Scientific Textualizations of Tropical Cyclones in the Philippines: The Scientific Activities of the Observatorio Meteorológico de Manila (OMM) and Philippine Weather Bureau (PWB), 1860s-1940s

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Introduction: Philippine Tropical Cyclones and Typhoons as Subject of Historical Research

Meteorological observatories are concrete indicators of the bourgeoning modern atmospheric science in the nineteenth century. Meteorology played a role in advancing safer seafaring and lessening the losses during wreckage due to storms and typhoons in the seas. The relative success of several colonial societies in further expanding their presence on the high seas through modern shipping, faster communication through telegraphy, and the growing inter-island scientific knowledge exchange contributed to the creation of modern societies that served as a stepping stone of other political and economic expansion endeavours. These developments paved the way for the creation of a semi-invisible dynamic line of communication and knowledge production circulation network in the Pacific region. In his extensive studies about the work of the Jesuits on the development of tropical cyclone and typhoon prediction, Anduaga (2014, 2017, 2019, 2020a, 2022a, 2022b, 2022c) has illustrated the complex and dynamic conundrum of pioneering local scientific research initiatives, collaborative knowledge production, and regional and global knowledge network-building.[1]

[1] Aitor Anduaga, "Spanish Jesuits in the Philippines: Geophysical Research and Synergies between Science, Education and Trade, 1865-1898." *Annals of Science* 71, no. 4 (2014): 497-521; Aitor Anduaga, *Cyclones and Earthquakes: The Jesuits, Prediction, Trade, & Spanish Dominion in Cuba & the Philippines, 1850-1898* (Quezon City: Ateneo de Manila University Press, 2017); Aitor Anduaga, "History of Typhoon Science," *Oxford Encyclopedia of Climate Science* (26 April 2019)); Aitor Anduaga, "Los Jesuitas y el estudio de los tifones en Filipinas, 1865-1899" *Illes i Imperis* 22 (2020): 63-83; Aitor Anduaga, *Politics, Statistics and Weather Forecasting, 1840-1910: Taming the Weather* (London: Routledge, 2020b); Aitor Anduaga, "Epistemic Network: The Jesuits and Tropical Cyclone Prediction, 1860-1900." *Isis* 113(3): 513-536; Aitor Anduaga, "Red de Conocimiento: Los Jesuitas, las ciencias de Observatorio y su Evolución en España y Ultramar, 1855-1905," *Hispania*

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Coinciding and maximizing its contemporary technological developments such as inter-island telegraphic exchange and enhanced global shipping, the quantification of weather-related scientific work and centralization of knowledge transmission and dissemination enabled the robust growth of meteorology as a vital science for social and economic activities.[2] Moreover, the waves of scientific developments in the late nineteenth century facilitated the growth of formalized and localized sciences.[3] Global and local colonial dynamics suggested the invention of "colonial science" in the peripheral territories, in contrast to the usual structure of knowledge production wherein ideas originated from European countries and moved to their colonies. In the case of the Philippines, the Observatorio Meteorológico de Manila (OMM) and later, the Philippine Weather Bureau (PWB) served as the primary movers of the institutionalization of meteorology as a relevant and useful field of scientific endeavor in the Philippines from the late nineteenth to the early twentieth century.

In the past 20 years, studies in the field of environmental history have highlighted the critical appreciation of hazards and disasters as important events and turning points in Filipino society. For example, the perennial experience of the Philippine archipelago to tropical cyclones and typhoons has garnered more robust attention from historians, and studying them from a historical point of view serves as a springboard to a more diverse and expansive inquiry in environmental history, touching well-related fields such as institutional and intellectual history. A survey of select historical studies provides a picture of the current state-of-the-arts on the subject of historical tropical cyclones and typhoons. Scientific agencies and knowledge production in the Philippines from the late nineteenth to the early twentieth century saw a period of instrumentation, localized institutionalization, overseas network expansion, and "Filipinization."[4] These developments served as the historical backdrop in how scientific initiatives to understand a variety of atmospheric disturbances and phenomena. Two categories can be drawn from the historical studies on tropical cyclones and typhoons in the Philippines: (1) works dealing with the institutional activities and initiatives in meteorology, and (2) scholarly works that historicize tropical cyclone and typhoon experiences in the Philippine setting.

In the first category, in the case of studies on the nature and science of typhoons, the period had been dominated by the scientific efforts of the Jesuits in the Philippines and the institutional initiatives and networking they pursued. Anduaga (2011, 2014, 2017, 2020a, 2020b, 2022a, 2022b, 2022c) has set the historiographical landscape on the studies of Jesuit research on typhoons, their institutional activities, and their regional and global legacies as movers of meteorological research.[5] His work covers the nucleus of contemporary historical

Sacra 74 (2022): 231-246; Aitor Anduaga, "Transnational Co-production of Knowledge of Typhoon Warning Codes in the Far East, 1900-1039." *Minerva* 60 (2022): 301-323.

[2] Anduaga, *Politics, Statistics and Weather Forecasting, 1840–1910*, 3; Katharine Anderson, *Predicting the Weather: Victorians and the Science of Meteorology* (Chicago: The University of Chicago Press, 2005), 1–2.

[3] David Wade Chambers and Richard Gillespie, "Locality in the History of Science: Colonial Science, Technoscience, and the Indigenous Knowledge," *Osiris* 15 (Nature and Empire: Science and the Colonial Enterprise), 230.

[4] Alberto Elena and Javier Ordoñez, "Science, Technology, and the Spanish Colonial Experience in the Nineteenth Century," *Osiris* 15 (2020): 70-82; Warwick Anderson, "Science in the Philippines," *Philippine Studies* 55, no.3 (2000): 287-218; Jonathan Baldoza, "Under the Aegis of Science: The Philippine Scientific Community before the Second World War." *Philippine Studies: Historical and Ethnographic Viewpoints* 68, no.1 (2020): 81-110; Francisco Jayme Paolo Guiang, "The Development of Colonial Science and the Council under American Tutelage, 1933-1941." in *A History of the National Research Council of the Philippines: Research in the Life of the Nation*, ed. Francis A. Gealogo (Taguig: National Research Council of the Philippines, 2021): 7-32

[5] Aitor Anduaga, *Meteorológia, Ideología y Sociedad en la España Contemporánea* (Madrid: Consejo Superior de Investigaciones Científicas, 2011); Anduaga, "Spanish Jesuits in the Philippines,"; Anduaga, *Cyclones and Earthquakes*; Anduaga, "Los Jesuitas e el estudio de los tifones en Filipinas,"; Anduaga, *Politics, Statistics and Weather forecasting, 1840-*

literature on the subject matter. As a supplement to this historiographical observation, Alvarez (2016, 2024) adds that the scientific work of the Jesuits in the Philippines can be characterized as pioneering scientific activities that used novel instruments, the institutionalization of work, and external networking as primary framework to pursue their scientific and administrative objectives.[6] Moreover, the work of Udias (2019) also illustrates the aforementioned opinion as he presents a capsule discussion of the institutional history of Jesuit observatories and highlights the research, pedagogy, and worldwide network of observatories the order has established for two centuries.[7] Furthermore, Garcia-Herrera, et. al (2007) presents a "high-resolution chronology of typhoons and intense storms occurring in the Philippine Islands and their vicinity for the period 1566–1900," using the catalogue of Father Miguel P. Selga, former director of the Philippine Weather Bureau (1927-1941).[8] In the second category, there is also an expansive literature on the historical study of the political and socio-cultural impacts and meanings attributed to Philippine tropical cyclone and typhoon experiences. Bankoff (2003, 2004, 2006, 2007) has significantly contributed to shaping this approach to historical disasters in the Philippines.[9] Warren (2013, 2016) also ventured into the historical study of typhoons, underscoring the political economy of typhoon disasters.[10] In his recent work, Warren (2024) presents a comprehensive examination of "historicizing typhoons" in the Philippines, presenting it in a framework correlating institution-knowledge production, typhoon intensity, state responses, and contemporary issues related to typhoon disasters.[11]

Building on the mentioned past studies about typhoons in the Philippines, this work examines the scientific efforts of the OMM and PWB, analyzing their work and initiatives as forms of scientific textualizations on these storms. Drawing from Anduaga's (2014, 2020a, 2022a, 2022b, and 2022c)[12] studies on the work of the Jesuits on tropical cyclones and typhoons, this work attempts to supplement the historical literature about the subject and argues based on the mentioned approach. The scientific textualizations came in various forms: local data collection, the publication of scientific work, and external and regional scientific partnerships. From understanding their genesis, tracing their origins, and tracking their movements and impacts on human settlements, the OMM and the PWB spearheaded instrumentation and institutional efforts to produce knowledge about atmospheric disturbances

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1910; Anduaga, "Epistemic Network,"; Anduaga, "Red de Conocimiento,"; Anduaga, "Transnational Co-production of Knowledge."

[6] Kerby Alvarez, "Instrumentation and Institutionalization: Colonial Science and the Observatorio Meteorológico de Manila, 1865-1899," *Philippine Studies: Historical and Ethnographic Viewpoints* 64, nos. 3-4 (2016): 385-416; Kerby Alvarez, "A History of Institutional Meteorology in the Philippines, 1865-1972," *Oxford Research Encyclopedia of Climate Science* (17 April 2024), https://doi.org/10.1093/acrefore/9780190228620.013.942.

[7] Agustín Udías, "Jesuits and the Natural Sciences in Modern Times, 1814-2014," *Jesuit Studies* 1.3, 2019: 1-104.

[8] Ricardo García-Herrera, Pedro Ribera, Emiliano. Hernández, and Luis Gimeno, "Northwest Pacific Typhoons documented by the Philippine Jesuits, 1566–1900," *Journal of Geophysical Research* 112 (2007): 1-12. https://doi.org/10.1029/2006JD007370.

[9] Greg Bankoff, *Cultures of Disaster: Society and Natural in the Philippines* (London: RoutledgeCurzon, 2003); Greg Bankoff, "In The Eye of Storm: The Social Construction of the Forces of Nature and the Climatic and Seismic Construction of God in the Philippines," *Journal of Southeast Asian Studies* 35, no.1 (2004): 91-111; Greg Bankoff, "Winds of Colonization: The Meteorological Contours of Spain's Imperium in the Pacific, 1521-1898," *Environment and History* 12 (2006): 65-99; Greg Bankoff, "Bodies on the Beach: Domesticates and Disasters in the Spanish Philippines, 1750-1898," *Environment and History* 13(3), 2007: 285-306.

[10] James Francis Warren, "A Tale of Two Decades: Typhoons and Floods, Manila and the Provinces, and the Marcos Years," *The Asia Pacific Journal* 11.43 (3): 1-21; James Francis Warren, "Typhoons and the Inequalities of Philippine Society and History," *Philippine Studies: Historical and Ethnographic Viewpoints* 64, nos. 3-4 (2016): 455-472.

[11] James Francis Warren, *Typhoons: Climate, Society, and History in the Philippines* (Quezon City: Ateneo de Manila University Press, 2024).

[12] Anduaga, "Spanish Jesuits in the Philippines"; Anduaga, "Los Jesuitas e el estudio de los tifones en Filipinas"; Anduaga, "Epistemic Network"; Anduaga, "Red de Conocimiento"; Anduaga, "Transnational Co-production of Knowledge."

primarily affecting the Philippine archipelago and the larger Pacific region. The scientific work and activities of these institutions laid down the foundation of meteorological infrastructure in the Philippines in the late nineteenth and early twentieth centuries, and they became active, albeit controversial, scientific institutions in the region.

The Jesuits and their Research Work on Tropical Cyclones

The Establishment of the OMM and PWB

The introduction of institutional meteorology in the Philippines followed the return of the Jesuits in the Pacific from their banishment from the archipelago from 1768 to 1859. This signalled the propagation of new forms of scientific knowledge and the proliferation of a more public character of science, through the establishment of mission observatories and introduction of novel scientific instrument. The Jesuits' passion for atmospheric sciences, rooted in their engagement with progressive scientists and institutions in Europe, paved the way for new scientific advancements in the Philippines. The Philippine archipelagic environment served as a new ground for the Jesuits' application of their expertise in the natural sciences, specifically in meteorology. The mission's long-established scientific tradition is grounded in their advocacy of spiritual and scientific development through schools, universities, and observatories.[13] In his study on the Jesuit scholarly tradition, Harris (1989) transposes various ideas to present a significant overview: (1) Robert Merton's sociological postulate of societal pressure, (2) Rivka Feldhay's study of "Jesuit ideology" as the foundation of values and missionary work, and (3) the concept of "apostolic spirituality."[14] A critical reading of his work leads us to the understanding of the Jesuits' pursuit and the legitimation of scientific work as acts of pursuing their missionary work. In an earlier exegesis, Teilhard de Chardin (1968) considers their deep involvement in a multitude of scientific fields as the realization of their use of research to understand God's creations.[15] Harris (1989) further adds that it is contradictory to juxtapose "science" and "Jesuits," as the quest to "discern underlying patterns of coherence in the hope of finding how the pieces fit together" is profoundly embedded in their system.[16] In a more recent scholarly analyses, Anduaga (2022a, 2022b, 2022c) has given historical emphasis on the significance of the established knowledge networks on meteorology resulting from the proactive research enterprise of the Jesuits.[17]

In January 1865, a small, make-shift observation facility was built in one of the buildings of the *Ateneo Municipal de Manila* and was devoted to daily weather observations and data collection. It ran for months doing the routine task of observation and documentation, until a typhoon passed by Manila in September 1865. The Jesuits supervising the laboratory, José Colina and Jaime Nonell, decided to work with the information they had collected about the typhoon and publish a study in one of Manila's dailies, the *Diario de Manila*.[18] The report

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[13] Agustín Udías, "Jesuits' contribution to meteorology," *Bulletin of American Meteorological Society* 77, no. 10 (1996), 2308.; Anduaga, "Spanish Jesuits", 505–6.

[14] Steven Harris, "Transposing the Merton thesis: Apostolic spirituality and the establishment of Jesuit scientific tradition,' *Science in Context* 3, no. 1 (2008): 29–32.

[15] Pierre Teilhard de Chardin, 'The religious value of research,' in *Science and Christ*, trans. Rene Hague (New York: Harper & Row, Publishers, 1968), 201.

[16] Steven Harris, "Confession-Building, Long-Distance Networks, and the Organization of Jesuit Science," *Early Science and Medicine* 1, no. 3 (1996), 289.

[17] Anduaga, "Epistemic Network,"; Anduaga, "Red de Conocimiento,"; Anduaga, "Transnational Co-production of Knowledge."

[18] John Schumacher, "One Hundred Years of Jesuit Scientists: The Manila Observatory 1865–1965," *Philippine Studies* 13, no. 2 (1965), 259.

captured the attention of some of Manila's residents. Merchants and seafarers asked the Jesuit Superior, Father Juan Vidal, to instruct the Jesuits in Manila to continue taking weather observations and provide them with additional ideas about typhoons, as well as typhoon warnings. The Jesuit leadership in the Philippines responded positively to the merchants' request, and, in return, the merchants offered financial aid to purchase new and better instruments from abroad. Schumacher (1965) considers this work of the Manila Jesuits to have been "an immense humanitarian service to the Philippines."[19] From then on, the laboratory became known as the OMM. In 1866, Federico Faura, a Jesuit scholastic, arrived in Manila to head the work of the weather observation facility in the Ateneo.[20] He led the facility for five years, before returning to Spain to complete his priesthood education, as well as to familiarize himself with the methods employed by European weather observatories.[21] Under Faura's directorship, the OMM conducted weather observation and daily documentation mostly centered in the vicinity of the city of Manila, which gradually revealed its potential to support Manila's maritime and trading sectors. The OMM's emerging public engagement resulted in the realization of the Spanish colonial state's aim to make it part of the government structure. In 1880, the colonial government formed a commission composed of the various Spanish civil departments, the Spanish Navy in the Philippines, the Spanish government-controlled telegraph company, and the Jesuits to draft a proposal to transform the OMM into a state meteorological service (servicio meteorológico).[22] After years of the gruelling bureaucracy of the Overseas Ministry in Madrid, the colonial government in Manila succeeded in its plan. In 1884, King Alfonso XII issued a royal decree declaring the OMM as the official meteorological service of the colony and directing the colonial government to place it under direct administrative management and appropriate funds for its expansion.[23]

The Jesuits' centuries-long network of mission activities made them efficient facilitators of inter-institutional scientific communication and engagements. A great example of this was their network of observatories studying tropical disturbances in various parts of the world: Belen in Cuba, Tananarive in Zimbabwe, Zikawei in China, and Manila in the Philippines.[24] The Jesuits' objectives in pursuing this network fall into two categories: (1) to institutionalize their passions in meteorology and astronomy, and (2) to study the nature and tracks of *huracanes* (hurricanes) in the Caribbean and *tifones* (typhoons) in the Pacific.[25] In Europe and the Antilles, Fathers Angelo Secchi, Stephen Perry, and Benito Viñes were among the Jesuit scientists who specialized in the invention of new meteorological instruments. The existence of the Jesuits' mission networks in different parts of the globe enabled the circulation not only of theological activities but also of their scientific studies, communications, and instrument familiarity. On the Pacific side, the Jesuits in Manila brought in the archipelago instruments invented and used by their European and Caribbean colleagues. The bulk of the money they received from private donors was used to purchase instruments from Europe, such as Secchi's invention, the universal meteorograph. The Jesuits in the OMM, though initially reliant on European inventions, also made instruments designed to measure precisely

[19] Ibid.

[20] William Repetti, *The Manila Observatory, Manila, Philippines*, 2.

[21] Repetti, *The Manila Observatory*, 13; Schumacher, "One Hundred Years of Jesuit Scientists," 259.

[22] Saderra Masó, *Historia del Observatorio de Manila*, 74.

[23] "Establecimiento y organización de un servicio meteorológico en las Islas Filipinas,"' Ultramar, 603, Expediente 14, 1890/1897, Archivo Histórico Nacional (AHN), Madrid, Spain; Saderra Masó, *Historia del Observatorio de Manila*, 79–81.

[24] Udías, "Jesuits' contribution to meteorology," 2309.

[25] Miguel Saderra Masó, *Historia del Observatorio de Manila, fundado y dirigido por los Padres de la Misión de la Compañía de Jesús de Filipinas, 1865–1915* (Manila: E. C. McCullough, 1915), 24.

meteorological conditions and disturbances in the Philippine archipelago. The traditional framework of colonial science, wherein the periphery frequently plays the role of the receiver of development from the metropole[26] was not wholly applicable in the case of the Jesuits and the OMM in Manila. For example, they collected and published weather data in newspapers in Manila; and they wrote scientific reports about certain atmospheric disturbances such as tropical cyclones, and these were used and cited by European travellers in their respective scientific memoirs and travel accounts. This knowledge production aligns with another colonial science framework wherein formalized and localized sciences cemented the dual approach of scientific development in the colonies, as well as the fulfillment of the colonial vision of integrating the colonized peoples into the institutions of modernity.[27]

The OMM's work on weather forecasting and public advisories expanded in the latter part of the 1860s and continued until the 1880s due to the influx of financial support from businesses who are into inter-island shipping and foreign commercial trading, owned by Spanish and Chinese *mestizos*, and European and American entrepreneurs.[28] As Anduaga (2014) argues, this was the "exogenous commercial element"[29] of the mutual relationship between the OMM and the commercial sector. On the one side, the OMM provided weather forecasts, and on the other, businesses gave financial donations that were used for the maintenance and improvement of facilities of the OMM.[30] The OMM relied heavily on donations to purchase instruments from abroad. For example, donations received after the OMM's first typhoon warnings of 1865 were used to purchase instruments such as the Secchi's meteorógrafo universal, which enabled the continuous recording of meteorological observations.[31] In 1877, 88 wealthy families and businesses contributed to the construction of a new building in the Ermita district of Manila, outside the walled city of Intramuros (Fig. 1).[32] Aside from direct monetary donations, the OMM also received funds from newspaper companies that published their daily weather reports, since their sales increased due to the subscriptions made by individuals and companies who wanted to receive weather information. The OMM not only attracted the attention of Manila's business sector, it also gained popularity among international shipping and trading companies and diplomatic officials because of its work in regional weather monitoring and forecasting, as well as the studies it produced about the typhoons in the China Sea and the western Pacific. As a reflection of their commitment to the shipping and trading sectors, the Jesuits of the OMM launched them to markets in the Philippines and abroad, like in Europe and Hong Kong. In January 1886, Father Faura presented to the scientific community in the Philippines and Spain his version of an aneroid barometer, contextualized in the Philippine archipelagic setting (Fig. 2).[33] Four years later, it was widely sought after by merchants, traders, collectors, and wealthy people.[34] Local merchants were able to buy this device, which they used at ports, or while at the sea; but some

[26] George Basalla, "The spread of Western Science." *Science* 156, no. 3775 (05 May 1967), 613.

[27] Chambers and Gillespie, "Locality in the history of science," 230; Robert Peckham, "Disease and Medicine," in John M. MacKenzie (ed.) *The Encyclopedia of Empire* (John Wiley and Sons, 2016), 7.

[28] Anduaga, "Spanish Jesuits in the Philippines," 504–5.

[29] Ibid., p. 503.

[30] Repetti, *The Manila Observatory*, 1; Schumacher, "One Hundred Years of Jesuit Scientists," 259; Saderra Masó, *Historia del Observatorio de Manila*, 27.

[31] Ibid.

[32] Schumacher, "One Hundred Years of Jesuit Scientists," 261; Saderra Masó, *Historia del Observatorio de Manila*, 170–71.

[33] Federico Faura, *El barómetro aneroide aplicado a la previsión del tiempo en el Archipiélago filipino (*Manila: Imprenta y Litografía de M. Perez, 1886); Saderra Masó, *Historia del Observatorio de Manila*, 96.

[34] Saderra Masó, *Historia del Observatorio de Manila*, 96.

wealthy families used them as house displays. In late 1897, Father José Algué'[35] marketed his invention, the barocyclonometer, an attempt to combine the properties of Father Faura's aneroid barometer and Father Benito Viñes' cyclonoscope (1888), an invention made to detect Caribbean cyclonic movements (Fig. 2).[36]

Fig. 1. The main building of the OMM from the 1880s up to its destruction in the Battle of Manila in February 1945. Image courtesy of the Manila Observatory Library and Archives Website: http://archives.observatory.ph/files/photos/1-Prewar/1_01.jpg

Algué's invention was initially discussed in his 1895 work *Baguios ó Tifones del 1894: Estudio de los mismos seguido de algunas consideraciones generals acerca de los caracteres de estos meteorós en el Extremo Oriente*.[37] The institutional seals of the OMM (from 1865 to 1901) and the PWB (from 1901 to 1945) were based on various types of weather barometers, a Torricelli mercury barometer, and an aneroid barometer (Fig. 3). Although the OMM benefitted from the said revenue streams, it also received financial support from the Spanish colonial government in Manila, especially for large projects, such as the establishment of secondary stations. In 1887, the colonial government laid out a plan for a network comprising a central station and 13 secondary stations scattered in key geographical posts on the island of Luzon. Once built,

[35] José Algué was a Spanish Jesuit who became a member of the Society of Jesus in 1871. He studied theology in France, and later, mathematics and astronomy at Georgetown University, under the supervision of Father John Hagen. He was a constant companion of Father Faura on their research trips abroad and led various scientific missions in the Mindanao region. He served as the Assistant Director of the OMM from 1894 to 1897, then as the Director from 1897 to 1927 (from 1901 to 1927 as the Director of the PWB). His first years as Director were some of the most crucial years – the Philippine Revolution (1896-1898), the Spanish-American War (1898), and the Filipino-American War (1899-1902). He retired from his post in 1927, leading the OMM in its transition from being a Spanish colonial state agency to an expanded weather bureau under the US Insular Government in the Philippines. See Ángel Hidalgo, *El P. José Algué, S.J.: Científico, inventor y pacifista (1856-1930)* (Manila: Observatorio de Manila, 1974).

[36] "Aneroid barometer applied to the prediction of the weather in the Philippine archipelago," *Report of the Philippine Commission to the President, Part 4* (Washington: Government Printing Office, 1901), pp. 328–32; Benito Viñes, "The Antilles Cyclonoscope," trans. Isabella Owen, *Weatherwise* 42, no. 5 (1989), 258–61.

[37] José Algué, *Baguios ó Tifones de 1894: Estudio de los mismos seguido de algunas consideraciones generales acerca de los caracteres de estos meteorós en el Extremo Oriente* (Manila: Imprenta Litografía Partier, 1895), 173-183.

these stations were tasked to send daily, weekly, and monthly reports to the central station in Manila.[38]

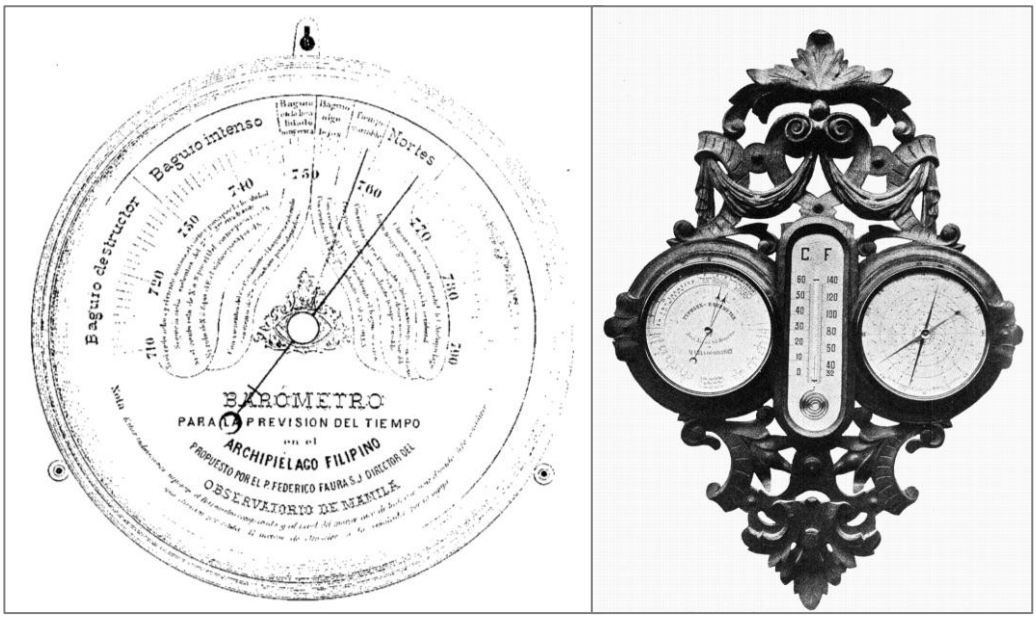

Fig. 2. Left, Faura's aneroid barometer (1886); [39] right, Algué's barocyclonometer (1897).[40]

The US annexation of the Philippines in 1898 changed the dynamics of colonial politics in the Pacific region. As a new player, the United States had to position and project itself as a reputable military power. Their victory in the Spanish-American War (May–December 1898) forced the US to lay out ambitious plans on how to systematically control their newly acquired territory. Taking over the OMM was a strategic war decision for the United States. The American forces that arrived in the Philippines in May 1898 were not sufficiently familiar with the terrain and seas of the Philippines. They needed to secure control of vital geographic positions to carry out the military plans to pacify the islands. This is where they needed the collaboration of the Jesuit scientists and the crucial functions the OMM could provide. The US Army tapped the OMM's scientists to provide them with vital naval and geographic information about the Philippines, such as the country's topography, weather, and climatic conditions of the islands, as well as the maritime outposts of the Spanish government. They also requested that Father Algué, the OMM's director, continue the scientific work and service despite the military presence in the area. At this stage, they informed him of the US government's interest in taking over the OMM and explicitly asked the Jesuits to continue running it.[41] The US government, after their acquisition of the Philippines from Spain, framed their political and economic projects in the islands under the guise of a benevolent and civilizing mission to reform the structure of governance, introduce public education and health

[38] Saderra Masó, *Historia del Observatorio de Manila*, 74–81.

[39] Faura, *El barómetro aneroide.*

[40] Saderra Masó, *Historia del Observatorio de Manila*, Figura 161.

[41] Schumacher, "One Hundred Years of Jesuit Scientists," p. 267; James Francis Warren, "Scientific Superman: Father José Algué, Jesuit meteorology, and the Philippines under American rule, 1897–1924," in *Colonial Crucible: Empire in the Making of Modern American State*, Alfred McCoy and Francisco Scarano, eds. (Madison, Wisconsin: The University of Wisconsin Press, 2009), 508.

systems, and Westernize the Filipino culture.[42] Through the Philippine Commission Act No. 131, the US Insular Government reorganized the OMM and expanded its work under a new name: the Philippine Weather Bureau (PWB).[43] The PWB acquired instruments from the United States and established additional stations as soon as areas were selected, surveyed, and secured. Rain stations were also established in different positions around the archipelago to function specifically as facilities measuring and documenting rainfall.[44] Importantly, American Jesuits arrived to work at the PWB and became part of the bureau's scientific staff.[45] By employing American Jesuits, the US Insular Government in the Philippines maximized their scientific expertise while lessening the presence of Spanish scientific personnel in the bureau. The US Insular Government prioritized the expansion of the PWB's presence throughout the Philippine archipelago. From 1884-1887, the OMM network of stations consisted of one central station in Manila and 13 secondary stations all on the island of Luzon. From the reorganization of PWB in 1901 up to 1915, secondary and rain stations numbered 52.[46] I argue that this institutional expansion resulted in the OMM being a dynamic scientific agency in terms of weather data collection in the Pacific region.

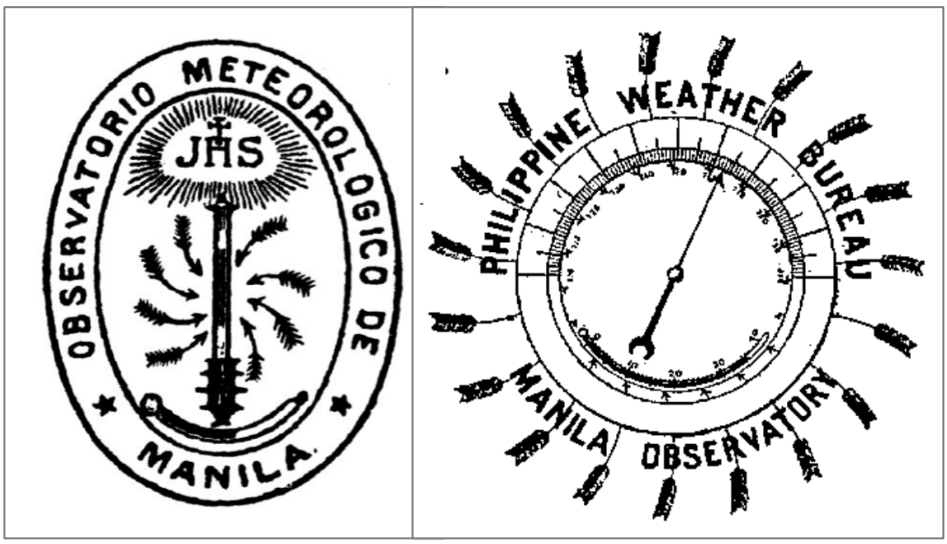

Fig. 3. The Seals of the OMM (1865-1901) and the PWB (1901-1945)

[42] Paul Kramer, *The Blood of Government: Race, Empire, the United States, and the Philippines* (Quezon City: Ateneo de Manila University Press, 2006); Victor Roman Mendoza, *Metroimperial Intimacies: Fantasy, Racial-Sexual Governance, and the Philippines in U.S. Imperialism, 1899–1913* (Quezon City: University of the Philippines Press, 2002); Kristine Hoganson, *Fighting for American Manhood: How Gender Politics Provoked the Spanish-American and Philippine-American Wars* (New Haven: Yale University Press, 1998).

[43] "Philippine Commission Act No. 131," in *Annual reports of the war department for the fiscal year ended June 30, 1901, Published Laws and Resolutions of the Philippine Commission* (Washington: Government Printing Office, 1901), 276–79; Philippine Weather Bureau, *Weather Bureau Centennial, 1865–1965* (Quezon City: Philippine Weather Bureau 1966), 7. Some of the provisions of the law are the following: (1) a budget allotment to purchase new instruments, (2) sending weather reports and storm warning signals to port authorities, insular government officials, and local administrators of cities and towns, and (3) sending storm warnings to China, Formosa, and Japan.

[44] *Report of the United States Philippine Commission to the Secretary of War for the period from December 1, 1900 to October 15, 1901* (Washington: Government Printing Office, 1901), 51.

[45] Warren, "Jose Algué: Scientific Superman," 509.

[46] *Annual reports of the War Department for the fiscal year ended June 30, 1905*; *Volume IX: Report of the Philippine Commission; Part 2 and Volume X: Acts of the Philippine Commission (Nos. 1408-1538, inclusive), and public resolutions, etc., from October 19, 1905 to September 15, 1906* (Washington: Government Printing Office. 1906), 400

Scientific Studies on Tropical Cyclones and Typhoons

Since the establishment of the OMM in the late 1860s, the Jesuit scientists treated the Philippine cyclones (*ciclones*) and typhoons (*tifones* or *baguio [bagyo in Philippine local languages])* that regularly hit the archipelago as a subject of scientific inquiry. The OMM's research initiatives and publications starting from the 1860s until the end of the nineteenth century reflect the dual-pronged approach of harnessing information from the local Philippine environment and the broader Pacific region. Anduaga (2014) argues that in 1880, 15 years after its establishment, the OMM made typhoon research its principal task.[47] For decades, the OMM made and published notable works on the history, origin, nature, and movement of typhoons in the Philippines and the Pacific seas. Fathers Faura and Algué teamed up and produced several publications on cyclones and typhoons. Faura's *Señales Precursoras* contains information about cyclones and typhoons, recent studies about them, and precautionary measures in situations of cyclonic landfall, one of the first compilations of research and observation notes about tropical cyclones in the Philippines.

The local scientific studies on tropical cyclones and typhoons, aimed at identifying the nature and unique character of these Philippine atmospheric experiences, blossomed the location of the country in global knowledge production on atmospheric cyclones. Indeed, the OMM and the PWB were active institutions in the region and had consistently produced notable publications on the subject. Father Miguel Selga, a Jesuit meteorologist and former director of the Philippine Weather Bureau from 1927 to 1941, extensively studied the nature of Philippine cyclonic phenomena, specifically typhoons. In one of his studies, he describes a Philippine typhoon as:

> [A] storm or vast system of violent winds rotating counterclockwise around a center of calm. Abundant rain accompanies the storm. The center itself has a relatively leisurely forward motion. This combination of motions has caused the stunned observer to speak with awe of a storm that turned around and came back. Typhoons are born in the Pacific, east of the Philippines. They then follow a curving almost parabolic path that in general cuts across the Philippines into the coastal regions of China and/or Japan.[48]

To understand Philippine cyclones, the geographic character of the typhoons in the archipelago needs to be emphasized. Selga adds, "…by the term Philippine typhoon is meant one whose influence was felt in the Philippines. Though a typhoon lasts many days, a single date is given most times..." [49] Known respectively by Filipinos and Spaniards in the Philippines as *bagyo or baguio,* by the Portuguese in India and China as *tifones,* and as *huracanes* in Spain, the origin and the etymology of the words are indicative of its presence, regularity, and severity of tropical cyclones and typhoons in the various regions.[50] Alternatively, the idea that typhoons have also social and cultural identifications needs to be recognized. Historically, people consider typhoons as devastating events, taking lives or inflicting harm to people, and causing destruction of property. Using this point of view, we can see how people from a certain period of time have known or identified a typhoon as a social or cultural phenomenon. Thus, in such a manner, nature-driven events became more historical if they have been considered hazardous or have caused disaster to human populations or settlements. Typhoons do not only sink ships

[47] Anduaga, "Spanish Jesuits in the Philippines, 504.

[48] Miguel Selga, "Catalogue of Philippine Typhoons: 414-1703," edited by Victor Badillo, *Philippine Studies* 20, no. 1 (1972), 12-13.

[49] Ibid.

[50] Bankoff, "Winds of Colonization," 66.

and disrupt economic activities but, by their very frequency and intensity, influence societies and even shape peoples' cultures.[51]

In scientific studies, newspaper reports, and literary materials, a lot of names or labels have been commonly used to describe this particular natural hazard. The terms *tifón*, *baguio*, *huracán*, and *ciclón* appear in a lot of documents. According to their respective historical analyses of the epistemology of these terms, both Selga and anthropologist Henry Otley Beyer concluded that they have distinct origins, even though they were used interchangeably. Selga explains that *ciclón* is of Indian origin, referring to tropical cyclones formed in the Bay of Bengal and striking the coasts of India and Bangladesh,[52] while *huracán* has its roots in the Caribbean, named after *Hunrakan*, the Mayan Indian god of big winds.[53] Meanwhile, storms that normally hit the coasts of the Philippines, China, and Japan are commonly called *tifón* or *baguio*.[54] His fellow Jesuit meteorologist, Father Algué, argues that *tifón* was derived from the Chinese *taifung; fung* means wind while *tai* refers to extreme character, one that changes direction.[55] Beyer further explains the Chinese origin of the term *tifón*. Using several accounts, like that of a Chinese-Buddhist pilgrim named Fa-hien (414 BCE) about his exploration of Palawan-Sumatra-Java area, several terms existed, almost all referring to typhoons as "great wind": tai-fung, *ta-fung*, *ta-feng*, and *dai-fu.*[56] A typhoon's character as a "great wind", as well as being a "black wind", and having "violent rain," can also be observed in the written accounts of Chinese travellers and chroniclers, such as *Ling-wai-tai-ta* (Report from the Region beyond the Mountains) by Chou Ku-fei (1178 CE), *Chu-fan-chi* (Description of the Barbarous Peoples) by Chau Ju-kua (1225 CE), and *Ling-piau-lu-I* by Liu Sun (618-906 CE).[57] Given this, we can see that the label *tai-fung/tifón*/typhoon emerged as a hazard experienced on the western coast of the Philippines, and southern seas of mainland China.[58] The Spaniards during their initial interactions with indigenous Filipinos in the late 16th century observed the latter's use of *bagyo* to designate strong winds, probably derived from the Sanskrit *vayu* which corresponds to wind.[59]

The quantity of OMM's and PWB's research initiatives and publications from the 1880s to the 1910s also reflects the two-pronged approach of collecting information from the Philippine local environment and the broader Pacific region. From 1880 to 1914, the OMM and the PWB published 70 research works: 15 during the last years of the Spanish era (1880-1898), and 55 during the early years of US rule (1899-1914). In the more than five decades from the 1880s, the OMM published 39 notable works on the nature and history of tropical cyclones and typhoons in the Philippines and its nearby regions, and related studies such as on instruments and codified scientific manuals, thousands of volumes of meteorological data, in the form of daily, monthly, and annual reports, as well as republished and translated works that were made available from in the 1920s and 1930s (Fig. 4).

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[51] Ibid.

[52] Ibid.

[53] Bankoff, "Winds of Colonization," 66.; I. R. Tannehill, *The Hurricane Hunters* (New York: Dodd, Mead and Co., 1957), 7.

[54] Selga, "Catalogue of Philippine Typhoons: 414-1703," 12-13.

[55] Algué, *The Cyclones of the Far East*, p. 11.

[56] *Letter from H. Otley Beyer dated 16 April 1924*, SELS3.1 023, Selga Correspondences, Institutional Data Records, Manila Observatory Library and Archives.

[57] Selga, Catalogue of Philippine Typhoons: 414-1703," 7-9.

[58] Ibid., 10.

[59] J. R. Francisco, *Indian Influences in the Philippines* (Diliman, QC: University of the Philippines, 1964), 40.

Year	Title	Author
1882	*Señales Precursoras de temporal en el Archipiélago Filipino*	F. Faura
1882	*Los Ciclones del 20 de Octubre y 5 de Noviembre de 1882*	F. Faura
1886	*El Barómetro Aneroide aplicado a la prevision del tiempo en el Archipiélago Filipino*	F. Faura
1895	*Baguios ó Tifones del 1894: Estudio de los mismos seguido de algunas consideraciones generales acerca de los caracteres de estos meteorós en el Extremo Oriente*	J. Algué
1895	*El Baguio de "Gravina"*	J. Algué
1897	*Baguios ó Ciclones Filipinos: Estudio teórico-práctico*	J. Algué
1897	*El barociclonometro*	J. Algué
1898	*El Baguio de Samar y Leyte, 12 y 13 de Octubre de 1897*	J. Algué
1899	*The Barocyclonometer*	J. Algué
1899	*Tifones de Archipiélago Filipino y mares circumvecinos*	J. Doyle
1900	*El Baguio del 9 de Setiembre de 1900*	J. Coronas
1904	*The Cyclones of the Far East*	J. Algué
1905	*El Barometro aplicado a la prevision del Tiempo en el Archipiélago Filipino*	M. Saderra Mata
1906	*The Hong Kong Typhoon, September 18, 1906*	J. Algué
1906	*El Baguio de "Cantabria"*	M. Saderra Mata
1908	*The Typhoons of 1908*	J. Coronas
1909	*Typhoon-Warning Code of the Manila Observatory*	J. Coronas
1909	*The Hongkong Typhoon, July 27 and 28, 1908*	J. Coronas
1909	*The "Tarlac" Typhoon, September 18 to 27, 1908*	J. Coronas
1909	*The Typhoon of May 23 to 31, 1908*	J. Coronas
1909	*The Typhoons of 1909*	J. Coronas
1909	*Three Typhoons in Luzon, October 4 to 13, 1908*	J. Coronas
1910	*The Typhoons of October, 1909*	J. Coronas
1911	*The Typhoon of the Batanes Islands and Southern Formosa, August 21 to 29, 1911*	J. Coronas
1911	*The Typhoons of 1910 and 1911*	J. Coronas
1913	*The Barocyclonometer for use in the North Atlantic*	J. Algué
1913	*The Typhoons of October, 1912*	J. Coronas
1930	*Primer Catálogo de Baguios Filipinos*	M. Selga
1931	*Typhoons of August 1931*	M. Selga
1931	*The Typhoon of Visayas, December 5-6, 1931*	M. Selga
1932	*The Typhoons of Jolo-Indo-China, April 29-May 5, 1932*	M. Selga
1935	*Charts of Remarkable typhoons in the Philippines, 1902-1934*	M. Selga

1935	*Catalogue of Philippine Typhoons, 1848-1935*	M. Selga
1936	*Outlines of Philippines Frontology*	C. Deppermann
1937	*Are There Warm Sectors in Philippine Typhoons?*	C. Deppermann
1937	*Wind and Rainfall Distribution in Selected Philippine Typhoons*	C. Deppermann
1939	*Some Characteristics of Philippine Typhoons*	C. Deppermann
1939	*Typhoons and Depressions originating to the Near East of the Philippines*	C. Deppermann
1945	*Typhoons Originating in the China Sea*	C. Deppermann

Fig. 4. Scientific Studies made by the OMM and PWB on Philippine Typhoons (1882-1945) [60]

In *Baguios ó Ciclones Filipinos* (1897), Father Algué further emphasized the important geographic and localized character of tropical cyclones and typhoons that pass by the archipelago, arguing that approaching the matter through this would enhance the Spanish colonial government's mechanisms and responses in making towns and communities safer from tropical cyclones and typhoons.[61] In 1904, an updated, English version of this book, titled *The Cyclones of the Far East* (1904)[62] was published under the auspices of the US Insular Government in the Philippines, and supported by the US Coast and Geodetic Survey. The book is divided into two parts: the first deals with the Jesuits' theories about the occurrences of Philippine cyclones and typhoons in the Pacific, and the second details the indicators related to these cyclonic phenomena, with a brief discussion of Father Algué's invention, the barocyclonometer.[63] In September 1900, the American military government in the Philippines sent the officials and personnel of the OMM to a meteorological congress that was part of the 1900 Universal Exposition in Paris, France. Father Algué presented the OMM's work and publications during this meeting, including the two-volume geographical, meteorological, and climatological report *El Archipiélago Filipino*, the cartographic volume *Atlas de Filipinas* (1899), a report on the 1897 Luzon earthquake, and his barocyclonometer (see Fig. 5 for Algué's publications).[64]

In the 1930s, Father Selga published catalogues of Philippine tropical cyclones and typhoons, namely *Primer catálogo de baguios Filipinos* (1930), *Charts of Remarkable Typhoons in the Philippines, 1902-1934* (1935), and *Catalogue of Philippine Typhoons, 1848-1934* (1935), which Anduaga (2014) characterizes as a complete picture of the typhoon experience in Southeast Asia.[65] The third one is a descriptive listing of the recorded meteorological disturbances from the earliest one in the 5th century up to the 18th century. These catalogues are based on his survey of foreign accounts about Philippine tropical cyclones and typhoons, mostly based on Chinese, Indian, and Arab chronicles, and Jesuit and Spanish

[60] Titles of these materials are based on the lists and collections found in: Saderra Masó, *Historia del Observatorio de Manila*, pp. 196-200; Manila Observatory Library and Archives Website <archives.observatory.ph>; University of Michigan Digital Collections; University of Michigan Special Collections Research Center (UM-SCRC); Postal de Archivos Españoles (PARES); and the Biblioteva Nacional de España-Biblioteca Digital Hispánica (BNE-BDH).

[61] Algué, *Baguios ó Ciclones Filipinos*, iv-v.

[62] José Algué, *The Cyclones of the Far East* Second (Revised) Edition (Manila: Bureau of Printing, 1904).

[63] "Report of the Director of the Philippine Weather Bureau", Appendix G of the *Report of the Secretary of Interior, September 1, 1903 – August 31, 1904* (Washington: Government Printing Office, 1904), p. 543; Algué, *The Cyclones of the Far East*.

[64] Saderra Masó, *Historia del Observatorio de Manila*, 141–42; *Barocyclonometer: New edition prepared by the Manila Observatory and published by La Estrella Norte* (Manila: UST Press, 1937).

[65] Anduaga, "Spanish Jesuits," 511.

government reports. In 1972, an updated English version of the work was published, edited by a Filipino Jesuit historian at the Ateneo de Manila University, Victor L. Badillo.[66]

After the OMM's reorganization as the PWB in 1901, the expanded work on tropical cyclone and typhoon studies was evident in its official reports and bulletins. From 1902 to 1940, it produced hundreds of maps that illustrate the tracks of tropical depressions, and tropical cyclones and typhoons in the Philippine and Pacific atmospheric areas. These track maps show the regularity and approximate locations of cyclonic movements in the Philippine archipelago's vicinity. Based on the available records from the Manila Observatory Library and Archives (MOLA), there were 213 maps showing the approximate tropical cyclones and typhoon paths and tracks.

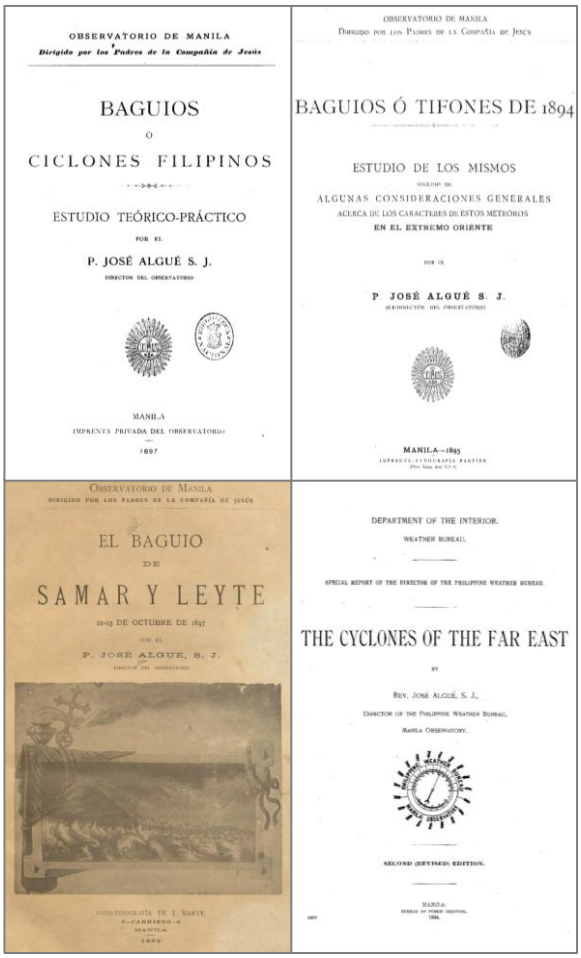

Fig. 5. Published Studies on Philippine Tropical Cyclones and Typhoons authored by José Algué, 1895-1904. Upper Left: *Baguios ó Tifones de 1894* (1895); upper right: *Baguios ó Ciclones Filipinos: Estudio teórico-práctico* (1897); lower left: *El Baguio de Samar y Leyte, 12-13 Octubre de 1897* (1898); lower right: *The Cyclones of the Far East* (1904).

The information indicated in the maps corroborates Bankoff's (2003) observation that, based on the annual US Insular Government reports, the period from 1880-1930 saw an increase in the number of recorded and documented tropical cyclones and typhoons in the

[66] Miguel Selga, "Catalogue of Philippine Typhoons: 414-1703."

Philippines.[67] Moreover, the maps also present a picture of approximated tropical cyclone and typhoon movements in the greater Pacific region (Fig. 6). Aside from maps that focus on the Philippines, the PWB also made reports about typhoons that hit other parts of the Pacific, as well as summaries of storms that passed through the region in specific periods (Fig. 7). Examples of these are the Cantabria Cyclone of 22-28 September 1905, the Four Typhoons of September 1907, the Yap Typhoon of 17 December 1920, the Naha Typhoon of 23-25 August 1931, and the summary map of cyclones from 1901-1920.

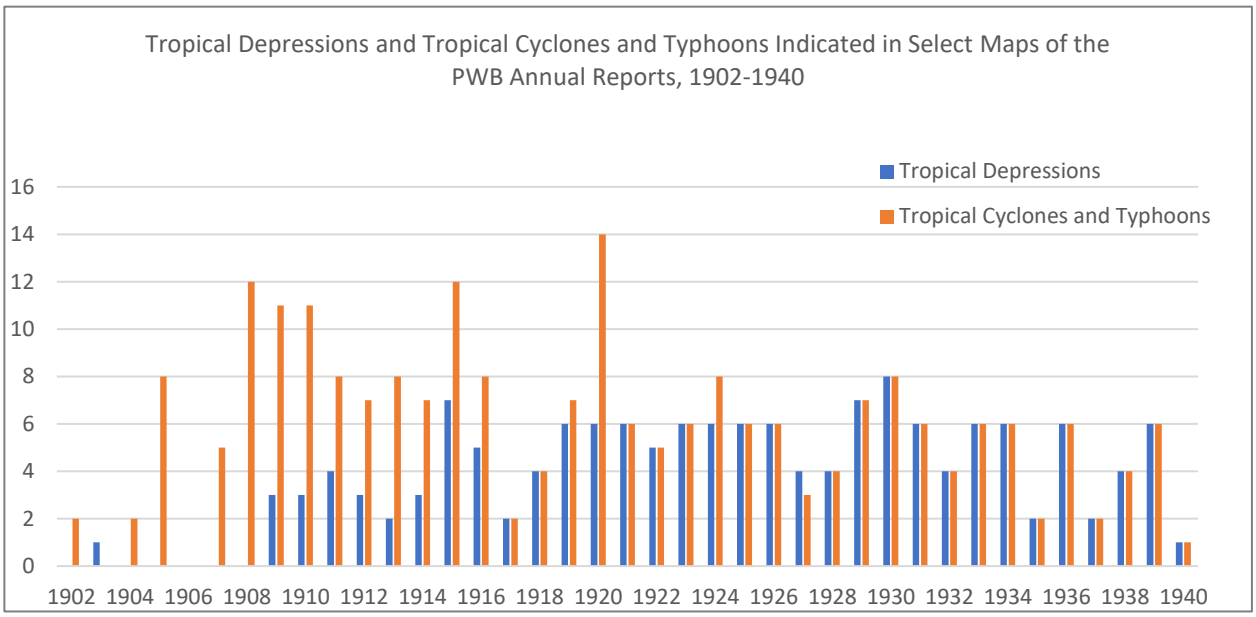

Fig. 6. Tropical Depressions and Tropical Cyclones and Typhoons Indicated in Select Maps of the PWB Annual Reports, 1902-1940.[68]

Regional Scientific Knowledge Networks on Tropical Cyclones and Typhoons

As the studies made by Legarda (1999) and Fast and Richardson (1987) emphasize, the nineteenth-century Philippine political and economic situation was highly dependent on external domains and affairs and was controlled by Anglo-American institutions, in particular, trading houses who were dominant in external trade and influenced local agricultural production.[69] Aside from this fact, natural hazards pushed colonial administrations to act on the worsening domestic agricultural situation in the archipelago. To halt the losses in agriculture, trade, and commerce, governments and private sectors of different colonial territories ventured into supporting meteorology as an instrument to calculate and manage trade and shipping on the high seas. Therefore, the idea of meteorology as a modern colonial science developed in dual trajectories: (1) the evolution of the nature of colonial science, from the exploratory phase seen on natural history expeditions to the rise of institutional laboratories, and (2) modern weather observation through the use of new instruments for atmospheric condition prediction.

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[67] Bankoff, *Cultures of Disaster*, 43.

[68] "Maps." Manila Observatory Library and Archives (MOLA) <https://archives.observatory.ph/english/get_maps.php>.

[69] Benito J. Legarda, *After the Galleons: Foreign Trade, Economic Change, and Entrepreneurship in the Nineteenth-Century Philippines* (Quezon City: Ateneo de Manila University Press, 1999); and Jonathan Fast and Jim Richardson, *Roots of dependency: Political and economic revolution in the 19th century Philippines* (Quezon City: Foundation for Nationalist Studies, 1987).

Cannon (1938) claims that OMM "was the first ever to give warning of weather conditions in the China Sea and the Western Pacific…"[70] The work of the Jesuits and OMM on weather observation and meteorology, in local and regional scales, was not the earliest in the Pacific. As early as the late 18th century, the Dutch had already established meteorological outposts in Dejima, on the coast of the city of Nagasaki in Japan.[71] Their meteorological data has been valuable in the reconstruction of the climate of Japan based on archival sources. In 1849, the Russian Orthodox Mission in Japan expanded its small meteorological unit and operated at the expense of the Russian Embassy until 1863.[72] Throughout the nineteenth century, "Japanese" institutional meteorology gained momentum.[73] During the second half of the nineteenth century, several observatories were in operation and conducting meteorological observations in China, serving the traders and merchants of various European nations. In 1869, meteorologist Sir Robert Hart, Inspector General of the Chinese Imperial Maritime Customs initiated a project wherein he organised the meteorological observation system of the bureau.[74] And in 1872, several decades after they had resurrected their mission in China, the Jesuits founded a meteorological observatory in Zikawei, Shanghai.[75] Cannon (1938) adds, "the two Jesuit observatories were able to predict and broadcast weather warnings for the entire China coast, and the islands of the south."[76] It should be noted that as early as 1890, the director of the Zikawei Observatory, Father Marc Dechevrens, proposed to British authorities in Hong Kong a detailed proposal of collaboration with all the meteorological stations on the China coast centralized in Zikawei, as they were already making weather maps for the area.[77] This proposal stemmed from the fact that the Zikawei Observatory, under Father Dechevrens' leadership, made the bold move to be the central weather observatory in the China Coast, given the fact that it had direct relations with the meteorological observatory in Manila, maximizing their common Jesuit connection as scientists and institutions.

Along with this line of development, the OMM led the pack of colonial institutions that pursued scientific research and institutionalized the meteorological work in the region. Anduaga (2014) argues the significant role of the OMM not only as one of the earliest in Southeast Asia and the Far East but also the one that succeeded in expanding its work and developing a proactive meteorological infrastructure, to disseminating information for public consumption.[78] Looking at two statements in 1917 and 1927 on the work of the OMM/PWB, its enviable position and function showcase its utmost importance as a scientific institution in the Pacific region:

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[70] Thomas B. Cannon, 'History of the Jesuits in the Philippines,' *Woodstock Letters* 67(2), 1938, p. 141.

[71] Gaston Demaree, Takehiko Mikami, Togo Tsukuhara, and Masumi Zaiki, "In the Wake of 'De Liefde':: The instrumental meteorological observations of the Vereenigde Oost-Indische Compagnie (VOC)," Bull. Séanc. Acad. R. Sci. Outre-Mer 59(2-4), 2003, pp. 385-405.

[72] P. Kevin MacKeown, *Early China Coast Meteorology: The role of Hong Kong* (Hong Kong: Hong Kong University Press, 2010), p. 11.

[73] Takuya Miyagawa, "Building the Imperial Meteorological Network and Making 'Japanese Meteorology,', 1868-1945,"Seoul National University Doctoral Dissertation, 2015; G. P. Konnen, M. Zaiki, A. P. M. Baede, T. Mikami, P. D. Jones, and T. Tsukuhara, 'Pre-1872 Extension of the Japanese Instrumental Meteorological Observation Series back to 1819', *Journal of Climate* 16, 2003, pp. 118-131.

[74] Zhu, *"*Typhoons, Meteorological Intelligence,*"* 20.

[75] MacKeown, *Early China Coast Meteorology*, 20.

[76] Cannon, "History of the Jesuits in the Philippines," 141

[77] Agustín Udías, *Searching the heavens and the earth: The history of Jesuit observatories* (Dordrecht: Kluwer Academic Publishers), 160.

[78] Anduaga, "Spanish Jesuits in the Philippines," 512.

The progress in the time service of the Philippine Islands is made evident from the fact that since October 1, 1917, the Cavite Radio Station, cooperating with the Bureau of Posts and the Manila Observatory, send out time signal of the 120th meridian East of Greenwich at 11 A.M. and 10P.M. every day, Sundays and holidays inclusive. Manila holds an enviable position in the Pacific and the interests of shipping companies making Manila a port of call are [sic: is] too prosperous to be overlooked. Accurate time signals and wise typhoon warnings are of immense value to the units of the United States Asiatic Fleet, to Army transports and in general to oversea [sic] the shipping. [79]

A glance at the map of the Far East will easily convince anyone that, with stations at Guam and Yap, both the efficiency of the Philippine Weather Bureau as an outpost to guard to whole Far East against surprises in the lines of typhoons would be tremendously increased. Both stations were round to off the system of the Philippine meteorological service toward the east, that is to say, toward the region of the Pacific where the great majority of typhoons are formed. [80]

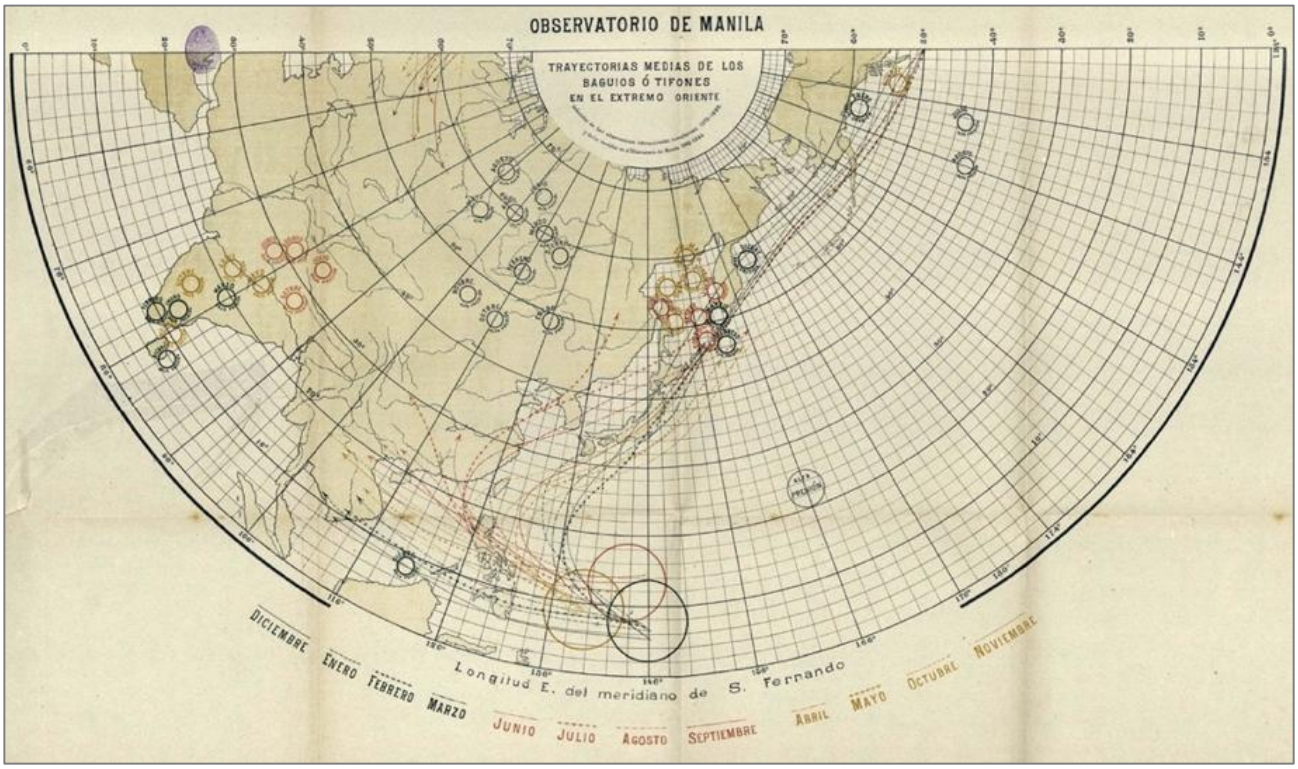

Fig. 7. *Trayectorias Medias de los Baguios o Tifones en el Extremo Oriente*.[81]

MacKeown (2011) pointed out that no other meteorological observatory rivalled the OMM in its impact in the blossoming of meteorology in Hong Kong.[82] Father Faura stated in 1880 that establishing weather and typhoon forecasting institutions in the archipelago would not only help the Spanish Navy in its mandate to monitor the seas, but also the neighbouring colonies, due to the position of the Philippines at the forefront of the Pacific Ocean, as tropical

[79] "Wireless Time Service in the Philippine Islands," *Science, New Series*, 46(1198), Dec. 14, 1917, p. 582, INS S1.1 061, Institutional Records, Manila Observatory Library and Archives. Emphasis added by author.

[80] José Coronas, "Importance of Yap and Guam as weather stations near the origin of typhoons" (1927), COR S2 011, Personnel Data Records, Manila Observatory Library and Archives. Emphasis added by author.

[81] José Algué, *Baguios ó Tifones de 1894: Estudios de los mismos segudo de algunas consideraciones generals acerca de los caracteres de estos meteoros en el Extremo Oriente* (Manila: Imprenta Litografía Parter, 1895), 170.

[82] MacKeown, *Early China Coast Meteorology*, p. 17.

cyclones and typhoons travel from the Philippines to China, and never the other way around.[83] (See Figure No. 5) In 1907, the Manila Harbor Board reported that PWB, played an important part in an extensive and comprehensive system of meteorological stations in the Pacific, as it led the collection of data from "stations situated in various places over the Far East from Japan to Borneo," and that the service was not only for the PWB, "but for all the meteorological departments in all countries and colonies of the Far East."[84] The board concluded that the service provided prompt and accurate information to weather bureaus in the widely scattered region of the Pacific, was "aided in giving proper forecasts for their respective localities."[85]

The OMM, PWB, and the Observatories in western Pacific

Available data shows that by the year 1914, the PWB successfully established communications and relations with scientific institutions, organizations, and observatories around the world. Covering four regions (Europe, Asia and the Pacific/Oceania, Americas, and Africa) and 48 countries, the PWB had scientific exchanges with 308 institutions and observatories (Fig. 8).

Region	Countries	Institutions/Observatories
Europe	17	165
Asia and the Pacific (Oceania)	10	37
Americas	17	99
Africa	4	7
Totals	48	308

Fig 8. Summary of the Number of Institutions with Scientific Exchanges with the OMM and PWB.[86]

Among these institutions, 22 are found in the western Pacific region, belonging to five countries and territories – China, Japan, Indochina, Java, and Singapore. [See Table No. 5] Generally, these institutions had a fair and smooth relationship with OMM, but notably in two countries the OMM's ties expanded; the active turned lukewarm communications with Hong Kong Observatory and the intimate relations with the Tokyo Observatory.

The list of OMM's incoming and outgoing correspondence with their fellow Jesuits, Filipino officials and scientific staff, and foreign individuals and government institutions reveals the extent of their scientific communication network and their active engagements with different individuals and institutions regarding their scientific research and public service. Most of the exchanges stem from the continuous reliance of foreign institutions on information from the PWB, and the development of further scientific collaboration between the OMM with the experts from Europe and the United States. The bulk of this surviving collection of correspondence dates to the 1910s to 1930s, when Father Selga served as assistant director and later as director of the PWB (Figs. 9 & 10).

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[83] "Establecimiento y organización de un servicio meteorológico en las Islas Filipinas", Ultramar,604, Exp.14.

[84] T*he Port of Manila, Philippine Islands*: *A yearbook devoted to foreign commerce and shipping of Manila and the Philippines* (Manila: Manila Harbor Board, 1934), 33.

[85] Ibid.

[86] Saderra Masó, *Historia del Observatorio de Manila,* 201-210.

	Other Pacific Meteorological Observatories	Year Established	Form of Scientific Exchange
Manila Observatory	Batavia Observatory (Java, Indonesia)	1869	WDE
	Chinese Imperial Maritime Customs (Shanghai, China)	1869	DC, WDE
	Zikawei Observatory (Zikawei, China)	1872	DC, WDE, TW, MS
	Tokyo Central Observatory (Tokyo, Japan)	1875	DC, WD, TW, MS
	Hong Kong Observatory (Hong Kong Island)	1883	DC, WDE, TW
	Phù Liễn Observatory (Hải Phòng, French Indochina)	1903	WDE
	Royal Thai Meteorological Service (Bangkok, Thailand)	1923	WDE
	Bosscha Observatory (Lembang, West Japan)	1923	WDE
	Meteorological Division of the British Malayan Survey Department (Kuala Lumpur, British Malaya)	1927	WDE

Fig. 9. Manila Observatory and the nature of its relationship with various observatories.[87] Legend: DC, Direct Communications; WDE, Weather Data Exchange; TW, Typhoon Warnings; MS, Magnetic Surveys.

Incoming							
Personnel	Jesuits (Local)	Jesuits (Abroad)	Filipinos (Local)	Filipinos (Abroad)	Government Officials	Foreigners	Unknown
J. Algué	4	--	2	2	2	10	1
J. Coronas	--	--	1	--	--	--	--
F. Faura	--	--	--	--	3	--	--
W. Repetti	--	--	--	--	--	--	1
M. Saderra Masó	--	--	--	--	--	--	--
M. Selga	6	10	45	2	12	89	11
Outgoing							
Personnel	Jesuits (Local)	Jesuits (Abroad)	Filipinos (Local)	Filipinos (Abroad)	Government Officials	Foreigners	Unknown
J. Algué	4	7	1	--	1	1	2
J. Coronas	1	1	--	--	--	2	--
F. Faura	--	--	--	--	--	1	--
W. Repetti	--	--	--	--	--	--	--
M. Saderra Masó	--	--	2	--	--	1	--
M. Selga	--	3	17	--	15	26	--

Fig. 10. Incoming and Outgoing Correspondences of certain Jesuit Officials of the OMM, 1880s-1940s.[88]

[87] Ibid.

[88] Manila Observatory Library and Archives, http://archives.observatory.ph/english/personnel_records.ph

Typhoon "Feud": Manila and Hong Kong, 1899

Zhu (2012) argues that one rationale for the establishment of a specific network of observatories on the China Coast, namely the Shanghai, Zikawei, and Hong Kong, was to properly coordinate typhoon warning communication with Manila since most of the typhoons that arrive in that area pass by the Philippines first.[89] The interactions between the Manila and Hong Kong observatories reflects a complex inter-island scientific relationship. This was realized in several parameters, including information sharing through telegraphic connections and an influx of donations from Hong Kong merchants to OMM. This cooperation started with the successful establishment of a submarine cable between Manila and Hong Kong in the early months of 1880.[90] The Hong Kong traders and the colonial government headed by Governor John Pope Hennessey had been keen to create regular telegraphic communications between the two countries, sending petitions to the Spanish colonial government in Manila. Their primary reason was to share regular daily weather bulletins, meteorological notes and observations, and, critically, typhoon warnings.[91] But, the relationship between the OMM and the island colony's official weather agency, the Hong Kong Observatory, turned out to be lukewarm and volatile, as the supposed inter-institutional scientific partnership and public sector-driven engagement were marred by bureaucratic competition and scientific distrust amongst its agency heads.

Father Faura was not keen to commit formally to the request because of the cost of telegraphic communications and, more practically, because he already had established contact with the closer meteorological stations in Shanghai and Xiamen which, arguably, Hong Kong could also rely upon for the same meteorological information. An example of a typhoon advisory was the *Señales de Mal Tiempo*, a flyer or pamphlet containing weather notes and advice for seafarers.[92] In the same year, Governor Pope Hennessy wrote a letter to the Spanish Governor-General asking for regular wireless communication of meteorological notes and observations to be established between their respective colonies.[93] After almost two years of limited communication, however, an initiative led by a private telegraph company in 1882 enabled a more stable weather communication reporting service and network between Manila and Hong Kong.[94] The OMM's 53 typhoon warnings issued between 1879 and 1882 captured the attention of businessmen from the nearby British colony of Hong Kong, which lacked a weather observatory.[95] These merchants signified their intention to donate to the Jesuits for the purchase of supplementary apparatus and the improvement of their laboratory.[96]The Manila-based newspaper *El Comercio* reported in 1880 that the Hong Kong traders donated to the

[89] Marlon Zhu, "Typhoons, meteorological intelligence, and the inter-port mercantile community in nineteenth-century China." Doctoral Dissertation, State University of New York, Binghamton, 106.

[90] Schumacher, "One Hundred Years of Jesuit Scientists," pp. 261-262; Miguel Saderra Masó, *Misiones Jesuíticas de Filipinas, 1581-1768 y 1859-1924* (Manila: Imprenta Pontificia de la Universidad de Sto. Tomas, 1924), 101.

[91] MacKeown, *Early China Coast Meteorology*, pp. 29 and 33; Saderra Masó, *Historia del Observatorio de Manila*, 63; Zhu, "Typhoons, meteorological intelligence," 169-172; Schumacher, "One Hundred Years of Jesuit Scientists," pp. 261-261; Saderra Masó, *Misiones Jesuíticas*, 101.

[92] *Servicio Meteorológico*, 1885-1897, SDS-12433 and 12434, National Archives of the Philippines (NAP), Manila.

[93] MacKeown, *Early China Coast Meteorology*, 33.

[94] Saderra Masó, *Historia del Observatorio de Manila*, 70.

[95] Marcial Sola, *Report of the director of the Philippine Weather Bureau, 1902*, Part 2: Meteorological service in the Philippine Islands, 1865-1902 (Manila: Bureau of Printing, 1903), 1011.

[96] Saderra Masó, *Misiones Jesuíticas*, 101.

OMM to purchase new instruments; it was spearheaded by several companies, such as the Hong Kong Shanghai Banking Corporation (HSBC).[97]

Since the establishment of the Hong Kong Observatory in 1883, its director, August William Doberck treated other observatories on the China coast, such as Shanghai and Zikawei, as inferior. For him, the Hong Kong Observatory should be an independent and leading institution of typhoon studies, not auxiliary to other observatories. This was rooted in an initial proposal of the Shanghai Chamber of Commerce Meteorological Committee wherein Zikawei would be the central station of a small network of weather agencies on the China coast, and that a Jesuit will be appointed as "*Director-General of the China coasts and seas.*"[98] Saderra Masó (1915) considered this as the "el pecado original" (the original sin), which motivated Doberck's hostile attitude towards the Zikawei Observatory and its director, Dechevrens, and later, to the OMM.[99] Upon Doberck's arrival in Hong Kong, he reported to the Hong Kong Colonial Secretary that there was no existing weather service on the China coast and that it had several stations that had useless instruments.[100] These observations blatantly disregarded the existence of Jesuit observatories that were in their second decade of existence by the time of Doberck's arrival. In early 1889, Father Faura made a bold decision to cut Manila's weather report sending service to Hong Kong due to a misunderstanding with Doberck. In an apparent display of a defensive stance, the latter published an open letter in the newspaper *Daily Press* on 04 July 1889, saying that the correspondence from Manila did not matter in the smooth running of the weather observatory in Hong Kong.[101] But due to the persistent requests from Hong Kong merchants and colonial governments having trading outposts in Hong Kong and on the China coast, the OMM gradually normalized its ties with Hong Kong, despite Doberck's consistent disregard of their work. The communication between the two observatories continued professionally until the end of the century when differences broke out between the OMM Jesuits and the Hong Kong Observatory director concerning the Spanish-American War in Manila. The wars in the Philippines – the Philippine Revolution of 1896-1898, the Spanish-American War of 1898, and the Philippine-American War of 1899 caused severe disruption to OMM's work, including its relationship with the neighbouring British island colony.

On 17 February 1899, Father Algué, then the OMM's director, received an order from the US War Department in Washington prohibiting the OMM from sending messages, reports, and typhoon warnings to nearby territories in the South China Sea, especially to Hong Kong.[102] The order was a result of earlier communication between Willis Moore, Chief of the US Weather Bureau, and Doberck, where the latter recommended that the Americans bar the OMM from communicating with Hong Kong.[103] In an obvious and calculated move to accommodate the advice of a colonial official from a neighbouring colony, the US Military Government in the Philippines executed the order from the US War Department. Doberck argued that the OMM was sending "sensational" or exaggerated reports because it was under the supervision of "men with little scientific education."[104] In a letter published in Manila and Hong Kong newspapers on 7 March 1899, Father Algué repudiated Doberck's accusations, arguing that the

[97] Zhu, "Typhoons, meteorological intelligence," 172-273.

[98] MacKeown, *Early China coast meteorology*, 42.

[99] Saderra Masó, *Historia del Observatorio de Manila*, 69 and 84.

[100] Ibid., 70.

[101] Ibid., 72.

[102] Saderra Masó, *Historia del Observatorio de Manila*; Repetti, *The Manila Observatory*, 19.

[103] Zhu, "Typhoons, Meteorological Intelligence," 255.

[104] Repetti, *The Manila Observatory*, 19; Zhu, "Typhoons," 256–57.

OMM's work was for the welfare of the public.[105] The issue continued to make headlines with press commentaries in both countries siding with the OMM and the Jesuits, and commercial groups such as the Hong Kong Chamber of Commerce (HCC) expressed their disappointment with the two weather agencies.[106] On 03 April, after almost two months of suspension, a request from Hong Kong's business sector channelled through the governor of the British colony, Arthur Blake, led to the US government lifting the restriction and the OMM resumed its reporting to Hong Kong.[107]

The end of the controversy served as a catalyst for US appreciation of the OMM's scientific work. Zhu (2012) describes this 1899 incident between the two observatories as a "news-mediated incident."[108] The Hong Kong newspapers played a crucial role in creating public sentiment favorable to their chosen protagonist in the issue. In the last quarter of 1899, commentaries published in the *China Mail* show that Doberck's boorish treatment of the Manila Fathers had caused much loss to Hong Kong.[109] Moreover, this event exhibits the reality of inter-colonial political relations in the region. The US, which just came from a war with Spain, had to be cautious in dealing with Western counterparts as they took on their new colonial possession in the Pacific. Since the "request" came from an ally country, Doberck's expert commentary on the Jesuits was received not merely as a petition, but as war advice that needed appropriate action from the US military in the Philippines. The issue pushed the US and British colonial governments to move cautiously in dealing with the scientific clash, which concerned various war and economic interests. The issue might have been a product of institutional rivalry, but the event fell under the auspices of international war and involved various colonial interests.

The OMM and PWB at Colonial Expositions and Scientific Congresses: Showcasing Science, Projecting the Empire

International colonial expositions and scientific congresses became avenues for the OMM and PWB to present their scientific research, showcase their inventions, establish external connections and networks, and gain international prestige as one of the leading scientific institutions and observatories in the world (Fig. 11). In these international political and scientific gatherings, the OMM and PWB successfully portrayed themselves as modern scientific institutions in the Pacific, proudly promoting their scientific research, projects, and achievements, and strongly projecting the subtle and not-so-subtle image of Spanish and US empires, which both banked on modern scientific knowledge to pursue their respective colonial and imperial projects. Ultimately, the network established in this scientific endeavour served as the "extension" of their institutional relationship with the western Pacific meteorological observatories. Anduaga (2014) argues that the international community continued to recognize

[105] Letter of José Algué to the US Provost Marshall, Algué Correspondence Folder, 1893–1900, Manila Observatory personnel data records, Manila Observatory Library and Archives.

[106] See Zhu, "Typhoons, meteorological intelligence," 258-265. According to Zhu, the published letter from the Jesuits contained changed words and paraphrased sentences, and omitted parts of Doberck's original letter; Hong Kong Daily Press, 28 March 1899, cited by MacKeown, *Early China Coast Meteorology*, 177.

[107] Zhu, "Typhoons, Meteorological Intelligence," pp. 258-265.

[108] Ibid. The author argued that Father Algué paraphrased Doberck's original letter.

[109] MacKeown, *Early China Coast Meteorology*, p. 174; *El servicio Meteorológico del Observatorio de Manila: Vindicado y rehabilitado (1899)* (Manila: Imprenta del Observatorio, 1899).

the value of the OMM's scientific work, despite Spain's loss in the Spanish-American War of 1898, and its sale of the Philippines to the United States.[110]

Year	Exposition/Congress	Participants from the OMM/PWB
1883	Universal Colonial Exposition, Amsterdam (Netherlands)	F. Faura
1885	Meteorological Society of Hamburg (Germany)	F. Faura
1887	Colonial Exposition, Madrid (Spain)	F. Faura
1888	Colonial Exposition, Barcelona (Spain)	F. Faura and J. Algué
1889	Meteorological Congress, Paris (France)	F. Faura and J. Algué
1893	Meteorological Congress Chicago (USA). Part of Columbian Exposition.	F. Faura and J. Algué
1895	Regional Exposition Manila (Philippines)	
1900	Meteorological Congress Paris (France)	J. Algué, F. Cicera, M. Saderra Masó
1902	French Colonial Exposition Hanoi (Indochina)	
1904	St. Louis Exposition Missouri (USA)	J. Algué, Roman Lacson, Roman Trinidad
1905	Meteorological Congress Innsbruck (Austria)	J. Algué
1920	First Pacific Science Congress Honolulu, Hawaii (USA)	M. Saderra Masó
1923	Second Pacific Science Congress, Melbourne and Sydney, (Australia)	M. Selga
1925	Vatican Missionary Exposition Rome (Italy)	
1926	Third Pacific Science Congress Tokyo (Japan)	M. Selga
1929	Fourth Pacific Science Congress Java (Indonesia)	W. Repetti
1930	Far East Weather Service Directors' Conference	M. Selga
1931	International Overseas Colonial Exposition Paris (France)	
1932	First Philippine Science Convention Manila (Philippines)	Staff of the PWB
1933	Fifth Pacific Science Congress Victoria and Vancouver (Canada)	W. Repetti

Fig. 11. List of International Expositions and Scientific Congresses where the OMM/PWB participated, 1883-1937.[111]

After they participated in the Vienna Meteorological Congress in 1873, the Jesuit Fathers were encouraged by congress delegates to publish their studies.[112] It came to fruition in 1875 when the Signal Service Office in Washington, D.C. asked for their published weather bulletins in the international scientific community.[113] In the 1883 *Exposición Colonial Universal* held in Amsterdam, Father Faura presented his book, together with his aneroid

[110] Anduaga, "Spanish Jesuits," 519.

[111] Repetti, "The Manila Observatory", *The Woodstock Letters* 77(4), 238-243; Repetti, *The Manila Observatory*, 37-39.

[112] Federico Faura and José Algué, *La meteorológía en la exposición Columbina de Chicago (1893): Memoria escrita* (Barcelona: Imprenta de Henrich y Compañia en Comandita, 1894), p. 115; Saderra Masó, *Historia de Observatorio de Manila*, 30.

[113] Saderra Masó, *Historia de Observatorio de Manila*, 30.

barometer, to the delegates from different scientific institutions in Europe and Asia.[114] The OMM also participated in the *Exposición General de Filipinas* in Madrid in 1887 and *Exposición Universal de Barcelona* in 1889, where it received the highest appraisal and honours.[115]

In the 1893 Columbian Exposition in Chicago, the OMM presented to the exposition delegates its meteorological instruments from Manila. This international exposition included scientific lectures that featured meteorological devices such as anemometers, thermographs, snowfall recording apparatus, and different types of thermometers.[116] The exposition also featured exhibits that showed advancements in instrument use and application. Physical notions such as *presión atmosférica* (atmospheric pressure), *temperatura de aire* (air temperature), *corrientes aéreas* (airstreams), *meteoros acuosos* (aqueous meteors), and *psicrómetros* composed the exhibit that had on display barometers, barographs, thermometers, *teletermómetros* (tele-thermometers, for measurement of temperature of distant places), anemometers, anemoscopes (wind direction indicators), and pluviographs.[117] Fathers Faura and Algué admitted that indeed, the invention, in general, and the use of recording instruments had opened new horizons in the science of meteorology.[118] They added that experimental meteorology had changed since Secchi's meteorograph was presented to the scientific community and featured at the universal expositions held to popularize inventions—the 1867 and 1878 expositions in Paris and the 1873 exposition in Vienna.[119] Faura and Algué were very optimistic that, through their report, the Columbian exposition would inspire youth to pursue studies in meteorology.[120] The popularization of instruments and the rise of recording tools prompted the quick recognition of meteorology as an indispensable pillar of colonial development. Indeed, the number of instruments that the OMM had acquired at the time of the Columbian Exposition was on par with the global trend.

In 1904, almost six years after the United States annexed the Philippines, the US celebrated the centennial of the 1803 Louisiana Purchase[121], a turning point in the history of its territorial expansion. In celebration, the St. Louis World's Fair, an international exposition showcasing the scientific, technological, and cultural advancements being made throughout the world, was held in Missouri. The World's Fair revealed the many sides of imperialism and exposed the United States' intention to transform the Philippines into a colony framed by its protracted notion of civilization. In 1901, the PWB participated in this event and exhibited its inventions, instruments, collections, and selected scientific publications. The PWB's team that headed to St. Louis included its director, Father Algué, and two Filipinos, Augusto Ferrer, a draughtsman, and Roman Trinidad, a mechanic.[122] Two other Jesuit scientists went to Missouri several months ahead to make the preparations. The exhibit was composed of three sections:

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[114] Saderra Masó, *Historia de Observatorio de Manila*, 61; Faura, *El barómetro aneroide aplicado a la previsión del tiempo en el Archipiélago filipino*, 2

[115] Saderra Masó, *Historia de Observatorio de Manila*, 97-98.

[116] Faura and Algué, *La meteorológía en la exposición Colombina de Chicago (1893)*, 23-24

[117] Ibid., 69-103.

[118] Ibid., 115.

[119] Ibid.

[120] Ibid., 115-116.

[121] The United States, during the administration of President Thomas Jefferson in 1803, purchased from France the vast Louisiana territory of France in North America. This significant land acquisition signaled the United States' continental expansion in the nineteenth century, giving the country massive agricultural and mineral resources for its economic projects.

[122] José Algué, "The Philippine Weather Bureau at the Louisiana Purchase Exposition in St. Louis," *Annual Reports of the Philippine Commission 1904* (Washington: Government Printing Office, 1905), 551; Repetti, *The Manila Observatory*, 39.

geographical, meteorological, and seismic. It had a two-story building and a giant relief map of the Philippines in front. The building was a 33x33 meter-sized structure; it housed meteorological and seismic instruments, special maps, and drawings.[123] The instruments the PWB exhibited included the Vicentinni microseismograph and seismometer for the seismic sections, and anemograph, kinemo-anemograph, ceraunograph, mercurial barometer, barograph, Algué's barocyclonometer, refraction nephoscope, solar chronometer, and hygrometer for the meteorological section.[124] The relief map measured 100x65 feet. Placed around it were eight smaller maps, which show the political and cultural divisions of the archipelago, as well as ethnic groupings, mineral resources, agricultural and forest products, seismic zones, average rain and temperature records for specific months, and meteorological districts and stations of the PWB. The relief maps also had models of Taal and Mayon volcanoes and the Manila Bay. The PWB presented some of its publications: the two-volume *El Archipiélago Filipino*, an atlas, and a book on its institutional history. Also displayed in the exhibit were some Philippine products, like embroidered *piña* cloth, sculptured shells, 150 specimens of wood, and furniture made from *bolonguita* and *narra*.[125] For the whole duration of the exposition, Filipinos were hired to take care of PWB's exhibit.

The PWB was recognized with an outstanding citation and its staffers were honoured with individual awards. It was also given a special honour for a model meteorological-seismological station and Father Algué received a gold medal for his barocyclonometer and other instruments made by the PWB under his supervision, such as the nephoscope, and the PWB version of the microseismograph.[126] The native Filipino personnel of the PWB exhibit, Trinidad, Ferrer, Gervasio de Guia, and Ramon Navarro who constructed the exhibit, and Roman Lacson, a Filipino *pensionado* (US Insular Government scholar) and law graduate from Georgetown University, who manned it over the months it was in situ, also received awards.[127] The US projected in the exposition the dichotomy of "civilization" and "savagery," which advanced the idea that conquest and administration of the Philippines were beneficial to the archipelago. The PWB symbolized modernity and scientific progress: a complete contrast to other Philippine-related exhibits which displayed the supposed "vulgarity" and "exoticism" of Philippine culture. To explain this duality, the US claimed the PWB as their creation and blatantly attempted to erase the bureau's Spanish origin. The PWB exhibit demonstrated to an international public – from travellers, traders, agriculturists, anthropologists, and even Olympic athletes – that the US pacification of the Philippines was benevolent and had brought enlightenment to the archipelago.

Conclusion

The scientific activities of the OMM and PWB from the 1860s to the 1940s illustrate the significant contributions of its local research initiatives and international scientific network-building and collaborations. On the one hand, pioneering scientific research work and publications of the Jesuit meteorologists on tropical cyclones and typhoons showcase the wealth of information and knowledge they helped produce to understand the said atmospheric phenomena that clearly impacted the social and economic life of the Philippine archipelago.

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[123] Algué, "The Philippine Weather Bureau at the Louisiana Purchase Exposition," 551.

[124] Ibid., 556-558.

[125] Ibid., 556.

[126] Ibid., 551; Report of the Philippine Weather Bureau, Appendix L, *Annual Reports of the War Department for the Fiscal Year ended June 30, 1905* (Washington: Government Printing Office, 1905), 416.

[127] Algué, "The Philippine Weather Bureau at the Louisiana Purchase Exposition in St. Louis," 551.

Beyond the conventional approach of what is considered foreign or local, the research work of the Jesuit scientists, despite its international expansion, remained primarily for the benefit of the Philippines as a "locality." The OMM and PWB's primary objective during the late nineteenth and early twentieth centuries was to provide a structured, scientific approach to weather forecasting and cyclonic predictions. Through research and the introduction of instruments catered to the local conditions of the archipelago, the Jesuits advanced a form of public science, which served the government and private commercial sectors, making meteorology a vital support for bureaucratic governance and public engagement in the colonial Philippines. On the other hand, the OMM and the PWB successfully established regional and global network links and partnerships not only for the purposes of inter-state collaborations for safer shipping but also for efficient dissemination and exchange of information on meteorology. For almost eight decades of its institutional existence, the OMM and the PWB, engaged their contemporary meteorological observatories in the region, contributing to the establishment of dynamic networks of meteorological knowledge sharing and dissemination. It thrived as an institution that weathered the restive era of economic transformation and scientific collaboration from the late nineteenth to the early twentieth centuries.

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