to the trend, as some may argue, of "sinicizing science" in the early 1930s[596]. Like Cai, Luo Jialun(罗家伦), the then chancellor of Qinghua University, published an article in 1930 titled "if China is to have science, science must speak Chinese." This title, as Luo explained, came from a phrase of Goethe that he came across when he was studying in Germany — "If Germany is to have science, science must speak German." As Luo argued, it was by the efforts of figures such as Goethe, Schiller, and many scientists, that French and Latin were no longer the languages of court and science. German came to be dominant as the embodiment of "national spirit" and "national thought." Luo asserted that this transition was parallel to Germany's marching from being a "barbaric and backward" country to a civilized one.[597] Surely, the overarching concept of science in Goethe's era must be remarkably different than modern science with clear disciplinary cuts in the 1930s. However, being a historian himself, Luo's line of argument placed science and the language of science at the center of China's galloping toward a civilized nation reverberated with Chinese scientists then. As Luo continued in this article, the most pressing mission to tackle this problem was to settle a feasible Chinese terminology acceptable to the scientific community and larger society as soon as possible.[598]

Cai's effort of institutionalization gave scientists more voices, at least on the issue of terms. In

[595] Gao Pingshu ed., *Cai Yuanpei Quanji* [The Complete works of Cai Yuanpei], vol. 5, Beijing: Zhonghua Shuju, 1988, p. 426.
[596] Zhang Jian, Jindai kexuemingcishuyu shengding tongyi zhongde hezuo, chongtu yu kexuefazhan [The collaboration, conflicts, and scientific development of the unification of modern scientific terminology], in *Shilin* 2017, no. 2, pp. 24-32.
[597] Luo Jialun, "Zhongguo ruoyao you kexue, kexue yingdang xian shuo zhongguohua" [If China is to have science, science must speak Chinese], in *Tushu Pinglun,* 1932, vol. 1, no. 3, pp.1-5, p. 1.
[598] Ibid, p.5.

1928, the new Translated Terminology Unification Committee(大学院译名统一委员会) began to operate as a branch of the Council of Universities(大学院). As the government fully funded the cause, scientists no longer needed to raise the money for personnel and the workplace, which sometimes were out of their own pockets, such as in the case of their collaboration with the Beijing government in 1919. Rather, they were now only responsible for reviewing the already translated terms from the committee's own professional interpreters. In other words, editing scientific terminology, terms of measures included, became a national cause with the dedicated governmental branch. In 1932, Guoli bianyi guan (the National Institute for Compilation and Translation 国立编译馆, hereafter NICT) under the Ministry of Education replaced the committee. Besides terms, the institute was also influential in publishing translated books and supervising terms in textbooks which were mandatorily sent to the institute for inspection. SSC members continued to serve in and for these institutes and presented in their regular meetings.[599]

NICT was determined to deliver a far more complete and systematic work than its predecessors in the Qing court and Beijing government. In the year of its founding, the institute launched several projects on editing terminology of Math, Physics, Chemistry, Astronomy, and Engineering altogether.[600] In 1932, the Ministry of Education convened a meeting to discuss the unification of chemical terms and other educational issues. In April 1933, the ministry extended the discussion by including the subjects of astronomy, mathematics, and physics. This meeting was intended to review and translate foreign textbooks, which naturally led it to take the standardized catalogs of scientific terms in Chinese as its major task.[601]

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599 Guoli bianyi guan (NICT), *Guoli Bianyiguan Yilan* [An overview of NICT], Nanjing: Guoli bianyi guan, 1934, p. 29.

600 Wen Changbin, "Zhongguo jindai de mingci shencha huodong" [A Review on the Unification of Scientific Terms in Modern China:1928-1949], in *Ziran bianzhengfa tongxun*, 2006, vol. 28, no.2, pp. 71-78.

601 Guoli bianyiguan, *Jiaoyubu huaxue taolunhui zhuankan* [Published Record of Ministry of Education Chemistry

After the meeting, the ministry decided to push a project aimed at systematically translating scientific terminologies sorted by discipline. Under the ministry's command, NICT quickly drafted a proposal of physical terminology and handed it to the Chinese Physical Society (hereafter CPS) for review in March.[602] In August, CPS answered the call by summoning the Physical Nomenclature Reviewing Committee (物理学名词审查委员会), a small branch of seven members during its annual meeting.[603] The committee walked carefully on this issue, and more than 200 scientists were consulted. In their reviewing meetings participated by physicists, chemists, astronomers, and engineers, Nanjing's nomenclature was severely criticized as not being scientifically accurate. The character of Gong was extremely problematic for the committee. While they recognized the character conveyed universalism of the metric system as in "gong ren" or "universal recognized," going was overused and failed to bear any numerical meaning as a prefix.[604]

Meeting], p.4, pp.9-11, and pp. 14-17.

602 Chinese Physical Society was founded in 1932. As one can imagine, its council members were all SSC's members. Chinese Physical Society was one of many disciplinary academic societies that SSC helped to build in 1930s. See, Wang Shiping, Yang Guozheng, "Zhongguo wuli xuehui bashi nian" [80 years of Chinese Physical Society], in *Wuli*, 2012, vol. 41, no. 8, pp. 506-512, p. 506.

603 Zhongguo wuli xuehui [Chinese Physical Society], *Zhongguo wulixuehui dierci nianhui baogao* [Report of the Second Annual Meeting of the Chinese Physical Society], Beiping: Zhongguo wuli xuehui, 1933, p. 6.

604 Ibid., p. 51.

		Japanese terms (new created Chinese characters)	SSC 1915	SSC 1919 (ministry of education in Beijing Government)	*Chinese Physical Society* 1934
	kilometre	粁	千米	粁 (pronunced as 千米)	仟米
	hectometre	N	百米	粨 (pronunced as 百米)	佰米
	decametre	N	十米	籵 (pronunced as 十米)	什米
length	metre	米	米	米突 or 米 (pronunced as 米)	米
	decimetre	N	分米	粉 (pronunced as 分米)	分米
	centimetre	糎	厘米	糎 (pronunced as 厘米)	厘米
	millimetre	粍	毫米	粍 (pronunced as 毫米)	毫米
	kilogramme	瓩	千克	兛 (pronunced as 千克)	仟克
	hectogramme		百克	兡 (pronunced as 百克)	佰克
	decagramme		十克	兙 (pronunced as 十克)	什克
mass	gramme	瓦	克	克兰姆 or 克 (pronunced as 克)	克
	decigramme		分克	兝 (pronunced as 分克)	分克
	centigramme		厘克	兣 (pronunced as 厘克)	厘克
	milligramme	瓱	毫克	兞 (pronunced as 毫克)	毫克
	kilolitre	竏	千立特	竏 (pronunced as 千立)	仟升
	hectolitre	竡	百立特	竡 (pronunced as 百立)	佰升
	decalitre		十立特	竍 (pronunced as 十立)	什升
volume	litre	立	立特	立特 or 立 (pronunced as 立)	升
	decilitre	竕	百立厘米	竕 (pronunced as 分立)	分升
	centilitre		十立厘米	竰 (pronunced as 厘立)	厘升
	millilitre	竓	立厘米	竓 (pronunced as 毫立)	毫升

In January 1934, the new terminology, which was very much identical to SSC's 1915 proposal, was proved by the Ministry of Education and got official recognition. According to CPS, this nomenclature was highly "internationalized" since it abandoned most of the traditional terms once and for all (except Sheng for a liter) and took phonetically translated terms of the metric system. Prefixes followed a consistent decimal relationship, with Qian(仟) as thousand, Bai(佰)as hundred, and Shi (什) as ten. The only traditional element was the inclusion of the Fen-Li-Hao (分厘毫) system, which originated from the Song Dynasty and indicated the numerical hierarchy of 1/10, 1/100, and 1/1000.[605]

605 Fen-Li-Hao(分厘毫) system was an invention of Chinese historical metrology which dated back to 10th century. The northern Song dynasty demanded to transfer local taxes to the capital, but varied local measures made adjusting accounts impossible. During 1004 to 1007, Liu Chenggui (刘承珪) was charge to reestablish fiscal and metrological order. Liu started the transition from the long-standing numerical Shu-Lei-Zhu(黍累铢) system to the deciaml Feng-hao-li system which was more suitable to measure smaller weights. The Deng-steelyards (戥子 or 戥秤) were small steelyards with a beam shorter than 30cm and a sliding weight weighed only 2.4 grams, which were manufactured in the reform to facilitate the calibration of Shu-Lei-Zhu system. Since the Deng-steelyards can weight things as light as 40mg, Feng Li Hao system along with Deng-steelyards became popular after, as they catered to the needs of local markets and enabled a more accurate measuring of light weights such as silver, gold, rare medicines, and other valuables. The first Deng-stealyard was made in 992. Deng-steelyards remained to be widely-used in the 1930s, and Feng-Li-Hao appeared both in governmental terminology such as Gongfen (公分), Gonghao(公毫), and in scientific terminology, such as Li Mi(厘米) or Hao Mi(毫米). Guo Zhengzhong, "The Deng Steelyards of the Song Dynasty (960-1279): In Commemoration of the One Thousandth Anniversary of their Manufacture by Liu Chenggui" (published in 1989, and translated by Li Qinming and Hans Ulrich Vogel), in Jean-Claude Hocquet (ed.), *Une activité universelle: Peser et mesurer à travers les âges* (Acta Metrologiae IV, VIe Congres International de Metrologie Historique, Cahiers de Métrologie, Tomes 11-12, 1993-1994), 1994, pp. 297-306.

However, an awkward situation has been made with its official endorsement, in that the new terms coexisted with those of NBWM as both were recognized by the state. Admittedly, a similar situation happened when the Beijing government's Ministry of Education recognized SSC's 1919 terms as contradictory to the terms in 1915. While in the 1910s, Beijing was halfhearted in promoting official measures, the inconsistency of two sets of nomenclatures terms caught a lot of eyes this time. NBWM was far more invested and determined to popularize its own nomenclature, just as much as scientists did, who wielded much bigger influence in the political sphere through institutionalization. Under the order of the Ministry of Education, in August 1934, publishing houses in Shanghai began to print out the 1934 physical terminology into books as referential material for students.[606] Institutional conflicts were swiftly ignited when the NBWM and Ministry of Industry found out about the circulation of these books, on which the terms of measures were radically different from theirs.

The 1935 Debate

The 1935 debate on the terms of measurements unfolded as bitter institutional conflicts between ministries, and CPS and NBWM. On the one hand, CPS, as a scientist's organization, sided with NICT with the full support of the Ministry of Education. On the other, scientific terms stroke NBWM's nerves heavily which operated under the leadership of the Ministry of Industry. 1934 was quite sensitive: according to NBWM's original plan in 1930, it was supposed to be the year when primitive unification of measures was to be achieved nationwide[607]. But now they were lagging.

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[606] Guoli bianyi guan, *Wulixue Mingci[Physical terminology],* Shanghai: Shangwu yinshu guan, 1934, pp.1-2.

[607] Quanguo duliangheng ju, *Quanguo Duliangheng Huayi Gaikuang* [An overview of metrological unification], Nanjing: Guomin shuju, 1933, pp. 26-29.

The last thing the bureau wanted was a stab behind the back from colleagues in Nanjing. In August, as NBWM saw the appearance of the books, it quickly submitted a worrisome report to the Ministry of Industry. The ministry responded by transferring an official complaint to the Ministry of Education, hoping that the latter would denounce the new scientific terminology by stopping the publication of the books immediately. As the bureau explained, they were deeply annoyed by the fact that the publication of different nomenclature from NICT with the official endorsement of the Ministry of Education, despite the Legislative Yuan had legalized their terms in 1928 metrological law, was no less than an open and severe attack against "the rule of law"(法治).[608]

Whether the terms were scientific or not was mentioned in the letter. It was probably more crucial that, standing from the point of metrological administration, NBWM spoke with an indisputable authoritative, and condescending tone. The "rule of law" was a common rhetoric weapon of the bureau in their propaganda, where they persuaded the people to switch to the metric system out of "the spirit of the law." After hearing the attack of NBW, CPS and physicists felt belittled by the arrogance of this attitude because the role and importance of science were in question, which prompted them to take a firmer stance. In October, CPS submitted its petition letter to the Ministry of Education and its superior, Executive Yuan(行政院). They argued that, first and foremost, the terms of NBWM disobeyed "the spirit of science," hindered "education of science," and interfered with the "prosperity of science."[609] Following the potency of rhetoric was the meticulous sieving of NBWM's terms under the lens of science. Their criticism of official terms

608 Wen Changbin, "mingguo shiqi", p44.

609 Zhongguo wuli xuehui, "Zhongguo wuli xuehui wei qingqiu gaiding duliangheng biaozhunzhi danwei shang xingzhengyuan ji jiaoyubu shu" [The petition letter on changing the terms of measures from Chinese Physical Society to the ministry of education and Executive Yuan], in *Dongfang zazhi*, 1935, vol.32, no.3, p. 100.

came from three aspects.

First, NMWM mistook the definition of mass(质量) for weight(重量). Mass was the physical description of the quantity of matter, while weight was the expression of matter under certain gravity. The definition of a kilogram in the metrological law was thus not scientifically accurate enough, as it misused these two definitions. It was ridiculous that NBWM, as the representative of China's national metrological administration, should make such a rookie mistake, which, as later another scientist commented, "anyone who went to middle schools should know to avoid."[610] Secondly, the definition of a liter by the law was also not scientifically sound since the newest scientific definition has recalibrated a liter as 1.028 cubic decimeters instead of 1 cubic decimeter. Last but not least, the term "gongfen" (公分) was extremely misleading. In NBWM's terminology, gongfen could be one centimeter, one gram, and one deciare (ten squared meters) at the same time.[611] The lack of accuracy of gongfen in science was so obvious that Yan Jici (严济慈), who was among the seven main responsive reviewers of the physical terminology in 1934, gave an example later in a great sarcastic tongue later:

> "We now have a copper plate that is 50 gongfen long and 40 gongfen wide. The area of its surface is 0.02 gongfen, which also happens to be 2000 squared gongfen. Since this plate is 0.5 gongfen thick, and it weighs 8930 gongfen so that the density of it is 8.93 gongfen per cubic gongfen.[612]

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[610] Ibid., p. 101.

[611] *Zhongguo wuli xuehui disanci nianhui baogao* [Report of the Third Annual Meeting of the Chinese Physical Society], Beiping: Beihua yinshua ju, 1934, p. 9.

[612] Yan Jici, "lun gongfen gongfen gongfen" [On the terms of gongfen, gongfen, and gongfen], in *Dongfang zazhi,* 1935, vol.32, no.3, p. 80.

Adding to the attacks on the "scientific applicability and accuracy," the issue of the character "Gong" was accentuated again in this petition letter. To physicists, putting the character "Gong"(公) in front of every term served no solid function other than differentiating the metric terms from traditional metrology. Another connotation of the character "Gong," that is, "governmental," seemed more alarming to scientists, as they deemed it quite an intrusion of their own territory. As early as 1928, Wu Chengluo began to notice the chaotic situation of scientific terminology, as he called them "special measures"(特殊度量衡)[613]. While Wu himself was involved with NICT's endeavor on chemical terminology, NBWM did not stop there. The bureau made plans to add the character Gong to other non-metric physical terms such as Dyne, the unit used to gauge force in modern physics, or the Ampere, the base unit of electric current. CPS contended that this presumptive action from NBWM would not only confuse scientific laymen but was an intrusion of scientific autonomy as "Gong" was a stamp of governmental hegemony in the eyes of scientists.[614]

Clearly, lying behind this petition letter was the question of who had the ultimate saying to determine metrological terms. As the petition letter ended, the Chinese Physical Society pointed out that, compared to an earlier time, "making modern metrological law is a highly scientific cause and professional opinions of scientists should be the criterion. That is the reason why in countries around the globe, this matter has been handled by physicists alone. Thus, as the cluster of Chinese physicists, it is the duty of the CPS to submit this petition letter."[615]

Firmly believing the legitimacy of their disagreement, CPS decided to raise more attention to its favor by sending this petition letter to influential newspapers such as Dagong Bao(大公报) as a

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613 Wu Chengluo, "Yanjiu Duliangheng wenti yinqu zhi tujing" [Proper path of studying measures], in *Dongfang zazhi*, 1935, vol.32, no.3, p. 68.
614 Zhongguo wuli xuehui, "Zhongguo wuli xuehui wei qingqiu gaiding duliangheng biaozhunzhi danwei shang xingzhengyuan ji jiaoyubu shu", p. 100.
615 Ibid, p. 101.

strategy to avoid suppression of NBWM through the political channel.[616] The polemic among governmental apparatus continued. The Ministry of Industry responded to the petition letter with a softened tone by arguing that non-metric scientific terms were not the ministry's concerns. They nevertheless reasserted that terms of ordinary measures were within their jurisdiction and the current law must be respected. CPS submitted its second letter to Executive Yuan, arguing that the ministry avoided confronting the scientific side of the issue and cowardly escaped in front of its requirement to change the metrological law.[617]

NBWM answered the attacks from CPS quickly. In its response, NBWM recognized that the legal definitions of liter and weight were indeed inaccurate. However, there was no need for a change of the legal clause since it caused no difficulty in "usual use" as common people paid no attention to the differentiation of mass, and weight like physicists did. The gongfen problem was also not visible in "usual use" since people would know whether they were talking about the area, length, or weight units.[618] As the quasi-civil face of NBWM, the Chinese Society of Weights and Measures, whose members were mainly inspectors, published two articles in its official magazine and confronted the issue candidly. The association smartly used the "common use" and scientists' elitism as their strongest anti-arguments. Those phonetically translated terms, such as Mi, were "not accorded to the customs of our nation[...]and hard to understand by common people". Even though the official terms did not possess systematic prefixes with consistent numerical relationships, they caused no problem in the eyes of the association and NBWM. It was a bit

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616 Wu Chengluo, "Yanjiu Duliangheng wenti yinqu zhi tujing" [Proper path of studying measures] in *Dongfang zazhi*, 1935, vol.32, no.3, p. 68.

617 Zhongguo wuli xuehui, "Zhongguo wuli xuehui zaishang xingzheng yuan shu", in *Dongfang zazhi*, 1935, vol.32, no.3, p101.

618 Quanguo duliangheng ju, "Fading duliangheng biaozhunzhi danwei dingyi yu mingcheng queli zhi yuanyou", pp. 120-139.

inconvenient to memorize at first, but "every Chinese learns it since childhood and knows the numeric relationship between the terms."[619] "The least few," or the physicists in CPS shall not represent the masses. The terms of physicists instead of official nomenclature would confuse common people. To respond to the controversy of gongfen the society argued that if some physicists found it problematic, they might as well write it as "one gongfen long"(一公分长) or "one gongfen heavy."(一公分重) The society summed up that the lawful terms were not decided thoughtlessly but went through a lot of discussions within governments since 1913. Quite contrary to the pedantry of CPS, it believed that "the correctness in science was not the foremost concern for nomenclature," and again, "those least number of physicists" should abide by "the rule of law."[620]

Infuriated by those two articles, CPS pitched its tone up once again. Physicists fought back by publishing an article in newspapers titled "a respectful notice from the Chinese Physical Society to all Chinese." CPS alleged that it was "deeply disappointed by those two articles by the Society of Weight and Measurements" and "in the fear that incorrect understandings of science may further spread." Not satisfied by NBWM's explanation for misuse of mass and weight, CPS criticized that the bureau and the society "surprisingly ignored" the problem. The remaining misuse of these two concepts in the law was to make "science yielded under regulating of law," thus, giving a "bad example in history of science." (创见之恶例) Moreover, the metric system was "beautiful and good" in that it contained prefixes with clear numerical relationships. However, the official terms which granted each unit with a specific term canceled the concision of units and "the fundamental

[619] Zhongguo duliangheng xuehui, "Duliangheng biaozhunzhi fading mingchen zhi jieshi jiqi zai kexue shang zhi yinyong" [Explanation of lawful terms of metric system and their application on science], in *Dongfang zazhi,* 1935, vol.32, no.3, p. 92

[620] Ibid., pp. 93-94.

advantage of the metric system." For the attack on elitism, CPS contended that "the reviewers of physical terms were selected by CPS, the representative of all Chinese physicists——how could it be 'the least' of physicists?"[621]

The crescendo of this dispute finally came on public media when the magazine *Eastern Miscellan*y noticed the ongoing debate in the spring of 1935. As one of the most prominent publications in modern China, the magazine enjoyed a national readership and was known for its politically neutral stance and wide coverage of topics. Zhou Changshou (周昌寿), a senior editor of the magazine and also a physicist himself who participated in the editing of physical terminology earlier, decided to organize a forum to further the discussion. The problem of terms of measurements, as Zhou explained to common readers, "looks not very moving and relevant to us at first glance." However, the essence of this problem was "extremely important and complicated." NBWM, CPS, NICT, and the Society of Weight and Measurements, other prominent scientists from Tsinghua University, Peking University, and Academica Sinica were invited to give their opinions. Many professors also sent their thoughts to the editorial office, even though they were not being asked. Zhou was much surprised by how widely the topic attracted the audience and begged his readers to appreciate "how important this topic is to the academia."[622]

As for the debate in the magazine, it was hardly a debate. Most articles in the magazine followed the viewpoints of CPS. Out of all the 17 articles published, only four pieces by Wu Chengluo, NBWM, and the Society of Weight and Measurements insisted that legal terms needed to be followed.[623] The rest believed that physicists' terms were more scientific than lawful terms. It must be pointed

[621] Zhongguo wuli xuehui, "Zhongguo wulixuehui jinggao guoren" [A respectful notice from the Chinese Physical Society to all Chinese], in *Dongfang zazhi,* 1935, vol.32, no.3, p. 102.
[622] Zhou Changshou, "Daoyan" [Forewords], in *Dongfang zazhi,* 1935, vol.32, no.3, p. 61, p. 64.
[623] Ibid., p. 64.

out that what worried some scientists most was not metrology but NBWM's growing influence on other scientific matters. Zeng Zhaolun(曾昭抡), an MIT-trained professor and one of the early founders of SSC, mentioned NBWM's improper ambition on the myriad system. Traditionally, China used the Myriad system(万进制) or four-digit phrasing for the larger numbers, which were grouped into ten thousand rather than thousands in the West.[624] As a debate within the circle of scientists in the 1930s, Wu Chengluo considered the issue a metrological one and thus belonged to the jurisdiction of NBWM.[625] NBWM later submitted its large number system of four digits to the Ministry of Industry.[626] Even though Zeng himself agreed with Wu's scientific idea on the myriad system when being consulted by NBWM, Zeng nevertheless expressed his worries about the NBWM's far-reaching hand on the scientific matter beyond the metric nomenclature[627]

Another important aspect of the debate on *Eastern Miscellany* was many scientists' reservations about the CPS's nomenclature. While most scholars agreed with physicists' terms, they nevertheless offered to provide "improvements." For example, some considered "liter" could be translated as "li"(立) instead of "sheng"(升) since the latter was still from traditional terms while meter and gram have been dealt with phonetically.[628] Some believed that the revised SSC's 1919 terms were more concise than the original, as two characters for a term are way too redundant.[629]

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[624] For a detailed discussion on the issue of "big numbers", see. Guo Jinhai, "Mingguo shiqi de dashumingming ji Zhengyi [The Nomenclature and Controversy of Large Numbers in Republican China] in *Zhongguo keji shuyu*, 2012, vol. 14, no.2, pp.44-51.

[625] Wu Chengluo, "Dashu mingming biaozhun zhi yanjiu" [The study on the standards of the nomenclature of large numbers].in *Yinhang zhoubao,* 1933, vol.17, no.50, pp. 25-33.

[626] "Duliangheng faling" [Legal orders of measures]", in *Gongye biaozhun yu duliangheng,* 1935, vol.1, no.7, pp. 75-77.

[627] Zeng Zhaolun, "Dui duliangheng mingci ji daxiaoshu mingming de jidian yijian" [several ideas on the naming of metrologcial terminology and the issue of large number and decimal number], in *Dongfang zazhi*, 1935, vol.32, no.3, p. 87.

[628] Liu Tuo, "Liu Tuo xiansheng yijian" [Opinion of Mr. Liu Tuo] and Cai Fangying, "Cai Fangying xinasheng zhi yijian" [Opinion of Mr. Cai Fangying], both in *Dongfang zazhi*, 1935, vol.32, no.3, p. 103.

[629] Xu Shanxiang, "Gaiding duliangheng mingcheng ji dingyi zhi shangque" [discussion on alteration of metrologcial terminology and its definitions], in *Dongfang zazhi*, 1935, vol.32, no.3, pp. 77-79; Zhang Yihui," Biaozhunzhi duliangheng mingming pingyi" [On terminology of standard metrology] in *Dongfang zazhi*, 1935, vol.32, no.3, pp. 82-85.

This discrepancy among scientists was related to a unique politics of nomenclature within the scientists' circle. As Zeng Zhaolun pointed out, "anyone who studies modern Chinese history of science would see that the discussion of terminology occupied no small portion in research papers before 1931." The reason was that "the number of Chinese scientists who could do independent research was limited in the past," so the majority could only dwell on terminology issues to "flaunt themselves to the others." Terminology was considered valuable yet easier work. Anyone who wanted their name marked in history would participate in the discussion.[630] Zeng's observation was not isolated. Luo Jialun, who advocated "science to speak Chinese," commented on this problem that "scientists who were keen on translating terms created them from their too fertile imaginations and after that, they stubbornly hold up on their creation," and led to the confusion of terminology.[631]

As he continued, Zeng expressed his appreciation towards the work of NICT, whom he considered the national authority that settled many unnecessary disputes on terminology. Indeed, Zeng had his share of this terminological politics in the scientist's circle. As a chemist, Zeng translated chemical terminology earlier in the 1920s. According to him, the translating work was extremely difficult. On the one side, SSC's members came up with their terms, and on the other, the resistance was fierce from other scientists such as Zheng Zhenwen(郑贞文), who was a renowned chemist and senior translator hired by Shanghai Commercial Publishing House. For decades, Zheng was dedicated to translating chemical terms, and many textbooks took Zheng's terms. According to Zeng, the issue only ended with the intervention of NICT and the accident when the library and warehouse of Zheng's publisher were bombed to the ground by the Japanese

630 Zeng Zhaolun, "Dui duliangheng mingci", p. 87.
631 Luo Jialun, "Zhongguo ruoyao you kexue", p.4.

in 1932, together with books that had Zheng's terms burnt to ashes.[632]

The debate came to the final act in 1935, on March 1st and 2nd, when the Executive Yuan summoned the representatives from both ministries, Academica Sinica, CPS, and NBWM, to settle the nomenclature conflict. As both sides insisted on their own nomenclature, the meeting was unproductive, if not fruitless. The Executive Yuan then sent official demands to all related institutions for their professional opinions, including esteemed universities, academic associations, local government branches, and other central ministries. More than seventy opinion letters arrived at the Executive Yuan before the mid of May 1935.[633] Twenty-nine letters stood with the government, among which 22 were from central and local governmental branches, and only two were from the universities. Twenty-eight letters supported scientific terms, and all of them were from universities or academic groups.[634] CPS also conducted its own survey to gain public support. Not surprisingly, out of 177 reports from teachers at universities and middle schools, 170 sided with CPS. In front of this rivalry, the government summoned a meeting again in August 1935, only without the invitation of CPS this time. The final solution for the nomenclature dispute recognized the legitimacy of official nomenclature, but CPS's terms were allowed to be used in the limited scenario of "scientific research."[635]

The State and Science

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632 Zeng Zhaolun, "Ershinianlai huaxue de jinzhan" [Development of Chemistry in recent 20 years], in *Kexue*, 1935, vol.19, no. 10, pp. 1531-1526.

633 "Duliangheng bianozhun danwei mingcheng yu dingyi kai shengchahui" [Examination Board summoned on the standard terms of metric system and its definition], in *Kexue*, March 1935, vol 19. no. 3, p. 439.

634 "Dulingheng wenti teji yi" [First special collection on the issue of measures], and "Duliangheng wenti teji er" [Second special collection on the issue of measures], in *Zhongguo shiye,* 1935, vol.1, no.7 and no.8.

635 Zhongguo wuli xuehui disici nianhui baogao [Report of the Fourth Annual Meeting of the Chinese Physical Society], 1935, pp. 40-47.

Was the debate only about measures? Did the struggle for naming right, be it between two ministries, CPS and NBWM, or even within the circle of scientists, fully explain the debate? Most current literature on the debate stopped in 1935. The debate itself was depicted as fundamentally a scientific discussion. However, I argued in this part that the debate needed to be resituated in the wider context of the 1930s. The period was characterized by a growing governmental interest in controlling science which was crystalized by the Chinese Scientific Movement(中国科学化运动). Its populist approach of promoting science among common people clashed with scientific elitism, which much defined the debate.

While the struggle regarding who shall get the right to make terms remained to be the focused issue of *Eastern Miscellany*, the evaluation of customary terminology started to emerge as another core issue. Understanding tradition required one to take a cultural stance toward the past, and both sides differed fundamentally. One distinctive example was from Yang Zhaolian(杨肇镰) gave a valuable inroad. Like others, Yang, as a physicist, began to work for Academica Sinica after 1927. As a pivotal figure, he also participated in the editing work of Chinese physical terminology. Unlike others, Yang did not rush to the terminological dimension directly in his article but engaged the topic by first giving a purview of metrological history. Yang alleged that the history of the metric system gave an "interesting reference" to China's situation. Similar to China, the metric system came into being before the beheading of Louis XVI, the time when France was experiencing "great political turmoil with dangerous currents underlying." And "the tendency of reform was so strong that even the king could not block."[636] Yang begged his readers to note that the metric system was:

[636] Yang lianqian, "Guoji quanduzhi shulue" [Brief history on international metric system], in *Dongfang zazhi*, 1935, vol.32, no.3, p. 72.

> "...drafted by scientific professionals, based on the spirit of revolution, following scientific theory. France determined to push fundamental reform so that the terminology of measures and the institution of metrology has been changed [...] They did not put new adjectives before old terms and claimed that the corrupted things could become things marvelous(变腐朽为神奇). Also, didn't they talk to the people, saying that 'the measures are better to be new, but the terms are better to be old.'[...] Why? For people who created the metric system knew that the corrupted things had no ways to transfer into things marvelous, and the essence of revolution shall not yield to old customs[...]Our debate is not about new terms for new measures, but whether the new way is better than the old."[637]

By surprisingly juxtaposing China in the 1930s and revolutionary France in the 1790s, Yang gave his version of metrological reform a foreign apotheosis. Yang's radical approach to tradition, where he claimed that the corrupted have no ways to be marvelous, drew a clear line between things scientific, new, and by implication, western between things unscientific, traditional, and Chinese. The "new way" of making terms, which was revolutionary and scientific, cared not so much about cultural accommodation nor making a gradual transition among ordinary people. In this sense, the terms of metrology were not only a scientific issue or an institutional dispute but to take a cultural stance where reserving traditional legacy yielded to scientific universalism.

Yang's view, which many scientists in this debate echoed, resulted from the enshrinement of capital science in modern China. As early as the 1910s, the founders of SSC believed that historically,

637 Ibid, p.73.

"in the powerful countries of the world, the development of their civil liberties and national strength was paralleled with the progress of scientific studies. Nations with no scientific studies will perish." To them, science can "increase the material wealth of human society, sharpen the human mind, prolong human life, and wield huge impact on human ethics."[638] Later, cultural changes reinforced this view that the effect of science spilled over from science itself. Particularly, the New Cultural Movement boasted of the value of capital science. At the same time, its iconoclastic attitude rejected tradition and advocated building a new culture based mainly on western ideas such as democracy and science. Science was ideologized as an overarching Panacea to almost all problems in China.[639] On the other hand, the omnipresent 'science' resulted in a sort of "tyranny of science." Hu Shi observed in the 1920s that "science in our country is supremely respected: no matter whether one understands it or not, no matter one is into the new or the old, nobody dares to explicitly neglect or insult it."[640] On another occasion, he said with a sarcastic tone that "from the sky to earth was all 'science.'"

The rising tides of scientism since the end of the 1920s and a glorified image of science have shaped the debate much. NBWM faced a chorused attack from scientists and intellectuals; among all the articles on *Eastern Miscellany*, only Wu himself and the Chinese Society of Weights and Measures were entirely in line with NBWM. It was an ironic scene since Wu was also at the center of the scientists' circle. He was one of the early members of SSC and a board member of more than ten other scientific organizations and journals.[641]

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[638], "Fakan Ci" [foreword of the journal], in *Kexue*, January 1915, vol.1, no.1, pp.3-7.

[639] Lin Zaiping, "Du Ding Zaijun xiansheng de xuanxue yu kexue" [Read on Mr. Ding Zaijun's S*cience and Metaphysics*] in *Kexue yu Renshengguan*, Shanghai: Yadong Tushuguan, 1923, p.161.

[640] Hu Shi "Kexue yu renshengguan huxu" [Hu's foreword on science and metaphysics], in *Kexue yu Renshengguan*, Shanghai: Yadong tushuguan, 1923, p.10.

[641] Wu Miao, Zhongguo jingdaihua jincheng zhong Wu Chengluo gongxian zhi yanjiu [The research of Wu Chengluo's contribution in the modernization of China], unpublished dissertation, Shanghai Jiaotong University, 2009, pp.9-10.

Surprisingly, Wu Chengluo also tried to dissolve attacks from his peers in a cultural dimension. Both of his answering articles on *Eastern Miscellany* touched on the very issue that Yang addressed. Wu believed that the terms were better to be old, with "minimum alteration so it will satisfy the need of science." The reason was that the metric terms are both a scientific issue and a social and cultural problem. Culturally, "the purpose of importing western new culture is to make it as part of our own culture later, and this culture must be spoken out in our own language. In this way, science could be socialized, and society could be scientific too."

As for Chinese terms, Wu did not regard them as corrupted. Wu contended that the metric system had its own imperfections. For instance, the basic measures for weight, and gram, were too small and could not be correlated properly with the basic measures of meter and liter, which were too big. Even western scientists had already complained about this disproportion of basic units and the concomitant difficulties in applying the metric measures in the study of electromagnetism. On the other hand, using Chinese traditional metrological nomenclature in the metric system helped the scientists to avoid such problems, as gong Jin, or kilogram, was the basic unit. Furthermore, just like the metric system, traditional terms were also developed and organized from length units to calculated weight and volume. Wu believed that one could find "metrology in our culture was a solid system if it is studied via a scientific way." In a nutshell, traditional terms of measures were also scientific in a way that could help the metric system in the Chinese context.[642]

Wu's rather conservative cultural evaluation of traditional metrology radically differed from that of Yang. Science was to perfect what China already had rather than to substitute the latter. Moreover, Wu's emphasis on appropriating science to China's cultural setting especially received

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[642] Wu Chengluo, "Dulianheng biaozhun", and Wu Chengluo, "Yanjiu Duliangheng".

criticism from scientists. Sa Bendong(萨本栋), a professor of engineering who later on became the chancellor at Xiamen University, wrote in his piece that Wu's argument on this "sinicized science" was ridiculous. For metrology was a part of universal science and should not be confined in its meaning through unjustified localization. Sa asked: "Should we obliterate Arabic numbers altogether too so that we can have a 'sinicized' Math？"[643] For scientists who participated in this debate, hardly anyone would be against the idea of at least keeping some element of Chinese culture in metric terms; after all, the project was to translate metric terms into the Chinese language. Nor would Wu and NBWM question the necessity of introducing the metric system. Underlining Sa's sarcasm was the defense of the innate universalism of science, which was challenged by Wu's conservative attitude toward sinicized science. More importantly, Wu's stance should not be dismissed as a random excuse but came from the changes in Nanjing's science policy in the 1930s. Wu's "scientific society" or Sa's "Sinicized science" were specific terms emerging from a governmental science movement, the Chinese Scientific Movement(中国科学化运动).

In 1932, Chen Lifu(陈立夫) and Chen Guofu（陈果夫）, leaders of "CC Clique," an influential political faction mainly represented the interest of the Nationalist Party, began to summon a scientific association that, under the direct patronage and guidance of the government. Besides hoping to strengthen China through Science, the Chen brothers also aimed to steer scientists to stand in line with the interest of Nanjing and the Nationalist Party. Chinese Scientific Movement Association(中国科学化运动协会, hereafter CSMA) was set up in the summer of 1932. Chen Lifu himself had studied mining science at the University of Pittsburgh, and he was ardent in promoting

643 Sa Bendong, "Zhongguo duliangheng wenti zhi wojian" [My opinion on Chinese metrological issue], in *Dongfang zazhi*, 1935, vol.32, no.3, p.86.

the association and gaining the support of scientists[644]. As Gu Yuxiu(顾毓琇), a professor of electrical engineering at Tsinghua University, recalled, Chen Lifu paid a lot of personal visits to scientists in 1932, persuading them to join in.[645]

CSMA was alleged to be a non-governmental organization following the example of the Royal Society in Britain and constituted mainly by independent scientists like SSC. However, it is not far-fetched to say that CSMA was the civil face of Nanjing's ambition to control science. CSMA's upper echelon was occupied by the CC clique, including Cheng Lifu, then the head of the organization department of the Nationalist Party, or Pan Gongzhan(潘公展), the chief of social affairs of the Shanghai municipal government who later on took charge of metrological unification in Shanghai. Wu Chengluo was also a leading member of the CSMA, as he was one of three managing directors in 1932 and remained on its managing board throughout the 1930s.[646]

As Japan's encroachment on Manchuria showcased the nation's weakness in 1931, lack of science was diagnosed as the core illness of the nation. CSMA stated in its 1932 manifesto that China was a sad combination of an impoverished society(社会的贫陋) and an uneducated population(人民的愚拙). Nanjing saw the growing gap between science and common people. The scientific knowledge was "monopolized by few scientists, but never socially populated," thus CSMA advocated to "socialize science and scientific society"(科学社会化，社会科学化). To fulfill its goal, CSMA preferred the method that was "advised by scientific principles, but also carries out China's own cultural values." CSMA took a populist approach and aimed to directly enlighten "at least 5

644 On Cheng Lifu's key position in this movement, see, Cai Yuanxie, "Cheng lifu yu zhongguo kexuehua yundong yi", in *Zhonghua mingguoshi zhuanti lunwenji dierjie taolunhui,* Taipei: Academica Historica, 1993.

645 Chengshou, "Kexue yu kexuehua: Gu Yuxiu de liniang fengxi" [Science and scientification: a study on Gu Yuxiu's thoughts], in *Kexue jishu yu bianzheng fa*, 2007, vol.24, no. 4, pp. 84-88. On Cheng Lifu's key position in this movement, see, Cai Yuanxie, "Cheng lifu yu zhongguo kexuehua yundong yi" [Comments on Cheng Lifu and Chinese Scientific Movement], in *Zhonghua mingguoshi zhuanti lunwenji dierjie taolunhui,* Taipei: Academica Historica, 1993.

646 See on the bottom covers of *Kexue de zhonguo,* vol.1, no.1 and vol.1, no.6.

million people": "science will be sent to the people and become the shared wisdom of people." With its divine power, science could "prolong the endangered life of our nation" and "restore our dying Chinese culture."[647]

CSMA had ample resources to realize its populist ideal of science. With the financial resources channeled through KMT's central headquarters(中央党部) in Nanjing in the form of periodic "donations," CSMA's activities to popularize science went far further than that of SSC and its elite circle. CSMA established 11 branches in big cities and major provinces.[648] National resources also tilted toward CSMA's favor. Starting in 1933, CSMA members gave monthly science speeches on China National Radio in Nanjing. In 1934, *Zhongyang ribao*(中央日报), the official party newspaper controlled by the Chen brothers, began to publish a weekly science supplement with the contents fed by CSMA.[649] To raise the awareness of science among common people. CSMA published its official magazine, *Kexue de zhongguo* (Scientific China, 科学的中国), which followed suit of the successful popular science journal in the United States, *Scientific American*. Besides the magazine, other efforts included regular science speeches, science exhibitions, science movie plays in public places, science education, and small scholarship to talented students in middle schools, or even in some cases, the production of "scientific toys" for children.[650]

While not questioning the value and importance of science, CSMA's populist strategy nevertheless has shaken the enshrined yet aloof image of scientists and modern science then. One good example was the "Popular Science Exhibition" held in Beijing in 1933. The organizer, Gu

[647] "Zhongguo kexuehua xiehui faqi quzhishu" [The object letter of founding Chinese Scientificization Association] in *kexue de zhongguo,* 1933*,* vol.1 no.1 pp.1-3.
[648] *Zhongguo kexuehui yundong xiehui huibao* [Association reports of Chinese Scientificization Movement Association], in *Kexue de zhonguo*, 1933, vol.1, no.6, p.22.
[649] Peng Guanghua, "Zhongguokexuehuaxiehui", pp.65-66.
[650] Fan tie*quan,* "Ershi shiji sanshi niandai kexuehua yundong zhong de shetuan canyu" [Society participation of the scientific movement in the 1930s], in *Kexuexue yanjiu*, 2010, vol.28, no.9, pp. 1302-1307.

Yuquan(顾毓琇), a core member of CSMA's Beijing branch, was asked why placed the exhibition in a park rather than in universities or scientific institutes. Gu answered: "It is all very well to open the exhibition in academic institutes and schools, but that means the people come to science. On the contrary, the exhibition in Zhongshan Park indicates that science comes to the people." [651]

Wu Chengluo was also a leading member of the CSMA, as he was one of three managing directors in 1932 and remained on its managing board throughout the 1930s.[652] Wu Chengluo participated in CSMA's activities actively from its founding day when the debate on metrological terminology emerged. With the benefit of the platform provided by CSMA, Wu Chengluo took advantage of raising awareness of measures among CSMA's audience. As early as 1933, Wu argued on the *Kexue de Zhongguo* that "one of the prerequisites to scientize China was the unification of measures […] The spirit of science is about seeking the truth, but our people are good at fraud, which has everything to do with the chaotic situation of measures. Without unified measure, every modernizing cause would fail". [653]

Wu criticized the elitism of scientists, arguing that science was "aristocratic." Even though there were efforts to popularize science made by scientists, "such as the translation of terms among scientists circle," it hardly sufficed the purpose to scientize China. Because "popularizing western science" was one thing, developing "our own science" was more urgent. While scientists like Sa Bendong taunted the idea of "sinicized science" in the debate, Wu explicitly questioned the universality of science with his evaluation of the famous quote of French scientist Louis Pasteur, "science knows no countries":

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651 Gu yuquan. "Tongsu kexue zhanlanhui de yiyi" [Meaning of the popular scientific exhibition] in *Beiping Chenbao*, 11 October 1941.

652 See on the bottom covers of *Kexue de zhonguo,* vol.1, no.1 and vol.1, no.6.

653 Wu Chengluo, "zhongguo kexuehua de xianju wenti" [The prerequisite of scientificizing China], in *Kexue de Zhongguo*, 1933, vol. 1 no.2, pp.1-2.

"[…]it is not entirely true. While the methods and principles have no boundaries, the actual use of science varies due to place and situation. The way to study science must suit this nation's actual situation of affairs. To popularize science, we must use the contents found in this nation."[654]

Similar to his argument that traditional measures had their own scientific elements, Wu explained in his other on *Kexue de zhongguo* article that: "we could find a lot of scientific contents if we read our own indigenous culture in a truly scientific method[...]We should not be ashamed that our culture is not science per se; if we explain and develop it with scientific methods, spirit and principals, all the ancient subscripts, the Si Ku Quan Shu(四库全书), or the official and unofficial histories, could all become scientific."[655] For Wu, the tradition was just as indispensable as science in their own way. Wu explained that, "we cannot say that people then did not understand science simply because we have better learned and sophisticated scholars nowadays; by the same token, the depth of our understanding of national studies(国学) is far less than that of ancient gentlemen."[656]

Universal Science before tradition and indigenous culture or vice versa were thus at the core of understanding the 1935 debate. For Wu, preserving Chinese culture was the priority and goal. In 1935, Wu gave a lecture titled "the position of measures in Chinese culture." Wu began by urging the necessity of building a "new culture": "during this extremely dangerous time, if we are not keen

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654 Ibid.

655 Wu Chengluo, "Zhongguo kexuehua zhi jinxi" [The past and present of scientificizing China] in *Kexue de Zhongguo*, 1933, vol. 1, no. 1. pp.7-8.

656 Quanguo duliangheng ju, "Fading duliangheng", p.23

on building a new culture for China, then in no ways could our nation come to life from death[...]without western cultures, we could not cope with the dangerous situation." Wu admitted the advantages of western culture, particularly its material expressions such as science and military strength. However, far from rejecting Chinese tradition, Wu saw merits on both sides: "western cultures are materialistic, and our own cultures are spiritual. Separation is harmful to both sides, whereas accommodation is beneficial for both sides". Wu continued to allege that, historically, "our nation is the first civilized one in the world." China must "preserve and develop her own culture"; only after could China absorb the foreign cultures. Specifically, to answer to the challenge aroused in the debate, keeping traditional terms in the metric system was the way to "connect two cultures" since "those who know only national learning and those who know western learning could all see the convenience of governmental nomenclature," so that "part of the national culture will persist and hold hand in hand with foreign cultures."[657]

The conservative cultural stance and an emphasis on common people were much highlighted in Wu's way of thinking about Chinese metrological reform in the debate. Wu bluntly called scientists' nomenclature the "Europeanized translated terms"(欧化译名). [658] Surprisingly, as one of the main advocates of the metric system in China, Wu expressed his appreciation for Japan's return to traditional metrology. Since the 1920s, with the rising tide of nationalism in Japan, discussion of abandoning the metric system and sticking to traditional shakkanhō(しゃっかんほう, 尺贯制)

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[657] Wu Chengluo, "Duliangheng xinzhi zai zhongguo wenhua shang de diwei" [The position of legal measures in Chinese culure], in *Zhejiang qinnian,* 1935, vol. 1, no. 9, pp. 169-171. Besides his distinctive accommodating perspective on cultural issue, also important is his materialistic western/ and spiritual eastern dichotomy, which was not only possessed by Wu alone, but also highly featured in early debate in 1919 in "science and metaphysics debate". As the dichotomy shared globally in 1920s, it served as an arguing point of debating participants such as Liang Shumin(梁漱溟)then: this dichotomy has been used against the rise of scientism and served to reflect the European war, which partially resulted from materialism of science.

[658] Huayi Wu Chengluo "Ouhua shi duliangheng biaozhunzhi danwei zhi xitong de jiantao" [Reflection on the Europeanized translation of the system of metric terms], in *Gongye biaozhun yu duliangheng*, 1934, vol.1, no. 5, pp. 7-12.

has been heard. Wu considered that as the phenomenon of “the restoration of national spirit” in Japan and concluded that tradition should not be abandoned for the metric terms. In sharp comparison, Wu also traveled to colonial Vietnam at the end of 1934 when the debate came to a climax. He witnessed that because the authority had forbidden the traditional measures, the metric system also suffered since local people found it too difficult to grasp without a customary auxiliary system.[659] Wu and NBWM also explicitly expressed their disdain for elitism in the debate. As NBWM explained to Executive Yuan in its report, “measures are for the need of all citizens...and cannot leave too far from the society”: “common people first possess the notion of Chi Jin, then they could learn Gong Chi (meter) or Gong Jin(kilogram) ... Those who know foreign language must yield to those who doesn’t.”[660]

On the other hand, KMT’s populist science policy amounted to a competition that was keenly felt by scientific groups such as SSC. Admittedly, SSC listed “popular scientific education” as one of its most important tasks in the 1910s. Their main journal, *science,* was supposed to have two editions, one for professionals and one for scientific laymen, yet the latter’s publication never came into being due to a lack of funding. In 1933, Yang Xiaoshu(杨孝述), director general of SSC, proposed a complete plan to “scientize the population.” It was not well received by the managing board: among Yang’s plan of making science movies, editing volumes of books, and a speech tour targeting common people, only his advice of publishing a science pictorial was granted.[661] In 1935, Liu Xian (刘咸), the chief editor of the journal *science*, began a reform. While maintaining the journal as a scientific publication among academics, Liu significantly increased the content of

659 Wu Chengluo, “Huayi quanguo duliangheng zhi huigu yu qianzhan” [The reflections and prospects of national unification of measures], in *Gongye biaozhun yu duliangheng*, 1937, vol. 3, no. 8, pp.1-24, p. 18.
660 Quanguo duliangheng ju, “Fading duliangheng”, p.21.
661 Wang Jiliang “Kexue huabao fakanci” [words on the new issue of scientific pictorial], in *Kexue huabao*,1933, vol. 1, no. 1, pp. 1-2.

popular science, "making sure that ordinary readers shall appeal to science." Liu explained that "our readers shall first be students in high schools and universities, then teachers in middle school, then science specialists, and finally, ordinary science lovers."[662]

Let's end our discussion with Wu's final assessment of the 1935 debate. After the debate in *East miscellany,* Wu ordered the publication of a special issue in the official magazine of the Ministry of Commerce. With a volume of more than 100 pages, this issue claimed to "honestly enlist the various stances of both sides as they were." Wu alleged that the purpose of this issue was to showcase the importance of dealing with "the conflicts between 'Science' and 'Society.'" Maybe because it was meant to be circulated among his colleagues in NBWM, Wu took a lesser official tone in his introductory essay, which granted us an in-way into his honest evaluation of the debate. According to Wu, he was reading a book by Huang Fu(黄郛) on the European war while the debate was still going on and came across a commentary in the book from Cai Yuanpei. Wu temporarily served Cai as his secretary in the late 1920s. Judging from Wu's tone, he also regarded Cai highly.

Wu quoted Cai in paragraphs. Cai said: "what moves me (in the book) is mainly the author's point on the cultivation and education of the people, arguing that 'two contradictory characters'(两种相反的性质) exist simultaneously among people." As Cai continued, he gave these "contradictory characters" some concrete correlates in society:

> "Our nation from the Qing Shihuang and Han Wudi has held certain absolutism in the face of this world of relativism. This absolutism forced people to stick to one idea and

[662] Liu xian, "Kexue jinhou zhi dongxiang" [the future change of *science*], in *Kexue,* January 1935, vol. 19, no.1, pp.1-3.

reject other possibilities. From the current political turmoil to the standstill of China's social development, these phenomena all originated from this mindset, be it sticking to the old or chasing after the new."

Wu placed the 1935 debate in this grand struggle of sticking to the old or chasing after the new and concluded below that "our nation's gentlemen's debate on metrological nomenclature, and the fact that our cause of unification has been influenced virtually by the debate, these phenomena are also the results from this conflict of 'two contradictory characters.'" For Wu, scientists' attack could be reviewed as the pursuit of metrological modernity in the form of absolutism which rejected the old and "the corrupted." While Wu criticized this stance and took an accommodating cultural view, Wu encouraged his colleagues, and probably also us, to think of the debate as a footnote of the grand transition of modern China from the global to the local and from the old to the new.

Conclusion

In 1945, as the war came to its closure, the Chinese Society of Engineers approached NBWM for the final solution to the metric nomenclature. The society deemed the market system had completed its function as common people were familiar enough with its transition to the metric system. China should now only use the metric system, and a nomenclature recognized by the state and professionals was much in need. However, far from the re-launching of a formerly bitter debate, the whole proposal was more likely a drama set by NBWM, as the society had partially sided with

NBWM in 1935, and Wu was the one who initiated the organization of the society in 1917.[663]. In May, NBWM and SSC met with the Chinese Society of Engineers for further discussion. Not surprisingly, the Chinese Society of Engineers was represented by Wu Chengluo himself. In July, the Ministry of Economy made its final decision, which was a compromise. Ke(克) was used for the gram, and the character gong was deleted for most of the units. The scientific differentiation between mass and weight was recognized by law. However, Gong remained for the units of length, and some of the traditional terms, such as Chi, were kept.[664]

This compromise satisfied neither side, and both continued to use their own terms. In 1954, PRC decided to set National Metrological Bureau(国家计量局) to facilitate the first five-year plan. However, since the conflicting terms caused difficulty in gathering accurate economic data and coordinating production,[665] the bureau proposed to settle the nomenclature issue. Shortly after, the bureau submitted its terms based on Nanjing's terms to the central government. The decade-old debate restarted in the wider society. Starting from June 1956, *Guangming Ribao*(光明日报), the official newspaper of the CCP, organized a forum and asked for opinions from its readers. Among more than twenty pieces of opinions collected from workers, middle school teachers, and government officials, Yang Zhaolian as a representative of scientists, uttered his voice again. Maintaining his former position that the corrupted was not savable, Yang proposed to eradicate all customary terms. After all, Yang alleged that the "reactionary" KMT government sabotaged the spirit of science with its reactionary nomenclature. Following customary terms at the expense of

663 *Lin Hongxun xiansheng fangwen jilu* [The interview report of Mr. Lin Hongxun], Taibei: Zhongyang yanjiu yuan jindai shi yanjiu suo, 1982, p. 18. Wu Chengluo, Duliangheng mingming yijian zhi fenxi [An analysis of the metrological nomenclature], in *Duliangheng tongzhi*, 1945, no. 29, pp. 1-9.

664 "Duliangheng biaozhun wenti jueyi an" [The final decision of the metrological issue] in *Duliangheng tongzhi*, 1945, no. 29, pp.13-19.

665 "Guanyu duliangheng danwei mingcheng de taolun" [On the discussion of metrological nomenclature], in *Guangming ribao*, 4 August 1956; "Jin yibu kaizhan duliangehng danwei mingcheng de taolun" [On the continuation of the discussion of metrological nomenclature], in *Guangming ribao*, 15 September 1956.

science, Yang continued, was a travesty to people's ability to accept new things and their love of science in the new socialist regime.[666] The final decision was made after a series of meetings in 1957. Chinese Physical Society again fiercely attacked Nanjing's nomenclature, though the KMT government could not defend itself this time. The new nomenclature completely took the opinion of scientists, and almost all traces of Nanjing's terms were eradicated with only exceptions: Gong Jin(kilogram) and Gong Li(kilometer) were allowed to be used simultaneously with the new terms.[667]

The debate around metric nomenclature lasted for more than half a century and was probably the longest one in the global process of metrication. How do we then place the Chinese debate on proper metric nomenclature in the global metrological past? The most important lesson was that the "scientist as pioneers" narrative, as this chapter heavily questioned, did not always work. One tended to think of science as the source of universal progress. In many countries, scientists positioned themselves as the main force that would initiate metrological reforms. Science was at the core of the metrological modernity that the metric system represented. However, this narrative in which "scientists led the state" for the metrological issue was not true in the Chinese case. Chinese governments and scientists developed two distinctive sets of metric nomenclatures, and the tension continued building through the first three decades of the 20th century and broke out in 1935.

Even within one nation, the thinking of metrology was highly plural and diverse. In any sophisticated debate engaged in multifaceted ways, both intellectually and politically, there was

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666 Yang Zhaolian, "Caiyong guoji mizhi duliangheng jiu yingdang zunshou ta de mingming fa de jinsheng" [Follow the spirit of naming for the nomenclature of the metric system], in *Guangming ribao,* 16 October 1956.

667 Mao Yisheng, "Yonghu gongzhi jiliang duanwei de zhongwen mingchen fangan" [We support the Chinese nomenclature for the metric system], in *Guangming ribao,* 8 July 195*9.*

no clear cut among the various stances of participants. Rather, their perspectives were influenced by the constant interaction between science and state, metrological tradition, and at times scientists' personal ambition to mark their names. Although two camps could roughly be identified, the state and science did not necessarily go against each other: scientists, on the one hand, tended to cling to the government to gain more support, and similarly, the technocratic regime must rely on the expertise of scientists. On the other hand, when scientists detected a threat to their autonomy and their enshrined ideal of pure science, they did not hesitate to position themselves against the government, even though it was exactly the institutionalization of scientists into the state that granted them the political energy to raise the issue at the first place.

Moreover, the difference in attitudes towards metrological tradition specifically and indigenous culture generally gave the debate another layer. Nanjing's new national science policy treated science and the metric system as functioning tools for nation-state building. This attitude led to an emphasis on cultural particularity and the populist approach. On the other hand, scientists maintained a strong belief in the universalism of science and the metric system, pushing them to question traditional metrology's scientific value. The state viewed the prioritization of global before local as negligence of the common people, which invited Nanjing's critique of elitism. Both sides have painted nomenclature with a heavy cultural hue. Indeed, science was never kept in a cultureless cocoon, and metrology was a cultural carrier. This fact prompted Nanjing to defend the value of traditional metrology but was often forgotten as the metric system eradicated countless local metrologies from the surface of the Earth.

When the debate pointed to things outside of science, such as culture, much at stake was the conviction of capital science and its purity, a culturally neutral and objective ideal. Those Chinese scientists must be extremely disappointed if they knew that the metric system was not that scientific at its birth anyway. With the benefit of hindsight, we now know that the metric system was not entirely accurate at its birth. The calculation mistakes were deliberately covered by its creators for the sake of keeping France's leading position in scientific measures during the European metrological meeting in Paris in 1804. These mistakes were only corrected afterward.[668] Indeed, the metric system, though considered neutral, objective, and scientific, came out of complicated human intentions and practices and bore constant shaping from wider social, political, and cultural settings.

The 1935 debate also put the assumption of scientific universalism into question. Global-wide metrication guaranteed by the universality of modern science was more of a historical myth without solid evidence and consideration of local politics, customs, and tradition. Indeed, a closer look at the specific and drastically varied processes of metrological unification in different nations suggests a far less "universal" reality. The United States, for example, in the 1920s, did not introduce the metric system mandatorily but only applied them to international trade and other limited domestic sectors. In Japan, the metric system was hindered by the rise of populism. Groups for traditional measures made open protests against the metric measures. Not to mention Britain and her constellation of colonies, who did not abide by the metric system at all but used the British Imperial System to compete with the metric system globally, even though the introduction of the metric system kept being a topic in parliament.[669]

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668 Ken Adler, *The Measure of All Things: The Seven-Year Odyssey and Hidden Error that Transformed the World*, New York: The Free Press, 2002, Ch. 4.

669 The metrological reform of Japan, British Empire and USA, see, Rexmond C. Cochrane, *Measures for Progress: A History of the National Bureau of Standards*, Washington, D.C.: U. S. Department of Commerce, 1966; Julian Hoppit, "Reforming Britain's Weights and Measures, 1660-1824", in *the English Historical Review*, Jan., 1993, vol. 108, no. 426, pp.82-104. Also, Frederik Hyttel, *The Working Man's Pint: An Investigation of The Implementation of the Metric System in Britain 1851-1979,* unpublished B.A. thesis, University of Bath, 2009. For Japan, see Cheng

The local tradition remained an important dimension in NBWM's dealing with metric terms, and history remained a creative and reflective source in the face of a highly homogenized understanding of metrological modernity. As Wu pointed out, how to oscillate between two extremes of "chasing the new and sticking to the old" was underlined in 1935 but also pointed to two competitive approaches when we think about globalization which is still haunting modern China.

Huixian, *Zhangliang taiwan: rizhishidai duliangheng zhiduhua zhi lichen* [Measure Taiwan: the institutionalization of Japanese measures in Taiwan], Taiwan: Daoxiang press, 2014, Ch. 2.

Chapter 6: Measuring Semi-colonialism: the Metrological Negotiations in Shanghai (1931-1937)

Introduction

In 1935, Wu Chengluo, the prominent architect of the reform, appraised the progress of the metrological unification made by the Shanghai branch. Wu said, "the head of the local bureau and his inspectors[...]were responsible and spared no strength[...]Their spirit of hard work made them the champion of our nation." [670] Indeed, as the most extensive economic center and most cosmopolitan city in China, the reform in Shanghai bore paramount importance as it served as a bellwether for people in other cities. The whole nation worriedly watched the reform in Shanghai. For instance, the merchants in Changsha (长沙), the capital city in Hunan Province, which was hundreds of miles away, declared that if the reform in Shanghai could not succeed, they would not cooperate with the government in their city either.[671]

However, Wu's compliment on Shanghai's metrological reform only revealed half the story. The reform there did not go smoothly at all, and Shanghai's International Settlement (hereafter SIS) particularly proved to be a hard nut to bite. As officials from Nanjing, Jiangsu, and Zhejiang complained in 1931, Shanghai's reform suffered from the "imperial influence" because Shanghai's Municipal Bureau of Weights and Measures (hereafter MBWM) did their work "with hands tied"

[670] Duliangheng xuehui [Weights and Measures Society of China], "Ge shengshi xiaoxi"[Informations from provinces and cities], in *Duliangheng Tongzhi*, no.1, p6.

[671] "Hunan shengfu wei shishanghui tuixin dulaingheng ling changshashi shanghao" [Hunan provincial government's order to municipal chamber of commerce for the promulgation of new measures] in *Jianshe Gongbao*, no.1, 1932, March, p.2.

because SIS refused to cooperate[672]. Only in 1935, when SIS finally agreed to work on limited terms with MBWM after four years of negotiation, Wu granted MBWM the honorary title of "Champion." Moreover, imperial existence was not only an obstacle in Shanghai: Hankou's Japanese settlement, for example, also refused to cooperate. Colonial factors in Shanghai, or "semi-colonialism," thus added an indispensable dimension to our understanding of Shanghai and China's metrological past.

When mentioned semi-colonialism, one has already stepped into the theoretical deep waters. First coined by Lenin and then adopted by Mao Zedong, the term referred to a transitory social stage where a feudal nation coexisted with colonial powers before it slid into full colonization and capitalist society. While Mao and Lenin used the term with an apparent political agenda, the term did fascinate scholars for it gave a more balanced framework to place Shanghai's colonial elements, if not a complete version of colonialism, in republican China, which was a daring and at times aggressive nation-sate. For instance, Shu-mei Shih showcased that Shanghai's literature circle in the 1920s displayed an appreciation of cosmopolitan modernism in the imagery of Imperialist literature instead of forming a nationalism as a thorough critique against colonialism like India intellectuals.[673] Jürgen Osterhammel also saw the great potential of the term. By categorizing 26 historical phenomenons from imperialism and semi-colonialism in China, Osterhammel regarded semi-colonialism as a meaningful albeit vague framework that could not only be applied to

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672 Gongshang bu quanguo duliangheng ju [National Bureau of Weights and Measures, the Ministry of Industry and Commerce], Gongshang bu quanguo duliangheng ju duliangheng jianding renyuan yangchengsuo diyici baogaoshu [First report of the Training Center for Inspectors of Weights and Measures], Nanjing: Zhonghua yinshua gongsi, 1930. Also, "Yian(wushiqi)" [Motion, no. 57], in *Gongshang bu quanguo duliangheng huiyi huibian* [Collection of Records from National Metrological Meeting of the Ministry of Industry and Commerce], Nanjing: shiye bu, 1931. Part "motions", p. 130.

673 Shu-mei Shih, *The Lure of the Modern: Writing Modernism in Semicolonial China, 1917-1937*. Berkeley: University of California Press, 2001. The idea was shared by others such as Bryna Goodman. "Improvisations on a Semicolonial Theme, or, How to Read a Celebration of Transnational Urban Community," in *The Journal of Asian Studies*, November 2000, vol. 59, no. 4.

Shanghai but Persian, Latin America, and so on[674]. On the other hand, scholars such as James Hevia questioned semi-colonialism as a justified model. Hevia identified a surprising similarity between China's semi-colonialism with other fully colonized cases because "all the entities produced in the age of empire," even in British Indian, were "forms of semi-colonialism."[675] In other words, every colonialism was fundamentally semi-colonialism, for it was seldom in history that colonizers could succeed in a totally violent and coercive ruling without making any compromises, like in Shanghai.

The recent development of scholarship on Shanghai has brought a distinctive global perspective into the discussion of semi-colonialism in China in general and Shanghai specifically. Isabella Jackson has defined Shanghai's urban governance as a display of "transnational colonialism." SIS particularly was the unique specimen of semi-colonial polity, whose urban administration oscillated between a full colony that imitated British colonial tradition and a city-state that contended its political dependence in the face of competitive Chinese municipal government and the French concession.[676] In a similar vein, Anne Reinhardt made a comparison between India's and China's steam shipping at the turn of the 19th century. On the one hand, much like in India, steamships were the social space where the Chinese painfully experienced colonialism when they found themselves disciplined and canned in cheap cabins. The suppression, in turn, gave rise to shipping nationalism in the 1920s. On the other hand, British colonialism lacked the motives nor resources to fully colonize Chinese transportation but to cooperate with the Chinese government to maintain its imperial interests. Chinese government thus successfully safeguarded its shipping

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674 Jürgen Osterhammel, "Semicolonialism and Informal Empire in Twentieth Century China: Towards a framework of analysis," in Wolfgang Mommsen and Jürgen Osterhammel, *Imperialism and After: Continuities and discontinuities*, London: Allen and Unwin, 1986, pp. 290-314.

675 James L. Hevia, *English Lessons: The pedagogy of imperialism in nineteenthcentury China,* Durham & London: Duke University Press, 2003, pp.281-346; quotes see p. 26.

676 Isabella Jackson, S*haping Modern Shanghai: Colonialism in China's Global City,* London: Cambridge University Press, 2017. Introduction, pp. 1-21.

sovereignty, whereas India was tightly interwoven into the grid of British global imperial shipping infrastructure. Instead of taking sides, Reinhardt proposed the angle of "collaboration" characterized by the interdependence of colonialism and nationalism to "navigate" through the seemingly rivaling binary.[677]

This chapter has no intention to participate in the debate; however, it acknowledges that the importance of colonial factors, if not fully "colonialism." Colonial pattern even not in its full swing, played an essential role in Shanghai's metrological past. It asked such a question: if a colonial pattern could be detected in Shanghai, be it either semi-colonialism or transnational colonialism, were there also conflicts with a metrological dimension in Shanghai's zigzagged political landscape? The answer is positive. As articulate in Chapter one, China fell into the global metric camp where most nation-states imitated France as a role model to erase their internal metrological heterogeneity. On the other hand, particularly within the global British Empire, since the 19th century existed, another tradition. While the global competence of the metric system prompted the British to further enforce imperial weights and measures in trades with colonies, the British empire did not actively pursue the globalization of their measures. For instance, in Canada, local diversity in measurement practice persisted even when authorities sweated a lot of administrative efforts on measures in export markets since the late 19th century. In colonial Malaya, some local measures, including ones brought by Chinese merchants, continued to exist as officially recognized exemptions in the early 20th century. This was also the case in Hong Kong and Singapore. While the cases variegated in their details, we could nonetheless detect a repeated outline marked by

[677] Anne Reinhardt, *Navigating Semi-Colonialism Shipping, Sovereignty, and Nation-Building in China, 1860-1937*, Brill, 2020. Particularly pp. 10-11 and pp.61-62.

the consideration of colonial interests: British colonizers only unified measures in the global tied economic sectors and confined areas to smooth trade, whereas the vast hinterland of colonies was largely ignored.[678] More importantly, they tended to add British measures as an imperial infrastructure to the local metrological equation but to respect native metrological practices.

Aashish Velkar has termed this pattern the "Benthamite approach to metrology." Although Jeremy Bentham acknowledged that without a permanent standard, the British colonizing project "can be at best but imperfect," he also believed that unification should be confined to various local communities. Bentham admired the French idea of uniting the nation under one standard but contended that it was not practical as it would cause inconvenience.[679] Velkar's studies on Indian metrology showed that Benthamite thinking dominated colonial metrology. Moderate metrological reform was initiated by colonizers to tap into economic resources and became to be joined by indigenous elites in the 1930s. Recognized it as standardization from globalization, Velkar continued to argue the nation-state as an indispensable condition for ultimate metrological unification since Australia, Canada, South Africa, Singapore, and several other colonies in Africa and the Caribbean successfully reformed their metrology based on the metric system between 1950 and 1980. By placing failed colonial reform and successful national reform in a lineage, Velkar concluded that "in India, metrological reforms were possible when a nationalist state invoked

[678] An early case on dissemination of British colonial sugar measures, John J. McCusker, "Weights and Measures in the Colonial Sugar Trade: The Gallon and the Pound and Their International Equivalents", in *the William and Mary Quarterly*, Oct., 1973, vol. 30, no. 4 , pp. 599-624; For case studies on riots brought by colonial authority's attempt to unify indigenous measures in British Malaya, Por Heong Hong and Tan Miau Ing, "Contested Colonial Metrological Sovereignty: The daching riot and the regulation of weights and measures in British Malaya", in *Modern Asian Studies* , vol. 56 , no. 1 , January 2022 , pp. 407 - 426 ; on colonial Canada's forming of metrological codes in 19th century, see, Bruce Curtis, "From the Moral Thermometer to Money: Metrological Reform in Pre-Confederation Canada", in *Social Studies of Science*, vol. 28, no.4, 1998, pp. 547-570; on British political thinking of measures, see also, Aashish Velkar, *Markets and Measurements in Nineteenth Century Britain*, Cambridge: Cambridge University Press, 2012. pp. 16-27.

[679] Aashish Velkar, "Rethinking Metrology, Nationalism and Development in India, 1833 - 1956", in Past & Present, May 2018, vol. 239, no. 1, pp. 143–179, pp. 150-151; also, Julian Hoppit, "Reforming Britain's Weights and Measures, 1660- 1824", The English Historical Review, p.91.

tradition, in addition to quantification, to enforce measurement standards in the context of planned economic development." In other words, the colonial Benthamite tradition was an antithesis of metrological nationalism represented by the metric system.[680]

Seldom have we found historical cases in existent historiography where the Benthamite approach was juxtaposed with metric nationalism in one locale. Therefore, Shanghai became a unique contact zone where SIS, for its strong Benthamite tendency in its metrological administration, was engaging in constant negotiations and clashes with the Chinese municipal government as Chinese metrological reform was inching towards SIS's borders. Indeed, compared with other negotiations that the Chinese municipal government had with SIS, such as the conflict around tobacco taxation, metrological negotiation turned out to be a marathon of political wrestling, lasting from 1931 to 1937. However, current literature has not addressed the fore-mentioned aspects well. Much attention has been paid to the metrological statecraft and policymaking of the Chinese municipal government.[681] Even less noticed the conflicts between colonial authorities and the Chinese municipal government in Shanghai (mainly based on brief reports from Chinese newspapers like *Shenbao*), the long-term, sometimes bitter clashes between Chinese and foreign authorities did not receive their due attention.[682]

Taking the theoretical lens of semi-colonialism and its emphasis on collaboration, I started this chapter with an overview of triangular political segmentation in Shanghai. The unique landscape challenged Nanjing's reform and raised the question of unifying measures in the SIS and the French

[680] Aashish Velkar, "Rethinking Metrology" pp. 147-148.
[681] Just to give one example, Liao Xiaobo, Huo Ming: "Minguo shanghai duzheng shimo" [The history of Shanghai's metrology administration during Republic of China], in *Chongqing shifan daxue xuebao*, 2015, no.4, pp.56-62.
[682] Zheng Chenglin, Shi Jiahui, "Nanjing duliangheng gaizhi zhongde shanghui canyu" [The Participation of Chambers of Commerce in the Unification of Weights and Measures under the Nanjing Nationalist Government], in *Lishi yanjiu*, 2017, no.4, pp. 95-112, pp. 101-103.

concession. I argued that the metrological negotiation in Shanghai featured constant compromises in a semi-colonial scenario. While the early negotiation proved to be fruitless for conflicted motives and interests on both sides, semi-colonial middlemen such as guilds and the chamber of commerce who straddled between political borders successfully inter-mediated the tension. With their help, SIS and the Chinese municipal government have struck an acceptable deal. This collaboration did not cancel the tension since it did not satisfy both sides, nor should it be a story solely about authorities. In the last part, I concentrated on hawkers in the markets, the slighted social group whose interests were sacrificed by urban authorities. They nevertheless found the living space by smartly exploiting the ambiguity of Shanghai's semi-colonial micro-geopolitical landscape. In sum, Shanghai's metrological story was an idiosyncratic blend of competing for metrological traditions and practices in a semi-colonial setting, which could shed light on the Chinese and the global history of metrology.

Measures in Semi-colonial Shanghai and Early Negotiation (1931-1932)

Shanghai by no means was inexperienced with things foreign: since colonizers knocked on the doors of Shanghai, which resulted in its opening as a treaty port in the 1840s, things novel and modern flooded into Shanghai. Among telephones, cinemas, and motor vehicles, quickly dismissed was also western metrological equipment such as scientific glassware, metal pan balances, and steel-made spring scales, which in their forms were quite different from typical Chinese wooden steelyards. But not merely the foreign measures, nor the bewildering readings of units on them, be it Japanese, Russian, French, or English, should be considered. Semi-colonialism was a political premise when Chinese metrological reform landed in Shanghai. Two foreign concessions existed in Shanghai then. Shanghai International Settlement (SIS)[683], which albeit maintained a relatively strong connection with the British Empire, enjoyed autonomous status with its own armed force, courts, and administrative apparatus. SIS was not a colony but an international settlement that protected and represented the interests of its member nations. In the 1930s, the Consular body of SIS consisted of 12 western nations. SIS also practiced a limited democracy. The Shanghai Municipal Council (hereafter, SMC), a cabinet of elected business representatives mainly from western ratepayers, served de facto as the standing government in SIS.

Next to it was Shanghai French Concession. While officially not a colony of the French Empire, the concession maintained much stronger connections with its homeland than SIS: the chief French official in charge was the Consul-General of France in Shanghai, appointed directly by the Foreign Ministry of France. The Municipal Administrative Council (Conseil d'administration municipale) served under the Consul-General to carry out the daily governance. Many pointed out that the French concession adopted many colonial policies in French Indochina and Algeria, such as in its police force. In the 1930s, SIS and the French concession coordinated their stances in front of the encroaching Chinese nationalism. But this cooperation sometimes also gave way to competitive imperialism between the two as conflicts happened with urban planning, such as bridge building for the bank, pandemic controls, and other social welfare projects.[684]

683 Liu Jinkun and Deng Chunyang, "Guanyu woguo jindai zujie de jige wenti" [Some Issues Concerning Concessions in Modern China], in *Nanjing daxue xuebao*, 2000, no.2, pp.22-31. There were two international settlements in modern China, one in Shanghai, the other in Xiamen, Gulangyu(鼓浪屿).

684 Isabella Jackson, *Shaping Modern Shanghai: Colonialism in China's Global City*, Cambridge: Cambridge University Press, 2017. See Ch.4. Also, Liu Xin "Linli zhijian:cong yangjingbang de zhili he jianshe kan gonggong zujie yu fa zujie zhijian de hezuo yu fenzheng" [Between the neighbours: Cooperation and Disputes between the International Settlement and the French Concession for Construction and Management of the Yang-king-pang] Master's thesis, East China Normal University, 2008.

The political landscape of coexisting three municipalities made political and judicial authority highly fragmented and paved the way to semi-colonialism. For example, extraterritoriality in Shanghai was one of the most visible manifestations of semi-colonialism: the exemption of foreigners from local jurisdiction and the exercise of political and judicial authority by consular courts in Western settlements.[685] Jointed courts chaired by foreign and Chinese judges were set up, yet Nanjing's nationalistic government succeeded in replacing them with Chinese laws and judges in 1927 in SIS and in 1931 in the French concession. While both SIS and the French concession maintained their authoritative status in their own territories, the Chinese municipal government managed to impose a limited but effective jurisdiction over Chinese citizens living in the settlements.

The zigzagged political landscape led to a situation where Shanghai opened its doors to all kinds of metrological systems. Metrological globality within the borders of Shanghai, thus, set the stage for the surprising entanglements between Chinese and foreign powers. Both SIS and the French concession allowed conflicting metrologies to pour into their territories. However, metrology was by no means a vacuum of colonial powers. For instance, SIS established its metrological administration through the Public Health Department. Following the example of a modern British hygienic institution, the settlement administration founded DPH in 1898. DPH covered a wide range of responsibilities, including food inspection in municipal markets, dairy farms, and abattoirs. DPH appointed 11 health inspectors for regular hygienic monitoring in those localities.[686] In 1924,

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685 Many studies in the past several years began to use international laws as new angle to view Shanghai's semi-colonialism. Stefan Kroll, "Public-Private Colonialism: Extraterritoriality in the Shanghai International Settlement", in Inge Van Hulle and Randall C.H. Lesaffer eds., *International Law in the Long Nineteenth Century (1776-1914): From the Public Law of Europe to Global International Law?* Leiden: Brill, 2019.
Also, Wanshu Cong and Frédéric Mégret "International Shanghai' (1863–1931): Imperialism and private authority in the Global City", in *Leiden Journal of International Law*, December 2021, vol. 34, no.4, pp. 915-933.
686 Lu Wenxue, "Shanghai gongbuju shipin weishen guanli yanjiu (1898-1943)" [The study on SMC's food security

with the prosperity of markets and the food industry, a new branch was separated to inspect the markets.[687] In 1932, DPH reorganized the branch to cope with the increasing workload of hygienic supervision in the markets and bread shops.[688] The official administration of measures became instituted in the early 20th century, and inspection of foreign measures became one of the official duties of inspectors as the markets grew in the settlement.[689] The difference in policies towards different measures reflected the colonial Benthamite approach: only foreign measures (mainly British) were under regular supervision, whereas DPH basically let the Chinese measures be. Besides colonial tradition, this somewhat laissez-faire policy also resulted from practical reasons: first, the department did not consider measures as their main task but merely a side job when conducting hygienic inspections in markets. Secondly, even though they did intend, the branch lacked sufficient staffing to check the tremendous number of Chinese measures.[690] To even manage foreign measures was already much on the plate.

In the Chinese city, the metrological reform in Shanghai started early. Shortly after the promulgation of the metrological law in January 1930, the Ministry of Industry and Commerce(工商部) listed Shanghai among the first patch of provinces and cities to implement the law. The plan was quite optimistic: Shanghai would only take one year to achieve metrological unification at the end of 1930. Municipal Bureau of Weights and Measures (度量衡鉴定所, hereafter MBWM) located in the building of Shanghai's Bureau of Social Affairs (社会局, hereafter BSA), which also supervised the operation of MBWM. Before MBWM officially started to function in 1930, it sent its

policy], in *Shilin*, 1999, no.1, pp. 64-82, p.69.

[687] Shanghai Municipal Archive (here after SMA), U1-16-4655, Annual report of Public Health Department, 1929, report of commissioner.

[688] Lu, "Shanghai gongbuju", p. 70.

[689] SMA, U1-16-504, letter from Public Health Department to secretary, 6 March 1934.

[690] SMA, U1-16-504, report from commissioner, 16 October 1935.

15 inspectors, who had just finished their training in Nanjing, to conduct a general survey in markets in May. It was meant to get a taste of what they were about to face. As they might have expected, the result was frustrating enough: among 63 different kinds of trades and industries in the city, measures employed came from Japan, Britain, America, France, etc. Beijing Government's semi-new measures introduced 20 years ago were also in use. Measures varied from shop to shop, guild to guild, and market to market. For example, the typical length measure, Chi(尺), ranged from 30.5cm to 38.1cm, so as volume measures. For weights, inspectors counted at least 16 different types.[691] When MBWM opened its door in August, it soon found the workload was too much for a small institute. Under MBWM's request, the municipal government granted it one more year to finish its unification at the end of 1931.[692]

In retrospect, one more year was not enough. MBWM did not have a good grasp of the workload ahead. First, MBWM knew the chaotic usage of measures in the markets after the survey but did not know how many measures precisely needed to be replaced. Secondly, MBWM was also short of hands, mainly because it took time to train professional inspectors in Nanjing. The number of inspectors grew from 15 to 20 after 1933,[693] impossible for a city like Shanghai, which held a population approaching three million in 1931.[694]

At the end of 1931, as most guilds had participated in the reform or at least pledged to switch measures in the future, MBWM announced a "primitive" unification. The job left was regular

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691 Liao and Huo, "Minguo shanghai duzheng shimo", p57.
692 Shanghaishi shehuiju*, Shanghaishi shehuiju yewu baogao* [reports of the bureau of social affairs], 1930, no.4-5, p.17.
693 "Benshi tuixing xinzhi duliangheng" [Promulgation of new weights and measures in our city], in *Shenbao*, 14, June 1931. Also, Shiye bu quanguo duliangheng ju [National Bureau of Weights and Measures, the Ministry of Industry], *Duliangheng jianding renyuan yangcheng suo biye tongxue lu* [Alumni of the Training Center for Inspectors of Weights and Measures], Nanjing: Shengying shuju, 1936, p.124
694 Gongbuju huawenchu [Chinese interpretation institute of SMC], *Gongbuju nianbao* [Annual report of SMC], 1931, p.133.

inspections in the markets and measure examination among guilds to make sure that the unified status remained.[695] However, the unification was far from satisfaction. As SGCC pointed out, many guilds merely made empty promises but took a "wait and see" attitude.[696] For example, two years after the announcement of primitive unification in 1933, a selected inspection around the Chinese city showed that: 364 pieces of legal measures were confiscated from 343 shops in the southern city; the number was 200 for 192 in Zhabei(闸北), northern city; 59 to 62 in the east, and 53 to 53 in the west. Considering the approximation between the number of illegal measures and the number of shops visited, it may indicate that at least one piece of old measures was still in per shop.[697]

One reason for the slow progress of metrological unification in Chinese city the existence of the Customs and the settlements. Despite the order from the Ministry of Industry and Commerce in 1932, which banned foreign measures in the customs,[698] Shanghai Customs, worrying the change would result in the loss of trade, still allowed importing foreign measures and goods measured by them. The result was that illegal measures, particularly English measures, continued to be popular to the extent that even MBWM had to order the production of measures with both reads of Chinese and English in 1933.[699] In 1934, MBWM found, for example, that silk cotton and coconut sugar were still measured by pounds.[700] MBWM ordered the merchants to mark imported goods, such as rice, with new measures when attributing them to the domestic market to solve the

695 Liao and Huo, "Minguo shanghai duzheng shimo", p. 59.
696 "Tongye gonghui xiaoxi" [Information from guilds], in *Shenbao*, 20 July 1931.
697 "Tongji: linshi jiancha tongjibiao" [Statistics: the charts of interim inspections], in *Duliangheng tongzhi,* no. 6, pp. 18-19.
698 "Shiyebu wei qingshang guanwushu congsu choubei keqi tongling quanguo ge haiguan" [The Ministry of Industry urged custom administration to quickly promote new measures in customs], in *Shiye gongbao*, no.91-92, 29 September 1932, pp.7-9.
699 "Zhongyang duliangheng xiaoxi" [National metrological messages], in *Dulingheng tongzhi*, no. 10, 1934, p21.
700 "Shanghaishi tonggao geye qudi yingzhi duliangheng micheng" [Shanghai city illegalized English metrological nomenclature], in *Shenbao*, 25 April 1934.

problem.[701] Under the constant pushing of MBWM, Custom reluctantly agreed to adopt the new measures as late as February of 1934.[702]

However, this does not solve the problem satisfactorily. Customs were merely a gate; no matter how one remeasured them, imports were produced at their source with foreign measures. For example, Shanghai imported pine timbers from Russia and America, measured and cut by English feet into a 16-foot-long, 12-inch-wide piece. After the Customs banned foreign measures and MBWM punished some timber importers who dared otherwise, merchants found it difficult to adjust to the change.[703] Foreign exporters refused to cut the timbers with Chinese measures as Chinese merchants required, for the orders from Shanghai were less than 10 percent of their total production. Changing the measure also meant purchasing other cutting machinery for China only, which foreign exporters did not accept.[704]

But more pressing was the very existence of the settlements, which provided a need for foreign measures that greatly hindered the metrological unification for the whole of Shanghai. Measures, after all, did not respect political borders. Many merchants in the Chinese city used the fact that their peers in the settlements did not switch as an excuse to put off the demands of MBWM.[705] For those who did change, it again caused discontentment as they deemed it was unfair if their peers in the settlement used the old ones.[706] Also, Some foreign stalls in the settlements kept selling imported measures to customers in Shanghai and other cities, be it metric

701 "Zhongyang duliangheng xingzheng xiaoxi" [Central metrological administration messages], in *Duliangheng tongzh*i, no.7, p. 5.
702 "Mingnian eryue yiri qi haiguan gaiyong xinhengqi" [The custom will switch to new measure on February 1 next year], in *Shenbao*, 23 September 1933.
703 SMA, S145-1-62, letter from Shanghai timber guild to MBWM, exact date unknown, 1932, pp. 3-4.
704 SMA, S145-1-62, letter from Shanghai timber guild to SGCC, 22 October 1934, pp. 40-46; SMA, S145-1-62, letter from Shanghai timber guild to SGCC, exact date unknown, 1932, pp. 7-8.
705 SMA, S398-1-37, letter from MBWM to SGCC, December 1932, exact date unknown, pp. 45-47.
706 Zheng and Shi, "Nanjing duliangheng gaizhi", p. 110. Zheng gave a detailed case of such conflict between merchants in the settlements and Chinese city in Tianjin.

and English ones.[707] As these cheap measures did not pay the examination fee, merchants in the Chinese city found it very difficult to compete with, which pushed them not to send their measures for examination either.

Moreover, MBWM allowed shops to use foreign measures when dealing with foreign customers from the settlements. However, MBWM's investigation revealed that almost all these shops used English measures in their transaction with Chinese customers, for it was more convenient to use one set of measures with different customers.[708] Some Chinese merchants in the foreign settlements even stepped further and pleaded with colonial authorities not to enforce new Chinese measures.[709]

Harsher rules came later that foreign manufactures who sold foreign measures were not allowed to operate in the Chinese city. Chinese stores in the settlements were encouraged by guilds to use new Chinese measures, which also helped reduce foreign measures in the markets.[710] However, those were merely defensive moves. Foreign settlements provided the need, supply, and venue for illegal measures. It was clear to MBWM that the problem had spilled out of the Chinese city alone. Chinese authorities now must deal with SIS and the French settlement directly, and managing these illegal measures in the settlements required concerted cooperation between Chinese and foreign municipalities.

The negotiation between colonial powers started early in 1931. While the French concession quickly agreed to switch, Shanghai Municipal Council (hereafter SMC) in the international

[707] SMA, S313-1-181, letter from BSA to Shanghai measure maker guild, 19 January 1934, pp. 27-32.
[708] SMA, S230-1-158, letter from BSA to the Ministry of Industry, 9 January 1937, pp. 50-56; SMA, S230-1-158, Correspondence between Chinese National Silk Benevolent Society, MBWM and Shanghai district court, 23 November 1933, 28 November 1933, pp. 7-11.
[709] SMA, U38-1-1827, the letter from Shanghai cattle and sheep guild to French Municipal Council, 15 May 1935.
[710] SMA, Q173-36-68, letter from BSA to SGCC (8, June 1933), pp. 128-131.

settlement proved to be a tough nut to crack, which received the primary attention in this part. The Chinese government began to make contact with SIS in April 1931.[711] Pan Gongzhan (潘公展), the Bureau of Social Affairs (BSA) chief, played a significant role at this stage. Pan was one of the significant members of the local KMT headquarters in Shanghai. He belonged to the "CC" Clan, a radical and nationalistic faction within KMT, and got appointed as the chief of BSA mainly because of this connection.[712] Under the invitation of Pan, on May 11th, the representatives from SIS and its police department came to meet Pan and representatives of the Chinese police, City & District courts, and the Chinese Ratepayers Association. Pan prepared a draft of regulation in advance and explained the establishment of MBWM and its plan to enforce the new law of measures in Greater Shanghai. In a more concrete sense, by the beginning of June, Pan hoped that inspectors from MBWM could begin their inspection in both settlements to achieve primitive unification on July 1st, 1931.[713]

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711 SMA, U1-6-119, "Aide Memoire" of the meeting on May 11th.

712 An Keqiang (Christian Henriot), *1927-1937 nian de Shanghai: shizhengquan, difangxing he xiandaihua* [Shanghai during 1927-1937: Municipal administration, locality and modernization], Shanghai: Shanghai guji chubanshe, 2004, pp. 26-27; see also, Bai Huashan, *Shanhgai zhengshang hudong yanjiu* [The study on the political-commercial interaction of Shanghai], Shanghai: Shanghai cishu chubanshe, 2009, particularly quarter 4 in chapter 2.

713 SMA, U1-3-3308, "Memorandum on the enforcement of the law of weights and measures in the settlement", May 11th.

Pan Gongzhan (1989-1975) Shanghai Library, a digital collection of *Shanghai memories* (http://memory.library.sh.cn/node/44518, visited on 05.06.2020, 15:52)

At first, representatives from SIS did not oppose the idea of metrological reform per se. However, BSA's plan to send inspectors to their territory raised great concern from SIS. From SIS's point of view, one of the main objects of the inspection was the detection of fraud, which was the duty of settlement police—allowing inspectors to work within the borders of international settlement meant to usurp the exclusive jurisdiction of SIS. Besides the inspectors, they insisted that BSA and MBWM, or other Chinese governmental apparatus, should not operate within the realm of international settlement. Pan was ready to compromise and agreed that Chinese police would not enter the settlement and inspectors shall only work in the presence of settlement police. If mistaken arrests of metrological fraud happen, Pan also promised that the Chinese government would pay the damages.[714]

[714] Ibid. Memorandum

However, the discussion swiftly slid into a deadlock when the issue of the inspectors came under the spotlight. SIS insisted that the metrological inspectors should not be the bureau's employees but rather selected by SIS, paid by the Chinese government. As SIS explained, one could find a former example of such an arrangement when the Chinese government tried to tax tobacco in the settlement. Tax inspectors selected by SIS did not station within the settlement in 1930.[715]

While keeping the Chinese government and its direct representatives away from the territory seemed to be the primary concern of SIS, it was SIS's drawing on the precedence of tobacco tax that drove Pan to speak with a more pitched, nationalistic tone. Pan regarded the case of tobacco as a rather shameful precedent and contended that the problem of measures was "a different matter" and "the environment is not the same." By the Chinese metrological law, the bureau was authorized to establish local Bureaux in the whole of China. Pan alleged that the settlement was a part of Greater Shanghai, so it was, too, under the jurisdiction of Chinese laws. SIS "could cooperate within the ambit of the provisions laid down by the central government[...], and the Chinese nation had never agreed that it had no administration powers in the settlement". Moreover, "the Chinese in the settlement must be treated the same way as the whole of China. The Nanking Government had the sole right to subject Chinese residence to their laws."[716]

The representatives of SIS did not argue with Pan's nationalistic passion but called attention to practical difficulties concerning the plan. For example, there was only one set of standard weights made out of brass in Shanghai, and it took time to train inspectors in Nanjing for at least three months. Therefore, it was immature to finalize the matter now, not to mention to hurry the market

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[715] Jin Xin eds., *Zhonghua minguo gongshang shuishou shigang* [General History of Commercial Taxation of the Republic of China], Beijing: Zhongguo shizheng jingji chubanshe, 2000, pp. 337-338.
[716] Ibid. Memorandum.

inspection in June. They nevertheless agreed to transfer the regulation draft that Pan handed in for the approval of SIS.[717]

It was interesting to note that SIS was not entirely sure about the legal base of its metrological authority in the settlement. A lawyer submitted an evaluation shortly after the meeting at the request of SIS. The report addressed the legal issue brought up by Pan. By scrutinizing the first and the ninth entries of Land Regulation and its bylaws, SIS found that colonial law did not explicitly mention measures. However, SIS ensured itself that, as one of the common legal principles was that in the settlements, "Chinese laws could be enforced by the council, without the reference of Chinese authorities." The council decided whether Chinese laws were applicable or not in the settlement. After reading Chinese metrological law, SIS also worried that, as measures "defined as private use could also be submitted to the inspection in the Chinese city, an inspection could also be made in residence there, which is contrary to western legal principles."[718]

However, the issue of law has not been mentioned again in later negotiations. Pan's mentioning of legal conflicts seemed a strategy to get the upper hand rather than an actual denial of the existence of colonial powers. On May 22nd, Pan met again with SIS. The meeting again was a deadlock. The conversation was mainly between Pan and Mr. Winter of SIS's general secretariat and Mr. Givens, head of settlement police. Pan was even more determined in this meeting to push the inspection into effect, partially because the deadline for primitive unification in July was

[717] Ibid. Memorandum.

[718] Ibid. Memorandum. For land regulations, Kotenev, *Shanghai: Its Mixed Court and Council*, Taipei: Ch'eng-Wen Publishing Company, 1968, pp. 557-573, p. 561.

approaching, leaving only several days to start an inspection in the settlement. Pan alleged that 15 inspectors under his command were prepared to inspect the settlement.[719]

On the other hand, the council feared that sudden change may create a hardship on traders generally and tend to create "breaches of the peace and that there should be a transitional period." The gradual transition was also based on the fact that small merchants in the settlement had bought "good scales," particular of the platform type——though not "legal" in the eyes of Pan——invested already "hundreds of dollars," which would be a dead loss to them. The council proposed at least one or two years of a transitional period when ordinary people will be educated about the new measures and old scales gradually worn out. The new measure only became mandatory after.

Inspectors, again, were a tricky topic. The settlement police were concerned with the tranquility of the markets. The very appearance of Chinese inspectors who "in making a shop-to-shop inspection as they obviously would issue several warnings to traders in the same road, there was a grave possibility of trouble arising." To prevent such annoying situations, traders with illegal measures should first be warned. Under the second violation of the law, their illegal measures shall be confiscated.[720]

Pan agreed to consider SIS's proposal for the transitional period and alluded to possible compromise regarding the implemented procedure of the inspection but refused to step back on the issue of the inspectors. SIS wishes to keep its police rights undisturbed by the Chinese within the settlement. SIS suggested that the "technical difficulties" could be overcome by picking

719 SMA, U1-6-119, "Aide Memoire", record of the meeting on 22 May 1931.
720 Ibid.

inspectors from the standing force of settlement police or civilians selected by SIS. They could also receive training from Nanjing, which “would make them, virtually, appointees of the bureau.”

Moreover, SIS made further compromises than the first meeting that their activities, including prosecuting illegal measures, would also be founded by the council, saving them money for BSA. Pan violently opposed it. By this arrangement, Pan and his bureau lost the direct commanding of its inspectors, who were merely nominal members of the bureau. It also meant that, If the bureau wished to give any instructions, it would first have to go through SIS since the council also mentioned its interest in prosecution.[721]

The lengthy discussion was not entirely unfruitful. Pan agreed to send a notice to the council the next day as a reference, stating how far the bureau would cooperate with the council. However, this notice was never sent to SIS. SIS received a declaration—if not an ultimatum, informing the council of the unification deadline: an inspection of the markets on June 1st and the shops on July 1st. There was now no pending negotiation.[722]

Nevertheless, the negotiation brought about the attention of influential figures within the settlement. Edwin Cuningham, a senior consulate from American Consulate General, wrote to Fessenden, secretary-general, and head of settlement administration, asking about the rumor that the settlement was prepared to adopt new Chinese measures. Fessenden, in his reply, expressed that it was very doubtful that MBWM would have the resolve and resources to administer the law

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[721] SMA, U1-6-119, “Memorandum”, report of the meeting on June 23rd; also “Aide Memoire”, the report of the meeting on June 23rd.

[722] Ibid.

in the settlement due to their inadequate supply of inspectors, standard measures, and instruments.[723]

It was no surprise that neither Fessenden nor the council at the time took the issue of measures seriously enough. Public opinion tended to question the progress of metrological unification in the Chinese city, as newspapers in the settlement kept a relatively closed eye on it. One article alleged that to make four hundred million people switch to another set of measures all at once was a "superhuman task." His witness was that Chinese tradesmen seldom used the new measures, at least those dealing with foreigners. Some branches of the Chinese municipal authority also did not use legal measures, not to mention the railway still used various standards from Russian and Britain. In conclusion, the article estimated that the transitional period would be at least 3 to 5 years.[724]

Meanwhile, the inspection in the Chinese city became more aggressive, and SIS noticed that more and more merchants got punished in the Chinese city for their refusal to cooperate.[725] Recognizing the determination of the Chinese municipal government, SIS decided to take some precautions. Under the direct order of the council, settlement police were required to stop Chinese officials from conducting any activities concerning metrological inspection within the settlement. On the other hand, Fessenden also did not want their relationship with the bureau to deteriorate furthermore. He ordered the head of the police that "if police measures are necessary, care should be exercised not to go beyond the strict exigencies of the situation."[726]

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[723] SMA, U1-6-119, letter from American Consulate General to General Secretariat, 28 May 1931; also, letter from General Secretariat to American Consulate General, 1 June 1931.
[724] SMA, U1-6-119, "weights and measures", shanghai, July 1931, vol.XIII, no. 145, in *British Chamber of Commerce Journal*, Vol.XVI, No.7.
[725] SMA, U1-6-119, report to SIS, the sender and receiver unknown, 30 July 1931.
[726] SMA, U1-6-119, letter from Secretariat General to Police Department, 2 June 1931.

On July 3rd, under the council chairman's request, Fessenden wrote to Pan and Yu Hongjun(俞鸿钧), the then secretary of the Shanghai municipal government, suggesting a further discussion. The meeting happened on 28th and yielded promising results for the Chinese: Fessenden accepted that inspectors would be selected and sent by the bureau.[727] However, Fessenden was not in a hurry to put his compromise into reality. He denied the bureau's request for further negotiation because he was too busy dealing with "international affairs" with Japan.[728]

In November, Pan gave Fessenden a revised draft of regulations, to which Fessenden replied that the council "prepared to agree in principle along the line." However, it was possible only if the inspection was carried out in the French concession and Chinese city to "the same extent." Moreover, Fessenden expected to put the terms of a transitional period in the regulations, as the French did.[729]

Fessenden's accentuation of identical terms indicated an essential context for understanding SIS's negotiation with the Chinese. The French concession, Shanghai municipal government, and SIS constituted a triangular arena on which the pros and cons of metrological policy have been weighed. Since the beginning, SIS has kept track of the negotiation concerning metrological inspection between the French authority and the Chinese government. The SIS chairman personally wrote to the Senior Consul of the French Concession to ask about their negotiation with the Chinese. Instead of finding an ally, SIS found that the French were prepared to cooperate with the Chinese since the Chinese system was basically the French metric system, "a modern system

727 SMA, U1-6-119, letter from Fessenden to Pan and Yu, 30 July 1931.

728 "Shanghaishi shehuiju wei chengbao banli benshi tequ tuixing xinzhi duliangheng jingguo qingxing jiyu fazonglinshi qiandingbanfa xieding qing jianhe beicha cheng shiyebu" [MBWM report to the Ministry of Industry about the regulations of promoting new measures in special districts], in *Shiye gongbao*, no. 53-54, 12 January 1932, pp. 27-28.

729 SMA, U1-6-119, letter from Fessenden to Pan, 6. December 1931.

of weights and measures," no less. "Every reasonable encouragement should be given" to this "highly recommended" project. However, he also reminded SIS that a transitional period of at least 12 months was agreed upon with Chinese authorities to ensure a smooth transition. The senior consul recommended SIS do the same with the Chinese.[730]

SIS was also well aware that a regulation draft had been agreed upon between the french authority and the Chinese municipal government earlier in June. The French also sent the regulation and the minutes of their discussion to SIS under request. Five Chinese inspectors, selected by the Chinese government, could conduct a metrological inspection in the French concession with the presence and protection of French police. Under such a case, it made less sense for SIS to pick inspectors independently, which might explain SIS's sudden compromise on the issue. On the other hand, the rest of the agreement seemed to be satisfied enough, highlighting the limit of authority bestowed upon Chinese inspectors: they shall not interfere and enforce the law on-site but report to their Chinese superior, who will then negotiate with them the French. Moreover, considering the actual difficulties of promoting new measures, SIS could postpone the inspections. The violators must be warned for the first time, and law enforcers could confiscate their illegal measures only on the second violation.[731]

Chinese attitude was also an important "control group" influencing SIS's policymaking. As Fessenden later explained, the council was not against the new measures per se since "there is no strong objection on the part of the council to the enforcement by gradual stages of the law of weights and measures in the settlement." However, Fessenden was very worried about Shanghai's

[730] SMA, U38-1-1827, letter from the senior consul to the chairman of SIS, 7, July 1931.
[731] SMA, U1-3-3308, copy of the regulation, 27 November 1931.

aggressive modernizing projects characterized by rising nationalistic enthusiasm: “the Chinese authorities often exhibit much greater activity in enforcing many of their reforms in the settlement rather than in their territory. I feel that as a matter of policy, the council should insist that these reform schemes should be stated in good faith in Chinese administered territory at least concurrently with enforcing similar measures in the settlement.”[732]

While the Shanghai government’s effort to achieve an agreement with SIS continued, the French concession began to start monthly inspections in their territory. A trial inspection with only mild warnings to law violators happened from December 14th to 24th,1931. In the Chinese city, MBWM burnt the illegal measures, whereas, in the French settlement, police kept them in police stations to avoid resistance from common people. From 1932, January 19th to 28th, 2945 stalls were checked, with 412 illegal measures seized. At the same time, in Chinese-controlled areas, including Nantao, Zhabei, Pudong, and western Shanghai, 1787 pieces have been found in 1754 shops.[733]

The unexpected outburst of the Battle of Shanghai in 1932 gave SIS relief from the urging of the Chinese government. The war spread rapidly in January in the north of Shanghai, and many branches of the Chinese administration ceased functioning. Together with the Nanjing government, the Central Bureau of Weights and Measures moved to Luoyang(洛阳) to the dangers of the potential Japanese invasion.[734] Lacking direct leadership from Nanjing, plus the turmoil brought by the war, SIS noticed that inspections in French concession stopped.[735] The focus of MBWM moved from the settlement to the Chinese city after the battle. The negotiation only

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732 SMA, U1-6-119, letter from Fessenden to council general, 15 April 1932.

733 “Fazujie shougai jiucheng” [The French concession has completed 90 percent], in *Shenbao*, 21 January 1932; U1-6-119, report of assistant secretary, 5 January 1933

734 Chen Chuanling, “Minguo duliangheng shiliao liangze”[Two pieces of historical materials about metrology of the Republic of China], in *Zhonguo jiliang*, 2009, no. 11, pp. 55-56, p. 56.

735 SMA, U1-6-119, secretary general to council general, 15 April 1932.

resumed when Wu Chengluo visited Shanghai in September. Wu was rather pleased by the progress made in the Chinese town but urged the bureau to settle the terms with SIS as soon as possible, as he deemed it should not be very difficult.[736]

On December 20th, Fessenden met with chief secretary Yu again. On the issue regarding a transitional period, Yu conceded that postponing the inspection was possible if SIS saw fit. However, this could not be in written terms on the official regulation of measures, for it contradicted the Chinese metrological law and invited criticism from the public. Also, Yu brought along the statistics regarding the inspection in the Chinese city as requested by the council. The progress of inspection outside the settlement was essential for the council to decide.[737]

However, SIS was not impressed by the statistics. While the number seemed quite promising, it contradicted the information the council gathered from Chinese merchants, who "are on the whole not keen on the proposed change." SIS noticed that inspection did not develop well in 1932, particularly in Chinese areas such as Zhabei and Nantao. SIS decided that the best way to deal with this question would be "watchful waiting." Evening if inspection should happen in the future, the matter must be firstly consulted with local merchants and gain their support.[738]

After the December meeting, SIS stopped further negotiations with the Chinese government. While both maintained contact in official correspondence, the bureau indeed began to feel the response rather cold, as no meetings were held afterward.[739] SIS stayed quiet. As Chinese metrological reform became an issue, in 1930 and 1931, the market branch noticed and reported

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736 "Wu Chengluo shicha quanshi duliangheng" [Wu Chengluo came and inspected measures in the whole city], in *Shenbao*, 26 September 1932.
737 SMA, U1-6-119, "Memorandum", report of the meeting on December 20th, 1932.
738 SMA, U1-6-119, report of assistant secretary, 5 January 1933.
739 "Benshi tuixing xinzhi duliangheng zhuangkuang" [The progress of new measures in our city], in *Shenbao*, 21 February 1933.

the problem of inaccurate Chinese measures, which prevailed in the markets alongside the health problems. Under such a circumstance, SIS began to accuse inaccurate weights and measures in 1931,[740] but no evidence suggested that such a policy was in effect.

Change of Strategy: T. K. Ho and SGCC (1933-1934)

In 1933, SIS continued to ignore the requests from the Chinese and kept their watchful waiting. Rumors and distrust jumped from the Chinese city to the settlement regarding the prospect of unification. In July and August, inspection restarted in the French territory after almost a year and a half. Yu, the chief secretary, revealed to the press that international settlement would also have its inspection.[741] This piece of information resulted in misinformation within the settlement administration. Dr. Dunscombe from the healthy public department expressed his concern, hoping to get a general opinion from the general secretariat. The arbitrary declaration from the Chinese might give rise to possible conflicts in the market, which his department supervised. Mr. Winter, from the general secretariat who participated in early negotiation, instructed him to call for the police should it happen. Particularly, Winter expressed his distrust of the French as Dr. Dunscombe was considering writing a letter to the public health officer of the French administration. "Do not

[740] Gongbuju huawen fanyichu [Chinese interpretation institute of SMC], "Weishengchu baogao" [Report of the department of public health], in *Gongbuju nianbao*, 1930, p. 175; also, "Weishengchu baogao" [Report of the department of public health], in *Gongbuju nianbao*, 1931, pp. 209-220.

[741] SMA, U1-6-119, letter from Yu to Fessenden, 24 October 1933; see also, "Shi shehuiju dingqi jiancha fazujie duliangheng" [Bureau of social affairs will regularly inspect measures in the French concession], in *Shenbao*, 14 July 1933.

write to French," Winter answered, for already, "there is a written agreement in existence between them."[742]

In August, Yu urged Fessenden again to restart the negotiation. The French concession's cooperation was mentioned as the reason for SIS's approval, hoping the international settlement could follow suit. Yu ensured him that the French had enforced Chinese metrological law entirely there.[743] Fessenden later wrote to French to check the authenticity of Yu's information. It turned out that the French were not happy with their arrangement with the Chinese: in Fessenden's "confidential information," the French concession had suspended the execution of the measures. The reason was similar: they noticed that the Chinese had not enforced the measures satisfactorily in the Chinese city. [744]

While the governmental negotiation was stuck in a dilemma, an essential change of strategy appeared from the Chinese side. Instead of the Chinese municipal government, the merchants, and commercial organizations, particularly Shanghai's General Chamber of Commerce (hereafter SGCC), became the principal negotiators in 1934. It seemed a clever strategy. One the one hand, SGCC maintained a more mutual status in the settlement. Since SIS was a highly commerce-oriented administration, SGCC maintained a generally friendly relationship with the foreign authority.

One the other hand, SGCC also had broad membership in the settlement, which enabled it to pass along the order of the Chinese state to members across the colonial border. SGCC had earlier

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[742] SMA, U1-16-504, letter from Dunscombe to Winter, 10 July 1933; letter from Winter to Dunscombe, 10 July 1933.
[743] SMA, U1-16-504, letter from Yu to Fessenden, 24 October 1933; also letter from Fessenden to French council, 1933. 10.26.
[744] SMA, U1-16-504, letter from French council to Fessenden, 3 November 1933.

cooperated closely with the Chinese municipal government in the Chinese city.[745] Therefore, at the beginning of 1934, the Shanghai Union of Stall-keepers in Various Markets(上海第一特区菜场摊户联益会) pleaded to the Department of Public Health (hereafter DPH), who supervised the municipal markets in the settlement. The union stated that miscalculated old and new measures led to many market disputes. Moreover, the Chinese municipal authority also urged it to promote the new measures among its broad members, who were conducting business in settlement markets. Thus, they asked permission to send their officers to markets, persuading stall-keepers to switch to new measures.[746] Since the union already made a deal with measure manufacturers in the Chinese city, stall-keepers could have a 10% discount. But to do so, the union needed to establish its stores in the markets. The union then wrote to settlement police for protection during their mission. The union alleged they had obtained the concurrence of most of the stall-keepers in the various markets.[747]

While the secretariat was somewhat open to this proposal and promised early reply and cooperation from the police department, both public health and police departments ignored the union's demand. In an internal discussion within the administration, DPH violently opposed the proposal. Instead of granting the union protection, DPH urged the police department to stop anyone who forced Chinese stallholders to purchase measures, for the mere appearance of the police would make the wrong impression on the stall-keepers that the SIS was helping the union

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745 *Zhu Ying, Shangmin yundong yanjiu(1924-1930)* [Studies on commercial citizen movement], Beijing: Beijing University Press, 2011, particularly chapter 7 and 8; Fang Weiguo: "Jindai shanghai tongye gonghui yu zongshanghui, shishanghui zhiguanxi" [Relation of Associations and General Chamber of Commerce or Chamber of Commerce in Shanghai], in *Shanghai jingji yanjiu,* 2014, no.3 pp.79-88; Xu Dingxin, "Cong shengshang shidai zouxiang qiyejia shidai; jindaihua Jincheng zhong de Shanghai zongshanghui" [From gentry-merchants to entrepreneurs: Shanghai's general chamber of commerce in the process of modernization], in *Jindaishi yanjiu*, 1991, no.4. pp39-68; Ma Min, *Guangshang zhijian* [Between merchants and officials], Tianjin: Tianjing renmin chubanshe, 1995.

746 SMA, U1-16-504, letter from Shanghai Union of Stall-keepers in Various Markets to public health department, 26 January 1934.

747 SMA, U1-16-504, letter form the union to public health department, 28 February 1934.

to enforce the purchase.[748] As the proposal was suspended for the moment, the secretary of SGCC, Shen Zhongyin(沈仲英), met up with the assistant secretary, T. K. Ho(Te Kui Ho, 何德奎). Shen pleaded this case to Ho, hoping the latter could wield some influence to allow the union's officers to enter the markets.

Shen came to the right person. T. K. Ho was vital in SIS's policymaking on Chinese affairs in the settlement.[749] Educated in the United States as a business specialist, Ho first served as the secretary of the Chinese Ratepayers Meeting in Shanghai in 1928.[750] Three years later, Ho began working with the SIS general secretariat as the representative of the Chinese Ratepayers' meeting.[751] Ho went even further on the colonial ladder of bureaucracy in 1931 when Ho officially became a standing member of the general secretariat, a status unique in his time.

It was important to note the context behind Ho's nomination. Partially due to the rising tides of nationalism since the 1920s in the settlement, the Chinese community constantly demanded to include the Chinese in the higher echelon of colonial administration. In 1928, the Chinese Ratepayers Meeting elected three Chinese business leaders to enter the SIS's municipal council. At the beginning of the 1930s, SIS reluctantly admitted two more Chinese entered the council, plus 5 or 6 Chinese serving in various committees.[752]

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748 SMA, U1-16-504, letter from the public health department to general secretary, 6 March 1934.

749 Not like the Chinese Ratepayers' meeting founded in 1920, the new meeting was more representative, including Chinese representatives in both international settlement and the French concession. Moreover, it was more determined to wield a Chinese influence in the administration in SIS. Li Dongpeng, *Shanghai Gonggongzujie Nashuiren Huiyi Yanjiu* [Study of Chinese Ratepayers' meeting in Shanghai international settlement], unpublished Master thesis, Shanghai Academy of Social Science, 2013, pp. 83-91. For more information on Ho, see a short biography in *Who's Who in China, Biography of Chinese Leaders,* Shanghai: *The China Weekly Review*, 1935, p. 82.

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751 "Gongbuju dongshihui ji" [The records of SMC meeting], in *Shenbao*, 6 June 1931.

752 Shanghaishi dangangguan, Gongbuju dongshihui huiyilu [The minutes of Shanghai Municipal council], vol.24, p. 503, p. 590.

The general secretariat that Ho served from 1931 was at the top of the colonial administration, which represented and was responsible to the SIS and managed all daily administrative matters. The head of the secretariat was a general secretary, under whom were two deputy secretaries, and also Ho, who was a Chinese “assistant secretary” (会办).[753] However, to the Chinese in Shanghai, Ho was called in newspapers the “Chinese general secretary” (华人总办). Though there was no such position, nor was Ho a general secretary, Ho was nevertheless one of the top representatives of Chinese interest within the settlement at the time. In 1937, Ho was promoted officially to deputy secretary and began to take charge of Chinese affairs, public health, and education in SIS.[754]

As one of those few Chinese elites with a high official position in SIS, Ho played an important role in the constellation of negotiations between SIS and the Chinese government. Ho participated in the meeting with BSA at the end of 1932. With his information from SGCC and his direct advice, SIS adopted a “watchful waiting” policy in 1933. However, it is wrong to assume that Ho’s position in colonial authority rendered him a pure instrument of colonialism. Quite the contrary, Ho smartly exploited the advantage of his position and protected the interests of the Chinese in the settlement when he could. For example, in 1931, Ho was able to grant the Chinese the right to establish and manage Chinese primary schools in the international settlement. Following his first triumph in 1932, Ho also persuaded the French and SIS to lift the iron gates that blocked the Chinese refugees for 24 hours, letting them enter the settlements during the Battle of Shanghai.[755]

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753 Ruan Ducheng, Zujie zhidu yu Shanghai gongong zujie [institution of concessions and Shanghai international settlement], Shanghai:Fayun shuwu, 1936, p. 111.

754 Shen Lan, “Babai zhuangshi weihe meineng chechu shanghai?”, in Wenshi yuekan, 2011, no. 2, pp. 15-16. See also, “He dekui shenren gongbuju fuzongban” [Te-kui Ho was promoted as the deputy secretary], in *Shenbao*, 19 June 1937.

755 “Introduction”, materials offered by Heshisanjie chenglieguan [Museum of He’s three Champions], Jinhua. See also, Gong Jianfeng, “Jinhua heshi sanjie”, https://wenku.baidu.com/view/d17271b8cfc789eb162dc800.html,

T.K.Ho (1896-1983)[756]

Ho swiftly began his lobbying. On March 15th, Ho met up with his direct superior, general secretary Jones. Jones gave Ho a sympathetic answer: he had no objections to the union selling measure in Markets as long as the purchase was not a result of compulsion. On the same day, Ho visited Dr. J. H. Jordan, commissioner of DPH. Jordan also opined that selling of measures itself on voluntary terms was acceptable.

However, losing control of the markets was a different matter. Jordan noticed that Shen and SGCC were also collecting membership fees among stall-keepers in his markets. “If we were not very careful,” Jordan told Ho, “We might have to appoint Mr. Shen as market manager.” It was on this ground that Jordan viewed the whole matter very seriously. He noted that at the moment,

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[756] Ping-ti Ho, Dushi yueshi wushinian[Fifty years of reading history and the world], p. 17. T. K. Ho was a relative of the renowned historian Ping-ti Ho (何炳棣). According to Ping-ti Ho, T. K. Ho was a well-respected member of the He family in Jinhua (金华), who also subsidized Ping-ti Ho’s study in Tsinghua University in the 1930s and advised him to further it in the United States. Another member of the family, He Bingsong (何柄松), was too a leading historian in Peking University since the 1920s, who was best known for his promoting of “new history” (新史学), which advocated the confusion of academic tradition with western historiography. Together, Ping-ti Ho, T.K. Ho and He Bingsong are known in modern times as “He’s Three Champions” (何氏三杰). Because T. K. Ho continued to serve in SIS during the Japanese occupation, he was charged with treason in 1945. See Ping-ti Ho’s autobiography, *Dushi yueshi wushinian* [Fifty years of reading history and the world] pp.12-22. Also, Shen Lan, “Babai zhuangshi weihe meineng chechu shanghai?” [Why the Eight Hundred Braves failed to leave shanghai], in *Wenshi yuekan*, 2011, no. 2, pp. 15-16.

stall-keepers unions or guilds held a good deal of market control. Knowing the connection between Ho and SGCC, Jordan threatened that he might have to "take steps."

In particular, Jordan was also very suspicious of establishing store selling measures in the markets, which were more like small headquarters to fasten Shen's control. Jordan could not understand why association members could not go to Shen's shops or offices and purchase their weights outside the markets. Ho asked the same question to Shen, and the answer was more of an excuse: Shen alleged that in the early morning, all storekeepers in the markets were at work and therefore were too busy that they "had no time to spare." Jordan laughed at this explanation: as far as he knew, the Chinese, "if they could obtain an article that they needed at 10% discount, they would go within any reasonable distance to make the purchase."[757]

Ho's activities resulted in vain. Secretariat took DPH's opinion. After all, the proposal from Shen and the union smelled too much of the Chinese government. In March, the secretariat addressed to the police again that Chinese officials and their other "agents" should not be permitted to function in the settlements, and police should provide protection against any coercive measures on the part of Chinese associations or others. However, "in view of the many issues between the council and the Shanghai municipal government which give rise to friction and irritation," it was not "wise or expedient for the council to oppose too actively." This attitude was based on the belief that "the ultimate adoption of the new weights and measures which probably will work itself out"[758] Jordan opined that "all we have to do is to 'sit pat.'"[759]

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[757] SMA, U1-16-504, notes on an interview between Dr. Jordan and Mr. T.K.Ho, 15 March 1934.
[758] SMA, U1-6-119, letter from Secretary Jones to public health department commissioner, 16 March 1934.
[759] SMA, U1-16-504, letter from chief health Inspector of markets bakeries etc. to commissioner of public health, 18 August 1934.

In principle, SIS's strategy of careful watching meant that SIS had no problem allowing individual storekeepers to use new measures as long as it did not threaten the order and its control in the market. On October 25th, stall-keepers asked permission to use new measures, for which the DPH answered that they could do it without considering the opinion of SIS.[760]

What's tricky here is that it is difficult to define an "individual" merchant's voluntary purchase of new measures. In the French concession, evidence showed that the change of market measures was actually organized and ordered by MBWM directly through the SGCC and its member guilds.[761] The situation went for international settlement as well. In November, the storekeepers in Fuzhou and Peking Road reported that Ren Hongsheng (任荣生), a fish dealer in the Hongkou market, convened a meeting with his peers. The meeting also invited officials from KMT headquarters and the Chinese government, with the help of some influential Chinese in the settlement and the French concession. When the meeting happened on November 24th, representatives of the Chinese police also appeared. DPH sent a disguised Chinese cadet inspector to the meeting. The information gathered was that stallholders should buy measures from KMT headquarters nearby, and in the markets, customers should also be "persuaded" to use measures.[762]

However, there was not much to be done, as SIS slowly lost control of the markets. These activities with Chinese governmental background were quite common in its territory and extremely difficult to forbid, which SIS termed "a hardy perennial."[763] In January of 1935, Ren sent his lawyer to ask permission from the council to allow storekeepers to switch measures. Ren

[760] Ibid.
[761] SMA Q173-36-68, letter from BSA to SGCC, 8 July 1933, pp. 148-150.
[762] SMA, U1-16-504, letter from K.J. Woo, cadet health inspector to H.T. Woolley, health inspector, 27 November 1934.
[763] SMA, U1-16-504, notes on the report of 27 November 1934, exact time unknown.

alleged himself the representative of around 24 markets in the city. Although SIS knew the Chinese government was looming behind the scenes, it nevertheless acquiesced to Ren's demand as long as no coercing happened, and it was out of the will of individual merchants.[764] Ren's agents entered the settlement markets in January and February and sent out propaganda pamphlets to storekeepers. They also collected storekeepers' signatures of consent that they promised to adopt new measures. Though Jordan was apprehensive about this "canvassing in our markets," no steps have been taken to prevent such activities.[765]

DPH had long found out these activities were neither individual nor without coercion. Health inspectors and Chinese cadet inspectors were stationed in every market. DPH understood the nature of these activities well. In April 1935, DPH's report to SIS clearly showed that the Chinese authority had ordered Shanghai stall-keepers union, in lieu of itself, to conduct propaganda among stall-keepers in the settlement. "For the past few months," the inspector reported, "union officials in conjunction with so-called representatives of stall keepers of various markets have approached the stall keepers and requested them to adopt the new system and at the same time collected 20 or 40 cents from each as bargain money for a pair of new scales. These scales are priced at 0.8, 1.0, and 1.2 Yuan per pair. The majority of the stall keepers are not willing to agree to the change but are being annoyed with the repeated calls made by the union officials." Another report pointed out that the number of shops that paid the bargain was at least 282 in five settlement markets.[766]

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[764] SMA, U1-16-504, letter from S. T. Maitland (lawyer of Ren) to secretary of SIS, 8 January 1935; letter from deputy secretary to Maitland, 10 January 1935.
[765] SMA, U1-16-504, letter from inspector to commissioner, 18 January 1935; report of inspector, 1 February 1935.
[766] SMA, U1-6-119, report to council, 23 April 1935.

Coercive or not, the new strategy of the Chinese worked. Evidence showed that more and more storekeepers in the settlement switched their measures in 1935. Based on the reports of his inspectors, the change in markets led Jordan to believe that "the time is ripe to collaborate with the government authorities." On the other hand, allowing propaganda activities threatened SIS's control of markets, damaging the council's authority. The simplest solution for Jordan was to grant the Chinese what they long asked for, namely, "a stall be made available in all the larger markets for the sale of these new weights and measures." Chinese will then have no reason to keep their propaganda in the markets.[767] In May of 1935, stores opened in the settlement markets. At the same time, DPH notified the storekeepers that these stores were not allowed to coerce the sale, nor should they conduct any activities related to the inspection of illegal measures.[768]

Shanghai municipal government noticed the softening attitude of the settlement. In July, they approached again to propose the inspection in the settlement. SIS again consulted with the French. After getting their answer that the law was now being enforced satisfactorily in the French concession,[769] in October, SIS agreed to introduce "an experiment." Not to give any excuse for intervention from the Chinese, SIS added an extra entry to SIS's existing licensee regulations. A Chinese licensee of any stalls, when selling to a Chinese customer, used only weights, measures, and scales prescribed by the Chinese government. If the implementation of such regulation in municipal markets were ideal, then the rule would extend to private markets and other licensed stores in the settlement.[770] However, SIS decided that "no form of written agreement should be

[767] SMA, U1-16-504, letter from commissioner to secretary, 6 May 1935.
[768] SMA, U1-16-504, letter from secretariat to the factory, 24 May 1935.
[769] SMA, U1-16-504, "memorandum to watch committee", record of July 1935.
[770] SMA, U1-16-504, letter from acting secretary to commissioner, 1 October 1935.

entered into" with the Chinese authorities, and no inspectors outside were allowed into the settlement.[771]

In many ways, such a plan was far from ideal for Chinese authorities. First, foreign measures were still allowed. In the beginning, SIS considered prohibiting any measures that were not accorded with Chinese law. However, Jordan argued that the interests of stallholders who, for many years past, have sold almost exclusively to foreigners using English weights and measures and Japanese stallholders or licensees who used measures of their homeland.[772] Also, the French concession informed SIS of its policy that Chinese merchants were permitted to employ weights and scales with English graduations when dealing with foreigners.[773] This policy was started in the concession in 1933 when Chinese inspectors confiscated the English scales of several Coffee houses and Butcheries and caused some protests.[774]

This policy ignited the direct conflict between Ho and Jordan, and Jordan insisted upon allowing old Chinese measures. For decades, SIS served as a silent night-watcher who took a "laissez-faire" attitude towards economic activities in the settlement.[775] For Jordan, any attempts to intervene in the regular order of the markets would be fruitless. When Chinese customers still use old measures in the markets, "to expect to coerce these hundreds of persons without producing very grave trouble is not feasible." He opined that this observation extended outside the settlement or

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771 SMA, U1-16-504, "memorandum to watch committee", record of meeting in August 1935.
772 SMA, U1-16-504, letter from commissioner to acting secretary, 23 November 1935.
773 SMA, U1-16-504, "memorandum to watch committee", record of July 1935.
774 SMA, U38-1-1827, letter from the union of beef and mutton to French municipal council, 25 August 1933, pp. 61-62; Ninbo association of fellow townsmen to French municipal council, 27 August 1933, pp. 65-67.
775 Fan Guo, Mosheng de shouyeren: *Shanghai gonggong zujie gongbuju jingji zhineng yanjiu* [The lonely night wather: a Study on SMC's Economic Policy], Tianjin: Tianjin gujichubanshe, 2012.

Shanghai and was not confined to the issue of the measure itself: any "rigorous" approach from authorities would surely result in failure.

His relatively liberal idea of economics led Jordan to believe introducing new measures did not necessarily mean a prohibition of the old measures. In other words, an addition was O.K., subtraction not. A "gradual education" was needed: storekeepers must be allowed to use old measures when required by the customers, and only after an extended period, using only new measures would be mandatory.[776]

On the other side, Ho was excluded from earlier meetings in 1934 between the Chinese municipal government and SIS but only joined the discussion later. It was needless to say that Ho was all for this "little experiment" and battled Jordan fiercely. Ho agreed that an eight-month period was necessary to give customers enough time to react. However, Ho believed the stall-keepers were using inaccurate old weights, which forced their customers to bring their old measures to check the balance. New regulations should create confidence in new measures in the mind of the purchasers and thus gradually obviate the necessity of using old measures. If the stall-keepers were required to keep a set of new weights while being permitted to use the old weights, the old inaccurate weights would most likely continue to be used by purchasers and sellers. The present unsatisfactory state of affairs would remain.[777]

Other practical problems also came to the surface with the discussion. First, the DPH did not have enough man-source to enforce the regulation. Approximately 7400 stores were in the settlement in 1935, and checking their measures was a mission impossible. The department regularly checked

[776] SMA, U1-16-504, report from commissioner to acting secretary, 2 October 1935.
[777] SMA, U1-16-504, letter from assistant secretary (T.K. HO) to acting secretary, 12 October 1935.

foreign measures in the markets, not the Chinese ones, for "the obvious reason" that both parties in Chinese transactions weighed their purchases.[778] The number of stores using Chinese measures and the sheer quantity of the Chinese measures in the markets were times larger than foreign measures, which was beyond calculation and the department's ability.

Secondly, the new weights were lighter than the old ones. The prices would fluctuate as they were entangled with the measures, but Ho was optimistic that the sellers and buyers themselves would adjust. Jordan regarded it as a threat to an orderly market, for the customers would claim that "they have been swindled out of the difference of weights." It also created a practical problem in setting the prices and brought disputes among buyers and sellers. As Jordan explained:

> "It is clear that, supposing an article costs, shall we say, two cents per Chinese Catty[779] and the kilo is one and two-thirds Chinese Catties, it would become extremely difficult to sell the article at three and one-third cents. And arguments will immediately arise as to whether the article should be sold at four cents per kilo, as the dealers will, needless to say, attempt to do, or three cents which will be the desire of the customers."

Without changing the prices according to new measures, Jordan concluded that the natural result was "nearly poorer households" since "dishonest stall-keepers" would quickly take advantage of the situation.[780]

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778 SMA, U1-16-504, letter from commissioner to secretary, 6 March 1934.
779 Catty here was old Chinese measure of weight, Liang(两).
780 SMA, U1-16-504, report of commissioner, 16 October 1935.

It seemed that Ho was correct. Stallholders only perfunctorily purchased a set of new measures but kept using the old ones in secret. Shen Tsu-Shung (沈祖生), who was in charge of SGCC's measures factory, informed Ho that he had sold some 2000 new weights to stall-keepers since his stores opened in the markets. Considering there were approximately 7400 stalls in the settlement, this was hardly impressive. Shen also observed that sold new measures were not in regular use.[781]

Admittedly, Ho's advocacy of the prohibition of old Chinese measures made him look like a Chinese government lobbyist. On the other hand, Jordan criticized Ho's "theoretic" understanding of the markets. Frustrated by the discussion as it increasingly leaned towards Ho's favor, Jordan wrote to the secretariat that he would not take responsibility should the new policy fail. After all, DPH had demonstrated its ability before in many activities so that "a little more stress might be placed on our practical experience."[782]

It seemed that Jordan's succeeded eventually. The meeting on November 1st decided on a notice issued to settlement markets on December 28th, 1935. A transitional period came into effect that both new and old measures would be allowed, which, according to Jordan, served as a "feeler" to the general sentiments of the markets to see whether the public could adjust themselves to the stall-keepers using new measures.[783] The only progress that Ho made was a warm warning: after the end of the transitional period, old measures "may not" be allowed.[784]

It is important to note the efforts of SGCC and T. K. Ho. in the lengthy negotiations between SIS and the Chinese municipal government. They acted as "colonial middlemen," agents who dwelled

781 SMA, U1-16-504, letter from assistant secretary to acting secretary, 23 October 1935.
782 SMA, U1-16-504, letter from commissioner to acting secretary, 26 October 1935.
783 Ibid.
784 SMA, U1-16-504, "Memorandum to watch committee", report of the meeting on 1 November 1935.

on the ambiguous place between the Chinese state and colonial powers and successfully mediated the bitter collision of both sides. Despite allowing the reform to enter the settlement, DPH's adamant attitude to maintain its grip on colonial markets raises the question: what was so important about the markets?

Markets and Hawkers

Simply put, if colonialism is a lifestyle, markets are at the center of it. In Shanghai, due to the commercial prosperity of the Ming and Qing Dynasty, the form of markets had already transited from weekly or monthly fairs to regular markets with fixed locations in the city before the arrival of colonizers.[785] In the 1850s, there were no markets in the settlement, as the small population and the policy of colonial segregation created no such needs. Food agencies and hawkers delivered goods directly to doors in the settlement.[786] The political turmoil in the late Qing, such as the Small Sword Society Uprising (1853-1855) and Taiping Rebellion (1851-1864), led to the pouring of Chinese refugees into the settlement. In 1865, the population of International Settlement and the French concession reached more than 130,000.[787] Food Markets emerged near Yangjinbang (洋泾浜), the border area between the settlement and the concession.[788] However, neither colonial

[785] Fan Shuzhi, Mingqin jiangnan shizhen tanwei [A Study on Cities and Towns in Jiangnan Area during Ming and Qing Dynasties], Shanghai: Fudan daxue chubanshe, 1990, pp. 17-26, p. 35.
[786] Tang Yanxiang, Chu Xiaoqi, *Jindai shanghai fandian yu caichang* [Restaurants and Food Markets of Modern Shanghai], Shanghi: shanghai cishuchubanshe, 2008, p. 272.
[787] *Shanghai tongzhi* [A General History of Shanghai], vol.1, Shanghai: Shanghai shehui kexue yuan chubanshe, 2005, p. 660.
[788] Yuan Hengquan, *Shanghai fushipin shangyezhi* [Commercial history of Shanghai's non-staple food industry], Shanghai: Shanghai shehui kexue chubanshe, 1998, p. 106.

nor Chinese authorities administered these markets: hawkers and peddlers gathered alongside the roads, which hindered transportation and endangered public hygiene.

Municipal markets at its birth were tainted with a strong hue of colonialism. Sir Thomas Hanbury(汉璧礼), a successful real estate developer who later entered the municipal council, saw the opportunity to bring western-style markets to Shanghai. Hanbury happened to own land property on Ningxing road (宁兴路, Rue de Weikwe) in the French concession near the markets. In 1864, Hanbury partnered with a French naval priest who owned a piece of land on the road and opened the first western market in Shanghai. The market provided hawkers with an open ground with several arch shelters. Hawkers could have a regular spot in the market after paying the due rent. The enterprise, however, failed for the lack of tenants, against Hanbury's hope that, by solving the problem of transportation and attracting the population around the market, the value of the nearby land property might also rise.[789]

In retrospect, Hanbury was correct concerning the potential of such markets. The ending decades of the 19th century witnessed the continuing growth of the population in Shanghai and the expansion of colonial territories. Providing modern public service and transplanting the western lifestyle into Shanghai became one of the significant needs of the colonial ruling. In 1892, SIS constructed its first municipal market in Hongkou (虹口), which remained the biggest market in the 1930s. At the beginning of the 20th century, the number of markets grew to seven. In the 1930s, when the metrological reform came to the markets, 17 municipal markets in the settlement

[789] Chu xiaoqi, "Jindai Shanghai caichang yanjiu" [A Study on the Food Market of Modern Shanghai], in *Shilin*, 2005, no. 5, pp. 107-115, p. 108.

had been established.[790] In the French concession, 14 municipal and private markets served the needs of the relatively smaller population there by 1937.[791]

Markets in the 1930s were no longer Hanbury's shabby construction but a show window of modern colonial life. SIS rebuilt and expanded the markets throughout time. Like a department store, municipal markets were two- or three-store cement buildings with glassy domes to induce the light, elevators, and big refrigeration houses.[792] Each floor held several booths for tenants. While the rent of the lower level was relatively cheaper for small stall-keepers, the upper level was better decorated, even with restaurants where Shanghai-landers could enjoy western cuisine, or in the words of contemporaries, "Big Dish" (大菜).[793]

In 1932, SIS set up the official regulation of the markets, and only registered tenants with certificates could conduct business in the markets. To protect public hygiene and promote the western idea of animal protection from prevailing vice among Chinese dealers and hawkers, SIS forbode the following activities in the markets: spitting, taking naps within the booth, bringing animals inside, and butchering animals (except for poultry under the condition that the birds were treated "humanely" in the process)[794]. Similar regulations also were implemented in the French concession. In the Chinese city, the municipal government followed the heels of colonial

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790 As the international settlement expanded from east to west and south to north, in 1935, there were 8 markets in east area, 4 in north, 2 in the central, and 3 in the west. Their policy was to ensure each area had one big municipal market and several smaller ones. Shanghai gongbuju huawenchu, "Weishengchu baogao" in *Shanghai gongbuju nianbao*, 1930, p. 175; also, "Weishengchu baogao", in *Shanghai gongbuju nianbao,* 1935, pp. 400-402.

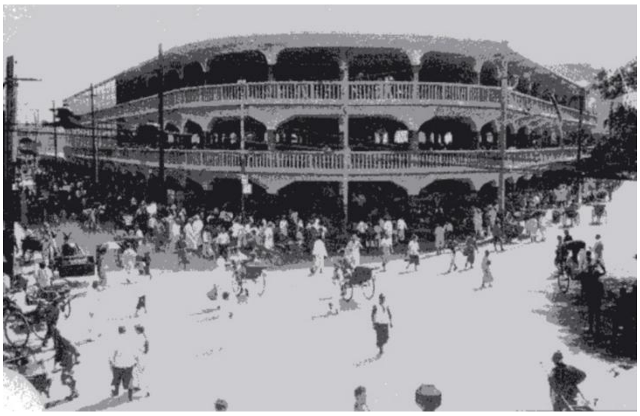
791 Chu, "Jindai Shanghai", p. 110.

792 Fuzhou market was a good example as such. Yuan, *Shanghai fushipin shangyezh*i, p. 107

793 "Shanghai baijing: shiwu hongkou xiaocaichang" [A hundred scenes in Shanghai: No.15, the small market in Hongkou], in Xu Daoming, Feng Jinniu eds., *Lin Weiyin xuanji* [Selected works of Lin Weiyin] Shanghai: Hanyu dacidian chubanshe, 1996, pp. 151-152.

794 "Gonggong zujie gongbuju gonggong caichang zhangcheng" [SMC's regulation of municipal markets] (26 June 1931), in Shi Meidin, *Shanghai Zujiezhi* [History of settlements in Shanghai], Shanghai: Shanghai shehuikexueyuan chubanshe, 2001, pp.705-706.

authorities, set up a similar rule, and ran their markets. On the eve of the Sino-Japan war, the total number of markets reached 47.[795]



Hongkou market in 1927 (Virtual Shanghai, picture ID: 1537, source: Takatsuna Hirofumi, Chen Zu'en, Riben qiaomin zai Shanghai (1870-1945), 2000, p. 43)

Fuzhou Market in 1928, (Virtual Shanghai, picture ID: 1667, Source: Shanghai lishi bowuguan ed., Survey of Shanghai 1840s-1940s, 1992, p. 175)

[795] Yuan, *Shanghai fushipin shangyezhi*, p. 107.

The colonial background of markets made it one of the most pivotal bustling spots of social life for both Chinese and foreigners. John B. Powell, who later became the chief editor of Shanghai's major newspaper, *Millard's Review,* recorded his impression of the markets when he first came to Shanghai in 1917:

> "Most of the housewives were accustomed to visiting the Hongkew Market conducted by the municipality. Many housewives experimented with native vegetables and discovered that they were superior to familiar American items. The market was quite sanitary and provided every possible item of foreign and domestic food. I was told that the market greatly resembled the Fulton Market in New York City, except for the difference in food items. A visit to the market was almost a social event because women would meet their friends there and compare notes as they visited the various stalls."[796]

The curiosity of purchasing exotic goods, which excited western housewives in Shanghai, embodied the semi-coloniality in markets. People and goods converged as markets catered to the needs of all sorts of customers, either western housewives or Chinese ones. As a local writer, Lin Weiyin (林微音) recorded:

> "The sky became light, yet in Hongkou Market, bulbs remained to reflect its light[...]The stores selling Russian bread started to sell[...]besides the stores selling Chinese

[796] John B. powell, *My twenty-five years in China*, New York: the Macmillan Company, 1945, p.39.

bread[...]Japanese Tofu wrapped in green paper, Chinese Tofu laid down on the slates[...]All the stalls on the third floor were for the cooked food, western and Chinese [...]The track of the Shanghai Volunteer Corps[797] came, and two or three men jumped out of it and went to get what they needed in the market. Western housewives and Japanese kitchen maids came afterward. At last, came Chinese maids; sometimes, they followed their mistresses. It is the climax of Hongkou Market."[798]

The demography of the customers and the goods suggested that Japanese, English, and Chinese measures appeared simultaneously in the markets. In other words, colonial markets were also colonial metrologically. The metrological diversity and the openness of colonial markets served as a sharp contrast to metrological nationalism, which was crystalized as "one nation with one measure."

For this reason, DPH adamantly insisted on keeping foreign measures and metrological diversity after it consented to the unification of Chinese measures (and Chinese measures alone) in the markets after 1935. However, this is not to say that the Chinese government was the only opposition to SIS's non-intervention policy. As Witold Kula put it simply in his study on European historical metrology in the Middle Ages, "the notion of measure is associated with cheating" from time immemorial.[799] Shanghai made no exemption of it, as the inaccurate measures constantly displeased foreign settlers. In 1910, a reader wrote the chief editor of *North China Daily,* complaint

797 Shanghai Volunteer Corps was a paramilitary organization stationed in the international settlement. It first originated in 1853 to defend the settlement during Taiping rebellion. It continued to operate under the guide of SIS until 1943.
798 Lin Weiyin, "Shanghai baijin", pp 151-152.
799 Witold Kula, *Measures and Men*, Princeton: Princeton University Press, 1986, p. 3.

that western housewives found the “short weight” of market goods due to the inaccurate “tiny little balance of the scale.” “Who would have thought it,” the reader commented. The colonial metrological experience served as a comparison that reminded him of Britain: “at home, it is different, where you have inspectors going their daily rounds, adjusting and inspecting scales, etc.” The reader, in the end, proposed to examine scales.[800] Similarly, another letter came with a far more serious tone:

> “[…] the supervision of weights and measures in Shanghai is nothing short of a scandal. Chinese shopkeepers are permitted to cheat their foreign and Chinese patrons to no small degree. There are hundreds of Chinese shopkeepers here doing a trade with foreigners who do not even possess a scale that weighs in pounds and ounces, though they sell their goods by the pound.”[801]

Foreigners, as the author continued, easily fell for the schemes of Chinese shopkeepers, almost like a “bared-face robbery.” That Chinese shopkeepers did not “possess a scale that weighs in pounds and ounces” may be a false impression. As mentioned before, many Chinese steelyards in Shanghai were engraved with English and Chinese metrological marks on the same beam, which enabled it to weigh both in Chinese and English units. Indeed, the Chinese steelyards or beam-

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[800] Rubber Broke, “Weights and Measures”, in *The North China Herald and Supreme Court & Consular Gazette*, 14 October 1910.
[801] Austral, “Weights and Measures”, in *The North China Herald and Supreme Court & Consular Gazette*, 27 July 1929.

scales were not trustworthy in the eyes of foreigners, along with the commercial integrity of the Chinese:

> "at present a small basket dangling at the end of a stick bearing notches or marks and a small weight which may be made to slide up and down serves many a shopkeeper to weigh out so many pounds of potatoes or other goods to the trusting foreigner, who is assured that 'belong five pound proper,' only to find when he checks the weight with his scale at home that he is about a pound and a half short."[802]

The author, in the end, suggested that the council issue licenses to shopkeepers to see that they were provided with "a standard scale of good make bearing a seal or stamp of the council and that such scale be regularly inspected and tested for discrepancies." However, we haven't seen any response to address the problem. The inaction of DPH might also be due to the dealing habit of Chinese customers in these markets. Our angry foreigner, after all, was not an experienced visitor to colonial markets. For a Chinese who lived in Shanghai in the 1930s, measures were indispensable for everyday market life. It might be surprising for the modern readership that measures were common household items. As Jordan, head of DPH, noted:

> "A short walk through any market will reveal the following facts: that the customer watches the stallholder weighing the article purchased, thereafter the purchaser, using

802 Ibid.

his or her own weights, checks up on the weights[...]There are some thousands of customers using their own form of weight."[803]

DPH hesitated to take action as it was impractical to persuade every Chinese customer out of their measure-carrying habit. DPH indeed considered addressing the metrological chaos and shaking the Chinese habit when the Chinese municipal government brought the issue to the table. In 1928 and 1934, the superintendent of the market branch of DPH sent requests to "home" (Great Britain) to ask whether it was possible to train inspectors of measures there. The answer was at least two years. A very old guild in Scotland, "the sworn meters and readers," offered training and test in only two weeks and was recognized anywhere in Britain.[804] However, the problem was that keeping a trained inspector dedicated to measures in every market was very expensive.[805] Also, the difference between the motherland and China was that "this work is easier in Great Britain because the bargaining habit is not so strong there, and weights and measures have been the subject of years of inspection."[806]

DPH also tried to draw wisdom from colonial experiences in other regions to solve the problem in China. When the superintendent traveled to Durban, South Africa, and Manila markets during his vacations, he noticed that a set of calibrated measures was kept in these markets for public use so that visitors did not have to bring their measures. Indeed, in British Malaya, particularly in the 1920s, the local colonial authority paid more attention to catering to customers' needs in the

803 SMA, U1-16-504, report from commissioner to acting secretary, 2 October 1935.
804 SMA, U1-16-505, letter from superintendent of inspectors to commissioner, 1 May 1940.
805 SMA, U1-16-504, letter from commissioner to general secretary, 7 May 1940.
806 SMA, U1-16-505, letter from commissioner to general secretary, 15 July 1940.

markets, and such public measures were placed. Many of these public measures were also of Chinese origin. The popular use of *Daching*(大秤) or *Liteng*(厘戥) was the result of the strong presence of the oversea Chinese commercial community, which also dominated in local manufacturing of measures in Singapore, Selangor and Vong Sam. However, the arrangement did not work because many of these public measures were worn out through overusing and lost their accuracy.[807] In Shanghai, DPH turned down the proposal of providing public measures in the markets. To take care of these measures, DPH still needed to hire a person in the market who could not be a "regular market coolie" but a Chinese "cadet type," which was impossible considering the staff and budget situation.[808]

In other words, SIS's municipal market in 1936 was a metrological haven where neither DPH nor MBWM administered metrology effectively enough. And it was in the context of colonial markets that the problem of hawkers became central in 1936 between the foreign and Chinese authorities. Generally speaking, hawkers should not attract the special attention of colonial authorities, as they were a typical scene in Shanghai. Peddlers and hawkers carried with them all kinds of goods. Among newspapers, food, toys, flowers, fresh vegetables, rice, salt, needles, thread, socks, handkerchiefs, towels, soap, cigarettes, mats, and bamboo poles (for hanging out clothes to dry), measures were in the inventory also.[809]

However, as old measures became illegal in the Chinese city, the markets in the settlement became a safe island to the hawkers who sold measures. In 1936, they were rampant. Health

807 Por Heong Hong and Tan Miau Ing, "Contested Colonial Metrological Sovereignty: The daching riot and the regulation of weights and measures in British Malaya", in *Modern Asian Studies*, vol. 56, no. 1, January 2022, pp. 407-426. On *Daching* and *Liteng*, see p. 412, footnote no. 12. On public measures in markets, see pp. 421-423. Even after Malaysia fully implemented the metric system in 1972, Chinese catty or 斤, and *tahil* or 两 are still in use.

808 SMA, U1-16-504, letter, 1 May 1940.

809 Hanchao Lu, *Beyond the Neon Lights: Everyday Shanghai in The Early Twentieth Century*, Berkeley: University of California press, 1999, Ch. 5.

inspectors received complaints from measure merchants in almost every market that hawkers sold old measures. On May 25th, 1936, as the transitional period had just entered the third month, the general secretariat received a letter of accusation. This letter was from Zeng A-mao(曾阿毛), who allegedly represented more than 600 stall-keepers from east markets in the settlement. Zeng reported that, recently, hawkers have been selling new measures in the market, the price from 1 to 2 Yuan, which was higher than the official price agreed upon by the council and Chinese government. The more severe problem was that the inspectors from the public health department forced the purchase of these new measures, which turned out to be inaccurate, "spurious, and useless."[810]

The market administration's potential corruption swiftly caught the settlement authority's attention. However, an investigation a week later indicated that neither this Zeng A-mao nor the address of his stall could be located in the market.[811] The chief health inspector assured the deputy commissioner of DPH that no inspectors under his supervision would coerce such a purchase. Later, the commissioner reported to the general secretariat that the case was a made-up: he suspected stallholders had knowingly purchased incorrect old-stale scales and then desired to cover themselves and blamed hawkers and inspectors. [812]

Even though the letter was fake, what it revealed should not be easily dismissed as completely false information. For example, the fictitious name, A-mao, was a common male name mostly used among lower strata of the urban population, which was very likely the name of a market stall-keeper should he exist. The case itself, which alleged that a market inspector was an accomplice

810 SMA, U1-16-504, Petition letter to secretary, 25 March 1936.
811 SMA, U1-16-504, letter from chief health inspector to deputy commissioner, 31 March 1936.
812 SMA, U1-16-504, letter from commissioner to secretary, 1 April 1936.

of coercive purchase, also revealed that whoever wrote the letter knew the micro-biology of markets. Although dwelling on the lowest echelon of colonial market administration, health inspectors wielded considerable power in the markets: they patrolled daily from stall to stall, responsible for fair dealing, maintaining hygiene, and of course, the usage of accurate measures. Their superior position to stall keepers created a hotbed for potential corruption. Local newspapers reported several cases earlier that some Chinese hooligans asked for bribes by masquerading as inspectors, and many suspected real inspectors conspiring with them. Phony Mr. Zeng was very likely aware of these cases and used them to successfully draw the attention of higher authorities.[813]

Last but not least, the official price of new measures, ranging from 0.8-1.2 Yuan, was wrongly quoted in the letter, indicating that the person who wrote this letter might never purchase legal measures. While SIS thought an ill-behaved stall-keeper was the writer, it was also likely that a measure maker sent it, hoping to repel the competition of hawkers in the market by SIS's hand. Or even worse, it was precisely the hawkers who sold the illegal measures that submitted the case, as the letter correctly quoted the price of illegal measures. In both cases, A-mao would also be a very suitable name.

While this case did not make much of a splash in the markets nor changed a bit of the track of metrological reform in the settlement, it never nevertheless brought the problem to the tables of Chinese and colonial authorities, which led to further conflicts. For example, the Shanghai weights and measures manufacturers' guild (上海度量衡业同业公会) wrote to SIS in 1935, alleging that

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[813] "Weishenchu jicha suozhanan" [The department of public health investigated the bribe case], in *Shenbao*, 25 September 1932; "Maochong gongbuju zhiyuan suozha"[Illegal Impersonation as SMC's clerk to ask for bribes], in *Shenbao*, 13 November 1932.

illegal measures were hawked about by “the unskilled and unemployed,” who took advantage of the special conditions of colonial settlement:

> “As the days pass, those hawkers increase in numbers. A recent investigation shows that they number more than a hundred[...]They cheated their customers. It is pretty evident that the scales sold by them are not the standard ones. They have defied the law, damaged the prestige of the government, given foreigners cause to ridicule us, violated the regulation of this association, injured our reputation, and hindered the adoption of the new system; they are despicable!” [814]

There is no denying that Hawkers’ lack of political and social representation made them easily the scapegoat of the lagging metrological reform. MBWM also noticed the situation of hawkers who fled into the settlement. MBWM sent a message to SGCC that if hawkers still existed in these markets as the guild failed to turn the tides, “strong measures should be taken” against it. On behalf of the fore-mentioned guild, the general chamber pleaded with SIS to address this issue in March of 1936.[815] DPH refused to act since the agreement with the Chinese government allowed the coexistence of old and new measures. Jordan insisted that old measures were necessary for the markets to be open to all customers.[816]

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[814] SMA, U1-16-504, letter from Shanghai measure maker guild to SIS, 17 November 1935.
[815] SMA, U1-16-504, letter from SGCC to SIS, 23 March 1936.
[816] SMA, U1-16-504, letter from commissioner to secretary, 26 March 1936.

However, this is not to say that colonial authority was always a friend to wandering hawkers. DPH held them also troublemakers, as they hindered transportation on roads and in markets and greatly endangered public health since they sold food and drinks that were not hygienic by the standards of the DPH.[817] Be repugnant in the eyes of governments and merchants as they may; hawkers were probably the social group that suffered most from the reform. As their profession became illegal overnight, it was more than the reform destabilizing their life rather than hawkers disturbing the market. Hawkers were visible in the everyday scene on the streets; they were not visible sociologically for urban administration. There were no general surveys about the actual livelihood of hawkers, but given the situation of other urban poor, their monthly income might be very well under 10 Yuan.[818]

Adding to their already pitiful conditions was the general chamber's direct market challenge, which had its measures factory. Exactly because of its semi-governmental background, their measures were cheaper than the common market price. A 6-kilogram hook scale, for example,

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817 Gongbuju huawen bianyichu [The Chinese interpretation department of Shanghai municipal council], "Weishengchu baogao" [The report of the department of public health] in *Gongbuju ninabao*, 1932, p.287; also, in *Gongbuju ninabao,* 1934, pp. 362-364.

818 The SIS and Chinese government conducted investigations of the living standards of Shanghai's workforce in the 1930s, yet hawkers were missing in these investigations. Considering their mobility, lack of organizational representatives such as guilds, and many the hawkers were not residents of Shanghai but lived in the vicinity of Shanghai. It was tough to give an accurate estimate of their income level. However, it might be referential to consider the income of their peers, that is, other urban poors. In 1929, BSA surveyed 1471 "wandering people" in its seven cold weather shelters, and 215 were hawkers and peddlers. Among which, only 4 were factory workers. "Yiqian sibai yu youmin wenhua de jieguo" [The answers from more than 1,400 wandering people], in *Shehui yuekan*, 1929, vol.1, no.4. It was reasonable to assume the income level of hawkers was lower than that of an average factory worker, which in the 1930s before 1937, were between 13 to 15.5 Yuan per month. "Shanghai de gongzi tongji" [The statistics of wages in Shanghai], in *Guoji laogong tongxun*, 1938, vol.5, no. 8, p.3.

According to a demographic census of Shanghai's slums, 310 hawker families lived in the slum with poor factory workers, peasants, fishers, rickshaw pullers, and waste collectors. "Diaocha shinei gequ Penghu" [Investigation of slum families], in *Shenbao*, 1 November 1928. Another social survey made in 1930 indicated that the average monthly income of rickshaw pullers was 10.84 Yuan. Zhu Bangxing, Hu Linge, Xusheng eds., *Shanghai chanye he Shanghai zhigong* [Shanghai's industries and working class], Shanghai: Shanghai renmin chubanshe, 1984, p.142.

Other studies also proved that the income of rickshaw pullers was around 0.4 Yuan per day, and the average monthly income in Shanghai was around 9 Yuan in 1934. Hanchao Lu, *Beyond the Neon Lights,* pp. 76-78. The income level of poor factory workers was like that of rickshaw pullers; the monthly income of the working force from the three lowest professions (match manufacturing, spinning & weaving, and silk reeling) was from 6.3 to 9.5 Yuan. "Shanghai de gongzi tongji", p.3. In sum, the income level of hawkers should fall into a scope that was very similar to poor factory workers and rickshaw pullers, which was under 10 Yuan.

costs 0.8 to 1 Yuan, and a 6-kilo pan scale costs 1.3 Yuan. By comparison, measures manufactured legally within the settlement were 1.4 to 1.7 Yuan and 2.1 to 2.4 Yuan.[819] However, while buying legal measures from the Chinese city seemed to be a bargain than that from the settlement, hawkers offered a better deal for stall-keepers. Illegal measures carried by hawkers with similar weighing capacities only cost from 0.6 to 1 Yuan. In some cases, the price was only 0.4 Yuan apiece.[820] The mobile nature of hawkers also expanded their customer base as they hawked literally from door to door. These facts made hawkers highly unwelcome for SGCC, and the factory even sent their hawkers to meet such competence from hawkers selling illegal measures.[821]

The booming market of measures and intensified competition also waged rising hospitality towards hawkers. As Wei Zhiping(魏之屏), a member of MBWM, noted, the number of manufacturers went up from 42 in 1928 to 157 in 1936. The sheer number of products rose more than two times from 111,776 pieces in 1932 to 250,978 in 1936.[822] The swiftly increasing number of manufacturers intensified the competition in the market. The animosity towards hawkers grew to the extent that merchants began to catch the hawkers by themself. Their highly mobile nature made the seizure and conviction of such activities difficult. In some cases, merchants had to pretend to buy some illegal measures as hard evidence to present to the police in the Chinese city.[823] The hawkers caught red-handed must pay a considerable fine, sometimes as much as 30 Yuan, which equaled three months' income.[824]

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819 SMA, U1-16-504, letter from chief health inspector to commissioner, 24 May 1935.
820 SMA, U1-16-504, letter from the factory to SIS, 16 May 1935; letter from chief health inspector to commissioner, 24 May 1935.
821 SMA, report from inspector, 22 May 1935.
822 SMA, Y9-1-37-63, Wei Zhipin, "Benshi duliangheng zhizao zhi jingbu", p. 49-51.
823 SMA, U1-16-504, report from health inspector to chief health inspector, 10 February 1935. The case happened in Perry Road market.
824 SMA, U1-16-504, report from health inspector to chief health inspector, 10 February 1935.

The international settlement, therefore, became the last safe island for them, particularly during the half-year transitional period, when old measures were still allowed alongside the new. Ironically, the colonial administration, for its distrust of Chinese guilds, provided de facto protection for hawkers. Jordan thought these hawkers were possibly selling correct measures or even sometimes got marked by MBWM. The only reason for merchants' criticism was that hawkers "did not belong to the group authorized to set up a stall in the market." Jordan then decided not to take any action against hawkers before the end of the transitional period.[825]

But these metrological fugitives' living spaces continued to shrink in the settlement. On March 22nd, inspectors investigated eight markets in the central area where at least 90 percent of stall keepers had already purchased new measures.[826] In the northern area, the percentage was 65 in the biggest Hongkou Market and 85 in the other three smaller markets. New Chinese measures were prepared to deal with Chinese customers in almost all licensee stores in the central and north area, including foreign shops. The western area was the same. DPH saw the time was ripe.[827] On 1936 July 1st, a new regulation was effective: old Chinese measures were now illegal among stall-keepers in the whole international settlement.

The traces of hawkers disappeared in the archives of DPH simultaneously. For many, it suggested a successful transition. For fear that a metrological change might cause market panic, SIS carefully monitored local newspapers published in Chinese territory and the settlement.[828] The reaction was quite peaceful, with only moderate complaints. As new regulations did not

[825] SMA, U1-16-504, letter from commissioner to secretary, 26 March 1936.
[826] Sinza Market 87%, Perry Market 96%, Mohawk Market 97%, Seymour Market 95%, Dan Zung Market 93%, Annam Road 94%, Ta Tung Road 90%, Racecourse 96%. SMA, U1-16-504, report from superintendent of food,markets and bakeries to deputy commissioner of public health, 22 May 1936.
[827] SMA, U1-16-504, reports from inspectors in north and west areas to superintendent, 22 May 1936.
[828] Excerpts in their archive were from all major press then, including Z*hongyangribao, Shenbao, Mingbao, Shanghai times, China Times, Evening Post* and so on.

include personal usage of old measures, stall-keepers reported that private citizens still asked for old ones in dealing, such as in noodle shops or restaurants.[829] While DPH was not able to answer to the needs of these stall-keepers to act upon the behavior of individual customers, it claimed that "every effort is being made by this department to get the remainder of the shops to obtain and use the new weights" and inspectors summoned those who did not daily.

Till October of 1936, more than 7.000 pieces of old Chinese measures were confiscated.[830] As witnessed by inspectors, more than 80% of shops had already switched to new measures.[831] With no single drop of ink given to the fate of hawkers who were wandering in their markets six months ago, DPH then concluded in their reports that they may "congratulate ourselves upon the progress made so far, especially as we cannot use force as in the Chinese controlled areas."[832]

Conclusion

Japan's invasion of Shanghai in 1937 changed the course of the reform, and in November, MBWM was dismantled during the war[833]. The war in 1937 and its consequent economic turmoil resulted in a shortage of daily necessities and an even more chaotic situation of measures in Shanghai.[834] The frauds of "short weight" on coal and rice became out of control in the 1940s,

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829 SMA, U1-16-501, letter from Preparatory office of the First special district branch fo the Shanghai butchers' association to SIS, 17 August 1936.
830 SMA, U1-16-501, letter from commissioner to secretary, 1 October 1936.
831 SMA, U1-16-501, letter from Superintendent to deputy commissioner, 21 August 1936.
832 SMA, U1-16-501, letter from report from health inspector in north area, 20 August 1936.
833 Liao and Huo, "Minguo shanghai duzheng shimo", p.61.
834 Arthur Young, *China's Wartime Finance and Inflation, 1937–1945*, Cambridge: Harvard University Press, 1965; Christian Henriot, "Rice, Power and People: The Politics of Food Supply in Wartime Shanghai," in *Twentieth-Century China*, 2000, no.1, pp. 41-84.

which ignited the fury among foreign citizens in SIS and the French concession. Local newspapers such as *Evening Post* and *North China Daily News not surprisingly* pointed fingers at Chinese stall keepers' dishonesty and alleged that Chinese steelyards made fraud easier.[835] Urged by the foreign community, SIS had no choice but abandoned its "laissez-faire" policy and impose even harsher regulations on measures to stabilize prices in the markets. DPH eventually found its inability to monitor the measures in the markets by itself and resorted to the iron hand of settlement police.[836] At the same time, measures continued to be a realm for metrological nationalism even when its major opponent, SIS, disappeared. When SIS stopped functioning in 1943 under Japanese pressure, the Chinese puppet government in Shanghai "reestablished" MBWM and declared the yielding of the jurisdiction of measures from SIS in the settlement as a success of Chinese nationalism.[837]

Far from a triumphant story that a global norm was swiping across the earth with its divine homogenizing magic, the negations between SIS and Chinese authorities in Shanghai reminded us to pay attention not only to units such as nation-states but specific locales and their metrological plurality within. It was a story closed related to two conflicting and, at times, contradictory metrological traditions. The protracted seven-year struggle between the Chinese state and colonial authorities revolves not around measures per se but hinges on other sensitive issues. The former tried to unify measures on colonial soil as a nationalistic enterprise, and the latter was determined to maintain its authority in the settlement. Metrological semi-colonialism was

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835 SMA, U1-16-505, excerpt from *the Evening Zaria*, 17 April 1940. The file contains more than a dozen excerpts of other reports from newspapers in 1940.

836 See for example, SMA, U1-16-505, letter from commissioner of public health to secretary and commissioners general, 9 May 1940; letter from superintendent to commissioner, 8 May 1940; report of the joint inspection of police department and DPH, 15 August 1940.

837 "Duliangheng jiandingsuo chongsheng quanxian" [Municipal bureau of weights and measures reclaimed its jurisdiction], in *Shenbao*, 15 August 1944.

diversified and pluralistic compared to a unified, singular nationalistic metrological system. Thus, metrology opened a battlefield for metrological colonialism vs. nationalism, and Shanghai's semi-colonialism was an indispensable foreground to understand this duality.

On the other hand, collaboration was another essential layer that decidedly made metrological reform a semi-colonial story. While determined to maintain its political authority in front of the tides of Chinese nationalism, SIS slowly conceded to MBWM's encroaching demands for metrological reform in the settlement. The Chinese government could not harvest any meaningful results from its early pitched tone of metrological nationalism. Only through the guilds SGCC and T.K. Ho, the middlemen who represented commercial interests in both SIS and the Chinese city did Chinese authorities manage to promote new measures in the settlement. However, the collaboration satisfied neither side completely. SIS had to yield its metrological monopoly in the colonial markets but helped to bring in new Chinese measures, and the Chinese municipal government failed to eradicate foreign measures in the settlement. Last but not least, hawkers in the markets, who were easily dismissed from the grand scope of the global norms but only came into sight when placed under the lens of locality, were the main victims of the reform. Although they found markets in SIS, a semi-colonial cleavage, as their temporary refuge to escape metrological violence at the beginning, the reform in the eyes of hawkers still meant a hazardous road to a once familiar business, rising animosity from competing merchants with political ties, and an ever-shrinking space to earn one's living.

What's missing in history sometimes speaks more. SIS's cooperation with the Chinese sharply compared its early ruling pattern. The International Settlement particularly was ardent to bring western modernity to Shanghai, ranging from electricity, clean water, public parks, and cinemas to their social campaigns against "Chinese vice" such as spitting, animal cruelty, prostitution, etc.[838] The legitimacy of colonialism in Shanghai was not only manifested through the navigating gunboats on the Huangpu River but also gained from such "civilizing lessons" that had been willingly given to the Chinese, if not bitterly taken by them. However, the specialty of measures was that the colonizers lost their voice in the competition for metrological modernity. As SIS opened its markets to all kinds of measures, it was now the Chinese who had a modern, unified, scientific, and accurate metrology in Shanghai. Despite SIS drawing reasons from many technical issues to repel Chinese reform, it could not utter a single disagreement on the legitimacy of modernity attached to new Chinese measures per se. Their speechlessness added an important footnote to the "retreating colonial modernity" in 1930s Shanghai.[839] At the same time, by turning the table around, the Chinese state successfully weaponized the global norm as a tool for strengthening nationalism. It reminds us to recognize the centrifugal force that countered homogenization in the historical process of globalization.

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[838] Just to give one example of these civilizing lessons in Shanghai, Christian Henriot, *Prostitution and sexuality in Shanghai: A social history, 1849-1949*, Cambridge: Cambridge University Press, 2001. Also, Gail Hershatter, *Dangerous pleasures: Prostitution and modernity in twentieth-century Shanghai*, Berkeley: University of California Press, 1997.

[839] On the competence of modernity between Chinese local society and foreign administration, Hu Cheng, "Shanghai jinchang yu zaihua xiren de daode jiaolu: yi Shanghai dejinhui wei zhongxin de guancha (1918-1924)" [Prostitution Abolishment in Shanghai and the Moral Quandary of Western in China: The Shanghai Moral Welfare Committee (1918-1924)], in *Xin shixue*, March 2011, vol. 22, no. 1, pp. 61-105. Also, Hu Cheng, "Jianyi, zhongzu yu zijie: Shanghai xianshuyi manyan qijian de huayang chongtu" [Quarantine, Race and Politics in the International Settlement: Clashes between Chinese and Foreigners after the Outbreak of Plague in Shanghai in 1910], in *Jindaishi yanjiu*, 2007, no.4, pp. 74-90.

Epilogue: The Afterlife of the Nanjing Reform

During the summer of 2020, when China gradually returned to life from the eruptive global pandemic, I visited a steelyard store in Changsha, the capital city of Hunan Province. The store was located in Taiping Street, historically a commercial avenue since the Ming Dynasty, and now one of the city's many tourist sites (though it was likely a modern replica since Changsha was burnt down during the desperate retreat of the KMT army in 1939). The owner, Mr. Wen Zhifei(文志飞) runs this five or six-squared meter shop for almost 30 years here. He was born in a small county in Hunan and learned steelyard making as a family business. His grandfather began making steelyards in 1913 when the Beijing government tried to launch the reform to introduce the metric system. His father showed him the tricks at the age of 12. He had a lot of students, and together he estimated that they had produced "more than a hundred thousand" steelyards. His place was more an exhibition than a shop, as specimens of steelyards were laid down according to their sizes. The smallest was like a lollipop stick, while the biggest one, with a capacity of 200 Jin, was in front of the gate. He alleged that this huge steelyard in the shape of a swing was reproduced from a prototype in the Forbidden City that the Empress Dowager Cixi once used.

After telling him that I studied in Germany, he was somehow excited, saying that a German historian once wrote a book about him. He then showed me the copy sent from Berlin. It turned out it was not any historical monography, but a fifteen pages field research report conducted by the Max-Planck Institute for the History of Science. Two German historians did visit his shop in September 1998, yet Mr. Wen was not much highlighted in the report. Instead, it contained rich records and vivid illustrations of the making process of a steelyard by one of Mr. Wen's students back then. Neither was this field research productive. The major purpose of this project was to determine whether a Chinese steelyard with “a sliding weight” on its beam, which resembled Roman steelyards, was the result of independent development or of a transfer of European knowledge. Second, it also tried to investigate “the preconditions for the manufacture and use of the Chinese sliding-weight-steelyard.” While *Mozi*(墨子), an ancient Chinese canon, contained several lines that might indicate an early Chinese grasp on the lever principle, this topic met practical difficulties in locating more solid historical records. For the second purpose, the researchers delivered a remarkable job. The report contained a wide range of living proofs of China’s metrological tradition at the turn of centuries, from the steelyards making, unwritten business codes, to the dealing habits in local markets of Nanjing and Beijing. As the government intended to eradicate old-style steelyards and bring in other more accurate kinds of measures, the report also gave us a glimpse of the dying days of the Chinese metrological past. [840]

I did not regard Mr. Wen’s claims as a pretentious distortion of reality. It doesn’t hurt with a bit of drama in life. The man was kind enough to receive me and proud of his business and the history he carried. He kept a wall displaying all newspaper coverage and TV shows about him in the past two decades. He also told me with perfect certainty that he had never made any inaccurate steelyard, and hanging in the shop was an eye-catching plaque stating Gongping Cheng Tianxia(公平称天下), or “to measure all under the heaven fairly.”

[840] Jürgen Renn and Matthias Schemmel, *Waagen und Wissen in China: Bericht einer Forschungsreise*. Max-Planck-Institut fur Wissenschaftsgeschichte, Preprint no. 136, Berlin, 2000. Far an evaluation of this trip, Harald Witthöft, in *East Asian Science, Technology, and Medicine,* 2003, vol.20, no. 1, pp. 150-160.

Mr. Wen and the German report symbolized this dissertation’s local and global dimensions. Nanjing’s metrological reform endangered the very existence of small steelyard makers, a similar situation that Mr. Wen and his kind found themselves in after 1949. By absorbing the European experience of metrological nation-states, Nanjing tried to build a rule of accuracy in China through measures. Nanjing built a national network to enforce its monopoly. However, the lack of governmental competence, particularly in social mobilization, made it a lame march in front of separatism and imperialism. On the other hand, there were domestic enemies against the state’s encroachment on the autonomy of metrological affairs. Common people, such as peasants, ordinary storekeepers, housewives, and customers in markets, managed to resist the reform, which in their eyes, disturbed everyday routine rather than facilitated it. Local governments chose to ignore the requirements of Nanjing but pursue other more worthy goals. Social organizations such as Yahang proved to be a stronger presence in rural areas where the supervision of the state could not cover. Many intellectuals had reasonable doubts that it was a challenge to metrological traditions, and the dream to revive customary measures haunted modern Chinese history. All these aspects testified to the limitation of Nanjing in changing long-standing metrological habitus and, in general, how society maintained its own ways in the face of impositions and interference from the state.

On the other hand, the story was also decidedly a global one. While once one could detect the historical similarity between western and Chinese metrology as the 1998 report suggested, Chinese measures became problematized in front of a foreign gaze. Moreover, it resulted from a shifting global metrological landscape that required unified and scientific metrology as an intrinsic precondition for a civilized nation. China chose the metric system as its new national standard, despite the British trying their best to introduce their own metrology. At the same time, China's metrication also had wider repercussions, forcing both sides in the trans-Atlantic debate to adjust their arguments. We witnessed in this period also that ambitious governmental directives were animated from and around metrological reform. These projects were informed by globally circulating sociological knowledge, industrial standardization, and transnational stigmatization of "Chinese characters" and aimed at thoroughly metricizing industrial, agricultural, and social psychological sectors. Nanjing's adamant desire to transplant a French metrological tradition which was crystalized as one nation, one state, and one system, led to a bitter clash with the foreign authorities' Benthamite approach toward measures in Shanghai. In this case, the struggle of metrological dual globality continued to exist within China even after it made the decision to go metric.

However, it was not to say that the Chinese fully accepted the metric globality without a second thought. There was once a time when daring Chinese and foreign mused the possibility of offering Chinese metrology to the world. This tension between conservatism and globalism in measures later resulted in a bitter contestation of nomenclature between scientists and technocrats. The 1935 debate marked a unique feature of metrication in China, where traditional terms were kept, whereas most nations either directly took the original metric terms or phonetically translated them. While the Chinese scientists aimed at bringing the metric system and the spirit of science intact to China as the rest of the world did, the state was stubborn about keeping traditional metrological terms to facilitate common people's acceptance. Nanjing developed a governmental initiative to build a scientific China and to control scientific affairs within its grip. The conflicting views on balancing local and global cultures once again indicated how measures were an arena for the wrestling between local and global factors.

Even though the new regime claimed its renouncement of Nanjing's policies and guided the new administration with a revolutionary and mass-centered ideology, the communist administration of metrology still ran on the old tracks that had been laid down by the KMT government, with a similar bureaucratic rationale. Indeed, the story of metrology was characterized by continuity after 1949. In 1950, the young PRC established its small metrological institute in Beijing, and Wu Chengluo was appointed as the first chief. The major task of this institute was to inherit essential assets from the former KMT government to set the communist regime's own metrological administration like every dynasty tended to do in Chinese history. These left archives, inspection instruments, and machinery were transported from Nanjing and Chongqing to Beijing, including the standard copies sent by BIPM in Paris. This handover marked the shift of regimes symbolically. Wu did not stay in his position for long as the institute quickly fulfilled its historical purpose. Beijing nevertheless inherited the national network of metrological administration built by Nanjing. Till 1953, 124 local branches operated with 840 dedicated inspectors. On January 1, 1955, the new National Metrological Bureau(国家计量局) began functioning with Li Chenggan (李承干), a former engineer of KMT's munition factory as the Chief. A reform followed, and a committee for metrication was formed in Beijing in 1956. The task of making China a thorough metric nation was now handed over to the PRC. [841]

China chose the Soviet Union as its sole model of modernization and industrialization. In 1952, Beijing ordered new standard copies from the big brother. Specialists and metrological academies from the Soviet Union and other communist brother nations, such as Poland, supported the Chinese government in the 1950s. As China started its first five-year plan in 1953, Soviet statisticians came, helping to establish a planned economy that operated on a vast database of collected economic information.[842] Affiliated departments of metrological inspections were set in most major state factories to monitor the implementation of industrial standardization, a vision that Nanjing had failed to realize. The unruled rural metrological vacancy was now under the supervision of the state. Yahang disappeared due to the new policy of state monopoly of the purchase and marketing of grains and other agricultural products (统购统销). Fraud by merchants also seemed to be under control, as they were under constant attacks in the early 1950s for their original sins of belonging to the bourgeoisie.

However, chaotic measures remained to be a headache for newly trained Chinese statisticians. Economic data was inconsistent and incomplete, partially due to diversified regional measures. In 1953, Jiang Zhouyuan (姜周元), an accountant of a local supply and marketing cooperative(供销社) in Wenzhou wrote to Beijing, urging to make Jin and Liang decimal. Jiang witnessed conflicts with customers during complicated conversions between units, not to mention the additional workload of unit conversion in bookkeeping, a tedious job he must often muscle through at night.

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[841] Guan Zengjian, *Zhongguo jinxiandai jiliang shigao* [Chinese modern and contemporary metrological history], Jinan: Shangdong jiaoyu chubanshe, 2005, p. 138-139.

[842] For a most recent work on statistics and statecraft in the PRC., Arunabh Ghosh, *Making It Count: Statistics and Statecraft in the Early People's Republic of China*, Princeton: Princeton University Press, 2020.

Jiang's letter was later replied to by *Renmin Ribao* and caught the attention of the central government. Jiang's voice seemed to be registered as the signal of public demand for a form. Later in 1958, Jiang received a governmental certificate that christened him as an "adviser for metrological reform," an honorary title that was granted to many others. [843]

In this context, a new proposal was scrutinized and approved by the National Science and Technology Committee. Under the support of scientists and three years of regional trials, the State Council of the People's Republic of China officially issued its order to unify measures and use new nomenclature in 1959. Beijing generally followed the dual track system left by Nanjing and allowed the market system to exist simultaneously with the metric system. Some minor changes were made, as it now took physicists' terminology and made the transition between Liang and Jin in the market system decimal. Medical measures continued to enjoy an exemption like in the Nanjing period. The English system was forbidden in principle, although it could be used on some "special occasions."[844]

However, the new ideology brought some new flavors to the story. During the height of the Cultural Revolution, China's national metrological network was much shaken. In Shanghai, formerly an epistome of KMT reform, seven workers of a local factory investigated the affiliated metrological inspection department in their factory in 1968. Their report alleged that scientific metrological management, rigid administration, and standardized inspection procedure were manifestations of the "revisionist economic policy". Metrological specialists and inspectors were criticized as self-righteous "intellectual aristocracy" who were superior to the working class. Beijing soon recognized the revolutionary action in Shanghai. Factories of other regions sent delegations to

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843 Huang Songguang and Ni Zhijian, "Zhongyang gongshang xingzheng guanli ju guanyu Jiang Zhouyuan gancheng hengqi gaizhi de fuhan" [The reprely form central industrial and commercial bureau to Jiang Zhouyuan's letter on steelyards reform], in *Zhejiang dangan*, 2014, no.3, pp. 50-51.

844 Guan, *Zhongguo jinxiandai*, p. 142.

Shanghai, learning this "revolutionary experience." It then led to shocks and turmoil in metrological branches around the country.[845]

The global and Chinese experiences all suggested that a successful transition of measures was a tough mission demanding money, full-fledged national metrological administration, a stable political environment, social mobilization, and adequate time for public acceptance. However, during the Great Leap Forward Movement, the National Metrological Bureau set up radical plans. It promised to "catch up with the advanced nations in meteorological administration within three years." The bureau demanded that its local branches be able to produce and inspect "whatever measures the socialist production needs." This effort resulted naturally in vain.[846]

But it seems that the Chinese story has a happy ending. Till the end of the 1970s, there were more than 300 000 metrological specialists monitoring industrial production. In the 1980s, a national network of metrological vocational middle schools trained even more inspectors who staffed the expanding metrological administration. China also boasted a dedicated metrological academy and publishing house in Beijing.[847] In 1985 after more than five decades, when Nanjing had issued its metrological law, a new metrological law was promulgated. Chinese metrological administration nowadays covers almost all aspects of metrological affairs with specific rules, from the shapes of measures to mandatory registration and regular metrological inspection in the production sector. The system has been functioning so rigidly to the extent that experts began to talk about "loosening up."[848] While the United States was never the best example to learn from in

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[845] Li Leshan, *Dangdai zhongguo de jiliang shiye* [The metrological cause in contemporary China], Beijing: zhongguo shehui kexue chubanshe, 1989, pp. 49-50.

[846] Ibid.

[847] Guan, *Zhongguo jinxiandai*, pp. 186-194.

[848] LI Bin, "Jiliang jiang buzai guande name kuan" [Metrology would not be governed in its current scope], inZhong zhilian jishu jiandu, 2001, no. 12, pp. 18-19.

the Nanjing period, many advised the state to draw from the successful experience of the U. S. where measures were not strictly governed.[849]

The global connections cultivated before 1949 were revived at the same time. In 1976, with the end of the Cultural Revolution, Beijing signed the *Convention du Mètre* (Meter Convention). China is currently a member of BIPM's all ten committees. The International Federation of the National Standardizing Associations (ISA) ceased functioning during World War II. In 1947 the new International Organization for Standardization (ISO) began to function under the United Nations. In 1978, China recommitted itself to metrological globalization with an open-door policy and joined ISO. In 2016, the 39th conference of ISO was hosted in Beijing. Xi Jinping's congratulatory letter to the conference pointed out, "standardization is the new lingua franca." China aims for a leading position of standardization in the global arena this time[850]

Till this very moment, almost every nation have recognized the metric system legally. Although in America and Britain, metrication still is an unfinished cause. The U. S. educators continue to advocate educating young students about the metric system so that no child will be "left behind" in waves of metrological globalization.[851] In Britain, Brexit once again brought a century-old debate between conservatism and continentalism, and we could not see an end to it.[852] However, no one tries anymore to transplant the British system into China like their ancestors once did. Nor does a

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[849] Guan, *Zhongguo jinxandai*, Ch. 13.

[850] Lu Jinsan, "Women weishenme xuyao jiliang kexue?" [Why do we need the science of metrology?] in *Zhongguo Jiliang*, 2021, no. 11, pp. 56-60. Also, Xinhua she, "Di sanshijiu jie guoji biaozhunhua zuzhi dahui zhaokai, Xi Jinping zhi henxin" [The 39 international conference of the International Standardization Association was held, and Xi Jinping sent a letter of congratulations], September 12,2016.

[851] Kern Craig, "No Child Left Behind: Teaching the Metric System in US Schools" in *International Journal of Applied Science and Technology*, April 2012, vol. 2, no. 4, pp. 40-48.

[852] For instance, Nicola Slawson "'It makes no sense': reaction to plan to revive imperial measurements in UK", in *the Guardian*，29 May 2022. Brexit more or less contributed to the recent public interest in metrology, a most recent reflection, James Vincent, *Beyond Measure: The Hidden History of Measurement*, London: Faber & Faber, 2022.

transnational debate happens that once attracted attention from leading intellectuals on both sides of the Atlantic. While we could revisit history, musing upon its numerous possibilities, the battle for universal scientific metrology has already been won. The global regime of accuracy based upon the metric system, which once only existed in the dream of Chinese reformists, is now the basic fact around the world.

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Anhui sheng zhengfu gongbao 安徽省政府公报
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Zeng Guofan(曾国藩)
Zeng Houzhang (曾厚章)
Zeng Jize (曾纪泽)
Zeng Zhaolun(曾昭抡)
Zhabei(闸北)
Zhang Fengqi(张凤岐)
Zhang Jian (张謇)
Zhang Shizhao(章士钊)
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Zhejiang(浙江)
Zheng Chi (正尺)
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Zhou Ziqi (周自齐)
Zhu Kezhen (竺可桢)
Zou Bingwen(邹秉文)
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