ICHM 2001 History of Meteorology

Health and Weather in Unfavourable Environments: Exploring the Historical Dynamics of Colonial Medical Meteorology in nineteenth-century Tropical Asia

Fiona Williamson

Introduction

Medical meteorology had a long precedent in medical thought across Eastern and Western traditions. This article considers the tradition of medical meteorology that was favoured by Western doctors in the nineteenth century, which was often applied within colonial contexts to the understanding of new climates and how these climates might impact on human health. Looking at British-held tropical and sub-tropical colonies of the Straits Settlements and Hong Kong respectively, this article explores how medical meteorology was stimulated by the new pathological and atmospheric conditions that Western settlers now inhabited in the name of the British Empire. Colonists brought with them concepts of climate and of disease causation that were underpinned by centuries of Hippocratic and Aristotelian thought. By 1800 these theoretical traditions were merging with newer empirical and systematic, observation-based scientific method. Drawing on ancient theoretical groundings, climate was thought to play a significant role in determining human health which, when combined with an emerging body of new instrumental weather observations made across the colonies, enabled doctors to look for patterns of cause and effect between climate and the human condition, or extreme weather and disease.[1]

The tropics, with high levels of humidity, heavy rains and heat, were thought to push the (European) body to the limits of its endurance and incubate the conditions for a whole range of malignant diseases to thrive. As meteorological records from the tropical regions became

[1] Matthias Heymann, "The Evolution of Climate Ideas and Knowledge," *WIREs Climate Change* 1 (2010): 581-597.

Corresponding author(s)
Fiona Clare Williamson, Singapore Management University, fwilliamson@smu.edu.sg

more commonplace, a quantitative method of comparing disease incidence with weather conditions became common practice in the medical institutions of the British Empire. Undertaking simple correlative studies, doctors saw that natural hazards, especially floods and droughts, could cause spikes in certain illnesses, information that was critical in enabling colonisers to understand and respond to their new environments. Based on similar methodological roots – especially the collation and correlation of large quantities of statistical data – medical meteorology and meteorology brought the unknown variables of climate and in health under recognisable and predictable medical and scientific frameworks.

There is a large body of literature that investigates the relationship of weather and human health in the past. Historical climatologists and historians of climate, for instance, have examined how long- and short-term climatic changes have affected the synergy between nutritional availability and human health; drawn correlations between epidemics with the availability of water or insect vectors, such as cholera and malaria; and have shown how declining human health may have fed into social unrest and dynastic change.[2] Historians have also been intrigued by how people thought about climate and health in the past. Mark Harrison and David Arnold, for example, pioneered research into how climates were constructed by Western scholars and scientists, often in connection with cultural assumptions and racial stereotypes of geographies, weathers and peoples. These assumptions came to influence assumptions of places as healthy or unhealthy and by extension, the characters of native populations.[3] Harrison's claim that European's found in India a unique disease environment, demanding a fundamental reappraisal of their medical knowledge and thus new forms of treatment, was one overarching reason for the pursuit of studies into tropical weather and disease by colonial medics.[4]

Arnold's conceptualisation of "tropicality" also provides a reason for why Europeans focussed so overtly on the climate as a potential source of ill-health.[5] Based on extensive research on British colonial medicine and popular thought about health in India, Arnold argued that colonists imagined disease as somehow more acute and malignant in tropical climes, which led to a general fear of tropical environments and a greater desire to investigate their

---

[2] Katherine Pribyl, Farming, *Famine and Plague: The Impact of Climate in late Medieval England* (Springer, 2017); Anthony J. McMichael with Alistair Woodward and Cameron Muir, *Climate Change and the Health of Nations: Famines, Fevers, and the Health of Population*s (Oxford University Press, 2017); Huidong Tian, et al., "Scale-dependent climatic drivers of human epidemics in ancient China," *PNAS* 114, no. 49 (2017): 12970-12975; Bruce Campbell, *The Great Transition: climate, disease and society in the late-medieval world* (Cambridge University Press, 2016); Timothy Brook, "Differential effects of global and local climate data in assessing environmental drivers of epidemic outbreaks," *Proceedings of the National Academy of Sciences USA* 114 (2017): 12845-7; Richard Grove, "The Great El Niño of 1789–93 and its Global Consequences: Reconstructing an Extreme Climate Event in World Environmental History," *The Medieval History Journal* 10, no. 1&2 (2007): 75-98; Harry F. Lee et al., 2017, "Climate Change and Epidemics in Chinese History: a Multi-scalar Analysis," *Social Sciences and Medicine* 174 (2017): 53-63; Qing Pei et al., 2015, "Epidemics in Ming and Qing China: impacts of changes of climate and economic well-being," *Social Sciences and Medicine* 136-7 (2015): 73-80; David D. Zhang, et al., "The causality analysis of climate change and large-scale human crisis," *PNAS* 108, no. 42 (2011): 17296-301.

[3] Laurence Monnais and Hans Pols, "Health and Disease in the Colonies: Medicine in the Age of Empire," in *The Routledge History of Western Empires*, ed. Robert Aldrich and Kirsten McKenzie (Routledge, 2014), 270-284; James Beattie, *Empire and Environmental Anxiety: Health, Science, Art and Conservation in South Asia and Australasia, 1800-1920* (Palgrave Macmillan, 2011); David Arnold, *Warm Climates and Western Medicine: the emergence of tropical medicine, 1500-1900* (Editions Rodopi B. V., 1996); Mark Harrison, *Climates and Constitutions: Health, Race, Environment and British Imperialism in India, 1600-1850* (Oxford University Press, 1999); Dane Kennedy, "The Perils of the Midday Sun: Climatic Anxieties in the Colonial Tropics" in *Imperialism and the Natural World*, ed. John M. MacKenzie (Manchester University Press, 1990), 118-40.

[4] Mark Harrison, *Public Health in British India: Anglo-Indian Preventative Medicine 1859-1914* (Cambridge University Press, 1994), 36.

[5] David Arnold, *The Tropics and the Traveling Gaze: India, Landscape and Science, 1800-1856* (University of Washington Press, 2006).

relationship with health.[6] Integral to this fear and misunderstanding were the extremes of weather that were thoroughly alien to Europeans used to more temperate climes: the overwhelming heat, continued humidity, tropical storms, typhoons and torrential monsoon rains. Monsoon failure, conversely, was understood as a significant contributor to Indian famines and subsequent epidemics, including cholera. While the proper relationship of weather and cholera was not fully understood during the early 1800s (cholera was thought to be transmitted through noxious airs known as miasma), the correlation of cholera outbreaks with extremes of rainfall was diagnosed by comparing weather records and disease data and, arguably, anecdotal observation.[7]

Given the centrality of meteorological records to contemporary research on tropical disease, it is perhaps surprising that the practice of medical meteorology has been largely ignored by historians, especially outside of the colonial Indian context. Even for historians of India, colonial medical meteorology has, for the most part, been tackled implicitly. Leela Sami, for example, looked at medical responses to famine during the devasting famine of 1876-8, investigating the issue through a detailed study of Madras Presidency records. Nevertheless, although she cites drought as a contemporary given cause of an associated epidemic fever, she does not delve further into the role that medical meteorology played in this discussion, through arguably this was not the intention of the piece.[8] Others, like Mark Harrison or Sheldon Watts, have investigated the work of contemporary doctors who noted connections between disease rates and the Indian climate but do not write on medical meteorology for its own sake.[9]

This absence is not symptomatic of any neglect on the part of the historians, rather it reflects the embeddedness of meteorology within day-to-day contemporary medical practices, as medical staff routinely made observations as part of their regular duties. Hospitals, for example, were often equipped with their own weather registering stations or, in some cases, small observatories. Annual departmental reports made by colonial medical officers made mention of particular weather episodes and outbreaks of epidemic disease, but their discussion was often limited to noting, rather than analysing in any depth. Specialist studies on the effects of heat on the human body were the exception to this rule but these were not meteorological studies per se but studies of human physiology, like the effects of exercising in the heat on the human body, that were undertaken by military doctors.[10] Occasionally medical meteorological studies were not undertaken by medical doctors at all but by meteorologists themselves, leading to a further complication in the history of medicine.[11] Indeed, when James Espy, the controversial nineteenth-century American meteorologist, raised the possibility of controlling

[6] David Arnold, *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth-Century India* (University of California Press, 1993), 37.

[7] Mike Davies, *Late Victorian Holocausts: El Ninõ Famines and the Making of the Third World* (Verso, 2001).

[8] Leela Sami, "The epidemiological, health and medical aspects of famine: Views from the Madras Presidency (1876-78)," in *Society, Medicine, and Politics in Colonial India*, ed. Biswamoy Pati and Mark Harrison (Routledge, 2018), 148-71.

[9] Mark Harrison, "The great shift: cholera theory and sanitary policy in British India, 1867-1879" in *Society, Medicine, and Politics in Colonial India*, ed. Biswamoy Pati and Mark Harrison (Routledge, 2018), 37-60; Sheldon Watts, "Cholera and the Maritime Environment of Great Britain, India and the Suez Canal: 1866-1883," *International Journal of Environmental Studies* 63, no. 1 (2006): 19-38.

[10] For example: The National Archives, UK (hereafter TNA) ADM 101/259/2, ff. 33-44. Journal of F. H. Blaxall, M.D. Ship's Surgeon, Notes on Heat Apoplexy in the Mauritius, 1866-7; TNA FD/1/3548, ff. 1-19. Tropical Climate Conditions by Dr D. Lee, 1930s.

[11] For instance: Gilbert Walker, "The Meteorology of India", *Journal of the Royal Society of Arts* 73, no. 3793 (1925): 838-55. Gilbert Walker, "Meteorology in India in Relation to Cholera", *The British Medical Journal* 2, no. 810 (1876): 55-56.

extreme weather, he had considered it a given that epidemics would be eliminated in tandem, something that medical professionals would likely have scoffed at.[12]

Much of the literature that *explicitly* addresses medical meteorology has focused on the seventeenth and eighteenth centuries and on European contexts. We can, for example, seek guidance from Andrea A. Rusnock's comprehensive overview of early-modern medical meteorology, undertaken by scholars including Robert Hooke, James Jurin and Félix Vicq d'Azyr, or see how Renaissance scientists including Tycho Brahe explored the influence of the weather on the body.[13] Moving forward in historiographical time, we can read Conevery Bolton Valenčius' study of early settlers in the American west; Huib Zuidervaart's work on the medical outputs of an early Dutch meteorological society or, Jan Golinski's discussion of the eighteenth century Hippocratic revival and what he terms "aerial sensitivity".[14] For the nineteenth century, the dedicated literature grows smaller, but Vladimir Jankovic has thought around how the British Victorians reconceptualised Classical views of the pathological agency of wind; Morton A. Skydsgaard has explored the rise and fall of the field in nineteenth century Denmark and, John Harley Warner has examined medical meteorology's influence on mid-nineteenth century American medical professionals.[15] While this literature looks geographically west, Harley Warner makes the interesting observation that medical meteorology contributed to the development of medicines and theoretical frameworks more suited to new, local circumstances than those imported from Europe, through its unique ability to relocate health in relation to a new climate and environment. His claim is certainly applicable to Western educated doctors operating in the tropics.[16]

This article therefore contends that, given its centrality to contemporary colonial medical, meteorological, and climatological discourses before 1900, medical meteorology ought to be given a more visible place in historical scholarship. Not only was it an essential element of medical reportage but, it was critical to contemporary understandings of how natural hazards and extreme weather may have amplified disease vectors and epidemics. Medical meteorology also became deeply integrated into emergent public health, sanitation and urban planning initiatives because of the recognition of the interconnectedness of weather and urban disease pathways. As such, medical meteorology was embedded at the heart of a multiplicity of colonial administrative functions, and colonial fears. Building on the work on tropicality within colonial India, this article highlights the practice of medical meteorology in the British colony known as the Straits Settlements (comprising Singapore, Penang Island and Province Wellesley, and Malacca) as an alternative counterpoint. It also examines how practices here were shaped by the wider imperial knowledge networks that crossed India and other British colonies such as Hong Kong. This redirection hopes to address a gap in the medical and

---

[12] Christopher Carter, *Magnetic Fever: Global Imperialism and Empiricism in the Nineteenth Century* (American Philosophical Society, 2009), 135.

[13] Andrea A. Rusnock, *Vital Accounts: Quantifying Health and Population in Eighteenth-Century England and France* (Cambridge University Press, 2009), 109-136. For a short discussion of Danish language texts on the subject, see: Morten A. Skydsgaard, "It's Probably in the Air: Medical Meteorology in Denmark, 1810-1875," *Medical History* 54 (2010): 218.

[14] Huib Zuidervaart, "An Eighteenth-Century Medical–Meteorological society in the Netherlands: an Investigation of Early organization, Instrumentation and Quantification. Part 1," *British Journal of the History of Science* 38, no. 4 (2005): 379-410; Conevery Bolton Valenčius, *The Health of the Country* (Basic Books, 2002); Jan Golinski, *British Weather and the Climate of Enlightenment* (University of Chicago Press, 2002), 137-69.

[15] Vladimir Jankovic, "Gruff boreas, deadly calms: a medical perspective on winds and the Victorians," *Journal of the Royal Anthropological Institute* 13 (2007): 147-64. See also: J. Burton, "Meteorology and the public health movement in London during the late nineteenth century," *Weather* 45 (1990): 300-7; Skydsgaard, "It's Probably in the Air"; John Harley Warner, *The Therapeutic Perspective: Medical Practice, Knowledge, and Identity in America, 1820-1885*, 2nd edn. (Princeton University Press, 1997).

[16] Harley Warner, *The Therapeutic Perspective*, 75-6.

meteorological literature for British colonial Southeast Asia, while acknowledging that medical meteorology there did not exist in a vacuum.[17]

It is well known that the natural hazards of Asia were conceptualised by nineteenth-century Europeans as facets of the tropical. This framing played to European's sense of the alien and extreme but relatedly the relationship of natural disaster to peaks in tropical disease. Indeed, this frame even helped justify imperialism. As Upamanyu Mukherjee has argued, the imagining of the tropics as zones of constant disease and disaster played into the concept of palliative imperialism, whereby colonists' right to rule was justified by their supposed paternalistic ability to mitigate disasters and to treat their tropical subjects.[18] As European enthusiasm for imperialism waned, and the atmospheric sciences took to new heights in the inter-war period, old ideas about weather, tropical hazards and health declined in many scientific circles. This article's chronological focus (roughly 1840-1920) therefore coincides with the rise of meteorology as an atmospheric science and decline of meteorology as a medical construct. It may be that the ways in which extremes of weather were thought about, and subsequently managed, as result of advances in tropical meteorology as well as in medicine and the understanding of the vectors of disease, ultimately caused the demise of the field. In exploring these related areas then, this article also hopes to provide a small contribution to the emerging field of the history of tropical meteorology, revealing its significance within tropical field-based science.

Medical Topographies in British Colonial Asia

In tackling the joined-up challenges of weather and health, nineteenth-century meteorology and medical meteorology shared a methodological similarity in their reliance on collecting and analysing vast quantities of statistical information. The British Empire provided both reason and means to coordinate and collect more weather and health information than ever before.[19] When the English East India Company (EEIC) thought about the potential of a particular place or region for development as a plantation or colony, one of their first investigations, usually undertaken by military officers, was of the local environment. Understanding whether the climate was temperate enough to productively grow plants with economic potential was a vital task, but establishing the healthiness of these unknown environments for settlement and development in the longer-term was also important.

Sir James Clark, for example, provided inspiration for officers voyaging to Asia, through publication of texts praising the healthful benefits of certain climates for specific ailments.[20] Clark had, like other medical practitioners of his time, such as James Johnson, James Ranald Martin and Robert Scoresby Jackson, been able to transpose commonly held Hippocratic ideas of the body into Asian locales but the tropics especially were perceived of as

[17] Exceptions include: Sandra Manickam, "Not just Skin Deep: Ideas of Racial Difference in Genetic Studies on Orang Asli from the 1950s," in *Malaysia's "original people": Past, Present and Future of the Orang Asli*, ed. Kirk Endicott (NUS Press, 2016); Fiona Williamson, "Weathering the British Empire: meteorological research in the early nineteenth-century Straits Settlements," *The British Journal for the History of Science* 48, no. 3 (2015): 475-492.; Lenore Manderson, *Sickness and the State: Health and Illness in Colonial Malaya, 1870-1940* (Cambridge University Press, 1996).

[18] Upamanyu Pablo Mukherjee, *Natural Disasters and Victorian Empire: Famines, Fevers and Literary Cultures of South Asia* (Palgrave Macmillan, 2013).

[19] Martin Mahony, "For an empire of "all types of climate": Meteorology as an imperial science," *Journal of Historical Geography* (2016): 29-39.

[20] Jame Clark, *The Influence of Climate in the Prevention and Cure of Chronic Diseases* (Thomas and Newbery, 1829).

generating and harbouring a specific range of injurious airs and miasmas thought to be heightened during periods of bad weather.[21]

From the very beginning, military doctors had therefore played significant roles in the establishment of factories or forts by producing advisory medical topographies of the region for the EEIC and British government. Medical topographies were essentially, a survey based upon, and supporting, the principles of medical meteorology, but balanced with narrative observation and theorisation on the qualities and dangers of the environment. They tended to follow a generic pattern, starting with a detailed geographical and geological description of a place before establishing the normative annual climate through a combination of anecdotal evidence and instrumental observations. They also noted any unusual meteorological phenomena and any known intelligence on regional diseases.

Certain features of the environment, like water, were narrated in depth. Here there was considerable difference in opinion on the interaction of precipitation and water with health, dependent on what form they manifested in, for example, humidity, groundwater, rain, or flood. John Caswall, for instance, a medical officer of the Madras Medical Service, was employed in Singapore during that colony's first decade under British rule to report on the island's medical topography. Describing a situation of near "complete saturation" caused by perpetually "moist" airs, miasmatic and unsanitary swamp "exhalations" and the frequent heavy rains of the north-east monsoon, he was astonished that colony was in fact remarkably healthy, free (or so he supposed) from the diseases that marked out other tropical settlements including "malignant intermittent fevers" and malaria.[22]

Dr. T. M. Ward produced medical topographies for Malacca and for Penang Island, the latter where the newly developing urban settlement of George Town was emerging. Written much later than Caswell's account, Ward had the benefit of a few more decades experience of the local climatic conditions which included piecemeal medical records and meteorological observations that spanned multiple years. As result he could make correlations between weather and disease outbreaks and was slightly less effusive about the healthiness of the Straits Settlements. Indeed, Ward's study of Penang for example, made in collaboration with an Assistant Surgeon (Madras), J. P. Grant, was an extensive critique of previous reports which he described as of a "vague and erroneous" nature and which had tarnished the island with a reputation for being insalubrious and unhealthy.[23]

Ward paid very close attention to the circumstances in which the meteorological observations had been made over the years, to verify and assess their accuracy for his studies. For Malacca, for instance, he used a set of early observations made under the direction of Colonel Farquhar in 1809, which had been published in the first volume of the *Transactions of the Royal Asiatic Society of Great Britain and Ireland* and compared these with a further set made in 1828. He considered how the instruments had been kept, whether there was any potential for contamination from excess heat and explained possible discrepancies between the two datasets. Like Caswell, he had inferred medical information from elements of the

[21] James Johnson, *The Influence of Tropical Climates, More Especially of the Climate of India* (on European Constitutions &etc., 1815); J. R. Martin, *The Influence of Tropical Climates on European Constitutions &c*, (London, 1853, new edn. 1856); R. Scoresby Jackson, R., *Medical Climatology* (London, 1862). For the history and evolution of miasma in medical thought, see: Caroline Hannaway, "Environment and Miasma" in *Companion Encyclopaedia of the History of Medicine*, ed. W. F. Bynum and Roy Porter (Routledge, 1993), 292-308..

[22] British Library (hereafter BL): MSS EUR D157. John Caswall, *Observations on the Medical Topography of Singapore* (1830), ff. 2, 6, 22-4.

[23] T. M. Ward and J. P. Grant, *Official Papers on the Medical Statistics and Topography of Malacca and Prince of Wales' Island…&c* (Government Press, 1830), preface.

landscape, noting how because of the absence of marshes in the vicinity of Malacca, that the town ought to be free of marsh 'effluvia,' and therefore ought to be healthier than Singapore or Penang which were known for being low-lying and marshy in many places.[24]

For Penang however, he considered the upland areas to be relatively healthy, supported by weather observations made at altitude on Government Hill. Indeed, a government-sponsored convalescent bungalow for officers and their families had been built to take advantage of the cooler temperatures and breezes on nearby Penang Hill, overlooking the main settlement. This was known at the time as "Mount Hygeia."[25] Ward's Penang topography wanders from the scientific to the subjective. On the one hand, his work provides extensive reference to studies of climate and disease by medical professionals working across the British Empire and China citing Johnson and others, including John Clark. Yet, he waxes lyrical about the beauty of the hills and their cool airs, claiming that the subsequent 'enervation of the soul' could not fail to help invalids in their recovery.

Hazardous Environments

Doctor Robert Little's study of Singapore was published almost two-decades after Ward's studies of Penang and benefitted from weather observations made by Lieutenant Charles Elliot at the short-lived Singapore Observatory (1841-45), even though he was rather critical of the quality of the observations that had been made during that time.[26] Little was particularly concerned to discuss the winds and, what he felt were superstitious beliefs held by "natives" and "resident Europeans" alike on their purported healthiness, dependent on their origin and the time of the year during which they blew.[27] But what most concerned him most (as Ward before him), was water. The frequent rain, he noted, was conducive to health. It cooled the earth and diminished "the generation of any atmospherical [sic] Malaria … by which all stagnation is prevented and marsh miasma is but little generated." [28] However, Little also warned of the dangers of humidity, as "Malaria or miasm find in moisture an excellent medium of transmission, and from the statistics of tropical countries it is well known that wherever there is much moisture there is a corresponding increase of diseases." Toxic miasma was created by excess water in combination with decomposing animal or vegetable matter, argued Little. In his opinion, miasma was a serious issue in Singapore because of the prevalence of swamps on the island and its frequent tidal and monsoonal flooding. Adding to the problem were the forest clearances that were then transforming the landscape into plantations and waste grounds of *lalang* (a tough grass) which had created more "vegetable decay and standing water."[29]

These views were not confined to the Straits Settlements but were echoed elsewhere in sub-tropical and temperate regions. Charles Courtney, for example, a British Royal Navy surgeon of the Provisional Battalion of Marines in the China Squadron during the Opium Wars between China and Britain created medical topographies for all the places that he visited, including Hong Kong, Guangzhou (Canton), Macao, Shantou (Swatow), Xiamen (Amoy),

[24] Ibid., pp. 14-16.

[25] Ibid., p. 3.

[26] Robert Little, "An Essay on Coral Reefs as the cause of Blakan Mati Fever etc, Part I: On the medical Topography of Singapore, particularly its Marshes and Malaria," *Journal of the Indian Archipelago and Eastern Asia* 3, no. 8 (1848): 459-463; Anon, "Miscellaneous Notices &c: The Singapore Observatory", *Journal of the Indian Archipelago and Eastern Asia* Vol. 3, no. 4 (1849): xxxvii-xlvi.

[27] Little, "An Essay on Coral Reefs as the cause of Blakan Mati Fever etc, Part I", 851-853.

[28] Ibid., p. 458.

[29] Little, "An Essay on Coral Reefs as the cause of Blakan Mati Fever etc, Part I", 458, 465-466.

Fuzhou (Fuchou), Ningbo (Ningpo), Zhoushan (Chusan), Shanghai and Beijing (Peking) and some major ports in Japan including Nagasaki, Hokkaido, and Tokyo.[30] Stationed with troops for the battle and occupation of Guangzhou from December 1857 to September 1858, for instance, Courtney described the subsequent year's weather month-by-month with instrumental records of the temperature, pressure and rainfall and gave detailed breakdowns of disease incidence in relation to the climate of each month. The weather was frequently accorded a significant role in creating the types and outcomes of disease across the year. In September, for example, he noted how the number of Intermittent Fever (probably malaria) had increased, a fact which he attributed to the change between the diurnal and nocturnal temperature and many cases of what he termed "debility" of an unspecified nature, where men had "clean tongues", "a small pulse", and "were scarcely able to walk" because of the "effects of the climate and previous sickness."[31] On moving to Hong Kong in 1859, Courtney was to write that conditions here were far less favourable than at Guangzhou and that the new colony was, and likely always would be, unhealthy due to the generally unsanitary conditions created by the weather in combination with the wet environment.[32] In particular, he argued that the high mountainous areas led to a constant flow of water that formed 'miasmatic' pools and swamps "favourable to the development of malaria."[33]

This pre-occupation with moisture and dangerous miasma was shared by others in Hong Kong including ship's surgeon John Buckley who, like Courtney, had been assigned to Chinese coastal waters. Noting for example that his ship's time in harbour at Hong Kong had been favourable because "the air was free from moisture," the situation changed in his last few days as heavy clouds and a drizzling rain commenced. He continued that, "This state of the atmosphere is the forerunner of that most unhealthy weather for which Hong Kong is celebrated and from which this this ship's Co [sic] suffered so much last summer … I think that a high degree of temperature should be joined to an atmosphere saturated with moisture to produce that excessive degree of debility for which Hong Kong is so justly renowned."[34] Buckley also referenced similar conditions in Singapore, describing the area of New Harbour (Tanjong Pagar) as "covered in mangroves, especially where the fresh water from the creeks and rivulets mixes with the salt water, at low water, there are immense tracts of black mud lying exposed to a burning sun, heaps of decaying mangrove trees mixed up with all kinds of putrefying animal matter, causing intense and rapid evolution of miasma. From this state of atmosphere, one would be led to expect the existence of Bilious Intermittent Fever."[35]

Despite their preoccupation with moisture as an indicator of ill-health, contemporary doctors also thought about the temperature. Little's work in the Straits Settlements, for instance, showed close connection with contemporary scientific experiments undertaken in London and in Edinburgh by Luke Howard and David Brewster respectively, the former on the influence of buildings on heat and the latter on establishing the mean temperatures of heat at tropical latitudes. It is here that Little's work as a medical doctor reveals the influence of global science in his assessments of the validity of available empirical evidence for the weather and

[30] The National Archives, UK (hereafter TNA), ADM 101/163. Appendix to the Journals of the Provisional Battalion of Royal Marines, Medical Topography of China and Japan by Charles Courtney, 1857-61.

[31] Ibid., pp. 8, 25.

[32] For more on Courtney, see: Michael Humphries, ed., *Surgeon on the High Seas: The Journal of Charles Courtney* (Atrrabates Press, 2012).

[33] TNA, ADM 101/163, pp. 17-19.

[34] TNA, ADM 101/185/4 Journal of Her Majesty's Sloop Rinaldo, China Station for the year 1871, Notes on Tropical Diseases, p. 37.

[35] TNA: ADM 101/185/4, p. 39.

his understanding of fluctuations in atmospheric temperature at local scales. Noting a two degree rise in temperature across twenty-year's worth of observations, for instance, he ascribed this phenomenon to short-term, localised, Anthropogenic factors, such as the increase of buildings and the loss of jungle.[36]

Relatedly, colonial doctors were preoccupied with seasonality and the impact of changes of season on human health. Medical topographies and ongoing studies reported the incidence of disease and disease types in concert with a detailed breakdown of the weather across seasons and noted the prevalence of illness during seasons or during and after extreme weathers. The onset of the annual northeast monsoon in the Straits Settlements, for example, was particularly to be feared, as it heralded the "commencement of the sickly season from its excessive dampness."[37] Courtney in Hong Kong attributed "intermittent, Remittent and Continued Fevers, Boils, Diarrhoea and Dysentery, and Hepatic affections" to annual weather cycles. Dysentery, for example, was most common during sudden changes of weather and "Intermittent Fever" was prevalent "about the equinoxes and in the cooler weather". The difficulty of pinning down the multiplicity of characteristics assigned to the fatal "Hong Kong fever" was also ascribed to the weather: as Courtney explained it, the disease changed with each season.[38] Seasonality, and the rapid changeability of weather from hot and dry to cool and wet, were considered the most dangerous scenarios for health and it is in this context that natural hazards were feared, beyond their immediate impacts on society.

Shifts in Thought and Practice

By the late-nineteenth century, the medical topography had given way to a more deeply embedded and regularised reporting of health and weather data. There had been a concerted push by scientific societies and observatories across the British Empire and the Asian region to ensure more standardisation in observation making and reporting, especially as the science of forecasting was becoming more relevant and adopted across the world. There had also been a push factor to more closely investigate the tropical atmosphere following a series of what were considered unusual events including cooler periods in the 1840s and 1860s which saw severe cholera epidemics in India and in China, as well as a series of strong El Ninõ events in the 1870s, 1880s and 1890s, resulting again in dearth or famine, cholera, and high mortality levels across many parts of Asia due to associated droughts.[39] Such events had generated much speculation about the influence of unstable climates on human health and pushed British officials in Asia to devote more attention to meteorological data gathering to identify patterns.[40]

---

[36] Ibid., p. 462. For discussion of the changing ideas on climatic changes, see: Philipp Lehmann, *Desert Edens: Colonial Climate Engineering in the Age of Anxiety* (Princeton University Press, 2022), 1-37.

[37] *The Singapore Free Press and Mercantile Advertiser*, 3 August 1843, p. 1.

[38] TNA, ADM 101/163, p. 29.

[39] Clive Oppenheimer, Clive, "Climatic, Environmental and Human Consequences of the Largest Known Historic Eruption: Tambora Volcano (Indonesia) 1815," *Progress in Physical Geography* 27, no. 2 (2003): 230-259; G. Gong, et al., "Influence of Climatic Changes on Agriculture" in Historical Climate Changes in China, ed. P. Zhang (Shandong Science and Technology Press, 1996), 406-25; Davies, *Late Victorian Holocausts*, 2001; McMichael, Woodward and Muir, *Climate Change and the Health of Nations*, 209-19; Rory P. D. Walsh, "Drought frequency changes in Sabah and adjacent parts of Northern Borneo since the late nineteenth century and possible implications for tropical rain forest dynamics," *Journal of Tropical Ecology* 12, no. 3 (1996): 385-407.

[40] Richard Grove, "The East India Company, the Raj and the El Nino: The Critical Role played by colonial scientists in establishing the mechanisms of global climate Teleconnections, 1770-1930," in *Nature and the Orient: The Environmental History of South and Southeast Asia*, ed. Richard Grove, Vinita Damodaran and Satpal Sangwan (Oxford University Press, 1998), 301-323.

In Hong Kong, for example, staff at the Seaman's Hospital had kept daily weather records during the 1850s and at the Government Civil Hospital from the 1860s.[41] In the Straits Settlements, the Medical Department had taken over the meteorological provision for the colony formally in 1869. These administrative changes had enabled more extensive correlative work to be undertaken as hospitals and departments accumulated long-term, detailed statistics.[42] It also meant that the head of the medical department also had to be very familiar with the science of meteorology. Thomas Irving Rowell, for instance, Principle Civil Medical Officer for the Straits Settlements was responsible for the first expansion of the meteorological registering station network across peninsula Malaysia and Singapore.[43] The observations made by this stage were also far more thorough than they had been earlier in the century, now encompassing pressure, air and evaporation temperatures, vapour tension and relative humidity, alongside precipitation, temperature and narrative observations of the wind.

The medical topography had been little more than a snapshot in time, building on the principles made famous by James Clark and, later, Robert Scoresby Jackson. The concept of stable local climates and their related healthful attributes had been destabilised by the reality displayed in multiple years' worth of weather observations, that pointed to decadal shifts and regional extremes that could not always be explained by localised deforestation or urban development. In the Straits Settlements, the myth of the stable latitudes of the intra-tropical convergence zone were re-evaluated by colonial officials as one in ten or in one in twenty-year disasters became apparent to longer-term settlers. They noted for instance, major droughts affecting Penang Island in 1849, 1864 and 1877 and Singapore in 1855, 1864, and 1877, the serious event in 1877 also reported by government meteorologists Henry Blanford in India and Charles Todd in Australia.[44] In Hong Kong, Colonial Surgeon Philip Ayers noted in his annual report for 1877 how the annual number of deaths had been higher than in any of the nine years' previous citing the "atmospheric conditions" namely the "greater heat" and "considerable decrease in the rainfall" for the increase in mortality.[45]

Another significant change was connected to new understanding of the vectors for disease. For example, in the Straits Settlements, cholera tended to be correlated to drought. However, in earlier droughts, such as that which occurred in 1849, the disease was connected to the rise of miasmatic airs but by the 1860s, there was an obvious shift in thought to connect cholera incidence to the lack of fresh water.[46] Dr F. K. Hampshire, colonial surgeon at Penang Island, for instance, argued that although cholera was "at its height in the hot and dry months" it was the "consequent deficiency of wholesome drinking water" and associated decline in

[41] Hong Kong Government Gazette (hereafter GA) Abstract of Meteorological Observations made daily throughout the year 1853, at the Seamans' Hospital, 29 April 1854; GA, Meteorological Observations taken at the Government Civil Hospital, Victoria, Hong Kong, 1st to 31st January 1861, 9 February 1861.

[42] Arnold, *The Tropics and the Traveling Gaze*, 44.

[43] 'Matters Meteorological', *Straits Times Weekly Issue*, 6 March 1886, p. 5.

[44] Don Garden, *Droughts, Floods & Cyclones: El Niños that shaped our Colonial Past* (Australian Scholarly Publishing, 2009); Davies, *Late Victorian Holocausts.*

[45] Sessional Papers Hong Kong (hereafter SP) 1878, Annual Report of the Colonial Surgeon, Hong Kong for 1877, *The Hongkong Government Gazette*, 6 July 1878, pp. 321-325.

[46] 'Pinang', *The Straits Times*, 3 July 1849, p. 3; 'Untitled', *The Straits Times*, 27 February 1864, p. 41; 'Pinang', *Singapore Free Press and Mercantile Advertiser*, 12 May 1864, p. 3; Untitled, *The Singapore Free Press and Mercantile Advertiser*, 11 August 1864, p. 3. Much of this work was undertaken by India-based doctors, for example: J. L. Bryden, *Epidemic Cholera in the Bengal Presidency: A Report on the Cholera of 1866-68, and its Relations to the Cholera of Previous Epidemics* (Office of the Superintendent of Government Printing, 1887); J. M. Cunningham, *Report on the cholera epidemic of 1875 in India* (Office of the Superintendent of Government Printing, 1876), 6.

public health that had caused the rise in cholera cases, rather than the weather per se in 1877.[47] In Hong Kong, Philip Ayers also had the same opinion. Writing in 1881 of the effects of heavy rains falling after a long period of drought, such as had occurred across the spring that year, he stated how these exact weather conditions were credited with bringing down levels of disease. This was not because of any miasma or thoughts about the effects of the weather on the body, but because the heavy rain "serves to flush the drains and subsoil", thus improve sanitation infrastructures and public health.[48]

In 1883, Ayers was to remark on how pleased he was to have the services of the newly established Hong Kong Observatory (opened that year) so as that responsibility for meteorological observations could be transferred from the Medical Department to the Observatory and in so doing, improve their quality and consistency.[49] Notwithstanding, after the transfer of the responsibility for meteorology to the Hong Kong Observatory, weather reports or commentary cease to appear in the annual medical reports at all, even during major epidemics, such as the bubonic plague outbreak of 1894.[50] Indeed, Hong Kong's medical reports under Ayers' direction were mainly concerned with the sanitary condition of the colony, which subject was to preoccupy him until he retired in 1895.[51] The opening of the Hong Kong Observatory in 1883 had coincided with a major cholera outbreak dealt with by another newly established institution: Hong Kong's Sanitary Board. Ayers had been instrumental in placing pressure on the colonial government to create this institution and to hire Osbert Chadwick, who as colonial consulting engineer, had undertaken a major report that looked at improving urban water infrastructure and linking domestic properties to a central supply, measures that were to be undertaken over the coming years.[52] These steps reveal the linkages between new medical ideas on disease vectors and resultant investment in improving public health through clean water.

In Hong Kong, comments on medical ailments that were instigated by the weather were taken up by Dr William Doberck, Director of the Hong Kong Observatory, after taking over the responsibility for meteorology from the Medical Department in 1883. He did not provide medical meteorology in the sense of correlations between weather patterns and illness, neither did he make anecdotal or pseudo-scientific comments on unhealthy or misamatic weathers, such as might have been done in the past. Instead, he followed the general theory derived from observation that malarial fevers followed heavy rains and appeared to "be particularly severe among those who dwell near the nullahs" (drainage channels).[53] The nullahs may have retained standing water for long periods which, as we know today, would have provided breeding grounds for malaria-bearing mosquitos.

---

[47] Robert L. Jarman, ed., *Annual Reports of the Straits Settlements, 1855-1941, Vol. 2 1868-83, 1877* (Archive Editions., 1998), 340, 389.

[48] GA 1882, Annual Report of the Colonial Surgeon, Hong Kong for 1881, *The Hongkong Government Gazette*, 3 June 1882, pp. 510-517, 516.

[49] GA 1884, Annual Report of the Colonial Surgeon, Hong Kong for 1883, *The Hongkong Government Gazette*, 24 May 1884, pp. 443-453, 453.

[50] SP 1895, Annual Report of the Colonial Surgeon, Hong Kong for 1894, *Papers Laid before the Legislative Council*, pp. 473-485.

[51] Obituary, Philip B. C. Ayers, C.M.G., M.R.C.S, 1899, *British Medical Journal* 2, p. 1140.

[52] Cecilia Chu, "Combating Nuisance: Sanitation, Regulation, and the Politics of Property in Colonial Hong Kong" in *Imperial Contagions: Medicine, Hygiene, and Cultures of Planning in Asia*, ed. Robert Peckham and David M. Pomfret (University of Hong Kong Press, 2013), 28.

[53] Special Report on Rainfall by the Hong Kong Observatory, 7 September 1891. Printed in the *Hong Kong Government Gazette*, 16 January 1892, p. 26. The report was commissioned by the government following a major drought across 1890-1891.

In Singapore, similar transitions manifested. In April 1877, the *Straits Times Overland Journal* reported, "the great heat of the weather, and … prolonged drought … ha[d] exercised a baneful effect on the health of the community owing to the consequent scarcity and bad quality of the water".[54] The medical rationale given for the cause and extent of cholera in 1877 was markedly different from the medical precepts espoused by James Randall Martin only twenty years earlier. From his research in India, Randall Martin argued in the mid-1850s (at around the same time as John Snow's recognition of how the disease spread) that cholera was issued from within, and could not be introduced to a country by ships from infected places. According to Randall Martin, epidemic cholera was present in the very soil of the Indian nation. While he did not rule out the possibility of conveyance by localised "ventilations" it could not, in his opinion, be passed from human-to-human.[55] Twenty-years later much of this had been debunked and expanded to other diseases too. Doctor Hampshire at Penang Island, for instance, had in 1877 also proposed, contrary to some popular belief, that the terrible drought was not the root of the rise of smallpox cases that year. This, he argued, was an introduced case, caused by infected sailors on a ship that had evaded quarantine at newly expanded facilities on a neighbouring island.[56]

Shifting views on causality were also prevalent in responses to floods. In 1859, for example, Charles Courtney had argued that floods were beneficial as they washed away the miasma and stagnant water that led to malarial disease.[57] Within a few decades however, district and municipal doctors and health officers were drawing different conclusions on the matter. After Hong Kong experienced record rainfall on 29-30 May 1889, resulting in what has been referred to as the "Great Rainstorm of the Century" for example, there was a notable spike in malarial cases.[58] The Colonial Surgeon attributed the greater prevalence of malaria directly to the rainstorms, citing how soil wash and landslips deposited alluvial matter onto lower lying areas which, combined with high temperatures and humidity had created the perfect mix of wet mud and standing water for the "evolution" of the disease.[59] His conclusions were supported by some of the highest district hospital admissions during June and a high incidence of malarial disease over the summer.[60] Contemporaries also noted how the floodwaters had polluted fresh water supplies and reservoirs with mud and other toxins, leading to an array of other health problems.[61]

Likewise, in Singapore three years later, the colony suffered an unseasonable flood "the like of which has never been known within the memory of the oldest residents" on 29 May 1892.[62] The flood waters had inundated much of the town, causing roadside embankments to break, waste channels to become silted by landslips and urban watercourses to flood their

[54] 'Fortnight's Summary', *Straits Times Overland Journal,* 28 April 1877, p. 1.

[55] Martin, *The Influence of Tropical Climates on European Constitutions &c*, 297.

[56] Quarantine facilities had been expanded on *Pulau Jerajah* (later *Jerajak*) for migrants from India and China arriving to work as indentured and coolie labour. The island was originally a leprosarium. See: Mike Gibby, *Jerajak: Penang's Untold Story* (Entrepot Publishing, 2018).

[57] TNA, ADM 101/163. Appendix to the Journals of the Provisional Battalion of Royal Marines, Medical Topography of China and Japan by Charles Courtney, 1857-61.

[58] Michael J. Jones, *A History of Hong Kong Typhoons from 1874* (PPP Company Limited, 2017), 140.

[59] SP 1890, Colonial Surgeon's Report for 1889, 27 June 1890, p. 330.

[60] Ibid., pp. 310, 314

[61] Jones, *A History of Hong Kong Typhoons from 1874*, 140.

[62] TNA, CO276-25: Municipal Engineer's Report for May 1892, 29 July 1892, p. 2067; 'Heavy Rainstorm in Singapore: Extensive Flooding', *The Singapore Free Press and Mercantile Advertiser,* 30 May 1892, p.2.

banks.[63] A particularly high incidence of disease was noted that year. Comparing mortality rates in Singapore with comparable Indian cities, the Health Officer for Singapore concluded that his station was far less healthy than those in India.[64] In his opinion, the main contributing factors were poor sanitation, overcrowding and endemic poverty but the flood, coming outside of the normal rainy season, had served to raise the disease and mortality figures far higher by exacerbating the effects of pre-existing problems.[65] The excess water had inundated and blocked the drains, for example, allowing waste matter to be deposited over roads, into houses and public places. Many of the poorer Chinese inhabitants, for example, lived in overcrowded homes built slightly below ground level which had become inundated with mud and foul water.[66] Alex Gentle, president of Singapore's Municipal Commission was to note that even the drains in the better European districts had become "defective" and "unwholesome."[67] Despite the availability of pumping engines, standing water had been left in many areas for a considerable time, prompting fears of a malaria crisis.[68] Then, on 18th January 1893, disaster struck again, with the worst floods in twenty years. Land slippages were unrelenting for several weeks after the flood itself, submerging several roads and houses as more than 25,300 tons of earth continued "its slow advance."[69] It was no surprise that the registered death rate for January was the highest of that year, with fevers and bowel complaints likely connected to the damp conditions and polluted water noted as the chief cause.[70]

The gradual recognition of cyclical atmospheric patterns and teleconnected events across regions (an important step toward realising the El Niño Southern Oscillation), pioneering work in better understanding disease vectors, such as microbial vectors rather than miasma in causing cholera, had enabled doctors to revaluate their assumptions about the ill-effects of humidity or marshes, and to work with new theories as to the health impacts of climatic instability. Norman Lockyer, for example, had drawn attention to an eleven-year cycle of the Indian monsoon, which he had related to sunspot activity, work which was then built upon by William Hunter, Director General of Statistics to the Government of India who connected this cycle with famine.[71] Not that this should tell a story of a teleological progression, however. Henry Blanford for instance, the first Director of the Indian Meteorological Department had expressed doubts over Lockyer's ideas and many other doctors remained undecided as to the impacts of too much, or too little, rainfall on different types of diseases and why.[72] Thomas Irving Rowell too, had noted in his 1882 annual medical report for the Straits Settlements how, despite the prevalence of cholera more generally, Singapore had remained relatively free of the disease. This happy fact he attributed to the "periodic and

[63] TNA, CO276-25: Municipal Engineer's Report for May 1892, 29 July 1892, p. 2066; 'Municipal Progress in May', *Straits Times Weekly Issue*, 29 June 1892, p. 8.

[64] TNA, CO276-25: Singapore Health Officer's Report for May 1892, 29 July 1892, p. 2068; 'Singapore Municipal Matters', *The Singapore Free Press and Mercantile Advertiser*, 28 June 1892, p. 10.

[65] TNA, CO276-24: Health Officer's Report for Singapore for April 1892, 10 June 1892, p. 1776.

[66] 'Heavy Rainstorm in Singapore', *The Singapore Free Press and Mercantile Advertiser (Weekly),* 31 May 1892, p. 346.

[67] TNA, CO276-25: Municipal Commissioners' Progress Report for May 1892, 29 July 1892, p. 2065.

[68] 'The Circus', *Daily Advertiser*, 3 June 1892, p. 3.

[69] TNA, CO276-26: Supplement: Municipal Engineer's Report for January 1893, 10 February 1893, p. 263.

[70] TNA, CO276-26: Appendix E-G, Deaths Registered in the Straits Settlements, during each month of 1892, 28 April 1893, p. 419r-v.

[71] Noman Lockyer and W. W. Hunter, "Sunspots and famines", *Nineteenth Century* 2 (1877): 583-602; Katherine Anderson, *Predicting the Weather: Victorians and the Science of Meteorology* (University of Chicago Press, 2005), 274-275.

[72] Henry Blanford, "The Eleven-Year Periodical Fluctuation of the Carnatic Rainfall", *Nature* 36 (1887): 227-29.

frequent squalls of wind and rain which visit us and purify the atmosphere," in addition to refreshing the water supply.[73]

This trend continued into the twentieth century, where traditional and more modern views co-existed in popular and medical culture. Cholera outbreaks in India are a case in point, where Sheldon Watts has argued that studies often presented contradictory findings.[74] In Hong Kong, the 1918 influenza pandemic and an epidemic form of meningitis were both thought by many to have been exacerbated by the weather. Detailed reports made by the Medical Officer for Health in Hong Kong during the 1910s, Dr Gale, correlated drops in temperature with increases in infections, with a corresponding decline on warmer days.[75] Likewise, with unseasonably low temperatures and rainy days in July 1918, a Singapore based medical practitioner argued that the "flu would only begin to pass with the arrival of the northeast monsoon in late November."[76] Similar sentiments were expressed by the President of the Municipal Council of Singapore that year, Mr W. Peel, who espoused in an October meeting that the council had done everything they could to contain and treat the flu scourge, only a change of weather could now eliminate it.[77]

Indeed, the relationship of climate with health also continued to be given credence by many high-profile doctors including Kenneth Black, Professor of Surgery at the King Edward VII College of Medicine in Singapore. Black had argued vociferously in 1932 that climate "is probably one of the most important factors in the life of man." Climate, he said, "has a direct effect upon health and an indirect effect through food, incidence of disease and mode of life."[78] Borrowing directly from geographer Ellsworth Huntington, he was a supporter of a form of climatic determinism that considered certain regions (mainly European and North American) optimum climates for energy and health. Black also expounded on the idea that "noxious stimuli" (of a type unspecified) present in the atmosphere contributed directly to a decline in mental health.[79] Although times were changing – indeed contemporary psychiatrists had remarkably different perspectives on the causes of mental illness – Black's medical perspectives could have come straight from a nineteenth century medical journal.[80] Indeed, as Cecilia Chu has argued for Hong Kong, the narrative surrounding public health was riven with preconceptions and stereotypes, many relating to the cultural practices of different races' apropos hygiene, as much as assumptions regarding climate as a causal factor in disease.[81] Anyone who has been inspired by historian Dane Kennedy's work on climatic anxieties will not be surprised. As Kennedy argued, rather than declining as new biomedical theories emerged, climatic causation saw something of a resurgence in the early twentieth century.[82]

---

[73] "Dr Rowell's Report", *Straits Times Weekly Issue*, 5 July 1883, p. 6.

[74] Sheldon Watts, "From Rapid Change to Stasis: Official Responses to Cholera in British-ruled India and Egypt: 1860 to c. 1921," *Journal of World History* 12, no. 2 (2001): 368.

[75] SP, 1918: Report on the Investigations of the outbreak of Epidemic Meningitis in Hong Kong by First Lieutenant Peter K. Olitsky for the Rockefeller Institute for Medical Research, p. 68.

[76] "Illness in Singapore", *The Straits Times*, 3 July 1918, p. 7.

[77] "The Influenza Scourge", *The Straits Times*, 26 October 1918, p. 10.

[78] Kenneth Black, "Health and Climate with special reference to Malaya," *Malayan Medical Journal* 7, no. 3 (1932): 99.

[79] Ibid., 101-2.

[80] Dr Van Wulfften Palthe, writing on mental illness suffered by Europeans in Batavia gave explanations including loneliness, distance from home and monotony of the environment as key stimuli: Palthe Van Wulfften, "Psychiatry and Neurology in the Tropics," *Malayan Medical Journal* 8, no. 3 (1933): 133.

[81] Chu, "Combating Nuisance", 17.

[82] Kennedy, "The Perils of the Midday Sun", 118.

The Fall of Medical Meteorology?

The first decades of the twentieth century brought significant changes in medical thinking that led to a further decline in the fundamental tenets of medical meteorology. Work on disease transmission and tropical illnesses, such as that by Ronald Ross on malaria, Patrick Manson on parasitology, or James Cantlie on leprosy and plague combined with urban health reforms at the local and metropolitan level, aimed at improving sanitation and living conditions, which were by then accepted as leading cause of the incubation and spread of disease. The colonies drew directly from the British urban reform movements, but also from their own experiences on the ground, especially in terms of managing more extreme weathers than was the case in Britain.

The 1907 publication of the Simpson Report for instance, a ninety-four-page milestone in Straits Settlements public health history, is case-in-point. Dr William Simpson was an expert on tropical health and sanitation who later became a professor and founder of the London School of Hygiene and Tropical Medicine.[83] His report on Singapore and George Town, Penang conducted during 1906 overwhelmingly pointed towards structural issues, especially housing design and in sanitary engineering, as the root cause of ill health and mortality there.[84] Flooding and poor mitigation such as ill-functioning, badly designed, poorly situated and easily overwhelmed culverts, channels and canals, were studied as a catalyst in this quagmire of cause and effect and, while the climate was still considered trying (especially for Europeans), the discourse was gradually being reframed toward climate as a factor in creating the conditions in which disease thrived, rather than being a cause, of illness.[85]

This shift can be seen clearly in Simpson's views on *Kampong Boyan*.[86] This *kampong* (the Malay word for village) was dominated by Baweanese migrants originally from East Java, many of whom continued to replicate their traditional ways of living in wooden, communal homes known as *pondok* in Singapore. Their community was built on mud flats adjacent the tidal Rochor River and mainly comprised mangrove swamps.[87] Simpson argued that traditionally the Baweanese style of stilt houses were well suited to damp, tidal environments but that in this instance, the spaces underneath the houses between the piles had been filled with extra rooms to accommodate the growing population. Now, every time the tide rose, or there were heavy rains or floods, these dwelling spaces would flood and inhabitants would end up living in these damp conditions for days and even weeks on end.[88] In George Town too, he pointed to the deficiencies of the storm-water drainage system which was, in his opinion, compounding tidal flooding into a serious hazard. Obstructed drains caused sea water to regurgitate and overflow, causing floods where none should have existed, creating a corresponding increase in malaria.[89]

---

[83] R. A. Baker R. A. and R. A. Bayliss, "William John Ritchie Simpson (1855-1931): Public Health and Tropical Medicine," *Medical History* 31 (1987): 450-65.

[84] Wellcome Trust Library, WA67O.JS6. W. J. Simpson, *Report on the Sanitary Condition of Singapore* (1907).

[85] "A String of Enquiries", *The Straits Times*, 9 September 1902, p. 4.

[86] The name *Kampong Boyan* is not used in modern Singapore, the area is now incorporated into *Kampong Kapor*. Its location falls between modern Kallang Road, Jalan Besar, and Lavender Street. See Map of Singapore showing the principle residences and places of interest, 1913 published by Fraser and Neave Ltd, Singapore, available at National Library of Singapore's Spatial Discovery website: https://search.nlb.gov.sg/spatialdiscovery/app/

[87] The Rochor was a tidal river until the 1950s: Yong Soon Tan, et al., *Clean, Green, and Blue: Singapore's Journey toward Environmental and Water Sustainability* (Institute of Southeast Asian Studies, 2009), 205. National Library of Singapore, SingaporeInfopedia, The Baweanese: https://eresources.nlb.gov.sg/infopedia/articles/SIP_1069_2007-06-20.html

[88] Simpson, 1907, p. 27.

[89] Ibid., p. 94.

Changing medical thought was not the only dynamic at work to undermine medical meteorology's place, however. Despite medical officer Irving Rowell's hand in establishing more meteorological registering stations across Malaya, for example, many of the new stations were not linked to medical facilities and, just as in Hong Kong after the opening of the Observatory, the medical department had less and less to do with the weather by the early twentieth century. Indeed, by the 1910s responsibility for meteorology was being taken away from the Medical Department in entirety. Placed first under the Museum's Service for almost two decades, it then enjoyed a brief two-year stint under the Surveyor General's Department prior to being established as a formal department in 1929.[90]

By the 1920s, it was apparent that aviation (commercial and military) and agriculture were the key drivers of meteorological investment by colonial governments, not health. The duties of the new Malayan Meteorological Service, for example, were devoted to forecasting for these industries. Their reports did not reference disease, although only a generation before, doctors had paid attention to nascent meteorological science and meteorologists had written about health. As Skydsgaard noted for Denmark, enthusiasm for medical meteorology had waned over the turn of the century as alternative explanations for epidemic disease gained credence and as Mark Carey has argued, the notion of tropics gradually turned from somewhere unhealthy to somewhere desirable in popular culture.[91]

Although medical meteorology may have ceased to be a valid field of research, the role of weather – especially extreme weather - in disease causation, remained. In 1945, for instance, survey reports completed by the British' Inter-Service Topographical Department on the Canton and Hong Kong region, published climatic and medical information together. Referring to linkages between the rainy season and the incidence of malaria, these reports discussed how the rains increased insect vectors and created conditions for other disease bearing insects to thrive. Elsewhere, the dangers of heat stress on military troops became an established field of enquiry. Such studies continue across the tropical world today and with good reason.[92] Thus, these preoccupations have not disappeared, only been reinvigorated in light of new medical knowledge and concerns.

Anthropogenic climate change is increasing the number and frequency of extreme events and, in tandem, decreasing societal resilience to disease. Many parts of South, East and Southeast Asia will be especially vulnerable to hazards including floods, droughts and heatwaves, all of which can increase the spread of disease vectors, increase mortality and impact on human health.[93] While modern knowledge about the relationship of climate and disease causation pivots on complex systems of interdependencies rather than the correlative patterns and simple climatic determinism of medical meteorology, some of the basic ideas and principles connecting climate and health under discussion today would not seem entirely alien to our nineteenth century forebears. Medical meteorology may have had its time, but its basic logic remains.

---

[90] TNA, CO273/541 Sir George Maxwell and Herbert C. Robinson, 'A Meteorological Department for Malaya', 1927.

[91] Skydsgaard, "It's Probably in the Air", 218: Mark Carey, "Inventing Caribbean Climates: How Science, Medicine, and Tourism Changed Tropical Weather from Deadly to Healthy," *OSIRIS* 26 (2011): 129-41.

[92] TNA, WO252/1467. *Hong Kong-Canton Area-Climate Medical*, Inter-Service Topographical Department, January 1945, ff. 7, 11.

[93] C. B. Field, et al., *"Summary for Policymakers" in Climate Change 2014: Impacts, Adaption and Vulnerability Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the IPPC* (Cambridge University Press, 2014), 6.