

**The Meteorological Work of the Chinese Maritime Customs Service,  
1869-1947**

by

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## INTRODUCTION

First conceived of in 1869, by the late 1930s the Chinese Maritime Customs Service had developed a network that was collecting meteorological data several times daily at fifty-two ports and lighthouses across the length and breadth of China. This data then travelled far and wide. In 1932 fifty Customs meteorological stations were relaying data to twelve observatories and research institutions operating in East and South East Asia, from Peking to Manila, enabling them to compile detailed statistics on China's climate. This data formed a fundamental component of the research activities of key institutions engaged in meteorological work in the Far East, most notably the Zikawei (Xujiahui, also formerly romanised by Anglophone speakers as Siccawei) Observatory in Shanghai, the Hong Kong Royal Observatory, and, after 1928, the Institute of Meteorology at Academia Sinica in Nanjing. More than this, meteorological data collected at Customs stations also had an immediate practical use, enabling the Hong Kong and Zikawei Observatories to issue daily weather forecasts and storm warnings for navigators sailing around the China coast. Indeed, as the Hong Kong and Siccawei Observatories forwarded this data, and the weather forecasts derived from it, to observatories located further afield, in, for example, Manila and Tokyo, the impact of the Customs meteorological project could be felt across the region.

This report will give a detailed summary of the history of Customs meteorological work from 1869 until 1947. The first section charts its development and expansion in the nineteenth and early twentieth centuries, assessing the motivations behind the establishment of this facet of the Customs' work. It also discusses the forging of professional links with Zikawei and Hong Kong Observatories, providing brief histories of the development and activities of each observatory. The second section will review in more detail the type of data collected, the frequency with which it was recorded, and the locations it was collected at. Patterns of transmission of this data to observatories and research institutes will also be outlined in the third section. The fourth section describes one of the most important products of the meteorological service, the establishment of a storm-warning system along

the China coast, while the last briefly notes the meteorological practice of the Customs fleet.

## 1) A METEOROLOGICAL SERVICE FOR CHINA

The idea of establishing a Customs-run meteorological service was first outlined by Inspector General Robert Hart in 1869. Hart envisaged the development of a network of Customs meteorological stations, tied to each custom house and expanding in tandem with the spread of the Customs' influence across China. Explaining his reasons for embarking upon such a project, Hart insisted that 'the worth of such observations to the scientific world, and the practical value they may be made to have for seafaring men and others on these Eastern Seas, will in due time be appreciated and acknowledged.'<sup>1</sup> Although Hart did not envisage that the project would yield any immediate practical returns, and although he was hazy on the finer points of how his scheme would benefit science, he was confident that that the vast amounts of data collected would in the future serve a useful purpose. Furthermore, the systematic collection of meteorological data in China was uncharted territory. As Hart put it in 1869, this scheme 'will tend so powerfully to assist in throwing light on natural laws, and in bringing within the reach of scientific men facts and figures from a quarter of the globe, which, rich in phenomena, has heretofore yielded so few data for systematic generalization.'<sup>2</sup> Ambitious for himself and for his Service, Hart was always keen to make the Customs a leading light when it came to scientific or technological innovation; the meteorological service was just one facet of its nineteenth-century expansion.

Hart, in characteristically ambitious fashion, initially envisaged that meteorological stations would be swiftly established at all ports, both coastal and riverine, with a Customs presence, including the lighthouses. Eventually, he imagined, a Central Weather Bureau would be established in Peking under

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<sup>1</sup> *Documents Illustrative of the Origins, Activities and...: Robert Hart, circular no. 28 or 1869 (first series), 12 Nov 1869.*

<sup>2</sup> *Documents Illustrative, vol. 1: Robert Hart, circular no. 28 or 1869 (first series), 12 Nov 1869.*

the joint auspices of the Customs Inspectorate and the Peking College (Tongwenguan). Hart's dream of a Customs observatory was, however, never realised and, moreover, the meteorological service itself did not get off to a flying start. Details on the early years of meteorological work are unclear, yet it seems clear from Hart's correspondence to his deputy in London, James Duncan Campbell, that it was not until 1874 that the project really got off the ground, although the Customs regularly recorded 1869 as the date meteorological work commenced.<sup>3</sup> Hart had fits of energy which he applied to such projects, and in 1873 he returned to meteorology for the first time since his 1869 circular. In March 1873 Hart instructed Campbell to order 20 sets of equipment to be distributed to stations, as well as registers.<sup>4</sup> Observations were scheduled to begin in January 1874 (see Appendix A). In May that year he told Campbell that the Customs was going to telegraph 'weather-news' every morning from Shanghai to Hong Kong, Nagasaki and Amoy (Xiamen), with each reciprocating to all. Hart also noted in March that arrangements were underway for the publication of Customs meteorological data (see Appendix A). Hart had also written to colonial governments across Southeast and East Asia to propose a regional scheme for the publication and exchange of meteorological data among observatories in Asia and the Pacific (see Appendix A), and was keen to establish systems for the Customs which would be easily understood by the French or Russians, for example.<sup>5</sup> Campbell liaised with the Astronomer Royal and the Royal Society, and attended the first International Meteorological Congress in Vienna in September that year to bring the Customs up to speed with developments in the field internationally. But there was no major progress initially. '*Meteorology* – are we never to make another step? Till I am certain of *Registers, Forms, and Instruments*, I can do nothing,' Hart wrote exasperatedly in September 1874.<sup>6</sup> The following year Hart was more optimistic, largely because Campbell had recruited an

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<sup>3</sup> The *Medical Reports* commenced publication in 1870, and contain some, mostly scrappy meteorological data in 1870 from Peking, Newchwang, and Ningpo, and in 1871 from Amoy, Foochow, and Takow.

<sup>4</sup> *The IG in Peking*, vol. 1, letter no. 49, Hart to Campbell, 14 March 1873.

<sup>5</sup> *The IG in Peking*, vol. 1, letter no. 55, Hart to Campbell, 23 May 1873; letter no. 56, 29 May 1873.

<sup>6</sup> Chen Xiafei and Han Rongfang (eds.), *Archives of China's Imperial Maritime Customs: Confidential Correspondence Between Robert Hart and James Duncan Campbell, 1874-1907*, vol. 1, letter no. 93 from Hart to Campbell, 30 September 1874.

experienced astronomer, Ralph Copeland (1837-1905), to run the meteorological service. 'Meteorology hangs fire,' Hart wrote in March 1875. 'I intend to put the management into Copeland's hands, connecting the coast stations with a head station under our astronomer at Peking.'<sup>7</sup> After protracted negotiations, however, Copeland could not be enticed to leave his post at Trinity College, Dublin, and Hart's plans came to nothing.

Certainly some Customs stations were equipped with meteorological instruments and began to record observations during the early 1870s – some of this data was incorporated into the reports of Customs surgeons in the twice-yearly *Medical Reports* which commenced publication in 1871.<sup>8</sup> But sixteen of the sets of instruments ordered from Britain in 1873 remained packed in storage at Shanghai and Amoy.<sup>9</sup> It was in 1879, with the beginnings of the Customs' relationship with Zikawei Observatory in Shanghai, that the meteorological service was launched in earnest. Impressed by the accuracy with which the observatory staff had predicted the course of a severe typhoon off the coast of Shanghai, Customs Coast Inspector (head of the Marine Department), Captain A.M. Bisbee, approached Zikawei Observatory, in collaboration with the Shanghai International Chamber of Commerce and the agents of various shipping companies, with the plan of establishing a public typhoon warning system.<sup>10</sup> The Customs began routinely to supply the Observatory with data from 1879 onwards. The list of volumes accessioned to the library at Zikawei records the acquisition of Customs data systematically from 1880.<sup>11</sup>

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<sup>7</sup> *Archives of China's Imperial Maritime Customs*, vol. 1, letter no. 142 from Hart to Campbell, 13 March 1875.

<sup>8</sup> Which precise stations commenced making observations first remains unclear. Some Chinese scholars have concluded that Hankow was the first, in November 1869. The earliest surviving Customs data in the Chinese Meteorological Administration archives, secured from Zikawei, is from 1876, but clearly there were earlier records: see '中国近代海关气象观测站', (Observations from Chinese Maritime Customs Meteorological Stations) URL: <http://cdc.cma.gov.cn/download/news/jdsta3.pdf>, accessed August 2008.

<sup>9</sup> W. Doberck to Colonial Secretary, 8 November 1883, Government Notification No. 380, Hong Kong Government Departmental Reports, 1883.

<sup>10</sup> T.R. Banister, *The Coastwise Lights of China* (Shanghai, 1933), p. 8. Also see Second Historical Archives of China [SHAC], 679(1) 3611, *North China Daily News*, 'The Story of Siccawei Observatory,' 15 Dec 1927.

<sup>11</sup> *Bulletin Mensuel*, 1880, p.235. The list of stations was: Pakhoi, Swatow, Takao (Gaoxiang, Taiwan), Taiwanfoo (Taipei), Foochow, Ningpo, Chinkiang, Wuhu, Chefoo, Taku,

This discovery of an immediate practical use for meteorological data prompted the expansion of the service. In addition to instructing the Customs staff at certain ports to take daily readings (there are no details of the exact ports at which data was collected at this point but the figure of 14 non-Jesuit stations (presumably the Customs ones) was given in 1880<sup>12</sup>) The establishment of the Hong Kong Observatory in 1883 and the establishment of a close relationship with its first Director, William Doberck, was critical to furthering accelerating these developments. From 1884 onwards meteorological stations were established at every lighthouse along the China coast. All these stations sent monthly meteorological returns to Zikawei and, from 1884, to the Observatory in Hong Kong. A telegraph service was instituted, with some stations contributing daily records to Hong Kong which were incorporated into the Observatory's *China Coast Meteorological Register* from 1884 onwards.<sup>13</sup> Zikawei's *Bulletin Mensuel* records the arrival in its library of a publication entitled: *Imperial Maritime Customs: Daily Observations taken at all the Treaty*

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Newchwang, and lighthouses at: Cape of Good Hope, Tsingseu, Sugar Loaf, Lamock, Chapel Island, Pescadores, Ockseau, Middle Dog, Turnabout, North saddle, Gutzlaff, Tungsha, Shaweishan, Shantung Promontory. Hankow was added in 1881, and Tamsui listed instead of Takao on Taiwan. The list of lighthouses was shorter.

<sup>12</sup> *Bulletin mensuel* [Zikawei], No. 65 (Jan.1880), p. 1.

<sup>13</sup> Doberck had secured the cooperation of the Great Northern and Eastern Extension Telegraph companies by November 1883. The firms agreed to transmit, *gratis*, meteorological telegrams between Hongkong, Manila, Amoy, Foochow, Shanghai, Vladivosok and Nagasaki: W. Doberck to Colonial Secretary, 8 November 1883: Government Notification No. 380, Hong Kong Government Departmental Reports, 1883; the arrangement was certainly put into practice in 1884: W. Doberck, *Observations and Researches made at the Hongkong Observatory in the year 1884* (Hongkong: Noronha & Co. 1885), pp. 5-6. For reasons of economy, publication in the daily newspapers was initially seen as sufficient. Observatory Director William Doberck expressed surprise in his first reports that he had been instructed to issue the data, and dissatisfaction at the impact on his budget. The *Register* was originally delivered by 'chair-coolie' to the royal Navy, the Hong Kong Harbour Office, and three newspapers in the colony. Only from 14 October 1893 was a printed version available, with the Observatory printing the *Register* itself daily: 'Report of the Director of the Observatory for 1893', in *Hongkong Government Gazette*, 12 May 1894, p. 399. Print runs from 1894 onwards survive, but earlier sets of this publication would need to be sought in the contemporary Hong Kong press, although Ho Pui-yin, *Weathering the Storm: Hong Kong Observatory and Social Development* (Hong Kong: Hong Kong University Press, 2003) seems to suggest that printed copies survive from 1887 onwards (pp. 170-72). The account given here is generally often confused or vague about precise detail, and seems to be wrong about this. Doberck noted in 1890 that the newspapers printed 'the register very incorrectly', and tardily (it was available for their afternoon editions, but was generally not printed until the following day, so negating its value as a weather forecast). He advocated that year the printing of the Register by the Observatory, following standard colonial practice, but this was not done until 1893: W. Doberck, *Observations and Researches made at the Hongkong Observatory in the year 1890* (Hongkong: Noronha & Co. 1891), p.3.

*ports and Light Houses on the Coast of China* from 1882 onwards. This is not recorded in Customs lists of its own publications. By 1886 it has a French language title, which might suggest that Zikawei had actually compiled the report from Customs data. By the turn of the century the Customs had gone a considerable way towards fulfilling Hart's initial vision of the meteorological service, although it was with the Jesuit institution rather than a central government observatory that the Customs worked.<sup>14</sup>

### **The Zikawei and Hong Kong Observatories**

Zikawei Observatory was officially established in what is now the Xujiahui district of Shanghai by the Jesuit missionaries of the Society of Jesus. Although work tentatively began at the Jesuit mission under the guidance of Claude Gotteland in 1845, it was not until 1872, when under the supervision of Augustin Colombel, that a permanent observatory was constructed.<sup>15</sup> The establishment of Zikawei was, of course, part of a centuries-old tradition of Jesuit astronomical work in the Far East dating back to the appointment of Father Schall and Father Verbiest as directors of the Peking Observatory in the late sixteenth century. Indeed, by the late 1920s the Order of the Jesuit Fathers was responsible for maintaining around thirty similar observatories around the world, in Asia, Europe and the Americas.<sup>16</sup>

After 1876, while under the direction of Father Marc Dechevrens (Zikawei director 1876-87), former incumbent of the chair of physics at the Jesuit Collège Vaugirard in Paris, the observatory's research activities began in earnest.<sup>17</sup> Its principal meteorological activities were two-fold; first and foremost it conducted and published research into meteorological patterns

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<sup>14</sup> Siccawei Director Louis Froc provided an account of the history and state of the service in 1905 to the Innsbruck conference: 'Meteorological Organisation of the Chinese Imperial Maritime Customs', Appendix XXI, in *Report of the International Meteorological Conference at Innsbruck, September 1905* (London: HMSO, 1908), pp. 105-107.

<sup>15</sup> Lewis Pyenson, *Civilizing Mission: Exact Sciences and French Overseas Expansion, 1830-1940* (Baltimore: 1993), p. 158.

<sup>16</sup> SHAC, 679(1) 3611, *The North China Daily News*, Father Gherzi, 'The Story of Siccawei Observatory,' 15 Dec 1927. See Augustin Udias, *Searching the Heavens and the Earth: The History of Jesuit Observatories* (Dordrecht: Kluwer Academic Publishers, 2003).

<sup>17</sup> Pyenson, *Civilizing Mission*, p. 158.

and phenomena and, secondly, it produced and issued weather forecasts, with a particular focus on storm-warnings. The study of cyclones, a recurrent danger for mariners on the China coast, was a speciality of the observatory – in fact, it was Dechevrens' publication of an article on the typhoon of 31 July 1879, based on observations taken at Zikawei and Kobe, Japan, that initially sparked the Customs' interest in collaborating with the observatory. Zikawei's research activities and publications did not only focus on storms, however. Reports on more general observations and compilations of data, such as rainfall and 'atmosphere', were also periodically disseminated by the observatory. Indeed, even after his retirement in 1887 Dechevrens continued to publish path-breaking work on the relationship between temperature and movements of air in the formation of cyclones based on observations made during his time at Zikawei.<sup>18</sup>

A close relationship existed between Zikawei and the Customs from the 1880s, and it was data contributed by the Customs that made these publications possible. In August 1918, for example, Zikawei employee Father Gauthier wrote to Customs Coast Inspector Eldridge thanking him for the Customs' help in compiling the observatory's latest publication, *Temperature in China*; forty percent of the documents used in the publication were supplied by the Customs, Gauthier informed him.<sup>19</sup> The second side of the Zikawei observatory's work, issuing weather forecasts and storm warnings, was made possible by the daily transmission of data from Customs meteorological stations, supplemented by observations and readings taken at sea and sent in by mariners. By processing this data, Zikawei was able to issue weather forecasts in the local newspapers. More importantly, after the establishment of the semaphore system, the observatory was able to issue reliable storm warnings to navigators (see section four).

Zikawei undertook at least two inspections of the entire Customs stock of meteorological equipment, with Father Stanislas Chevalier (Zikawei director

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<sup>18</sup> Pyenson, *Civilizing Mission*, p. 159.

<sup>19</sup> SHAC, 679(1) 761. 'Hydrographers, Naval Officials, Shipping, Merchants, Meteorological etc.', letter from Gauthier to Eldridge, 29 Aug 1918.

1887-97) visiting most installations in about 1895, and Father Ernesto Gherzi inspecting them in 1926.<sup>20</sup> The very close relationship between the Zikawei Directors and Customs Marine Commissioners is evident from the archives. While, for example, Coast Inspector Hillman could not attend the 1<sup>st</sup> Conference of Directors of Weather Services in the Far East in Hong Kong in 1930, he noted that Father Louis Marie Froc – the Zikawei director from 1897-1930, 'will doubtless act on my behalf'.<sup>21</sup> Zikawei kept an eye on the data supplied as well, pointing out probable errors or potential instrument defects.<sup>22</sup> It also trained (or at least familiarised) those of the Customs staff who became meteorological specialists.

In tune with the developments taking place in Shanghai, the Royal Society proposed the establishment of an observatory in Hong Kong in 1879, while the colony's Surveyor General with the support of the naval commander in chief had presented a proposal in October 1877.<sup>23</sup> These schemes came to fruition in 1883, when the Hong Kong Observatory was established by the British colonial authorities with the aim of providing information for the safe navigation of ships, storm warnings, seismological observations and a time service. The observatory was built on Mount Elgin on the Kowloon peninsular in 1883, and work began under the direction of Dr William Doberck, after his arrival in 1883.<sup>24</sup> Advocates of the establishment of the Observatory at Hong Kong were influenced by a number of considerations – the successful establishment of a service in India, and at Mauritius, were factors. The need for a regional storm warning system was clear. Hart's 1874 plea for just such regional co-operation was refereed to, and 'It is much to be hoped that Mr. Hart will take the present opportunity of renewing his advocacy.'<sup>25</sup> Shortly

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<sup>20</sup> SHAC, 679(1) 3611, 'Dossier: Meteorology, 1923-34,' CI to IG 1 april 1926, 3,686

<sup>21</sup> SHAC, 679(1) 3611, 'Dossier: Meteorology, 1923-34,' Hillman to Claxton, 24 feb 1930.

<sup>22</sup> SHAC 679(1) 21364, 'General Questions Concerning Meteorological Observations, 1930-47', CI to IG, 19 Nov 1930, no.4,530

<sup>23</sup> *Hongkong Government Gazette*, 17 November 1877, pp.510-513.

<sup>24</sup> Unless otherwise noted, this and the following paragraphs are derived from W. Doberck to Colonial Secretary, 8 November 1883, Government Notification No. 380, Hong Kong Government Departmental Reports, 1883.

<sup>25</sup> Major H.S. Palmer, 'On the proposal to establish a physical observatory at Hongkong', 17 July 1881, *Hongkong Government Gazette*, 3 September 1881, pp.801-813, quotation from p.11.

after his arrival in Hong Kong Doberck was ordered to contact the Customs. In September and October 1883 he visited Swatow, Amoy, Shanghai, Chinkiang, Kiukiang, Hankow and Takow, and on a Customs cruiser visited a number of lightstations.

Doberck called on and prodded customs Commissioners and Consuls, inspected what instruments he found at these sites, concluding that most of them were 'generally useless', and that their users ill- or un-trained, although intelligent enough, and he generally tried to stir up the Customs. The instruments stored in Shanghai and Amoy were tested and deemed still suitable for distribution. Doberck identified sites for installing the equipment, composed a set of instructions for undertaking meteorological work in China, drew up suitable forms, and formulated plans with the Coast Inspector in Shanghai and the Amoy Commissioner for a system of 35 reporting stations. The colonial government had already proposed to Hart that the new Observatory, as it was unrivalled in its location, should become the centre of 'the meteorological service of China', and the young, newly-appointed director was clearly ready to build on this, should Hart agree. Zikawei, it should be noted, is not mentioned in Doberck's report.

The Doberck whirlwind had the practical impact that he had intended. Hart ordered all recording stations to forward copies of their data to Hong Kong, and the mothballed instruments were distributed to new stations. The Customs sent an Assistant Engineer, John Reginald Harding, to receive instruction in the construction of meteorological installations in April 1885.<sup>26</sup> Doberck's *Instructions for Making Meteorological Observations, prepared for use in China*, and his *The law of storms the Eastern Seas* were reprinted as official Customs publications in 1887. The close relationship continued thereafter, even if the Customs declined to recognise Hong Kong as China's meteorological headquarters and instead developed a closer relationship with Zikawei. Doberck's Assistant (and later successor), Frederick George Figg made a site visit to the Customs stations which telegraphed observations to

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<sup>26</sup> W. Doberck, *Observations and Researches made at the Hongkong Observatory in the year 1885* (Hongkong: Noronha & Co. 1886), p. 2.

Hong Kong for the *China Coast Meteorological Register* in 1892, in order to inspect their equipment.<sup>27</sup> Although Doberck had laid great stress on the potential advantages to science of a close relationship with the Customs in developing an understanding not just of Chinese meteorology, but the 'meteorology of the northern hemisphere', it was the practical work of storm warning that he was in fact directed to concentrate on by the Hong Kong authorities, and which served to focus the collaboration with the Customs.<sup>28</sup>

Relations between the Zikawei and Hong Kong observatories, moreover, and between their respective directors, however, were often fraught, reaching a peak during T.F. Claxton's tenure as director of the Royal Observatory from 1912-32. Claxton had made a career in colonial meteorology, working as director of the Mauritius Observatory before arriving as Director Designate at Hong Kong in 1911, and was, in the words of Captain Eldridge, Customs Coast Inspector, 'inclined to the idea that the Royal Observatory of Hong Kong should take precedence in the Far East.'<sup>29</sup> Claxton's ambition and arrogance was not well-received by the incumbent of the Zikawei directorship, Father Froc an equally stubborn character who was loath to see meteorological work at Zikawei, developed through decades of dedication on the part of the Jesuit Order, interfered with. The two observatories remained on icy terms, often choosing to communicate through the Customs rather than directly with each other, although Claxton did visit Zikawei after his arrival in East Asia.

## Expansion of the Service

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<sup>27</sup> W. Doberck, *Observations and Researches made at the Hongkong Observatory in the year 1892* (Hongkong: Noronha & Co. 1893), p.1.

<sup>28</sup> W. Doberck, *Observations and Researches made at the Hongkong Observatory in the year 1884* (Hongkong: Noronha & Co. 1885), p.1; It was to this end, for example, that the Customs installed equipment at South Cape, Formosa, seemingly at Doberck's request: 'Report of the Director of the Observatory for the year 1889', *Hongkong Government Gazette*, 28 June 1890, p. 601; an enquiry into the Observatory ordered in 1890 was instructed amongst other considerations to investigate the balance (or otherwise) in the efforts it undertook on 'practical' work, and the 'general advancement of science'. The former was the administrative priority. *Hongkong Government Gazette*; 18 January 1890, p.58. The Observatory had failed to issue warnings about a storm the previous October.

<sup>29</sup> SHAC, 679(1) 3611, 'Dossier: Meteorology, 1923-34,' Capt. Eldridge, Coast Inspector, to Frederick Maze, Hankow Commissioner, 1 Dec 1923.

After the establishment of professional links with the two observatories, the Customs meteorological service rapidly expanded under the control of the Marine Department. By 1905 forty-one meteorological stations had been established, including those at twenty-one lighthouses. Furthermore, the numbers of institutions receiving Customs meteorological returns also increased. In 1900, for example, the Central Meteorological Observatory at Tokyo began to receive copies of the meteorological returns from the ports of Tagu (Taku), Yichang (Ichang), Jiujiang (Kiukiang), Wuhu, Zhenjiang (Chinkiang), Wenzhou (Wenchow), Shantou (Swatow), and Guangzhou (Canton). In 1905 the Manila and Hanoi observatories were added to the list of recipients.<sup>30</sup>

In its earliest years, the nascent Customs meteorological service did not follow any uniform practice and its instruments were of variable quality. The confusions which arose as its geographical scope and its responsibilities expanded led to various attempts to institute a standard procedure of taking and communicating readings. In 1903, Customs Deputy Inspector General, Robert Bredon, instructed that meteorological work would henceforth be supervised by the Coast Inspector and coordinated in the Coast Inspector's office. W.F. Tyler, then holding the post, took a close interest in the work. Inspections and repairs of meteorological instruments would be arranged by this office, and a uniform telegram code and monthly meteorological returns form was instituted.<sup>31</sup>

In spite of these attempts to establish uniformity, confusions and misunderstandings became even more prevalent in the twentieth century, as the Customs meteorological service and its beneficiaries expanded. The relationship between the Customs and the Zikawei and Hong Kong observatories was a reciprocal one from the start; daily and monthly reports were transmitted from Customs meteorological stations to the observatories for processing, and in return the observatories sent back weather forecasts by

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<sup>30</sup> *History of the Customs Meteorological Service.*

<sup>31</sup> SHAC, 679(1) 26159, 'Deputy Inspector General's Circular Memoranda, Nos 1-177,' Deputy Inspector General circular no. 51, 10 June 1903.

telegram (to those ports which had the facilities to send and receive telegrams), which were then displayed on a public notice board outside the Custom house. The transmission of information, however, became even more complex in the twentieth century when the Custom houses became obliged to forward their meteorological returns, plus the weather reports sent to them by the observatories, to an array of different institutions, including the Peking Observatory, the Jiaozhou (Kiaochow) Observatory at the German naval colony in Shandong, and the Ministry of Agriculture and Commerce (see appendix B).<sup>32</sup> In large part this was the result of an increasing interest on the part of the government in making use of meteorological data after the establishment of the Republic of China in 1912.

Negotiating this web of meteorological information became even more tricky after the establishment of the Nationalist government at Nanjing in 1928. From their inception the meteorological work of both the Customs and Zikawei Observatory had been clearly bound up with Western imperialism in China. While the semaphore service was of potential use to Chinese vessels, meteorological data collected by the Customs was, as a rule, used to serve distinctly foreign concerns. Father Gherzi broadcast his daily weather forecasts in Russian, English and French, but not Chinese, for example. Furthermore, the observatory's patrons were entirely foreign, comprising the French Navy, the French Concession authorities in Shanghai, the government of French Indochina, the French ministry of foreign affairs, and various foreign shipping companies. These organisations and authorities expected some return for their patronage. The French Navy, for example, received twice daily weather forecasts and occasionally asked the Jesuits to carry out geophysical surveys on their behalf in return for providing the hefty sum of Fr 10,000 towards the observatory's upkeep each year.<sup>33</sup> On coming to power, then, the Nationalists were committed to imposing Chinese authority over meteorological work in China and in channelling the data collected by the Customs – which was, after all, a Chinese government institution – into the service of China's needs.

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<sup>32</sup> See circulars no. 2579, 28 Oct 1916, and no. 3422, 9 April 1924.

<sup>33</sup> Pyenson, *Civilizing Mission*, p. 180.

One major step taken towards achieving this goal was the founding of the Institute of Meteorology (气象研究所) in the Nationalist capital of Nanjing shortly after coming to power, which took over and expanded upon the duties previously undertaken by the Peking Observatory. This was an institute within Academia Sinica (the Central Research Institute 中央研究院—precursor of the Chinese Academy of Sciences in the PRC, and Academia Sinica in Taiwan). This in itself was an indication of the seriousness with which the new government viewed meteorology, and the level of investment it was prepared to channel into meteorological research. In tune with the Nationalist government's realisation that such work was of considerable value to both commercial and military development, cutting-edge meteorological research, and weather forecasting, was to be taken out of the hands of foreign-run observatories, such as Zikawei, and placed under the control of local and central government. There was a clear nationalistic agenda, shared by many of China's young scientists, in such developments of an autonomous scientific capacity.<sup>34</sup> Suspicions of the Customs, and of Zikawei, were clear from the start: 'a meteorological research institution which cannot freely draw its observation material from a weather reporting organisation under its own control', it was stated in a 1931 account of the Institute and its work, 'eventually will be forced to play a very subordinate role in the development of synoptic meteorology.'<sup>35</sup> A 'subordinate role' was not what Zhu Kezhen (Coching Chu), the Institute's Director had in mind. As institutions such as the National Research Institute at Nanjing and the Tsingtao (Qingdao) Observatories increasingly pursued government-funded programmes of research in the 1930s, Zikawei gradually took a more peripheral role in the Customs' work.<sup>36</sup> A glance through the government-controlled institutions and departments to which Customs meteorological returns were being sent in the

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<sup>34</sup> Zuoyue Wang, 'Saving China through science: the Science Society of China, scientific nationalism, and civil society in Republican China' *Osiris* 2002 (17), pp.291-322.

<sup>35</sup> *The Academia Sinica and its Research Institutes* (Nanjing: Academia Sinica 1931), pp. 79-80.

<sup>36</sup> See, for example, circular no. 4726, 5 Oct 1933. Siccawei's side-lining by these new developments is also evident from Fr. Gherzi's request in 1933 for a nominal Customs Service title to give him some status at the Lisbon Meteorological Conference that year. Siccawei had historically represented 'China' at previous conferences. This could not be done: CI s/o 737 to IG, 15 June 1933, in SHAC, 679(1) 3611.

1930s conveys a sense of the various civil and military uses to which this data was being put (see appendix B). By 1933 twelve institutions were receiving these returns including, besides those already mentioned, the China National Aviation Corporation at Shanghai, the Jinan Reconstruction Bureau, China Coast Guard Administration, Hydrographic Department of the Chinese Navy, the Chinese Navy, Nanjing, and the Marine Department of the Ministry of Communications, Nanjing. Throughout this period observations continued to be sent to Zikawei, to the Central Meteorological Observatory in Tokyo, to the Central Observatory of Indo-China (Qiongzhou returns only), and, after the outbreak of war with Japan in 1937, to the Imperial Japanese Naval Authorities in Shanghai.<sup>37</sup>

Not only did the Nationalist government make greater use of Customs meteorological data in this period; it also increasingly established meteorological stations independently of the Customs. Although the number of Customs meteorological stations had increased to fifty by 1932, including those at twenty lighthouses, government-established stations increasingly challenged the Customs' monopoly over the collection of data and issuance of storm warnings. As early as 1925 the newly-formed China Coast Guard Administration, which operated under the jurisdiction of the Chinese Navy, announced its intention to establish five meteorological stations in the coming year, equipped with the most up-to-date instruments plus wireless radio stations for the quick transmission of data. By this date stations were under construction on Saddle Island, Singamen, Pratas Island, Haiman and Kingman, with the aim of improving meteorological research whilst also providing valuable storm warnings, aids to navigation (through a wireless direction finder), and information on the movements of pirates for mariners negotiating the notoriously dangerous journey between Hong Kong and the Philippines. The construction of a further station was planned on the Paracels, in response to a series of requests from various shipping firms. These stations were much better equipped than those belonging to the Customs, operating as mini-observatories; all were equipped with a wide

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<sup>37</sup> *History of the Customs Meteorological Service.*

range of meteorological instruments imported from Europe, and, unlike the Customs, all staff were to receive training from the Zikawei Observatory before taking charge of the stations.<sup>38</sup>

Two years later, in 1927, the Coast Guard Administration reported that its plans for a meteorological service had proved remarkably successful. All six stations were up and running, and all except Pratas were sending twice daily meteorological reports to the Coast Guard Administration by wireless radio. In fact, the Coast Guard Administration's pilot meteorological service was proving much more effective and efficient than that run by the Customs. Whereas meteorological stations belonging to the Customs were for the most part forced to relay daily reports through radio or telegraph stations under the control of a different establishment – a system which had proved unreliable since its inception – the Coast Guard Administration combined meteorological and radio-telegraphy facilities in each station. The onsite radio station at Pratas meteorological station, under the control of the Ministry of Navy, was particularly valuable to shipping in the area. Pratas received reports from stations across China, the Philippines, and Indo-China, in addition to approximately 500 unsolicited weather reports per month transmitted by ships. It also broadcast weather reports twice daily, plus storm warnings when necessary.<sup>39</sup> The evolution of a more efficient and better-equipped meteorological system under the control of different departments by the end of the 1920s suggested that the days of the Customs meteorological stations were numbered.

After the third National Meteorological Conference held in Nanjing on 2 April 1937, the Institute of Meteorology unveiled ambitious plans to fund the establishment of a far-reaching system of meteorological stations to supply it with information. These would range in scale from first to fourth class stations, with all provisional governments and municipal governments under

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<sup>38</sup> SHAC 679(1) 764, 'Hydrographers, Naval Officials, Shipping, Merchants, Meteorological', C. C. Hsin, Coast Guard Service director to Capt Hillman, Customs Coast Inspector, 30 June 1925.

<sup>39</sup> SHAC 679(1) 766, 'Hydrographers, Naval Officials, Shipping, Merchants, Meteorological', C. C. Hsin, Coast Guard Service director, to Capt Hillman, Customs Coast Inspector, 11 Jan 1927.

the direct control of the Executive Yuan (central government) being instructed to construct a first or second class station and all county (*xian*) governments being instructed to construct a third or fourth class station. The range of meteorological instruments to be supplied to the stations was impressive; first class stations were to be equipped with twenty-six different types of instrument. As Coast Inspector Carrel glumly noted in a letter to Inspector General Frederick Maze, the standard of Customs's meteorological stations lay somewhere between the third and fourth class as outlined in the Institute's guidelines.<sup>40</sup> In the face of the government's elaborate plans to establish a network of first-rate meteorological stations under direct government control, the Customs meteorological service was fast becoming obsolete by the late 1930s. Zikawei Observatory, rather than being heartened by the progress of meteorology in China, was also clearly alarmed by the government's plans. Zikawei had in the late nineteenth and early twentieth centuries been at the forefront of meteorological research in China, and had thus managed to gain privileged access to raw meteorological data, provided by the Customs and other organisations. Unwilling to see the observatory's standing eroded, Father Gherzi even proposed in May 1937 that the League of Nations finance the establishment of a nationwide meteorological service in China, comprising of forty stations under Jesuit control.<sup>41</sup> His proposal, of course, came to nothing.

The decline of the service was hastened by conflict. The instruments at forty-two of the fifty-two Customs stations and lighthouses that had collected meteorological data before 1937 were destroyed during the Sino-Japanese and Pacific War (1937-45). Wartime also saw a fundamental reorganisation of the National Government's activity, with the establishment of a new Central Meteorological Bureau in Chongqing in 1941, which took over all but the research activity of the Institute of Meteorology. Faced in 1946 with the cost of rehabilitating the meteorological service, and noting that other government departments now maintained well-equipped meteorological stations, Coast

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<sup>40</sup> SHAC 679(1) 3852, 'Meteorology, 1937-1945,' appendix X of letter from Coast Inspector Carrel to IG Maze, 16 Nov 1937.

<sup>41</sup> Pyenson, *Civilizing Mission*, p. 176.

Inspector R.G. Everest argued in 1946 that 'it appears that at the ports concerned Customs meteorological stations are superfluous and could be abolished without detrimental effect.' 'It is hoped,' Everest added, 'that gradually our meteorological activities will be discontinued altogether on the mainland and be confined to lightstations on the coast.'<sup>42</sup> In early January 1947 the Customs ordered meteorological work at posts to cease if other state meteorological stations were operating at the same locale.<sup>43</sup> This effectively heralded the withdrawal of the Customs from its previously central role in gathering meteorological data across China and circulating it across East Asia.

Zikawei faced escalating political problems in the aftermath of the war. The politicisation and militarization of meteorological work, and the heightened nationalistic tone of wartime and post-war life, meant that Chinese government agencies were keen to protect their own spheres of activity and reclaim sovereign rights where these were seen to be imperilled. The foreign presence in the Customs was a target after 1941, and Zikawei would seem to have provided an obvious target. It was the subject of conflict in 1947 with the Nationalist government's Central Observatory: in February 1947 Zikawei was ordered to close 'to maintain [Chinese] national rights.'<sup>44</sup> The Observatory's troubles multiplied when the communists took over the city in May 1949. On 12 December 1950 it was formally taken over by the Communist authorities, and incorporated into the Shanghai Meteorological Observatory. Anecdotal report suggests that Jesuit staff had continued to be important in the running of the Observatory up to that point, but had less of a role thereafter before their final expulsion. They were refused permission to take any of their papers with them when they left.<sup>45</sup> The militarized sensitivity of this area in early Communist China is also demonstrated in the oral testimony of a young Chinese meteorologist, who had worked as a wartime observer with a US military meteorological team in China. On offering his expertise to the new

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<sup>42</sup> SHAC 679(1) 3853, 'Meteorology, 1937-1945,' Capt R.G. Everest, Coast Inspector, to L.K. Little, IG, 15 Nov 1946.

<sup>43</sup> SHAC 679(1) 21364, 'General Questions Concerning Meteorological Observations, 1930-47', CI No.6383, Despatch to marine 9777, 7 Jan. 1947.

<sup>44</sup> *The Times*, 20 Feb. 1947, p. 6.

<sup>45</sup> Udín, *Searching the Heavens and the Earth*, pp. 167, 277; *Shanghai qixiang zhi*,

Communist authorities in Shanghai in 1949, who had banned the publication of weather forecasts, fearing these would provide information to assist the enemy in the still-ongoing civil war, he was immediately detained as a probable spy. He was kept in detention for four years. The only job he was ever allowed to hold thereafter, until he retired in the 1990s, was as a matchbox maker.<sup>46</sup>

## 2) COLLECTING METEOROLOGICAL DATA

Although the Customs established meteorological stations as early as the 1870s, there was at first no uniformity of practice in taking readings. The first effort to establish consistent practice came in 1885 when Hart circulated a standard form (see Figure 1) on which Customs houses and lightstations equipped with meteorological instruments were instructed to record observations at six-hourly intervals (four times daily).<sup>47</sup> This form also tells us what sort of observations were being made: barometer, dry and wet bulb thermometer, solar and ground radiation, rainfall and wind direction and force readings. Further attempts were periodically made to establish uniform practice, but the real turning point came when the Coast Inspector was made responsible for meteorological work in 1903.<sup>48</sup> Bringing together meteorological work under the control of one office greatly improved the quality and consistency of Customs meteorological observations.

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<sup>46</sup> 'Another National Day: 1949' by Sang Ye, translated by Geremie R. Barmé, <[http://www.danwei.org/scholarship\\_and\\_education/another\\_national\\_day.php](http://www.danwei.org/scholarship_and_education/another_national_day.php)>, accessed October 2007. The piece was originally published in Sang Ye, *1949, 1989, 1999* (Hong Kong: Oxford University Press, 1999).

<sup>47</sup> SHAC, 679(1) 26893, 'Inspector General's Circulars, Vol. 4, Second Series, Nos 318-450, 1885-89,' IG circular no. 321, 28 Dec 1885.

<sup>48</sup> SHAC, 679(1) 14704, 'Deputy Inspector General's Draft Circular Memoranda, Nos 1-60, 1900-04,' Deputy IG circular no. 51, 10 June 1903.

Figure 1: Meteorological observations form, 1885

Day	Hour	Attached therm.	Barometer no.	Thermometer						Rainfall		Wind		State of the weather	Remarks	Signature	
			Height	Dry bulb	Damp bulb	Max .	Min.	Solar rad. max .	Ground rad. min.	Gauge no.		Direction	Force				
				No.	No.	No.	No.	No.	No.	Inches	Hours						
1	3 am 9 am 3 pm																



Rather than employing a specialised staff trained in meteorological matters, the Customs simply relied upon its existing (foreign) staff to record observations. Inevitably this system of using staff with no training in or experience of using meteorological instruments led to frequent mistakes and misunderstandings. Although problems periodically continued to emerge, the circulation in 1905 of a book of *Instructions Concerning Meteorological Work*, written specifically for the Customs (Doberck's 1883 handbook had been more general) after a thorough investigation into the current procedures in place at all Custom houses and lightstations and the requirements of Hong Kong and Zikawei Observatories, led to vast improvements in the service. Firstly, the new *Instructions* laid out standard provisions of instruments, all of which were imported from Europe, to be supplied to *all* meteorological stations, consisting of a mercurial barometer, wet and dry bulb hygrometers, maximum and minimum thermometers, and a rain gauge. Furthermore, certain lightstations were supplied with barographs, and Gutzlaff lightstation near Shanghai was supplied with an anemometer. At the same time, a redesigned meteorological returns form was issued; unlike the previous form, solar and ground radiation observations were not included, although additional observations of percentage, kind, direction and movement of clouds, and direction and dimensions of waves were included.

The methods of recording observations laid out in the 1905 book of instructions remained largely unchanged for the next twenty-five years, although certain stations increased the number of daily readings from four to eight. The next substantial overhaul of this practice came in 1930, after a Customs surveyor, Swede T.H. Bülow-Ravens, was sent as the Customs' delegate to a National Meteorological Conference in Nanjing. Although all other Customs employees had 'only a sailor's knowledge of practical meteorology,' as Coast Inspector Hillman put it, Bulow-Ravens had been in charge of the Meteorological Office for several years, had been responsible for inspecting and repairing instruments, and had received training in

meteorological work at Zikawei.<sup>49</sup> At the conference the problem that certain Customs meteorological stations were making observations according to the metric system whilst others continued to use the imperial system was highlighted. As a result, 48 sets of new metric meteorological instruments were distributed amongst the stations in 1931, and in 1932 the metric system of reading instruments was put into force.<sup>50</sup> The 1930 conference was also notable for the fact that Bülow-Ravens was plainly surprised at how 'up to date' the instruments being used by the Institute of Meteorology were, and 'that so many people in China were qualified to carry out such work.'<sup>51</sup> The rapid growth of highly professionalized meteorological activity caught the Customs unawares and highlighted its own inadequacies. It also sheds light on Customs prejudices: only foreign staff took observations in the Customs system, as Chinese staff were not considered 'reliable' enough to be trusted to do so accurately. As a result up to 1930 the Customs took readings at 6 a.m. and 3 p.m. China Coast time, as Chinese would be on duty at night.<sup>52</sup>

The adoption of the metric system led to further confusions, at least initially. In a circular letter distributed in 1931 to all stations Coast Inspector Carrel admonished staff that, 'since the introduction at Customs Stations of the metric method of recording meteorological data and the supply of instruments with metric scales numerous errors and discrepancies have been noted in the Meteorological Returns, and several complaints have been received from observatories and institutions to which copies of the returns are transmitted.' In order to avoid errors in future, Carrel included step-by-step instructions on how to read the new metric scale thermometers and rain gauge, and also

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<sup>49</sup> SHAC 679(1) 21364, 'General questions concerning meteorological observations, 1930-1947,' despatch no. 4,390, Coast Inspector Hillman to IG Maze, 11 March 1930.

<sup>50</sup> SHAC 679(1) 3611, 'Dossier: Meteorology, 1923-1934', 48 max thermometers, 48 min, 48 hygrometers, and 48 rain gauge glasses were ordered (Bülow-Ravens to CI, Memo, 7 Nov. 1930; Chief Secretary Kishimoto to custom houses, 10 Nov 1931.

<sup>51</sup> Bülow-Ravens also had no Chinese. SHAC, 679(1), 3611, 'Dossier: Meteorology, 1923-1934', extract from W.O. Law, Commr. Nanjing, S/o 19 Apr 1930. The Institute had been running training programmes from its inception, and had also recruited a number of scientists trained overseas.

<sup>52</sup> And with a steadily declining role in the Customs for foreign employees – foreign recruitment except for contract staff was ended in 1929 – it was critical for the Customs to keep things simple until Chinese had been trained to take over: CI to Claxton, 14 April 1930 in SHAC, 679(1), 3611, 'Dossier: Meteorology, 1923-1934'.

included a completed meteorological returns form as an example (see appendix C). The new returns forms, in addition to the usual entries, also included columns for monthly and daily averages of the various instrument readings, which were calculated at the head office.<sup>53</sup> All stations were now encouraged to make observations at three-hourly intervals (six times daily); the minimum number of daily observations was four.

In December 1932 these instructions were expanded upon and consolidated in the second issue of *Instructions concerning meteorological work*. Distributed to all ports, this publication laid out detailed instructions for recording and sending observations taken from the new instruments. Indeed, the Coast Inspector evidently saw the issuing of new instructions as an opportunity to professionalize the Customs meteorological service, noting that 'there is still room for improvement'. Carrel lamented 'the fact that our observers do the work as a matter of duty, without the interest in it that volunteers would have, tends to imperfection and perfunctoriness,' urging Customs employees to 'try to perfect themselves in the art of taking observations to enable the Service to further enhance its value.'<sup>54</sup> In the face of increasing pressure to perform felt by the Customs during this period, Carrel was determined to stamp out any carelessness in the meteorological service and thus prove its continuing worth.

A second National Meteorological Conference held in Nanjing in April 1935 saw minor changes to procedure, resulting in the issuing of a third edition of *Instructions concerning meteorological work* in July 1935. Rainfall readings were reduced to two per day and all 3 pm readings replaced by readings at 2 pm.<sup>55</sup> A further conference in Nanjing in 1937 instituted further changes in line with the requirements of the National Research Institute. The principal change was the introduction of the 24-hours system of counting the day and the synchronisation of readings using 8-hour zone time (after the outbreak of

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<sup>53</sup> SHAC 679(1) 3611, 'Dossier: Meteorology, 1923-1934', Coast Inspector Carrel's circular enclosed in Chief Secretary Kishimoto to custom houses, 10 Nov 1931.

<sup>54</sup> SHAC 679(1) 21530, *Instructions concerning meteorological work*, second issue, IV Service Series, no. 27, 1932.

<sup>55</sup> *History of the Customs Meteorological Service*.

the Sino-Japanese War later in the year, however, the 9-hour zone time was generally adopted). This added an extra level of complexity to those taking readings at isolated lightstations, where the staff were required to carefully observe the time of sunrise and sunset in order to calculate the correct times for recording observations. Other changes included making the index error of barometer readings calculable at the stations (previously this had been calculated at head office), adaptation of the methods and definitions used to record cloud and weather observations in order to bring them in line with international usage, and the new requirement that stations record visibility observations.<sup>56</sup> A new instruction book was published in accordance with these changes in January 1939, when a new returns form, 'daily values of meteorological elements' was also introduced, to be filled in and forwarded to the Institute of Meteorology, Nanjing. Hart's dream of a Customs meteorological network serving both scientific and practical aims had clearly been realised by 1937. It was, however, something of a mixed blessing. Whereas in the beginning the Customs had approached meteorology in an amateur fashion, the interests, requirements and projects of the Nationalist government after 1927 meant that the Customs and its employees needed to work much harder and with more precision on their meteorological tasks.

## **CUSTOMS METEOROLOGICAL DATA**

The exact present whereabouts of the Customs meteorological returns initially proved puzzling. With the exception of summaries of data for certain ports in the late 1920s and 1930s, the mass of data so painstakingly collected between 1870 and 1949 is missing from the Customs Service archive in the Second Historical Archive of China in Nanjing. In 1934, in response to a request from the Institute of Meteorology, Nanjing, for copies of Customs meteorological returns between 1919 and 1928, Coast Inspector Terry replied that the Coast Inspector's office only held records from 1921 onwards, and

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<sup>56</sup> SHAC 679(1) 3853, 'Meteorology, 1937-1945,' Coast Inspector Carrel forwarding revised instructions to IG Maze, 16 Nov 1937 and *History of the Customs Meteorological Service*.

that these were the only originals in existence (see Appendix D).<sup>57</sup> These post-1921 records, however, are not present in the Marine Department section of the Nanjing archive. Archivists there have previously proposed in discussion that as this was 'National security-related material', then it might have been extracted long before the material was transferred to them. The data also does not appear to have been kept at ports as a matter of routine. In correspondence in 1930 the Newchwang (Niuzhuang) Commissioner complained that his office had no local data available (which might help shipping locally). Data was sent to the observatories 'but never retained at ports'.<sup>58</sup> Terry pointed out in 1934, however, that from 1914 copies of Customs meteorological returns were sent to the Peking Observatory and from 1916 to the Ministry of Agriculture and Commerce in Beijing. After its formation in 1928, the meteorological records held by these two institutions were incorporated into the Institute of Meteorology. The exact whereabouts of the Institute's archive is at present unclear, although there are files relating to it at the Second Historical Archives. It is not held at Academia Sinica, Taipei, which took no records to Taiwan in 1949. The Institute's founding director, Harvard-trained Zhu Kezhen, became one of the Vice-Presidents of Chinese Academy of Sciences. The Central Meteorological Institute became the Chinese Academy of Meteorological Sciences, under the Chinese Meteorological Administration (which itself grew out of a Central Military Commission Meteorological Bureau, established 1949). The location of the pre-1914 Customs meteorological returns initially proved even more uncertain. However, we do know that, from 1880, the Customs relayed meteorological data to the Zikawei and then the Hong Kong Observatories, comprising a large proportion of the data compiled in their monthly publications. Zikawei, moreover, made considerable attempts to disseminate its work to interested parties across China. In addition to occasional special reports, the Observatory published a 'Daily Weather Chart' from 1906 onwards, available by subscription to firms, navigation companies and other

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<sup>57</sup> SHAC 679(1) 3611, 'Dossier: Meteorology, 1923-1934', Acting Coast Inspector Terry to IG Maze, 10 March 1934.

<sup>58</sup> SHAC 679(1), 3611, 'Dossier: Meteorology, 1923-1934', B.D. Tisdall, Commr Newchwang, to IG, 3 April 1930

interested parties and consisting of a weather map and daily meteorological observations taken at the Customs stations.<sup>59</sup>

The bulk of the data derived from Customs stations now appears to be held by Chinese Meteorological Administration, at its central library and archives in Peking. An undated history of Customs meteorological work posted on its website lists data held, as well as data known to have been recorded, but not held (Appendix E). There are some inaccuracies, but the data seems mostly to fit with what we know survived in the Marine Department records. Representatives from the central administration removed data from the Zikawei archives in spring/summer 1953, and took it to Peking, while an inventory of all Customs meteorological returns held in the Administration's library was prepared in 1957. A second transfer of material from Zikawei to Peking took place in June 1959. It seems sensible to assume that this trawl for data also took material directly from the archives of the Customs Service Marine Department.

### **3) TRANSMITTING AND PROCESSING METEOROLOGICAL DATA**

Collecting data was relatively straightforward when compared to the troublesome task of transmitting the data to various observatories and research institutes. In the early years, of course, when the number of stations and recipients of data were limited, this matter was fairly simple. At least from the 1880s, all stations would send monthly meteorological returns, comprising of all daily observations for the month, to Zikawei and Hong Kong observatories (see Figure 1 for an example of the monthly meteorological returns form). After all meteorological work was centralised under the control of the Coast Inspector's office in 1903, all ports and lightstations were required to send meteorological returns to that office, which would then make copies and forward them to the observatories.<sup>60</sup> By 1905 twenty ports and twenty-two lightstations were sending returns to the two observatories.

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<sup>59</sup> SHAC, 679(1) 756, letter from Father Froc, Siccawei director, to Coast Inspector, 3 June 1906.

<sup>60</sup> SHAC, 679(1) 14704, 'Deputy Inspector General's Draft Circular Memoranda, Nos 1-60, 1900-04,' Deputy IG's circular no. 56, 2 June 1904.

Furthermore, by this date the Manila and Tokyo observatories had been added to the list of recipients of monthly returns from certain stations (see appendix B)

In addition to sending monthly meteorological returns, certain ports also transmitted observations twice daily directly to the observatories by telegram. The exchange of weather reports between observatories in the Far East and Pacific had occupied a central place in Hart's vision of the Customs meteorological service from its inception. In a memorandum circulated to colonial governments in Southeast and East Asia in April 1874 Hart outlined his plans for the daily telegraphic transmission of weather data between Hong Kong, Shanghai, Xiamen (Amoy) and Nagasaki, and also invited cooperation on a more ambitious scheme for the circulation of weather news among ten observatories located at points from Jakarta in the south to Passiette in the north. These weather reports were then displayed at harbours and customs houses, and were also supplied to local newspapers, so that seamen could learn of weather conditions in various directions (see Appendix A). As the telegraphic network extended across China in the late nineteenth century an increasing number of Customs stations began to transmit daily weather data to the observatories. In 1904, in an effort to establish uniformity, stations with a nearby telegraph office were instructed to transmit observations – using a five-figure code – by telegram twice daily, giving barometer readings, wind direction and force, state of the weather, temperature readings and the difference between the wet and dry bulbs, based upon observations taken at 6 am and 3 pm. Whereas prior to 1904 the Inspectorate had no exact knowledge of the recipients of the telegrams emanating from the various Custom houses, instructions were now issued to send telegrams only to the Zikawei and/or Hong Kong observatories.<sup>61</sup> The quick transmission of data enabled by the telegraph system was invaluable to the observatories' work in predicting storms and calculating weather forecasts. By 1905, a total of fourteen ports, plus Gutzlaff lightstation, were sending meteorological telegrams. The northern and eastern stations (twelve in total) sent telegrams

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<sup>61</sup> SHAC, 679(1) 14704, 'Deputy Inspector General's Draft Circular Memoranda, Nos 1-60, 1900-04,' Deputy IG's circular no. 56, 2 June 1904.

to Zikawei, whereas the southern stations sent telegrams to Hong Kong (four in total; Swatow (Shantou) sent telegrams to both observatories). Furthermore, various other observatories also received daily telegrams from Customs stations in useful locations; for example, the northern port of Chefoo (Yantai) also sent telegrams to the Tsingtao (Qingdao) and Tokyo observatories (see Appendix C). Throughout the existence of the Customs meteorological service the lightstations, with the exception of Gutzlaff, did not send meteorological telegrams as their isolated locations made it impossible.

This system became considerably more complex as both the number of recipients and number of ports collecting data increased. Indeed, the Customs Inspectorate was finding it difficult to keep track of the various pathways through which meteorological data was flowing. In addition to the two-way traffic between the two principal observatories and the stations, the Revenue Board (*Shuiwuchu*, the government department which the Customs operated under 1906-28) instructed the Customs in 1916 that the weather forecasts sent to the ports from Zikawei and Hong Kong must also be forwarded by telegram to the Peking Observatory and the Ministry of Agriculture and Commerce.<sup>62</sup>

Furthermore, throughout the twentieth century the number of stations transmitting data by telegram continued to increase. By 1920, meteorological telegrams were being sent to Zikawei Observatory from eighteen custom houses; Canton (Guangzhou), Amoy (Xiamen), Chungking (Chongqing), Tengyueh (Tengyue), Swatow (Shantou), Chefoo (Yantai), Kiukiang (Jiujiang), Ichang (Yichang), Newchwang (Niuzhuang), Chinhai (at Ningbo), Pakhoi (Beihai), Hoihow (Haikou), Shameen (in Guangzhou), and Wuchow (Wuzhou). Yet, the transmission of meteorological telegrams was fraught with problems, partly due to disruptions caused by fighting but mainly due to glitches in the telegraph service. In September 1920, for example, Father Froc, in a letter to the Coast Inspector protesting the late arrival of meteorological telegrams, held up the example of Wuchow (Wuzhou), a port

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<sup>62</sup> SHAC, 679(1) 26904, 'Inspector General's Circulars, Vol. 14, Second Series, Nos 2301-2591, 1915-16,' IG circular no. 2,579, 28 Oct 1916.

from which telegrams almost always arrived late, in one case by fifty-one days.<sup>63</sup> As Coast Inspector Hillman observed, late telegrams were of no use in predicting storms or issuing weather forecasts, pointing out that a recent typhoon at Wenchow (Wenzhou) could have been predicted had Zikawei received its telegrams on time.<sup>64</sup> After the Revenue Board took up the matter with the Ministry of Communications all telegraph offices were instructed to attach the utmost importance to meteorological telegrams.

Complaints about late arrivals, however, continued to be sounded throughout the 1920s and 1930s. In large part, the problems with this system were a result of the Customs' reliance on third-party organisations to transmit the data – principally the China Telegraph Administration – rather than controlling the transmission of data 'in house'. The Jesuit Fathers had long realised the importance of radio communication to meteorological work, and had operated a wireless weather service from Zikawei to serve the China Coast since 1914. Both the Zikawei and Hong Kong Observatories, moreover, found that wireless radio enabled staff to issue more accurate storm warnings by allowing ships to instantly radio in any changes in the weather. Ernesto Gherzi, Froc's assistant and later successor at Zikawei, was an especial radio enthusiast; by 1928 he was using wireless to broadcast storm warnings in English, Russian and French and in 1931, just after the arrival of civil aviation in China, he began broadcasting daily weather reports on 24-m and 42-m bands.<sup>65</sup>

The idea of installing short-wave radio at key Customs stations, such as Ningbo, Wenzhou, Amoy (Xiamen), Shantou and Shanghai, was first sounded by Gherzi, in 1926. This development – 'very easy to realise,' as Gherzi pointed out – would significantly enhance the work of the observatory by enabling Customs ships to quickly and regularly communicate meteorological

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<sup>63</sup> SHAC, 679(1) 26906, 'Inspector General's Circulars, Vol. 16, Second Series, Nos 3201-3493, 1921-24,' letter from Father Froc to Coast Inspector Hillman enclosed in IG circular no. 3071, 13 Sept 1920.

<sup>64</sup> SHAC, 679(1) 26906, 'Inspector General's Circulars, Vol. 16, Second Series, Nos 3201-3493, 1921-24,' letter from Coast Inspector Hillman to IG enclosed in IG circular no. 3071, 13 Sept 1920.

<sup>65</sup> Pyenson, *Civilizing Mission*, pp. 173-74.

observations to the land stations. As Gherzi pointed out, because telegrams were often delayed and because during storms telegraph cables were often broken, it would be wise to install short-wave radio in order to communicate meteorological data more reliably. During a storm this would, Gherzi observed, 'have a great consequence for the safe sailing of steamers which otherwise would have remained at anchor because of our lack of recent telegrams from the meteorological stations.'<sup>66</sup> The Customs, however, deemed it too costly to act upon Gherzi's suggestion.

Keen to circumvent the Customs' reluctance to install wireless radio at their stations, Zikawei arranged in 1928 to transmit daily weather reports and storm warnings to the Italian Navy based at Tianjin, which would then communicate them to the Customs authorities.<sup>67</sup> The Nationalist government after 1928 was also interested in investing in short-wave radio as a solution to the failings of the telegraph system. In 1929 the Customs Administration (*guanwushu*, the government department under which the Customs operated after 1928) instructed the Customs to experiment with short-wave radio as a means of transmitting observations from Amoy (Xiamen), Ningpo (Ningbo), Hankow (Wuhan) and Ichang (Yichang).<sup>68</sup> The use of radio to transmit meteorological data became even more important after the outbreak of the Sino-Japanese War in 1937, when it became impossible to send telegrams.

Even the headquarters of the Customs meteorological service struggled to keep up to speed with the complex web of data transmission in the 1930s. Indeed, in 1932 the number of Customs stations sending meteorological telegrams had increased to twenty-seven and the number of recipients had increased to fifteen (the number of recipients varied according to the port; see appendix B). A total of 284 meteorological telegrams were being sent per day by Customs stations. Furthermore, the number of departments and institutions receiving monthly meteorological returns had grown to twelve.

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<sup>66</sup> SHAC, 679(1) 765, 'Hydrographers, Naval Officials, Shipping, Merchants, Meteorological etc.,' Father Gherzi (Siccawei) to Capt B.H. Gowing, Acting Coast Inspector, 21 June 1926.

<sup>67</sup> SHAC, 679(1) 767, 'Hydrographers, Naval Officials, Shipping, Merchants, Meteorological etc.,' Father Gherzi (Siccawei) to Coast Inspector Hillman, 25 Feb 1928.

<sup>68</sup> SHAC, 679(1) 3611, 'Dossier: Meteorology, 1923-1934,' *Guanwushu* despatch no. 314, March 1929.

The expansion of this network of meteorological information was chiefly a result of the new Nationalist government's self-strengthening impetus. Investment in meteorological science, the government realised, could complement and help to further its military, commercial, and scientific endeavours. The new importance of meteorological matters to the government is highlighted by the fact that, whereas prior to 1928 the transmission of Customs meteorological data had been arranged according to agreements made between the Customs and the observatories, by the 1930s the government had taken over full control of the process. From 1935 onwards Customs stations were instructed simply to hand in their telegrams to local Chinese government telegraph stations, from which point on the data was out of the Customs' hands. From there, the data was transmitted to five central broadcasting stations, located in Tianjin, Xi'an, Hankou, Shanghai and Guangzhou (Canton), which would then publicly broadcast the data by radio, thereby eliminating direct contact between the Customs and the observatories on this matter. The privileged position of the foreign-run observatories – particularly Zikawei, which had long viewed itself as the true custodian of meteorological data and work in China – was also being eroded in this period. Much to Father Gherzi's indignation, after 1935 Customs meteorological telegrams were no longer sent to Zikawei Observatory; observatory staff had to listen in to the broadcasts just as everyone else did until, on Gherzi's petition, the government reluctantly agreed to allow Woosung Broadcasting Station to send data to the observatory.<sup>69</sup> What had begun as a largely foreign affair, which benefited the research activities of the Jesuit-run Zikawei Observatory and the British-run Hong Kong Royal Observatory, had by the 1930s become a central concern for China and China's government.

This shift in jurisdiction over meteorological data became all the more transparent after the outbreak of the Sino-Japanese War in August 1937, when the issue of government control over the flow of data became all-important. Government directives curtailing the transmission of

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<sup>69</sup> SOAS, Maze Papers, PP MS 2, Confidential letters and reports, etc., vol. 18, 'Memorandum re. meteorological telegrams sent by various Customs to Siccawei Observatory,' 10 August 1938.

meteorological telegrams from 1938 onwards clearly indicated how national security concerns and control over meteorological data were closely intertwined in the eyes of the government. Since 1935 meteorological telegrams had been sent twice daily from twenty-three Customs stations to the five central broadcasting stations. Yet in March 1938 several directives were issued by the Ministry of Finance instructing the Customs to cease transmission of daily telegrams from all stations on the Yangzi and in Jiangxi, Hubei, Hunan, Guangdong, Guangxi, Sichuan, and Yunnan provinces.<sup>70</sup> All those stations in areas occupied by Japanese forces, of course, also ceased to send telegrams to government controlled institutions and authorities.

Concerns over national security and the fear that meteorological telegrams might be intercepted by enemy authorities and thus fall into the wrong hands were, however, tempered by the usefulness of meteorological data to military operations. Thus, on 19 April 1938, after the government's initial panic on this matter had subsided somewhat, the Customs was directed to instruct Customs stations at Ningbo (Ningpo), Wenzhou (Wenchow), Fuzhou (Foochow), Guangzhou (Canton), Xiamen (Amoy), Shantou (Swatow), Qiongzhou (Kiungchow), Beihai (Pakhoi), Wuzhou (Wuchow), Tengyue, Chongqing (Chungking), Yichang (Ichang), Hankou (Hankow), Jiujiang (Kiukiang) and Changsha to recommence supplying meteorological data to local Chinese government telegraph administrations for transmission to government authorities in Hankou, Guangzhou and Chongqing. Furthermore, the Customs at Fuzhou, Xiamen, Shantou and Guangzhou continued to despatch telegrams to the Nanchang Aviation Commission while stations at Ningbo, Wenzhou, Fuzhou, Amoy, Shantou, Tengyue, Chongqing, Yichang, Hankou, Jiujiang and Changsha were instructed to send daily meteorological telegrams for use by the China Aviation Force. Transmission of telegrams at ten Customs stations remained suspended, however, and *all* stations – with the exceptions of Yantai (Chefoo), Qinhuangdao (Chinwangtao) and Weihai –

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<sup>70</sup> SOAS, Maze Papers, PP MS 2, Confidential letters and reports, etc., vol. 18, 'Memorandum re. meteorological telegrams sent by various Customs to Siccawei Observatory,' 10 August 1938. Directives were issued on 15 March as regards the Yangzi stations, and on 21 March as regards all other stations at which telegrams were to be discontinued.

had ceased to transmit telegrams to the observatories.<sup>71</sup> The war, then, cemented the transfer of control over meteorological data from foreign to Chinese hands.

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<sup>71</sup> SOAS, Maze Papers, PP MS 2, Confidential letters and reports, etc., vol. 18, 'Memorandum re. meteorological telegrams sent by various Customs to Siccawei Observatory,' 10 August 1938.

### 3) STORM WARNING SYSTEM

In 1869, Hart, on announcing his intention to establish a meteorological service, assured Commissioners that the extra work of collecting climate data would find its reward in the significant contribution made to scientific research. At the same time, he envisaged that the project would have a more immediate, practical use of communicating bad weather warnings to mariners. As early as 1873 he unveiled plans for the telegraphic communication of weather news between ports along the coast from Jakarta (Batavia) to Passiette, and wrote to the governments of various states in East and Southeast Asia inviting their cooperation in the scheme. It was not until 1879, however, that the idea of a storm-warning system for the China coast bore fruit. Impressed by Father Dechevrens' success in predicting the course of the July 1879 typhoon, the International Chamber of Commerce in Shanghai were persuaded to invest in a typhoon warning service by erecting a large semaphore on the Bund.<sup>72</sup> The launch of this service in turn necessitated the creation of the system of meteorological telegrams, as storms could only be accurately predicted through the fast communication of meteorological observations from Customs stations and ships at sea.

Maintained and manned at the joint expense of the French Concession and International Settlement municipal councils, the semaphore provided invaluable guidance to ships sailing in the coastal areas off Shanghai. Observing its usefulness, Dechevrens began to petition for an expansion of the storm-warning system to serve the entire China coast. A small step was taken in this direction in 1896, when the Customs first joined forces with Zikawei in running the warning system by erecting a signal station at Gutzlaff lightstation near Shanghai. This station repeated storm warnings issued by the observatory with the aim of giving further guidance to navigators entering or leaving the Yangzi estuary.<sup>73</sup> In the same year, moreover, Dechevrens was granted licence to send out telegraphic storm warnings across China free

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<sup>72</sup> Pyenson, *Civilizing Mission*, p. 158.

<sup>73</sup> Banister, *Coastwise Lights of China*, p. 10.

of charge.<sup>74</sup> Yet it was the early twentieth century which witnessed a massive expansion of the Customs' role in this aspect of the observatory's work. Froc first proposed a China-wide storm warning system at the International Meteorological Conference held in Innsbruck in 1905.<sup>75</sup> By the following year his idea had become reality; Froc wrote excitedly that the Customs had agreed to establish semaphores at most of its lighthouses. This series of semaphores would repeat warnings issued by Zikawei up and down the China coast, thereby providing, as Froc commented, much needed assistance to 'those poor fisherman and other junk-people who are helpless and lose everything, even their life, yearly, in so great numbers for want of knowledge.'<sup>76</sup> Because most lighthouses were situated far from any telegraph office (with the exception of Gutzlaff), semaphore operators relied on the willingness of passing vessels to communicate information about storm warnings gathered at ports along their route until the introduction of wireless radio in the 1920s. By 1931 the Customs operated seventy-five semaphores along the China coast, which repeated daily weather forecasts sent out from Zikawei.<sup>77</sup>

During daylight hours, clearly visible shapes and symbols were hung from the semaphores, the various combinations of which indicated longitude, latitude, and type and force of weather conditions, according to the forecasts made by the Zikawei or Hong Kong observatories.<sup>78</sup> This code was devised by Froc in 1904 and he was clearly pleased with the results of his labour, boasting in 1905 that his code had been swiftly adopted by the British Navy stationed in Weihaiwei.<sup>79</sup> During hours of darkness a complex system of night signals was used at some stations, particularly in difficult to navigate areas, consisting of

<sup>74</sup> Pyenson, *Civilizing Mission*, p. 159.

<sup>75</sup> Louis Froc, 'An International System of Weather Signals', in *Report of the International Meteorological Conference at Innsbruck, September 1905* (London: HMSO, 1908), pp. 99-101. Froc also delivered a report on the work of the Customs in China, using notes supplied by Coast Inspector W.F. Tyler: 'Meteorological Organisation of the Chinese Imperial Maritime Customs', in *Report of the International Meteorological Conference at Innsbruck, September 1905*, pp. 105-107. See also Froc to Tyler, 21 September 1905, in SHAC, 679(1) 756.

<sup>76</sup> SHAC, 679(1) 756, 'Father Froc, Siccawei, 25 Dec 1906.

<sup>77</sup> Pyenson, *Civilizing Mission*, p. 173.

<sup>78</sup> From 1882 until 1904 flags were used on the Shanghai and Gutzlaff semaphore poles. They were placed by more distinctive and easily seen shapes and symbols in 1904. See SHAC, 679(1) 756, Father Froc, Siccawei director, to Coast Inspector, 1 July 1904.

<sup>79</sup> SHAC, 679(1) 756, Father Froc, Siccawei director, 21 Sept 1905.

thirteen different formations of red and yellow lights indicating weather conditions and the number of islands in the vicinity.<sup>80</sup> The particular symbols used were, however, a cause of much discord between Hong Kong and Zikawei observatories, and also between the Customs and ships' navigators. In the late nineteenth and early twentieth centuries the two observatories advocated and used different storm signal codes, and Hong Kong, citing the confusion caused to mariners by this dual system, periodically urged Zikawei and the Customs to adopt the standard international code favoured by the observatory. Father Froc, incumbent of the Zikawei directorship 1884-1931, however, steadfastly refused, instead ardently expounding upon the superiority of the Zikawei code.<sup>81</sup> The Royal Observatory was the first to cave in, reluctantly agreeing, to Froc's satisfaction, to adopt the Zikawei storm signal code in 1920.<sup>82</sup> Froc continued to – rather jealously, it must be said – defend the Zikawei code against outside suggestions of improvements throughout the remainder of his years in China.<sup>83</sup>

Of course, neither the Hong Kong nor the Zikawei observatory directors had any control over the systems adopted by the various other organisations concerned with storm warning work and operating under the auspices of the Chinese government. The China Coast Guard Administration, for example, announced its intention to set up its own storm-warning system along the China coast in 1926. Unlike the Zikawei and Hong Kong systems, the signals used by their semaphores would be easily understood by those with no scientific knowledge or understanding of meteorology, thereby benefiting fishing fleets.<sup>84</sup> Nonetheless, Froc could be justly proud of Zikawei's

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<sup>80</sup> SHAC, 679(1) 761, 'Hydrographers, Naval Officials, Shipping, Merchants, Meteorological, etc.,' letters from Father Froc, Siccawei director, to Capt. Eldridge, Coast Inspector, 15 & 17 Jan 1920.

<sup>81</sup> See, for example, SHAC, 679(1) 761, 'Hydrographers, Naval Officials, Shipping, Merchants, Meteorological, etc.,' Father Froc, Siccawei, to Capt Eldridge, Coast Inspector, 3 Dec 1919.

<sup>82</sup> SHAC, 679(1) 761, 'Hydrographers, Naval Officials, Shipping, Merchants, Meteorological, etc.,' Father Froc, Siccawei, to Capt. Hillman, Coast Inspector, 16 April 1920.

<sup>83</sup> See, for example, Froc's protest against the adoption of the standardised international storm warning code suggested by the International Hydrographic Bureau in 1926. SHAC (1) 765, 'Hydrographers, Naval Officials, Shipping, Merchants, Meteorological, etc.,' Father Froc, Siccawei director, to Capt. Hillman, Coast Inspector, 26 Feb 1926.

<sup>84</sup> SHAC, 679(1) 3611, 'Dossier: Meteorology, 1923-34,' Capt. Hillman, Coast Inspector, to Father Chevalier, Siccawei, 25 March 1926.

achievements in setting up the storm-warning system in collaboration with the Customs. The semaphore service was the most immediate and the most practical result of the observatory's work and would not have been possible without the Customs' willingness to both collect and send meteorological observations and erect and man semaphores. Indeed, in Froc's estimation the role played by the Customs setting up an effective storm warning system was its crowning achievement when it came to meteorological matters. On leaving China in 1931, he claimed that:

It is thanks to them [Customs employees] that we have in China a meteorological system complete in every respect and functioning to the entire satisfaction of all. It is they who have erected those semaphores which repeat the signals the whole length of the coast from Newchwang to Swatow. It is they who have assisted to establish a code of signals which is destined little by little, it is my firm hope, to become universal for all countries in the world.<sup>85</sup>

While the long-term scientific value of Customs climate data was sometimes difficult to fathom for those not involved in meteorological work, its immense practical benefits – in aiding navigation and saving lives – were plainly visible in the storm warning service.

## **CUSTOMS VESSELS AND THEIR RECORDS**

In addition to the observations made at dedicated meteorological stations, the CMCS also generated a stream of meteorological data from a different source. Officers on board Customs vessels engaged in maintaining lights and aids to navigation, surveying, or anti-smuggling work along China's coast and rivers recorded meteorological observations several times daily in their ship's logbook. These observations were comprised of barometer and thermometer readings, wind direction and force, and sometimes a comment on the general state of the weather (see Appendix E for an example). When a vessel was stationary observations were made six times daily, and when on patrol readings were taken as often as every two hours. Although the logbooks of Customs vessels working on the rivers appear to be missing from the Customs Service Archive, approximately 1,170 deck logbooks belonging to

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<sup>85</sup> Banister, *Coastwise Lights of China*, p. 8.

ships operating on the coast have been preserved. These quarterly logbooks cover the period 1920-49, although complete runs are not available for most vessels. Customs ships were usually stationed and maintained at a 'home' port, using this as a base from which to conduct patrols or surveys of lights and aids to navigation in the surrounding area. In the south the base port would typically be Hong Kong, or occasionally Amoy (Xiamen); in eastern China the base port would be Shanghai; and in northern China the base port would typically be Chefoo (Yantai), or occasionally Weihai or Tsingtao (Qingdao). The ship's movements, and occasionally its longitude and latitude, were diligently recorded in the logbooks, thereby enabling us to see exactly when and where the observations were taken. Although no use was made of this material by the observatories at the time of the Foreign Inspectorate's existence, these logbooks are now the most important, and certainly the most complete, source of meteorological data surviving in the Customs Service Archive.

## CONCLUSION

Looking back on the development of Customs meteorological work in 1932, a Customs meteorological manual expounded upon the accomplishments of the service. 'The gathering of such an enormous amount of meteorological data... has not been fruitless,' the instruction book insisted. In particular, this work had 'enabled the scientists to extend the general knowledge of the natural laws governing changes in the atmospheric conditions and their effects in the Far East.'<sup>86</sup> Sixty years on from the inception of the meteorological service Hart's original dream of making a distinct contribution to scientific progress had been realised. Furthermore, even the Institute of Meteorology at Academia Sinica, the organisation at the head of the government's initiative to launch a state of the art meteorological service in the 1930s, acknowledged the debt it owed to the Customs. Writing to Customs Inspector General Frederick Maze in 1935, Zhu Kezhen declared that:

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<sup>86</sup> SHAC, 679(1) 21530, *Instructions concerning meteorological work*, second issue, IV Service Series, no. 27, 1932, p. 4.

In the past the Customs stations have always been a mainstay to the meteorological services in China. It indeed inspires admiration to think that so many of your stations have been making observations 4-8 times a day for twenty years, with practically no cost at all, to the treasurer of our government. This fact alone speaks greatly of the efficiency and economy of your administration.<sup>87</sup>

Whereas some may have doubted the utility of the project in its early years, by the 1930s its work had been vindicated. Just as Hart had hoped, the meteorological service, as with many other aspects of the Customs' work, had provided a successful model for other organisations to build upon or emulate.

But if the work was in one sense vindicated, it was also subject to political criticism and attack. Zhu's 1935 comment to Maze errs to the extent that there was indeed a cost to the government, as the Customs was a Chinese state agency, but it does not seem that Zhu saw the Service precisely in that light. His later writings and statements make it clear that the frustrations encountered during Institute of Meteorology's battle to assert a dominant position in meteorology in China were not forgotten. Zikawei, with its pretensions to national pre-eminence in China was the key target, but the work of the Customs was not differentiated from that of the Observatory with which it had worked so closely. And such issues as access to historic data records held by the Customs were revisited decades later – the Marine Department declined to hand over its sole copies of historic station observations in 1934, suggesting instead that it would have them transcribed if the Institute paid for this.<sup>88</sup> The entire meteorological system of the country served only Zikawei, Zhu claimed in 1951, and that served only Anglo-American shipping interests.<sup>89</sup> All of this foreign activity, Zhu later wrote, served only the economic interests of the foreign imperialist powers and their

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<sup>87</sup> SHAC, 679(1) 21364, 'General questions concerning meteorological observations, 1930-47,' Cochin Chu, Institute of Meteorology, National Research Institute, to Inspector General Maze, 9 April 1935.

<sup>88</sup> SHAC 679(1) 3611, 'Dossier: Meteorology, 1923-1934', Acting Coast Inspector Terry to IG Maze, 10 March 1934.

<sup>89</sup> The mostly French Jesuit scientists there would have rejected this latter charge, on the technical grounds that the Zikawei Observatory instead served France's 'mission civilatrice': Pyenson concluded that they 'served the geopolitical and military interests of France', *Civilizing Mission*, p. 336.

assault on China. It was not until 1949, he continued, and significantly not until the takeover of the Zikawei Observatory in December 1950, that the 'cultural aggression' of the imperialist powers on the meteorological front was terminated.<sup>90</sup> Meteorological research was considered vital to China's economic development, scientific development, and to its national defence. For a century it had seemed to serve foreign imperialism; from 1949 onwards it was instead to serve new China.

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<sup>90</sup> Zhu Kezhen, 'Zhongguo qixiang xuehui diyijie daibiao dahui kaimu ci' (Opening statement, first session of the general assembly of the Chinese Meteorological Society' (15 April 1951) and Zhu Kezhen, 'Zhongguo guoqu zai qixiang xue shang de chengjiu', (China's past achievements in meteorology' (1951), in *Zhu Kezhen quanji* (Complete works of Cohing Chu) v.3 (Shanghai: Shanghai keji jiao chubnshe, 2004), pp.56, 59-60. The language might fit the new times, but Zhu had consistently demonstrated his concern at the foreign colonisation of China's meteorological activity.