

William Doberck and the Chinese Maritime Customs Meteorological Standards Germination

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Introduction

In the nineteenth century, the establishment of large-scale meteorological observation networks globally became a trend, and people hoped to discover regularities in weather patterns through the statistical analysis of meteorological records. The major Western countries drew upon the existing military, astronomical, and amateur observation resources to establish corresponding meteorological observation networks. In this process, the calibration of meteorological instruments and the standardization of meteorological observations play a crucial role. To facilitate the use of data for weather mapping, meteorological instruments must be calibrated to ensure that data is collected and recorded in consistent units. The aim of standard meteorological observation norms is to minimize errors in weather recordings that may arise from human factors or force majeure events. However, in practice, implementing these norms, particularly within domestic contexts where difficulties may arise, is challenging. The implementation of international standards is even more complex. Consequently, the development of international standards for meteorological observations has emerged as a significant challenge that major Western countries are actively seeking to address.¹ It was only during the meteorological conferences held in Leipzig and Vienna in the latter half of the nineteenth century that a significant impetus was provided for the establishment of a unified meteorological culture across European countries. These conferences sparked extensive discussions on various aspects, including the types of instruments to be used, the scale of observations, the timing of observations, and methodologies for conducting observations.²

¹ Roskam C, "Constructing climate: the Hong Kong Observatory and imperial Britain's meteorological networks, 1842–1912," *The Journal of Architecture* 26, no. 8 (2021): 1241-70.

² Naylor S, "Weather instruments all at sea: meteorology and the Royal Navy in the nineteenth century," *Geography, technology and instruments of exploration*, (2015): 77-96.

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In November 1869, Robert Hart, the Inspectorate General of Chinese Maritime Customs, proposed the establishment of meteorological stations at Customs. Through continuous enhancements and upgrades, the Customs meteorological work not only formed the initial meteorological observation network in modern China but also emerged as a pivotal meteorological observation network in East Asia. This network laid a critical data foundation for the development of typhoon warnings, weather mapping, weather forecasting, and other operational activities of observatories across East Asia. However, during the Customs' initial meteorological endeavours, the number and types of meteorological instruments varied considerably among stations, and some Customs locations were even devoid of essential meteorological instruments—a situation that persisted until the 1880s. Hart, the Inspectorate General of Customs, fostered meteorological cooperation with the Xujiahui Observatory and the Hong Kong Observatory, resulting in expert guidance for Customs meteorological work. Notably, during this period when two observatories maintained collaborative relationships, the Chinese Maritime Customs demonstrated predominant partnership with the Xujiahui Observatory. Academic studies have rigorously traced the evolution of meteorological cooperation between these institutions, producing seminal works on their interdisciplinary collaboration.³ Despite the publication of *Instructions in the Use of Meteorological Instruments* (1880) – a 77-page technical manual authored by Marcus Dechevrens, director of the Xujiahui Observatory, and printed by the Zi-ka-wei Catholic Missions Press – this seminal work failed to gain traction among Chinese Maritime Customs officials. While existing studies acknowledge Customs' assistance in publishing the Director's meteorological observations in the Hong Kong Observatory, they have largely overlooked the intricate details of their interactions and the significance of this meteorological observation publication. By integrating information from Customs archives and historical press, this study explores the practical applications of the meteorological observation instruction by Hong Kong Observatory.

Customs early meteorological work

As meteorology emerged as a rapidly developing discipline in the second half of the 19th century, meteorological observation guidance and the expertise of meteorological professionals became integral components of the operational meteorological observation network. This was also evident in the establishment and preparation of the Customs meteorological service.

Failure of Candidates

In 1873, to advance the cause of Customs meteorological observations, Hart issued instructions regarding meteorological instruments, registers for meteorological records, and other related materials. He emphasized the necessity of equipping each station with Alexander Buchan's (1829-1907) *Introductory Text-book of Meteorology* and one or two additional books on meteorological subjects for the use of the customs clerk responsible for the instruments. This would not only serve as a guide for their meteorological work but also provide them with a deeper understanding of meteorological observations and records.⁴ Published in 1871, Buchan's book stands as a classic textbook of modern British meteorology and is also among

³ Yan Wu, *Science, Interest and Expansion of Europe: Zi-Ka-Wei Observatory (1873-1950) in the Context of the Territorial Expansion of European Modern Science* (China Social Sciences Press, 2013), 35-39; Yan Wu, "Observatory of Zi-Ka-Wei and Modern Meteorological Station Network Founded in China," *Studies in the History of Natural Sciences* 32, no. 2 (2013): 165-175; Hao Wang, "The Observatory of Zikawei and Meteorology in Modern China," *Academic Monthly* 49, no. 9 (2017): 173-184.

⁴ Robert Bickers and Catherine Ladds, *Chinese Maritime Customs Project Occasional Paper No.3: Robert Hart, Documents relating to, 1. the Establishment of Meteorological Stations in China; and 2. Proposals for co-operation in the publication of meteorological observations and exchange of weather news by telegraph along the Pacific coast of Asia* (Bristol University, 2008), 5, <https://www.chinafamilies.net/wpcontent/uploads/2021/06/occasionalpaper3.pdf>

the essential publications required for observers affiliated with the Royal Meteorological Society.⁵ This underscores the relevance and connection of Chinese Customs meteorological work to British meteorology.

The proposal of the customs meteorological scheme by Hart, the Inspectorate General of Chinese Maritime Customs, met with varied reactions in England. In June 1874, J.D. Campbell reported to Hart, stating: “I have been informed that Mr. Blandford, the Meteorological Inspector in Bengal who has recently returned, holds your scheme in high esteem but considers it overly ambitious. He expresses concern that it may falter unless you can secure someone with the expertise to execute and implement it.”⁶

India was a significant overseas colony of Britain, and Henry Blanford (1834-1893) served as the inaugural “meteorological reporter” for the British Indian government, focusing primarily on cyclone research.⁷ As a seasoned meteorological reporter, Blanford’s endorsement of Hart’s Customs meteorological programme is likely to align with his consistent advocacy for expanding the number of Indian observatories. He has emphasized repeatedly that only a diverse network of observatories can contribute to a more comprehensive understanding of weather conditions across the continent.⁸ Blanford’s only reservation about Hart’s Customs meteorological programme was the appointment of the person in charge, as their role was crucial for the successful implementation of the entire programme.

In telegraphic communications with Hart, Campbell suggested five candidates for consideration, with the final decision on employment resting with Hart. The first candidate to be disqualified was Philip Wodehouse (1811-1887), who had resigned as the governor of the Cape Town colony in 1870.⁹ He was deemed unsuitable due to his advanced age and the absence of specialized meteorological knowledge.¹⁰ The second candidate was the Austrian astronomer Robert Gustav Schram (1850-1923), who was 24 years and had worked as an assistant at the Geneva Observatory.¹¹ Although he fulfilled Hart’s requirement that the person in charge be a young man, the question of whether he had sufficient experience in teaching and meteorological observations was a matter of concern. ‘Experience in teaching and meteorological observations is a cause for concern.’¹² Hart’s vision for the Customs meteorological observation prompted him to want to establish an observatory in Tongwenkuan¹³ to oversee the Customs meteorological observatories. Consequently, he sought

⁵ Qian Chen and Beibei Li, “Analysis of Alexander Buchan’s meteorological research, practice and contribution,” *Progress in Meteorological Science and Technology* 14, no. 5 (2024): 71-75.

⁶ As an English man, Scot, he joined the London agency of the Chinese Maritime Customs in 1862 and maintained a close collaboration with Hart.

⁷ Roy T. “‘The Law of Storms’: European and Indigenous Responses to Natural Disasters in Colonial India, c. 1800–1850,” *Australian Economic History Review* 50, no. 1 (2010): 6-22.

⁸ Cullen B. and Geros C L, “Constructing the Monsoon: Colonial Meteorological Cartography, 1844–1944,” *History of Meteorology* 9, (2020): 1-26.

⁹ Blakeley B L, “Pensions and Professionalism: The Colonial Governors (pensions) Acts and the British Colonial Service, 1865–1911,” *The Journal of Imperial and Commonwealth History* 4, no. 2 (1976): 138-153.

¹⁰ Xiafei Chen, *Archives of China’s Imperial Maritime Customs Confidential Correspondence Between Robert Hart and James Duncan Campbell 1874-1907* (Zhonghua shuju, 1992), 15.

¹¹ “Schram, Robert,” Prof. Dr. Klaus Karttunen’s work Who Was Who of Indian Studies, accessed October. 17, 2023, <https://whowaswho-indology.info/6084/schram-robert/>.

¹² Chen, *Archives of China’s Imperial Maritime Customs Confidential Correspondence Between Robert Hart and James Duncan Campbell*, 100.

¹³ The proposal by Hart to establish an observatory at Tongwenkuan ultimately did not come to fruition.

candidates with teaching experience to fulfil this role.¹⁴ The third candidate was Ralph Copeland (1837-1905), a Scottish astronomer whose professional competence was widely acknowledged within the field.¹⁵ However, he expressed the need for an assistant to accompany him on regular visits to weather stations and to manage the meteorological instruments.¹⁶ Furthermore, the Italian astronomer Demetrio Emilio Diamilla Muller (1826-1908) also expressed his interest in the position.¹⁷ However, Hart was dissatisfied with the tone of his letter and subsequently disqualified him. After careful consideration, Hart decided to appoint the Scottish astronomer Copeland as the head of the Customs Meteorological Service. Unfortunately, the hiring process fell through in 1876.¹⁸ The field of Customs meteorological work suffered from a lack of guidance and expertise from professional meteorologists.

Details of Early Meteorological Work

Customs observatories constitute one of the most crucial aspects of meteorological work conducted by Customs. While there is no direct public documentation of the early operations of meteorological work within Customs, insights into this period can be gleaned from the annual reports penned by the Customs Medical Officer. These reports, which were partly based on the Meteorological Report of the local Customs Port Commissioner's Office or the Customs Gazette¹⁹ of the Department of Revenue, offer valuable details about the early implementation of meteorological observations at customs ports.

In the absence of unified management by the head of meteorological work, there was a significant variation in the types, models, and quantities of meteorological instruments available at Customs meteorological observatories. For instance, Beijing Customs utilized a Negretti&Zambra self-registering thermometer without a barometer;²⁰ Foochow Customs Department employed a mercury barometer;²¹ Shanghai Customs adopted Fortin's standard of 5/10 inch bore, No. 287²²; and Chinkiang Customs used a non-liquid barometer. The occurrence of unreliable measurements from existing meteorological instruments indicates that the Customs' instruments are inaccurate due to a lack of calibration.²³

The placement of instruments primarily includes thermometers and barometers. Regarding the placement of thermometers, each Customs station acknowledged the need for them to be positioned in a shaded area, but there were discrepancies in the specific arrangements at different ports. For example, at Newchwang Customs, they hung the thermometers under the balcony on the north wall of the Customs facility,²⁴ while Foochow

¹⁴ Wright S F, *Documents Illustrative of the Origin, Development and Activities of the Chinese Customs Service 1* (Statistical Department of the Inspectorate General of Customs, 1937), 177-78.

¹⁵ Chen, *Archives of China's Imperial Maritime Customs Confidential Correspondence Between Robert Hart and James Duncan Campbell*, 100.

¹⁶ Chen, *Archives of China's Imperial Maritime Customs Confidential Correspondence Between Robert Hart and James Duncan Campbell*, 69.

¹⁷ Gasperini A and Bianchi S, "Arcetri: 100 anni da Osservatorio Astrofisico," *Arcetri: 100 anni da Osservatorio Astrofisico*, (2021): 49-52.

¹⁸ Wenxin Xu, "The Construction and Transfer of the Hart Customs Meteorological Network (1869-1882)," *Customs and Economic and Trade Research* 43, no. 2 (2022):80.

¹⁹ As Hart had not yet promulgated the printing of a uniform register of meteorological records at this time, the meteorological reports are analyzed here on the basis of their appearance in the *Medical Reports*.

²⁰ R. A. Jamieson, *Medical Reports: volume 1*. (National Library Press, 2016), 130-32.

²¹ Jamieson, *Medical Reports 1*, 267-68.

²² Jamieson, *Medical Reports 1*, 367.

²³ R. A. Jamieson, *Medical Reports: volume 2*. (National Library Press, 2016), 260.

²⁴ Jamieson, *Medical Reports 1*, 238-39.

Customs placed them on the north-east wall.²⁵ As for the hanging position of barometers, Newchwang Customs installed the barometer at a height of 8 feet from the ground,²⁶ whereas Shanghai Customs hung it 16 feet from the ground.²⁷

Regarding observation times, most Customs entities conducted one observation between 8:00-9:30 a.m. and another between 3:30-4:00 p.m. Amoy Customs, however, had a higher frequency of observations, conducting six per day, averaging one meteorological observation every four hours starting from 4:00 a.m.,²⁸ totalling approximately one hour of observations daily. The majority of other customs ports conducted only two observations per day. The variations in meteorological work conducted at these customs can be attributed to the lack of a unified deployment and standardization of meteorological observations in their early stages, which paved the way for the subsequent implementation of meteorological norms.

Engagement of William Doberck with Chinese Maritime Customs

The Hong Kong Observatory was founded in Kowloon in 1883. Most of its senior staff were recruited based on recommendations from the Royal Observatory Greenwich in the United Kingdom. Similarly, most of the instruments utilized in the Observatory were sourced from British instrument manufacturers. Additionally, the Colonial Service was tasked with financing the construction of the Observatory's buildings and overseeing the management of its staff.²⁹ In 1882, the colonial public office solicited recommendations from astronomers of the Royal Society for candidates to serve as the director of the Hong Kong Observatory. Subsequently, in January 1883, William Doberck (1852-1941) was appointed to lead the newly established institution.³⁰ In May of the same year, Doberck was elected as a member of the British Meteorological Society.³¹ He was an energetic individual who aspired to make significant contributions to the field of meteorology.

Conducting Site Visits to Provide Expert Advice

Upon arriving in Hong Kong in June 1883, Doberck, the Director of the Hong Kong Observatory, conducted meteorological missions along the coast of China and in the Philippine Islands. He was also instructed to establish contact with the directors of the Xujiahui Observatory in Shanghai, the Chinese Maritime Customs, and the Manila Observatory to seek cooperation.³² Given the rapid changes in typhoons, maintaining friendly contact with neighbouring observatories was crucial. In September of the same year, Hart, from the Imperial Maritime Customs Service Administration, issued a notice requesting cooperation from Hong Kong: "The Hong Kong Government Astronomer, Dr. Doberck, will soon be on a

²⁵ Jamieson, *Medical Reports* 1, 49.

²⁶ Jamieson, *Medical Reports* 2, 513-20.

²⁷ Jamieson, *Medical Reports* 1, 16-17.

²⁸ Jamieson, *Medical Reports* 2, 301-05.

²⁹ Williamson F., "Just doing their job: the hidden meteorologists of colonial Hong Kong c. 1883-1914," *The British Journal for the History of Science*, (2021): 1-19.

³⁰ MacKeown P. K., "William Doberck—A Stormy Career Founding the Hong Kong Observatory," *Journal of the Royal Asiatic Society Hong Kong Branch* 44,(2004): 5-39.

³¹ "The Meteorological Society," *Symons's Monthly Meteorological Magazine* CCVIII, (1883): 55-56.

³² MacKeown, "William Doberck," 8-9.

meteorological mission to the ports of entry, and the Customs Officers concerned are requested to help Doberck.”³³

Hart held a positive attitude towards Doberck’s travels and offered to assist him in any way possible. However, the progress of Customs meteorological work was hindered by various issues. Hart hoped that the concerned customs commissioner would soon understand the purpose of Doberck’s visit and emphasized that cooperation could only proceed after obtaining authorization from the Inspectorate General of Customs.³⁴ Doberck spent two months visiting Shantou, Xiamen, Shanghai, and other Chinese ports of entry, as well as the Penghu Islands and the lighthouse at Macao on a Customs cruiser. Due to the vacancy of the head of the Customs meteorological observatory, some meteorological instruments had not been calibrated for use. During his stays in Shanghai and Xiamen, Doberck inspected, adjusted, and calibrated the existing Customs meteorological instruments. Recognizing the Customs Meteorological Stations as an important observation network in East Asia, Doberck aimed to expand the scope of the Customs Meteorological Observatory and standardize observations, thereby elevating the prestige of the Hong Kong Observatory.³⁵

In another quintessential example, during Doberck’s visit to the South Cape lighthouse in October 1883, J. Mcleavy Brown, the Customs Commissioner Officer, engaged in a discussion with Doberck regarding the installation of a meteorological instrument at the lighthouse. A summary of these deliberations contended:

He [Doberck] considers South Cape a highly important station for meteorological purposes, and especially is of opinion that continuous readings taken there by self-recording instruments would have great value. The matter will form the subject of a special report as soon as the present political difficulties in Formosa show signs of an approaching settlement, without which the suggestions to be made could not be carried out.³⁶

The significance that Doberck placed on the geographical location of the South Cape lighthouse and the worth of conducting self-recorded meteorological observations triggered meteorological observations at the lighthouse. Recognizing the Customs Meteorological work as a crucial observation network in East Asia, Doberck harboured hopes that by expanding the scope of Customs meteorological work and standardizing observations, he could elevate his own fame and the social standing of the Hong Kong Observatory. Utilizing his extensive knowledge of meteorology, Doberck was able to establish an initial safeguard for Customs meteorological observations and enhance their value. Amid this auspicious environment, Hart issued the following instructions: “From 1 April 1884, Customs regularly sent meteorological data to the Hong Kong Observatory free of charge through the British Post Office, which marked the formal cooperation between Customs and the Hong Kong Observatory.”³⁷

³³ “Second Series. No.235.Enclosure. Government House, Hong Kong, 23rd August 1883,” in *General Office of the General Administration of Customs of the People's Republic of China. Modern Inspectorate General of Chinese Maritime Customs, Part I. General Taxation Department General Orders, Volume 3.* (China Customs Press, 2012), 145.

³⁴ “Inspector General's Circulars.No.235.Peking, 7th September 1883,” in *General Office of the General Administration of Customs of the People's Republic of China. Modern Inspectorate General of Chinese Maritime Customs, Part I. General Taxation Department General Orders, Volume 3.* (China Customs Press, 2012), 144.

³⁵ Williamson F and Wilkinson C., “Asian extremes: Experience and exchange in the development of meteorological knowledge c. 1840-1930,” *History of Meteorology* 8, (2017):159.

³⁶ China Imperial Maritime Customs, *Customs Papers No.22. Reports on Light, Buoys, and Beacons, for the year 1884* (Statistical Department of the Inspectorate General of Customs, 1885), 76.

³⁷ “Inspector General's Circulars.No.271.Peking, 6th March 1884,” The Chinese Maritime Customs Published a Database of Modern Chinese Historical Materials, accessed January 17, 2021, <http://history.customskb.com/web/home>.

Furthermore, in December 1884, J. Mcleavy Brown, the Amoy/Xiamen Customs Commissioner Officer, highlighted in his annual report on the status of new meteorological instruments within the Customs that new instruments had been installed at appropriate stations within the Xiamen Customs during the year. Specifically, a set of meteorological instruments comprised of the following: one standard mercury barometer with an attached thermometer, one hygrometer with dry and wet bulb thermometers positioned side by side, one maximum thermometer, one minimum thermometer, and one rain gauge.³⁸ This new set of meteorological instruments was installed in accordance with Doberck's recommendations. The standard thermometers were positioned in each lighthouse station keeper's office. The four thermometers—dry-bulb, wet-bulb, maximum, and minimum—were enclosed in thermometer screens, following Doberck's suggestion, featured double-sided shutters, later known as the louvre box. This box was to be situated in the yard of the lighthouse, preferably in the centre of the lawn, and the rain gauge was also positioned in the yard. To provide a more vivid illustration of the thermometer screen, Brown incorporated a drawing into the report (Fig. 1), which was crafted by Doberck to scale, accurately depicting the intricate details of the thermometer screen.³⁹

Thanks to his collaboration with the Customs Service, Doberck was able to conduct meteorological research using data obtained from the Customs' meteorological work. During the regular meeting of the British Meteorological Society in 1888, Doberck, in conjunction with the Director of the British Meteorological Office, presented an article titled "Meteorology of South-Eastern China in 1886," which was based on meteorological observations recorded by Customs staff at the Customs House and lighthouse.⁴⁰ This underscores the mutually beneficial cooperation between Customs and Doberck.

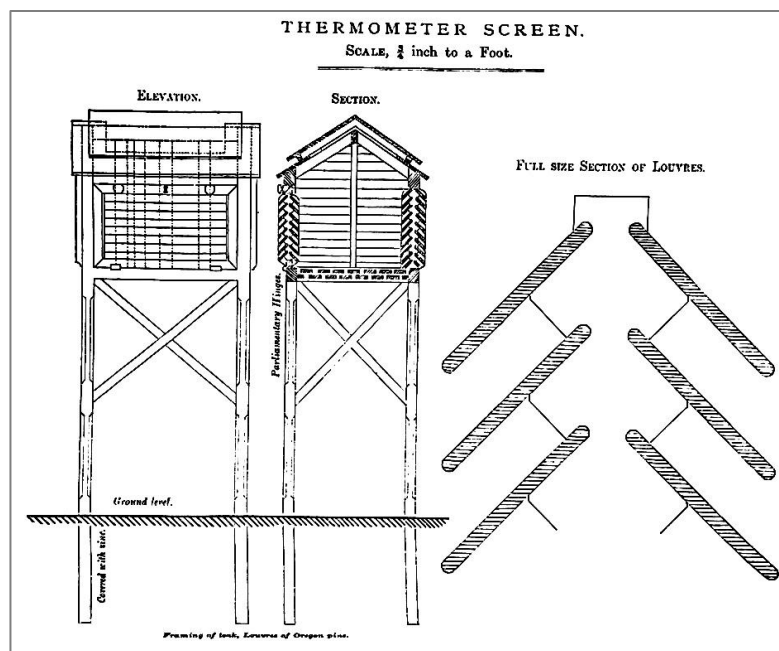


Fig. 1. Drawing of a Thermometer Screen for Positioning Thermometers

Source: China Imperial Maritime Customs. "Customs Papers No.22." *Reports on Light, Buoys, and Beacons, for the year 1884.*

³⁸ China Customs, *Customs Papers No.22.*, 72.

³⁹ China Customs, *Customs Papers No.22.*, 73.

⁴⁰ "The Meteorological Society," *Symons's Monthly Meteorological Magazine* CCLXVIII, no. 14 (1888): 57-58.

Recommendations and Applications for Lighthouse Meteorology

Lighthouses played a crucial role in facilitating the smooth operation of Customs meteorological activities. On 28 March 1876, A. M. Bisbee, the Coast Inspector of Customs, proposed to Hart that a standardized system for managing Chinese lighthouses should be established to clarify the responsibilities of lighthouse keepers. He emphasized that the U.S. government had already published a book titled *Instructions and Directions to guide Lighthouse keepers and others belonging to the Lighthouse Establishment*. Bisbee suggested that Customs should also publish a similar book detailing the daily and routine duties of lighthouses, outlining clearly all the tasks required of a lighthouse keeper, and enforcing adherence to these tasks, thereby fostering uniformity and good order.⁴¹

Hart placed greater emphasis on conducting certain types of meteorological observations, yet the initial meteorological instructions for Customs Lighthouses were not clearly defined. In 1884, a cooperative relationship was established between Customs and the Hong Kong Observatory, allowing Doberck to utilize his meteorological expertise to provide recommendations for improving Customs' meteorological practices. Given the importance of typhoon warnings for the commercial interests of coastal communities, Doberck addressed the need for observing approaching typhoons by issuing temporary observation instructions, which required reports to be conducted every half hour and additional equipment such as thermometers, barometers, and instruments to measure wind direction and force, as well as weather conditions. On this basis, the "Memorandum for Lightkeepers" was introduced. During typhoons, meteorological observations were conducted eight times a day: at 3 a.m., 6 a.m., 9 a.m., noon, 3 p.m., 6 p.m., 9 p.m., and midnight. In October 1884, J. Mcleavy Brown, the Amoy Customs Officer, dispatched a memorandum to the lighthouse keepers, expressing his hope that customs officers would adhere to the memorandum's guidelines for completing meteorological work at lighthouse observation points during typhoons. The memorandum primarily focused on establishing an orderly procedure for conducting meteorological observations.⁴²

In 1884, the Customs Lighthouse Meteorological Return Book, specifically the Lights Form, underwent a significant restructuring. At that time, the Meteorological Return Book contained 19 primary items that were to be observed and recorded by the managers of the Customs Lighthouse Observation Points, as outlined in Figure 2.⁴³

Furthermore, in April 1885, the Customs department dispatched J. R. Harding⁴⁴, an assistant engineer, to the Hong Kong Observatory to undergo training and receive instructions on the construction of meteorological facilities.⁴⁵ This initiative involved Harding's design for the arrangement of meteorological instruments in the Customs lighthouse layout plan. According to the existing 1889 layout plan of the South Cape Lighthouse, which features Harding's signature in the lower right corner and a serial number of 26 in the upper right corner for the meteorological instruments, the placement of anemometers was carefully considered.

⁴¹ *China Customs Papers No.6. Marine Department: Lights. 1875 Reports. (1)*, (Statistical Department of the Inspectorate General of Customs, 1876), 49-50.

⁴² *China Customs, Customs Papers No.22.*, 75-76.

⁴³ The fundamental tasks of the lighthouse keeper, such as polishing the lens, trimming the wick, and filling the lamp with oil, ensured that the flame was properly focused. In conjunction with the lighthouse's rotating mechanism at the top, this ensured that the light could be seen from all directions. Roman Belyaev, *Journey to the Lighthouse: History and Knowledge of Lighthouses*, trans. Wang Z. (Zhejiang Education Press, 2022), 30.

⁴⁴ Harding, a British national, joined the Customs service in December 1880.

⁴⁵ Bickers R., "Throwing light on natural laws": Meteorology on the China coast, 1869–1912," in *Treaty Ports in Modern China*, (Routledge, 2016), 179-200.

Doberck's expert advice has greatly benefited the Customs Lighthouse, which serves as a crucial component of the Customs Meteorological Observation Network. The recommendations for both typhoon and non-typhoon observations are designed to complement the daily work of customs lighthouse personnel, while also emphasizing the need for dynamic updates to meteorological records during periods of frequent typhoons. This enables the Customs Lighthouse to issue effective typhoon warnings in a timely manner.

Collaborative Publication of Meteorological Standards

In 1887, with the backing of the Statistical Department of the Inspectorate General of Customs, Doberck published a two-volume work titled *Instructions for Making Meteorological Observations Prepared for Use in China; The Law of Storms in the Eastern Seas*. It is important to note that all the works by Doberck published by the Customs on this occasion are reprints. The initial volume, which was originally published in the Hong Kong Telegraph in 1883,⁴⁷ also marked the inaugural publication of the Hong Kong Observatory. The other volume, issued by the Hong Kong Observatory in 1886, was specifically intended for use by mariners. Together with the nautical meteorological charts, this publication provided valuable assistance to mariners in avoiding strong typhoons during typhoon season.⁴⁸ Doberck's publications incorporated important contemporary works, with the first volume having a nuanced connection to the British Meteorological Director, Scott's *Instructions in the Use of Meteorological Instruments* from the Meteorological Society. Meanwhile, the other volume drew directly from the earlier research and methodologies of Reid, Piddington, Rosser, and Birtwistle.⁴⁹ This study focuses on the utilization of Doberck's *Instructions for Making Meteorological Observations Prepared for Use in China* within the context of Customs.

In the preface of that Instruction, Doberck emphasized that unregulated meteorological observations were futile and underscored the purpose of the guide: to assist Customs meteorological observers, shipmasters, and sailors navigating Chinese waters in conducting their observations and establishing a standardized, unified meteorological observation network. The collected weather data from these observatories would be sent to the Hong Kong Observatory for analysis, enabling it to issue timely warnings before adverse weather conditions arrive. Leveraging the Customs meteorological stations, Doberck aimed to establish a Chinese meteorological intelligence network centred around the Hong Kong Observatory and actively encouraged captains and sailors to participate. The book provided a concise overview of the use and calibration of various meteorological instruments, with a promise from the Hong Kong Observatory to conduct regular calibration for certain instruments. The publication served as a valuable reference for early Customs meteorological work, encompassing 22 pages that detailed barometers, thermometers, hygrometers, louvers, rain gauges, and their principles, construction, reading methods, and precautions. Additionally, it covered aspects such as wind, clouds, weather, and sea-level fluctuations.⁵⁰

Applications and Implications of Customs Meteorological Norms

Since the Customs had not explicitly defined the management responsibilities for Customs meteorological work, Doberck's meteorological instructions did not become a

⁴⁷ MacKeown, "William Doberck," 8.

⁴⁸ Pui-Yin Ho, *Weathering the Storm: Hong Kong Observatory and Social Development* (Hong Kong University Press, 2003), 169-181.

⁴⁹ Williamson and Wilkinson, "Asian extremes," 159-178.

⁵⁰ W. Doberck, "No. 7 Instructions for Making Meteorological Observations, Prepared for Use in China; and the Law of Storms in the Eastern Seas," in *Harvard University Library Collection of Unpublished Historical Materials on Old Chinese Customs (1860-1949) 208 vols.* (Guangxi Normal University Press, 2014), 1-48.

formally mandated chapter or regulation within the Customs meteorological practices. Consequently, Doberck's guidance on meteorological observations during this time is viewed as the nascent stage of standardized meteorological observations within the Customs.

Specific applications

Doberck's position as the director of the Hong Kong Observatory, rather than as a Qing dynasty Customs official, posed challenges to the implementation of the meteorological work guide. As Doberck lacked authority to supervise customs officials in conducting meteorological observations, the process of integrating the 22-page booklet he authored, despite his non-customs officer status, into Customs meteorological work in the late 19th century is illuminated by the following reports from within the Customs Service.

For the Pakhoi/Beihai Customs, A. Sharp Deane,⁵¹ the Customs Medical Officer, appended a table of meteorological observations to his annual report for 1889 and mentioned: "I append a meteorological table, the temperature being taken according to the rules laid down by the Astronomer at the Hong Kong Observatory."⁵² The astronomer of the Hong Kong Observatory mentioned in Deane's report was none other than Doberck. In the section on the calibration of meteorological instruments in the *Instructions for Making Meteorological Observations Prepared for Use in China*, Doberck repeatedly mentioned that government astronomers from the Hong Kong Observatory would provide calibrations,⁵³ alluding to himself. Doberck was very concerned about titles, considering himself first and foremost a professional astronomer, and has repeatedly used the title Government Astronomer in public.⁵⁴

Instances of the pamphlet being used within the Customs Service were not isolated. In his medical reports over the following five years,⁵⁵ Deane repeatedly emphasized that the temperatures recorded in his reports were measured according to the standards set by the astronomers of the Hong Kong Observatory, thereby affirming the relevance and applicability of Doberck's meteorological observing norms within customs practices. In addition, in January 1891, A. M. Bisbee (1841-1901), the Coast Inspector of the Customs, mentioned in his annual report the situation of the observation-point at the Gutzlaff Light:

The set of meteorological instruments lacked both a minimum and a ground radiation thermometer, and the rain gauge was too high above the ground. The Keeper's attention was called to this matter, and he was ordered to place it in accordance with the instructions in Dr. Doberck's pamphlet. The general condition of the station shows that the Keeper in charge attends carefully to his duties.⁵⁶

In the arrangement of meteorological instruments at Gutzlaff Light, Bisbee gave instructions to the lighthouse keeper to arrange the instruments according to the requirements in Doberck's pamphlet. Apart from the Gutzlaff Light, on 19 November 1891, Bisbee visited the North Saddle Light, which was managed by C. W. Bond,⁵⁷ the lighthouse keeper. Bisbee found that the lighthouse had a full set of meteorological instruments, except for a ground radiation

⁵¹ A British national joined the customs service in January 1880, but the date of their death is unknown.

⁵² R. A. Jamieson, *Medical Reports: volume 6*. (National Library Press, 2016), 13-15.

⁵³ Doberck, "No.7 Instructions for Making Meteorological Observations,"13.

⁵⁴ MacKeown, "William Doberck," 5-15.

⁵⁵ The rules established by the astronomers of the Hong Kong Observatory are referenced in Deane's annual reports for the Pakhoi Customs covering the years 1889-1890, 1890-1891, 1891, and 1893-1894.

⁵⁶ China Imperial Maritime Customs, *Customs Papers No.33. Reports on Light, Buoys, and Beacons, for the year 1890* (Statistical Department of the Inspectorate General of Customs, 1891), 39-40.

⁵⁷ A British national joined the Customs in June 1877 and was assigned to the Shanghai Customs.

thermometer, but the rain gauge should be positioned lower, and Bond was asked to place the gauge following the instruction.⁵⁸

Bisbee oversaw the Customs Coast Inspector, which involved a meteorological component. From his inspection of the lighthouse, he asked the lighthouse keeper to position the rain gauge at the lighthouse meteorological station according to the specifications in Doberck's instruction for Meteorological Observations.⁵⁹ Bisbee's behaviour is also indicative of the practical application of Doberck's publications in Customs meteorological work at the end of the 19th century.

Significance of Enactment

In 1905, the Customs, prompted by Coast Inspector W. F. Tyler, a British naval officer, published *Instruction Concerning Meteorological Work*. This document was the only guide for Customs and Excise meteorological work in the 20th century and featured a preface outlining Customs meteorological work in the 19th century.⁶⁰ The preamble highlights the pros and cons of meteorological work within Customs, noting that Customs meteorological observers were part-time employees with non-meteorological backgrounds, leading to varying qualities of observation records. However, thanks to the customs management system, the implementation of uniform norms and the advancement of standards for meteorological observations were successfully achieved.

The meteorological work of the Service has been going on for many years, but it is only recently that it has been systematized as a whole and its administration placed in the hands of the Coast Inspector. Valuable as the work now performed undoubtedly is, there remains room for improvement. The fact that our observers are mostly untrained men, and that they do the work as a matter of duty, without the interest in it that volunteers would have, tends to imperfection and perfunctoriness. On the other hand, the fact that all are members of one Service renders possible that uniformity of practice which is so important a point in meteorological matters.⁶¹

Historical experience demonstrates that the successful operation of a meteorological observation network necessitates the establishment of a unified meteorological observation code. In practice, Customs encountered numerous aspects of meteorological work that required refinement. However, the promulgation of a unified meteorological work specification was delayed due to the scarcity of professionals with meteorological backgrounds within the Customs Department. In 1887, Customs published *Instructions for Making Meteorological Observations Prepared for Use in China*, authored by Dr. Doberck, the Director of the Hong Kong Observatory⁶². This publication served as a reference for some customs offices to conduct meteorological work in the late 19th century.

While the regulation of Customs meteorological work had yet to be clearly defined at the end of the 19th century, despite the availability of reference books, there was no cohesive system to ensure customs staff adhered to meteorological observation guidelines, leaving

⁵⁸ China Customs, Customs Papers No.33., 40.

⁵⁹ The pamphlets and guides here refer to Doberck's *Instructions for Making Meteorological Observations Prepared for Use in China*; *The Law of Storms in the Eastern Seas*, published by the Customs Department in 1887, which is referred to differently by different Customs officers.

⁶⁰ Qian Chen and Xiaocen Li, etc., "Tyler and the Chinese Maritime Customs Meteorological Observation Protocols in the Late Qing Dynasty," *The Chinese Journal for the History of Science and Technology* 45, no. 3 (2024):520-31.

⁶¹ Shanghai Statistical Department of the Inspectorate General of Customs, *The Maritime Customs IV. - Service Series: No.27.Instructions Concerning Meteorological Work 1905*, (Tianjin Archives, 401206800-W0001-15-001048).

⁶² Doberck, "No.7 Instructions for Making Meteorological Observations,"13-15.

Customs meteorological work unregulated. However, it is important to acknowledge that Doberck, as a trailblazer in regulating customs meteorology, provided invaluable guidance for Customs meteorological work during that period. In 1905, Customs issued *The Maritime Customs IV. - Service Series: No. 27. Instructions Concerning Meteorological Work 1905*, marking the inception of strict management of meteorological work by Customs. This document explicitly stipulated that Customs meteorological work must be conducted in accordance with the entries outlined in the Instructions.⁶³ The successive meteorological norms introduced by the Qing Customs, including *Instructions for Making Meteorological Observations Prepared for Use in China* published by Doberck in 1887, drew the Customs' attention to meteorological standards and laid the groundwork for the official adoption of Customs meteorological norms at the end of the Qing Dynasty.

Conclusion

In the nascent stages of meteorological work by the Chinese Maritime Customs, a lack of regulation led to inaccuracies in meteorological records. Recognizing this, Inspectorate General Robert Hart decided to adopt a cooperative approach to enhance Customs meteorological work. Consequently, the Customs actively engaged with meteorologists across East Asia and, in collaboration with Doberck from the Hong Kong Observatory, published *Instructions for Making Meteorological Observations Prepared for Use in China*. This publication detailed meteorological instruments, observation elements, and observation times. Although authored by Doberck personally, it was utilized within the Customs' meteorological section. The partnership between the Customs and Doberck can be seen as a mutually beneficial strategy. Thanks to the meteorological advice and support provided by Doberck and the Hong Kong Observatory, the Customs' lighthouse meteorological observation sites improved, and the placement of meteorological instruments was incorporated into the initial planning stages of subsequent lighthouse construction, making meteorological observation a key additional function of Customs lighthouses. The correspondence between Doberck and the Customs regarding meteorological matters provided guidance for actual Customs meteorological observation work, serving as the seed for Customs meteorological norms reform and laying the groundwork for the reform of Customs meteorological work in the early 20th century.

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⁶³ R.E. Bredon, Circular Memorandum. No.51/D.I.G. Meteorological matters, 23rd June, 1903 in *Inspectorate General of Customs, Deputy Inspector General's office, SHANGHAI, 1900-1904* (Yantai City Archives, J090-001-0873).