The Art of Compromise: New Maps in Local Gazetteers of the Late Qing Dynasty

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Abstract: In the late Qing dynasty (1644–1911), local gazetteer maps helped to disseminate the innovations of longitude and latitude used in Western cartography. The use of longitude and latitude lines alongside the traditional Chinese cartographic method of "grid scales" suggests that mapmakers chose an ingenious compromise to accommodate new knowledge alongside traditional practices.

Historians of cartography fall into several different camps with regard to the interaction and mutual influence between Chinese and Western mapmakers. Joseph Needham asserted that traditional Chinese quantitative mapmaking technologies might have played an indirect role in the development of cartography in Europe during the fourteenth and fifteenth centuries. Correspondingly, the transmission of Western cartography to China by Jesuits influenced Chinese geography and cartography. Timothy Brook summarized how Chinese mapmakers made the "atlas" of the world by integrating traditional Chinese mapmaking methods and Western techniques. Modern world maps developed out of this collaborative exchange between Chinese and European mapmakers. Mario Cams argued that the *Map of the Complete View of the Imperial Territory* (*Huangyu quanlan tu* 皇輿全覽圖), officially drawn by the Qing government, represented an integration of Chinese and Western mapmaking techniques during this period.[1]

On the other side of the debate, Cordell D. K. Yee has argued that Chinese cartography was barely influenced by its European counterpart from the late sixteenth century to the early twentieth century and that the transition from Chinese cartography to European cartography was neither as quick nor as comprehensive as previous scholars had believed. However, he

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Acknowledgments. I would like to thank Shellen X. Wu and Peter B. Lavelle for their helpful, impressive, and thoughtful suggestions, hints, and critiques. I would also like to thank Shih-Pei Chen, Kenneth Hammond, Anne Gerritsen, and other members of the *Tu* in LoGaRT work group at the MPIWG for their insights and encouragement, as well as the anonymous referee and *Isis* Editor Alexandra Hui for their thoughtful comments.

[1] Joseph Needham, *Science and Civilisation in China*, Vol. 3: *Mathematics and the Sciences of the Heavens and the Earth* (Cambridge: Cambridge Univ. Press, 1959), pp. 495–680; Timothy Brook, *Quan tu: Zhongguo yu Ouzhou zhi jian de Dituxue Hudong* (Completing the Map of the World: Cartographic Interaction between China and Europe) (Taibei: Zhongyang yanjiuyuan jindai shi yanjiu suo, 2020); and Mario Cams, *Companions in Geography: East–West Collaboration in the Mapping of Qing China (c. 1685–1735)* (Leiden: Brill, 2017), https://doi.org/10.1163/9789004345362.

Isis, volume 113, number 4, December 2022.
 https://doi.org/10.1086/722360

acknowledged that the cartographic work of the Qing dynasty (1644–1911) was a polarized phenomenon. Efforts overseen by the imperial court employed foreign cartographic methodologies, while local objections to foreign influence lasted until the late nineteenth century.[2] In light of this disagreement in the scholarship, how did the arrival of Western cartographic knowledge play out at the local level? Using LoGaRT, we can turn to local gazetteers for the data to answer this question. Like the other contributors to this Focus section, I argue that local gazetteers provide a new and different perspective on the spread of science and technology, in this case the cartographic innovations of longitude and latitude lines.

During the Sui (581–618), Tang (618–907), and Five Dynasties (907–960) periods, "patterned guidelines," or *tujing* 圖經, became the foremost subgenre of geographical writing to supplement information on given localities.[3] With the participation of local scholars, *tujing* 圖經 evolved into the local gazetteer (*difang zhi* 地方志). The first recorded rules for mapmaking in China come from the *Six Principles of Cartography* (*Zhitu liuti* 製圖六體), created by Pei Xiu 裴秀 (224–271) in the Cao Wei (220–266) and Western Jin (266–316) dynasties. The first three principles refer to location, scale, and distance on a map, and the last three are supplementary explanations for the drawing of routes. In addition, according to historical records, Pei Xiu made the *Topographic One-Zhang Square Map* (*Dixing fangzhang tu* 地形方丈圖), no longer extant, and adopted "grid scales" (*Jili huafang* 計裡畫方). This method involves drawing quadrate grids on a map, with each grid's edge length representing a certain number of *li*, also known as the Chinese mile. The earliest extant map that employs the grid-scales method is the *Map of the Tracks of Yu the Great* (*Yu ji tu* 禹跡圖), drawn in the Song dynasty (960–1279), where each grid represents 100 *li*. The grid-scales method made it easy for map users to calculate distance and area, and it continued to be used in local gazetteer maps in the late Qing period, serving as one index of map quality.[4]

The absence of longitude and latitude lines became an identifiable feature distinguishing traditional Chinese maps from Western maps. Latitude and longitude lines date to the ancient Greeks—Eratosthenes (276 B.C.E.–194 B.C.E.), Hipparchus (190 B.C.E.–120 B.C.E.), and Ptolemy (100–170) all contributed to the concepts behind latitude and longitude.[5] The Jesuit Matteo Ricci (1552–1610) created the prominent *Complete Map of the Myriad Countries on the Earth* (*Kunyu wanguo quan tu* 坤輿萬國全圖) in China during Wanli's reign (1573–1619) in the Ming dynasty and introduced concepts like longitude and latitude, the "sphericity of the Earth," and other European cartographic innovations.[6] In the Kangxi period (1661–1722) of the Qing dynasty, with the help of Jesuit missionaries, the Kangxi emperor presided over a nationwide geodetic survey and established a longitude and latitude network centered on the imperial capital, Beijing. The survey covered 630 latitude and longitude points across the country and produced the *Map of the Complete View of the Imperial Territory* (*Huangyu quanlan tu* 皇輿全覽圖) (1718) using the Sanson-Flamsteed (sinusoidal) projection. During the reign of Kangxi's successor, Yongzheng (1723–1735), the Mapping House of the Imperial

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[2] See the chapters by Cordell D. K. Yee in *The History of Cartography*, Vol. 2, Bk. 2: *Cartography in the Traditional East and Southeast Asian Societies*, ed. J. B. Harley and David Woodward (Chicago: Univ. Chicago Press, 1994), pp. 35–202.

[3] Alexis Lycas, "The *Patterned Guidelines of Shazhou* (*Shazhou tujing*) and Geographical Practices in Tang China," *Centaurus*, 2020, 62:479–497, https://doi.org/https://doi.org/10.1111/1600-0498.12279.

[4] Huang Binhou 黃炳垕, *Cehui Zhangcheng* 測繪章程 (Ningbo: Liushuzhong ge, 1890).

[5] E. H. Bunbury, *A History of Ancient Geography among the Greeks and Romans, from the Earliest Ages till the Fall of the Roman Empire*, 2 vols. (London: J. Murray, 1879), p. 543; and John Parr Snyder, *Map Projections—A Working Manual* (Washington, D.C.: Government Printing Office, 1987), p. 90.

[6] Huang Shijian 黃时鉴 and Gong Yingyan 龔纓晏, *Limadou Shijie Ditu Yanjiu* 利玛窦世界地图研究 (Shanghai: Shanghai guji chuban she, 2004), pp. 87–93.

Manufacture Office (*Zaobanchu yutufang* 造辦處輿圖房) added new geographical information to the empire-wide *Ten-Rowed Map of the Imperial Territory in the Yongzheng Reign* (*Yongzheng shipai huangyu quan tu*雍正十排皇輿全圖) (1725), which was based on the Kangxi maps. Yongzheng's map adopted a compromise that balanced conflicting Chinese and Western cartographic methods by using grid scales while also marking longitude and latitude. In the Qianlong period (1736–1795), new survey results from Xinjiang and Tibet were incorporated into the *Map of the Imperial Repository of the Qianlong Reign* (*Qianlong neifu yu tu*乾隆內府輿圖) (1762), marking longitude and latitude lines without employing grid scales.[7] Subsequently, official maps compiled during the Kangxi and Qianlong reigns circulated beyond the palace and exerted considerable influence on the compilation of Qing maps.

With the aid of LoGaRT, I retrieved all the latitude and longitude maps that appeared in local gazetteers. LoGaRT accesses a database of 4,410 Chinese local gazetteers, containing 70,344 pages of images extending from the Tang dynasty to the Republic of China. Of these, 532 books and 5,575 images are from the Ming dynasty; 3,067 books and 55,364 images are from the Qing dynasty. The Qing dynasty, especially the late Qing, is a critical period for the introduction of Western cartography to China. Therefore, this essay focuses on local gazetteer maps in the Qing dynasty. I define the longitude and latitude gazetteer (LLG) map broadly—any gazetteer map that contains a component of longitude or latitude lines or longitude and latitude values falls within the scope of this research.

LoGaRT includes 1,366 images of LLG maps from forty-nine local gazetteers in the Qing dynasty. The *Guangdong Provincial Gazetteer* (*Guangdong tong zhi* 廣東通志) (1822), compiled by Ruan Yuan 阮元 (1764–1849), was the first gazetteer atlas with longitude and latitude lines. Guangdong Province produced the most significant number of LLG maps, followed by Hunan Province. LLG maps appeared in most provinces of the Qing empire (see Figure 1). While other Sinologists have argued that LLG maps that also featured grid scales indicated that the compilers were clinging to tradition, I argue the opposite: that such compromise maps suggest curiosity about innovations from abroad.[8] Let's take a closer look at these LLG maps.

COMPROMISE PRESENTATIONS

Before the arrival of latitude and longitude from the West, Chinese scholars developed certain analogous concepts. Yixing 一行 (673–727), an astronomer of the Tang dynasty, had observed the "celestial North Pole height" (*Beiji gaodu* 北極高度). Since the "celestial North Pole height" at a given location had the same numeric value as its latitude, Yixing's observation was considered a measure of geographic latitude.[9] During the Yuan dynasty, Guo Shoujing 郭守敬 (1231–1316) conducted astronomical surveys and measured celestial North Pole heights at twenty-seven locations.[10] The introduction of the Western concept of geographical longitude into China and its application to the calendar during the Song and Yuan dynasties led to the analogous term "distance difference" (*li cha* 裡差).[11] However, before the late Ming dynasty the

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[7] James A. Millward, "'Coming onto the Map': 'Western Regions' Geography and Cartographic Nomenclature in the Making of Chinese Empire in Xinjiang," *Late Imperial China*, 1999, 20:61–98.

[8] Iwo Amelung, "New Maps for the Modernizing State: Western Cartographic Knowledge and Its Application in Nineteenth- and Twentieth-Century China," in *Graphics and Text in the Production of Technical Knowledge in China: The Warp and the Weft*, ed. Francesca Bray, Vera Dorofeeva-Lichtmann, and Georges Métailie (Boston: Brill, 2007), pp. 685–726, https://doi.org/10.1163/ej.9789004160637.i-772.108.

[9] Xiang Huarong 向华荣 *et al.*, "Woguo Dili Jingweidu he Ziwuxian Shice Yange 我国地理经纬度和子午线实测的沿革," *Shaan'xi Tianwentai Tai Kan* 陕西天文台台刊, 1982, no. 1, pp. 23–24.

[10] Song Lian 宋濂, *Yuan Shi* 元史, Vol. 48, ed. Tianwen Zhi 天文志 (Beijing: Zhonghua shuju, 1976), pp. 1000–1001.

[11] Sun Xiaochun 孙小淳, "Cong *Licha* Kan Diqiu, Dili Jingdu Gainian zhi Chuanru Zhongguo 从'里差'看地球、地理经度概念之传入中国," *Ziran Kexue Shi Yanjiu* 自然科学史研究, 1998, 17(4):304–311.

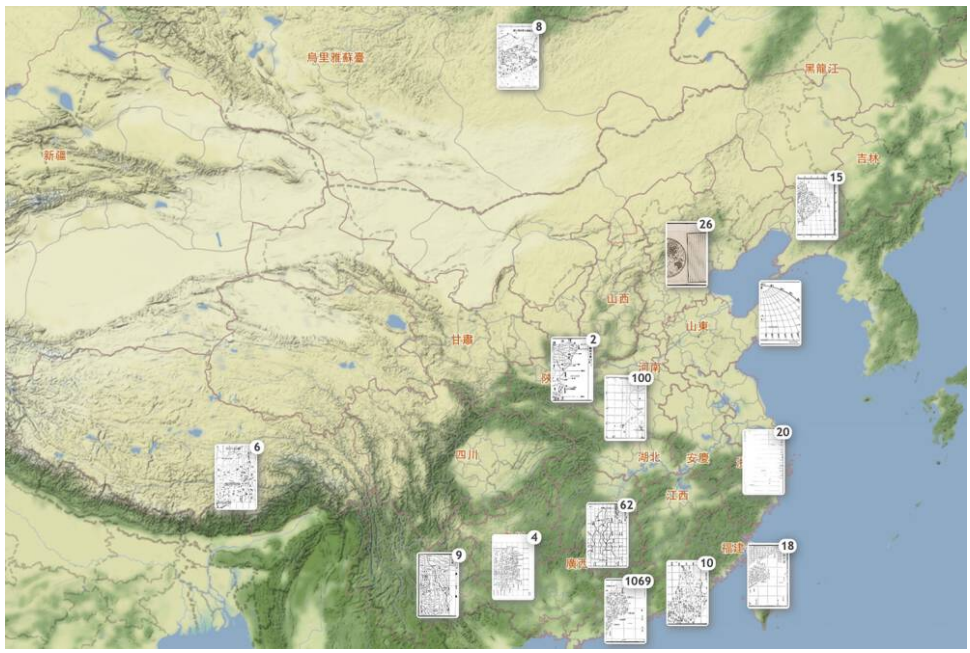

Figure 1. Geographical distribution of the longitude and latitude gazetteer (LLG) maps in the Qing dynasty featured in LoGaRT (https://www.mpiwg-berlin.mpg.de/research/projects/logart-local-gazetteers-research-tools). Guangxi, Yunnan, Tibet, Mongolia (includes inner Mongolia and Uria Sutai), Jilin, and Fengtian, located in the frontier; Guangdong, Fujian, Zhejiang, Jiangsu, Shandong, and Taiwan, which have maritime borders; and Henan, Shaanxi, Hunan, Hubei, Anhui, Guizhou, located in the inner Qing empire, all have LLG maps. Images from the open-access Harvard-Yenching Library online collection.

concepts of "celestial North Pole height" and "*li cha*" were used only by astronomers; they were not converted into latitude and longitude values for mapping. When Matteo Ricci introduced the concept of longitude and latitude, the Ming official Xu Guangqi 徐光啟 (1562–1633) combined concepts like "celestial North Pole height" 北極高度 and "*li cha*" 裡差 with geographical longitude and latitude, equating the former to geographical latitude and the latter to geographical longitude for the first time.[12]

In the Qing dynasty, Chinese cartographers who examined Western maps discovered the drawbacks of the traditional techniques of grid scales and looked to adopt more precise mapmaking techniques such as longitude and latitude lines. For example, Li Mingche 李明徹 (1751–1832), who initiated the compilation of LLG maps in Guangdong, also drew a large-size map with longitude and latitude lines.[13] It is quite possible that he referenced maps of the world or of Asia drawn by Europeans at that time.

Before the twentieth century, not every ordinary scholar had access to Western maps. But maps based on the *Map of the Complete View of the Imperial Territory* (*Huangyu quanlan tu* 皇輿全覽圖) (1718) and the *Map of the Imperial Repository of the Qianlong Reign* (*Qianlong*

[12] Yang Fan 杨帆 and Sun Xiaochun 孙小淳, "Dili Jingweidu yu Chongzhen Gaili *Xifa* de Queli 地理经纬度与崇祯改历"西法"的确立," *Kexue Wenhua Pinglun* 科学文化评论, 2017, *14*(4):62–75.

[13] Li Mingche, "Da Qing wannian yitong jingwei yutu, [China], 1819–1932," http://resolver.sub.uni-goettingen.de/purl?DE-611-HS-3226686.

neifu yu tu 乾隆內府輿圖) (1762) circulated in the empire and provided a crucial reference for the drawing of LLG maps. Dong Youcheng 董祐誠 (1791–1823) and Li Zhaoluo 李兆洛 (1769–1841) drew the *Imperial Complete Map of All under Heaven* (*Huangchao yitong yudi quan tu* 皇朝一統輿地全圖) (1832), which presented longitude and latitude grids as red dotted lines and marked the grid scales with solid black lines.[14] In 1863, Hu Linyi 胡林翼 (1812–1861) and Yan Shusen 嚴樹森 (1814–1876) updated Dong and Li's map for the *Terrestrial Map of the Unification of China and Foreign Counties by the Imperial Dynasty (Huangchao zhongwai yitong yu tu*皇朝中外一統輿圖) (1863). Hu and Yan drew grid scales on the submaps and supplemented them with longitude lines.[15] Those two maps became popular and widely cited sources for gazetteer compilers.[16]

The concept of "Chinese origins of the Western sciences" (*Xixue zhongyuan shuo* 西學中源說) alleviated the literati's ideological concerns about adopting new-style LLG maps. In the late Ming and early Qing dynasties, some scholars advanced the theory that Western academic knowledge originated from China. Emperor Kangxi gave this theory an official imprimatur with his support. By the end of the nineteenth century, Chinese scholars had shoehorned almost every Western discipline introduced into China into this theory.[17] Paradoxically, adopting Western techniques on maps became a way to highlight the superiority of traditional Chinese knowledge, and LLG maps became a means to revive ancient cartographic methods.[18] The "Chinese origins of the Western sciences" concept is now considered a compromise that enabled the literati to accept Western science. The compromise was also seen in LLG mapping, as LLG mapmakers combined new knowledge with tradition and balanced conflicting Chinse and Western cartographic methods.

The compromises that characterized LLG maps can be classified into four types. The first type can be found on early LLG maps, which still used the traditional grid scales but marked latitude and longitude values as well. In these maps, mapmakers labeled each grid representing a given number of *li* and also marked latitude values on horizontal lines and longitude values on vertical lines. For instance, in the *General Map of Guangdong* (*Guangdong yudi zongtu* 廣東輿地總圖) (1822), each grid represents both 1 degree and 250 *li* (see Figure 2).[19] In these

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[14] Dong Youcheng and Li Zhaoluo, *Huang chao yi tong yu di quan tu* (Changzhou: Bian zhi shu shu, 1832), https://www.loc.gov/item/gm71002481/.

[15] Hu Linyi 胡林翼 and Yan Shusen 嚴樹森, *Huangchao zhongwai yitong yutu* 皇朝中外一統輿圖 (Wuhan: Hubei fu shu jing huan lou, 1863). See also Amelung, "New Maps for the Modernizing State" (cit. n. 8).

[16] For example, those two maps were cited by the *Maps of Tibet* (*Xizang tu kao* 西藏圖考) and the *Illustrated Maps of Guizhou Province* (*Guizhou quansheng diyu tu shuo* 貴州全省地輿圖說): *(Guangxu) Xizang Tu Kao* (光緒)西藏圖考, ed. Huang Peiqiao 黃沛翹 (1886), 1:4b; and *(Xuantong) Guizhou Quansheng Diyu Tu Shuo* (宣統)貴州全省地輿圖說, ed. Guizhou diaocha ju 貴州調查局 (Guiyang: Guizhou diaocha ju, 1909), *fan li*: 1a–1b.

[17] Zhang Mingwu 张明悟, "Wanqing Xixue Zhongyuan Shuo Yanjiu 晚清西学中源说研究" (Ph.D. diss., Univ. Chinese Academy of Sciences, 2014); Wang Yangzong 王扬宗, "Xixue Zhongyuan Shuo he Zhongti Xiyong Lun zai Wanqing de Shengshuai '西学中源' 说和 '中体西用' 论在晚清的盛衰," *Gugong Bowuyuan Yuan Kan* 故宫博物院院刊, 2001, no. 5, pp. 56–62; and Michael Lackner, "'Ex Oriente Scientia?' Reconsidering the Ideology of a Chinese Origin of Western Knowledge," *Asia Major*, 2008, *21*(1):183–200, http://www.jstor.org/stable/41649946.

[18] *Guangdong Tong Zhi* 廣東通志, ed. Ruan Yuan 阮元, Chen Changqi 陳昌奇, *et al.* (Shanghai: Shangwu yinshu guan, 1934), p. 1436.

[19] *Ibid.*, pp. 1434–1435. Additional examples appeared in the following books: *Zhongguo Fanzhi Congshu (Huazhong 1105) Xiangyinxian Tu Zhi* 中國方志叢書 (華中1105) 湘陰縣圖誌, ed. Guo Songtao 郭嵩燾 (Taibei: Chengwen chubanshe youxian gongsi, 2014), pp. 36–37; *(Guangxu) Fengyang Fu Zhi* (光緒)鳳陽府志, ed. Feng Xu 馮煦 and Wei Jiahua 魏家驊 (1908), 1:1b–2a; *(Tongzhi) Danshui Ting Zhi* (同治)淡水廳志, ed. Yang Jun 楊浚 (1871), 1:1b–2a; *(Guangxu) Haiyang Xian Zhi* (光緒)海陽縣志, ed. Lu Weiyou 盧蔚猷 and Wu Daorong 吳道鎔 (1900), *tu* 2a–2b; *(Guangxu) Jiaying Zhou Zhi* (光緒) 嘉應州志, ed. Wu Zongzhuo 吳宗焯 and Wen Zhonghe 溫仲和 (1898), 1:10–12; and *(Guangxu) Huazhou Zhi* (光緒)化州志, ed. Peng Yisun 彭貽蓀 and Peng Buhao 彭步瀛 (1890), 1:23b–24a.

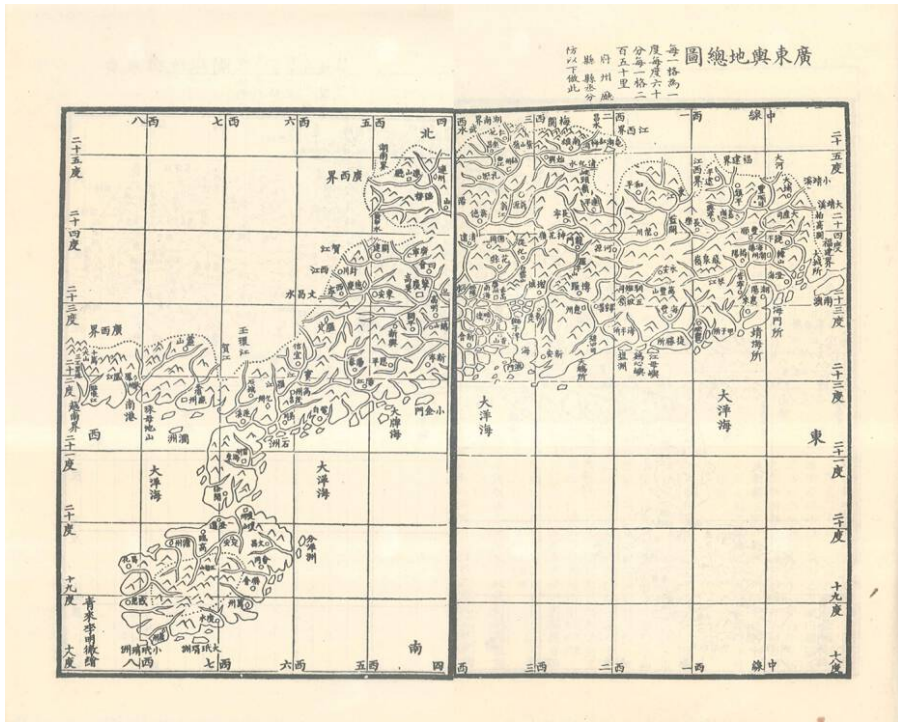

Figure 2. In the earliest LLG maps, mapmakers used the traditional grid scales and marked latitude and longitude values on the grids. In the *General Map of Guangdong* (*Guangdong yudi zongtug* 廣東輿地總圖) (1822), each grid represents 250 *li* and 1 degree. From *Guangdong Tong Zhi* 廣東通志, ed. Ruan Yuan阮元, Chen Changqi 陳昌, *et al.* (Shanghai: Shangwu yinshu guan, 1934), pp. 1434–1435.

LLG maps, each degree denotes about 200 *li*, 240 *li*, or 250 *li* on the Earth, respectively, but without genuinely reflecting the spirit of longitude and latitude. Instead, the mapmakers intended to convey the traditional Chinese astronomical notion that "for one degree of *celestial North Pole height* there are 200 *li* (or about 250 *li*) on the Earth." These mapmakers understood the relationship between longitude and latitude values and ground distances. They sought a middle way by indicating longitude and latitude values on the grids of *li*. Significant errors may arise in gazetteer maps, especially those depicting larger geographical territories like provinces and prefectures, when longitude and latitude grids and grid scales are used simultaneously. As the latitude increases farther to the north, the distance between two longitude lines becomes increasingly narrower, leading to errors.

As the demand for accuracy increased, mapmakers found it difficult to overlap grid scales with latitude and longitude lines. They developed a second compromise method to allow for the coexistence of longitude and latitude lines and the grid scales. The *Longitude and Latitude Map* (*Jingwei tu* 經緯圖) (see Figure 3) in the *Xiangyin County Illustrated Gazetter* (*Xiangyin xian tu zhi* 湘陰縣圖志) (1880) and maps from other gazetteers reflected this compromise.[20] On

[20] *(Guangxu) Nanyang Xian Zhi* (光緒)南陽縣志, ed. Pan Shoulian 潘守廉 and Zhang Jiamou 張嘉謀 (1904), *tu* 4–46; *Zhongguo Fangzhi Congshu (Huazhong* 297*) Dong'an Xian Zhi* 中國方志叢書 (華中297) 東安縣志, ed. Huang Xinju 黃心菊 and Hu Yuanshi 胡元士 (Taibei: Chengwen chubanshe youxian gongsi, 1975), pp. 8–12; *(Xianfeng) Tongzhou Fu Zhi* (咸豐) 同州府志, ed. Li Enji

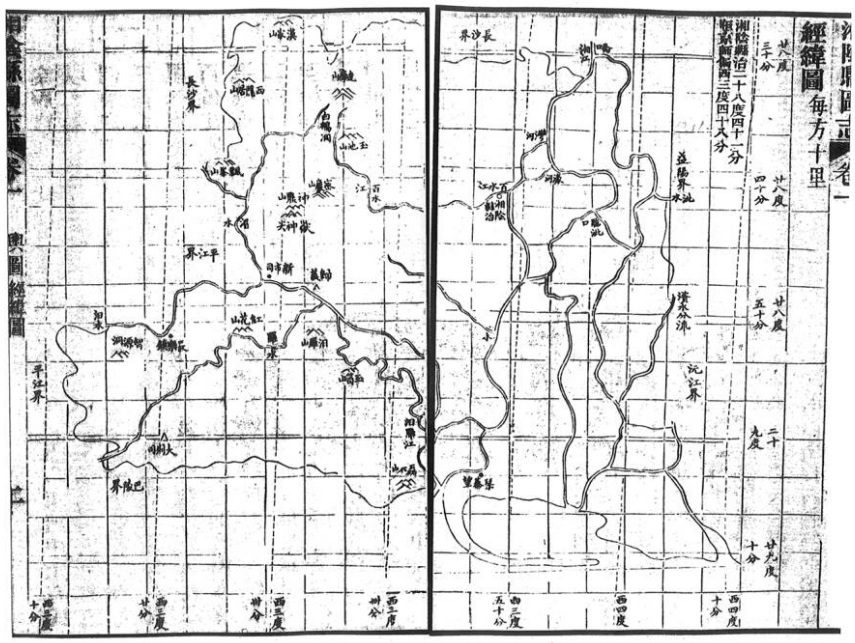

Figure 3. Longitude and latitude lines and the grid scales coexisted in the second type of LLG maps. The *Longitude and Latitude Map* (*Jingwei tu* 經緯圖) from the *Xiangyin County Illustrated Gazetter* (*Xiangyin xian tu zhi* 湘陰縣圖志) (1880) is one example. From *Zhongguo Fanzhi Congshu (Huazhong 1105) Xiangyinxian Tu Zhi* 中國方志叢書(華中1105) 湘陰縣圖誌, ed. Guo Songtao 郭嵩燾 (Taibei: Chengwen chubanshe youxian gongsi, 2014), pp. 36–37. Used with permission from Cheng Wen Publishing Company, Ltd.

the third type of LLG map, mapmakers draw grid scales supplemented with longitude lines, with horizontal lines also marking the latitude. We can see examples of this representation in several local gazetteers.[21]

On the last type of compromise map, the mapmaker drew grid scales and then wrote the longitude and latitude values in characters, placing them on the map in textual rather than visual form. For example, maps in the *Shuntian Prefectural Gazetteer* (*Shuntian fu zhi* 順天府志) (1889) and two other gazetteers presented the longitude and latitude values this way.[22]

李恩繼 and Jiang Xiangnan 蔣相南 (1852), 1:1b–2a; *(Guangxu) Wuchang Xian Zhi* (光緒) 武昌縣志, ed. Zhong Tongshan 鐘桐山 and Ke Fengshi 柯逢時 (1885), *yu tu*: 1b–2a; and *Xiangyin Xian Tu Zhi* 湘陰縣圖志, ed. Guo Songtao 郭嵩燾 (Changsha: Xiangyin xian zhi ju, 1880), 1:1b–2a.

[21] For example, it appeared in the following books: *(Guangxu) Fengtian Quansheng Diyu Tu Shuo* 奉天全省地輿圖說, ed. Wang Zhixiu 王志修 (1894), 1:6; *(Guangxu) Xizang Tu Kao* (cit. n. 16), 1:2b–4a; *(Tongzhi) Xuzhou Fu Zhi* (同治)徐州府志, ed. Wu ShiXiong 吳世熊 and Liu Xiang 劉庠 (1874), 2:1b–2a; *(Guangxu) Baise Ting Zhi* (光緒)百色廳志, ed. Chen Rujin 陳如金 and Hua Bensong 華本松 (1891), 2:1b–2a; *(Guangxu) Taoyuan Xian Zhi* (光緒)桃源縣志, ed. Yu Liangdong 余良棟 and Liu Fengbao 劉鳳苞 (1892), *juan shou*: 9b–10a; *(Xuantong) Guizhou Quansheng Diyu Tu Shuo* (cit. n. 16), *tu* 1; and *(Guangxu) Yidu Xian Tu Zhi* (光緒)益都縣圖誌, ed. Zhang Chengxie 張承燮 and Fa Weitang 法偉堂 (1907), 1:2b.

[22] *(Guangxu) Shuntian Fu Zhi* (光緒)順天府志, ed. Zhou Jiamei 周家楣 and Zhang Zhidong 張之洞 (1889), 19: *tu* 2–24; *Zhongguo Fanzhi Congshu (Huanan 0054) Qingyuan Xian Zhi* 中國方志叢書 (華南0054) 清遠縣志, ed. Li Wenxuan 李文煊 and Zhu Runfang 朱潤芳 (Taibei: Chengwen chuban she, 1967), p. 18; and *(Xuantong) Lehui Xian Zhi* (宣統)樂會縣志, ed. Lin Dahua 林大華 (1911), 1: *tu* 1b–2a.

The depiction of latitude and longitude on some maps proves neither that these mapmakers fully understood the concept of latitude and longitude nor that they grasped the equivalence between the "celestial North Pole height" and latitude or between *li cha* and longitude. The *Danshui Prefectural Gazetteer* (*Danshui ting zhi* 淡水廳志) (1871) and the *Shuntian Prefectural Gazetteer* (*Shuntian fu zhi* 順天府志) (1889), for example, both mistook the north–south latitude for the east–west longitude, confusing the two concepts.

More literati recognized the rapid advancement of Western sciences and technologies after the Opium War (1840–1842). After the Sino-Japanese War (1894–1895), when the Qing was defeated by neighboring Japan, Chinese intellectual elites' confidence in their native traditions and institutions sharply declined. The notion of "Chinese origins of the Western sciences" was quickly abandoned in the early twentieth century. The Qing court began to advocate for the general adoption of latitude and longitude maps. Considering traditional maps outdated and inaccurate—and useless in resolving border disputes—the Qing court started to redraw the national map in 1889, requesting that each province supply submaps using longitude and latitude lines. Although some provinces failed to submit the required maps owing to the shortage of professional cartographers, when this project was finished in 1899 more than half of the provinces had submitted maps marked with longitude and latitude lines.[23]

In the early twentieth century, books and maps introducing Western cartography came into vogue. New schools offered Western geography courses. Surveying schools affiliated with the army taught Western surveying and mapping technologies and popularized the concept of latitude and longitude. Influenced by these factors, LLG maps enjoyed a resurgence in popularity. Foreign maps also played an important role in this process. The *Gazetteer of Mongolia* (*Menggu zhi* 蒙古志) (1907) contains four maps with standard longitude and latitude lines (see Figure 4) and also adopted the longitude line running through London as the central line, which was quite rare at that time. The mapmakers also referred to several other maps, like the *China and Russia Bolder Map*, translated by Hong Jun 洪鈞 (1839–1893) from the Russian, and the *Complete Map of Eastern Regions Operated by Russia*, developed by Japanese surveyors.[24] Thanks to the growing abundance of geographic data in this period, LLG maps rapidly transformed.

THE MAPMAKERS

The rapid transformation of LLG maps was related to the opening of technical schools that trained students in the specialized mathematical and surveying skills necessary to produce such maps and the corresponding professionalization of mapmakers. In ancient China, mapmaking work would have been done by minor officials (*xu li* 胥吏) and artisan painters (*hua gong* 画工).[25] With the rise of local gazetteer compilation, local officials and scholars became involved in mapmaking. The mapmakers of local gazetteers of the Ming dynasty were mainly Confucian scholars (*ru sheng* 儒生), artisan painters, and book engravers.[26] For local gazetteers of the Qing dynasty,

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[23] Wang Yifan 王一帆, "Qingmo Dili Da Cehui: yi Guangxu Huidian Yutu wei Zhongxin de Yanjiu 清末地理大測繪:以光緒《會典輿圖》為中心的研究" (Ph.D. diss., Fudan Univ., 2011), pp. 140–143; and Amelung, "New Maps for the Modernizing State" (cit. n. 8).

[24] *Zhongguo Fangzhi Congshu (Saibei* 37*) Menggu Zhi* 中國方志叢書(塞北37)蒙古志, ed. Xia Rizhan 夏日琖 and Yao Minghui 姚明輝 (Taibei: Chengwen chuban she, 1968), pp. 345–348.

[25] Wang Yong 王庸, *Zhongguo Dilixue Shi* 中国地理学史 (Shanghai: Shangwu yinshu guan, 1938), p. 50. Pan Sheng pointed out that most mapmaking bureaucrats in the Song dynasty were *Hao zhai* 壕寨, junior technical officials responsible for surveying and mapping: Pan Sheng 潘晟, *Ditu de Zuozhe ji qi Yuedu: yi Song Ming wei Hexin de Zhishishi Kaocha* 地图的作者及其阅读:以宋明为核心的知识史考察 (Nanjing: Jiangsu renming chuban she, 2013), pp. 37–54.

[26] Pan Sheng 潘晟, "Shui de Xushu: Mingdai Fangzhi Ditu Huizhi Renyuan Shenfen Chukao 谁的叙述:明代方志地图绘制人员身份初考," *Zhongguo Lishi Dili Luncun* 中国历史地理论丛, 2004, *19*(1):74–81.

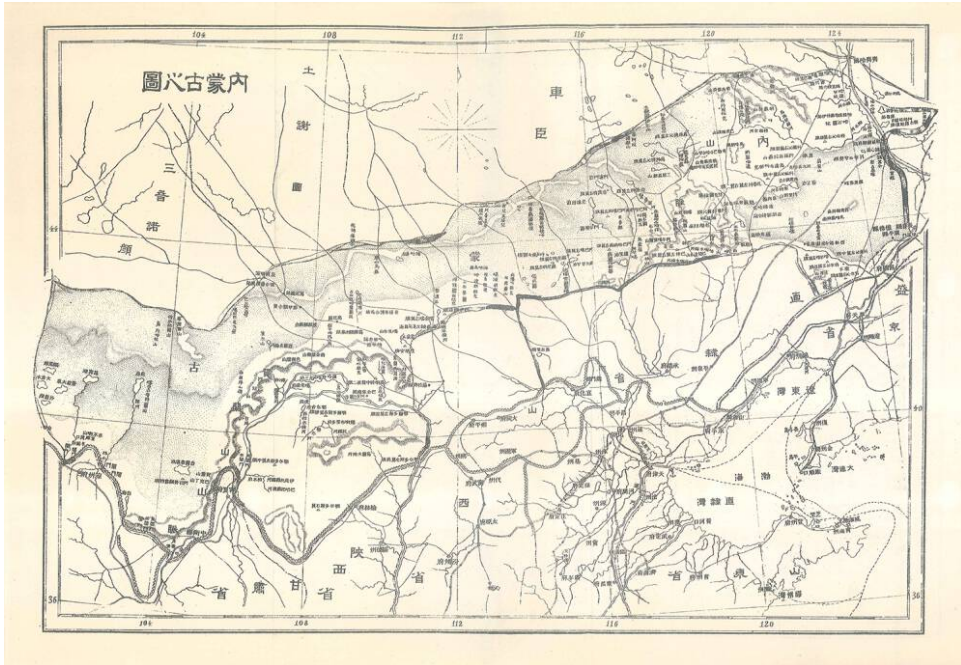

Figure 4. In the early twentieth century, LLG maps enjoyed a resurgence in popularity, and foreign maps played an important role in this process. The map of Inner Mongolia from the *Gazetteer of Mongolia (Menggu zhi* 蒙古志) (1907) referred to several foreign maps. From *Zhongguo Fangzhi Congshu (Saibei* 37) *Menggu Zhi* 中國方志叢書(塞北37)蒙古志, ed. Xia Rizhan 夏日琖 and Yao Minghui 姚明輝 (Taibei: Chengwen chuban she, 1968), pp. 345–348. Used with permission from Cheng Wen Publishing Company, Ltd.

the majority of mapmakers were students (*sheng yuan* 生員) who had passed the imperial examination at the county level; a second group consisted of minor officials, such as scribes (*dian li* 典吏) and clerks (*shu li*書吏); and a third group was government servants, mostly official assistants and scribes. There were also a few artisans, such as painters, carvers, and mapping personnel trained in new schools that taught science.[27]

Compared to the average gazetteer mapmaker, LLG mapmakers required more specialized skills. In 1799 the *Biographies of Calendar Scholars* (*Chouren zhuan* 疇人傳) was published, with further editions coming out in 1840, 1886, and 1898. These books introduced famous scholars who were versed in astronomy and mathematics and designated them "Calendar Scholars" (*Chouren* 疇人). Several important LLG mapmakers were listed in the *Chouren zhuan*: for example, mapmakers of Guangdong local gazetteers, including Li Mingche 李明徹 (1751–1832), Zou Boqi 鄒伯奇 (1819–1869), Chen Li 陳澧 (1810–1882), and Chen Changqi 陳昌奇 (ca. 1750–1830); and the mapmaker of Hunan local gazetteers, Yin Jiajun 殷家儁 (ca. 1820–1890).[28] Li Mingche 李明徹 (1751–1832), the mapmaker of the *Guangdong Provincial*

[27] Liu Gaowei 刘高伟, "Qingdai Fangzhi Ditu Zuozhe Chutan 清代方志地图作者初探" (M.A. thesis, Nanjing Normal Univ., 2018), pp. 66, 69.

[28] Ruan Yuan 阮元 *et al.*, *Chouren Zhuan Hebian Jiaozhu* 畴人传合编校注, ed. Feng Lisheng 冯立昇, Deng Liang 邓亮, and Zhang Junfeng 张俊峰 (Zhengzhou: Zhongzhou guji chuban she, 2012), pp. 565–568, 675, 77–78.

Gazetteer (*Guangdong tong zhi*廣東通志) (1822), studied Western painting in Guangzhou before learning astronomy and mathematics from imperial astronomers in Beijing. When he returned to Guangdong, Li Mingche traveled to Macao and discussed astronomy and geography with knowledgeable Europeans in the city. In 1819 he finished the book *Illustrations of the Universe and the Earth* (*Huangtian tushuo* 圜天圖說). It included a map of the Eastern and Western Hemispheres for understanding a globe-shaped Earth, a map of the Qing imperial territory, and maps of eighteen provinces marked with latitude and longitude lines.

Compared with contemporary local gazetteer maps, those drawn by Li Mingche were innovative in two respects. First, his maps are the earliest preserved local gazetteer maps featuring longitude and latitude lines. Second, Li increased the number of gazetteer maps by producing county-level maps within the jurisdiction of Guangdong Province, a practice others took up. The *Guangdong Provincial Gazetteer* (*Guangdong tong zhi*廣東通志) (1822) initiated the tradition of drawing LLG maps, and subsequent maps of local gazetteers in Guangdong kept innovating and improving on this format, including the *Zhaoqing Prefectural Gazetteer* (*Zhaoqing fu zhi* 肇慶府志) (1833) and the *Qiongzhou Prefectural Gazetteer* (*Qiongzhou fu zhi* 瓊州府志) (1841).[29]

The abundance of LLG maps in Guandong Province can be attributed to the training of Calendar Scholars by the Xuehai Academy (*Xuhai tang* 學海堂). In 1821, as the governor-general of Guangdong and Guangxi provinces, Ruan Yuan founded the Xuehai Academy in Guangzhou to foster local academic culture. Unlike other contemporary schools, the Xuehai Academy did not seek to prepare students for the civil examination but, instead, for work in applied fields. Ruan Yuan himself was a Calendar Scholar and advocated "acquiring knowledge widely and thoroughly." He proposed that astronomy and mathematics be taught at the Xuehai Academy alongside Confucian classics, history, and poetry.[30] Ruan established the "senior system" for the Xuehai Academy, appointing eight famous scholars who jointly took charge of teaching and mentoring students. The appointment of scholars proficient in arithmetic, geography, and astronomy as mentors helped to foster cartographic talent. The master of arithmetic and geography, Wu Lanxiu 吳蘭修 (active ca. 1821–1850), was among the first batch of mentors.[31] Teachers and students at the Xuehai Academy were mostly local elites. The school provided an institutional base for them to develop a collective identity and form a regional consciousness, as well as learn the skills necessary for the compilation and publication of local gazetteers.[32] Scholars from the Xuehai Academy with knowledge of astronomy and mathematics shouldered the vital task of drawing local gazetteer maps.

Hunan Province produced the second largest number of LLG maps. Calendar Scholar Yin Jiajun 殷家儁, who drew the general map of the *Hengyang County Gazetteer* (*Hengyang xian zhi* 衡陽縣志) (1872), was the first to add azimuths on the LLG map. The map is centered on the county government, with a meridian running through government offices and pointing northward as a radius. The radius is then turned in a clockwise direction and marks the angle—the azimuth angle—between the meridian and the intersection on the map frame. Azimuths against

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[29] *Zhongguo Fangzhi Congshu (Huanan 47) Qiongzhou Fu Zhi* 中國方志叢書(華南110)瓊州府志, ed. Ming Yi 明誼 and Zhang Yuesong 張岳松 (Taibei: Chengwen chuban she, 1967), pp. 10, 46.

[30] Benjamin A. Elman, "The Hsueh-hai Tang and the Rise of New Text Scholarship in Canton," *Journal of Hunan University (Social Sciences)*, 2006, 20(2):13–20.

[31] Zheng Liancong 郑连聪, "Ru Yuan yu Xuehai Tang Yanjiu 阮元与学海堂研究" (M.A. thesis, Central China Normal Univ., 2003), pp. 17, 20–25, 37–42.

[32] Tang Langshi 唐朗诗, "Xueshu Gongtongti zhong de Zhengzhi Shijie: yi Shijiu Shiji Guangdong Xuehai Tang wei Li 学术共同体中的政治世界:以十九世纪广东"学海堂"为例" (M.A. thesis, Fudan Univ., 2012), pp. 11–28.

due north, east, south, and west are 0, 90, 180, and 270 degrees, respectively. Yin's LLG maps influenced mapmaking in surrounding areas, such as the *Dong'an County Gazetter* (*Dong'an xian zhi* 東安縣志) (1875).[33]

New changes occurred in the last years of the Qing dynasty, as more professional surveyors trained by the official survey schools became LLG mapmakers. In the early twentieth century, the Qing court sought to reform its military. Because surveying played an important role in military affairs, the government established special survey agencies. To fill the demand for qualified surveyors, in 1906 the Qing Ministry of the Army 清政府陸軍部 issued a call for all provinces to open survey schools. The ministry set regulations for these schools and mandated that the curriculum include courses on mapping, surveying by theodolite, field measurement by plane-table, arithmetic, and geometry.[34] Although the Xuehai Academy was forced to close in 1903, its role was continued by the Guangdong Army School of Surveying (*Guangdong lujun cehui xuetang* 廣東陸軍測繪學堂), established under the Guangdong and Guangxi Bureau of Military Training in 1906. Among teachers at the new survey school, Luo Zhaocang 羅照滄 (ca. 1850–1920) had studied at the Xuehai Academy, Yao Hongfa 姚鴻法 (1882–1947) graduated from the Imperial Japanese Army Academy, and three Japanese scholars were specially hired to teach geodetic surveying, topographic surveying, cartography, and advanced mathematics. By the end of the Qing dynasty in 1911, the school had trained over 220 students. Those graduates became professional surveyors and were dispatched to different localities in Guangdong, where they participated in survey work. The resulting changes were not confined to treaty ports like Guangdong but showed up in local gazetteer maps across the country. LLG maps are different from typical maps, and their makers needed to have a certain intellectual background. Only those scholars with specialized knowledge could cross the technical threshold required for disseminating longitude and latitude knowledge and for genuinely understanding and drawing LLG maps.

CONCLUSION

During the late Qing period, local mapmakers equipped with astronomical and mathematical knowledge integrated traditional Chinese cartography, based on the notion of grid scales, with Western longitude and latitude technology and settled on an eclectic and ingenious compromise approach. Thanks to the dissemination of official maps and the publication of mapping data during the Kangxi and Qianlong reigns in the seventeenth and eighteenth centuries, LLG maps could draw from this earlier period of transmission and exchange. Before the twentieth century, prominent mapmakers of LLG maps were known as Calendar Scholars. In the twentieth century, professional surveyors filled the ranks of leading mapmakers. This phenomenon reveals a technical threshold for disseminating longitude and latitude knowledge. The knowledge requirement for cartography made it hard to adopt these cartographic innovations fully before the significant educational and institutional reforms of the early twentieth century.

To return to the question raised at the beginning of this essay: my research using local gazetteers as a source shows that the introduction of Western cartography did not meet significant resistance. Western cartography became popular in the late Qing dynasty owing to its novel methods and high precision. Some mapmakers who did not understand the concepts of longitude

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[33] *Zhongguo Fangzhi Cunshu (Huazhong 113) Hengyang Xian Zhi* 中國方志叢書 (華中113) 衡陽縣志, ed. Peng Yulin 彭玉麟 and Yin Jiajun 殷家儁 (Taibei: Chengwen chuban she youxian gongsi, 1970), pp. 14–15; and *Zhongguo Fangzhi Congshu (Huazhong 297) Dong'an Xian Zhi* 中國方志叢書(華中297)東安縣志, pp. 8–12.

[34] *Zhongguo Cehuixue Shi* 中国测绘学史, Vols. 1 and 2, ed. Yu Cang 喻沧, Liu Zijian 刘自健, and Zhongguo cehui shi bianji weiyuanhui 《中国测绘史》编辑委员会 (Beijing: Cehui chuban she, 2002), pp. 455–488.

and latitude nonetheless indicated these on their maps or adopted a compromise that combined graticules and grid scales. However, it requires a certain amount of knowledge to grasp modern cartography, and especially to draw maps with longitude and latitude markings based on numerical data. Only after the fall of the Qing dynasty in 1911 did local gazetteer maps that adopted Western cartographic techniques become more common.