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Atmosphere, environment, society: The typhoon vulnerability nexus in early twentieth-century Hong Kong

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Abstract

By looking at how typhoon risk was managed in early twentieth-century colonial Hong Kong, this article argues that bringing a historical lens to the discussion of the human–climate–environment nexus is an essential part of studies of resilience and vulnerability. It interprets physical evidence of the strength of a natural event against human factors, including structural and social vulnerabilities and governance. Investigating two of the deadliest typhoons to have hit Hong Kong's shores (1906 and 1937), this article notes that social vulnerabilities played a major part in turning the typhoon of 1937 into a worse disaster than 1906, despite advances in storm warning and typhoon defences in the intervening years. Thus, with our close lens and with hindsight, we can extrapolate the many factors that contributed to decreased resilience, potentially learning from each disaster as a window into understanding risk elsewhere today.

Keywords: disaster, risk, vulnerability, colonialism, Hong Kong, typhoons

In disaster risk literature, disasters are not considered natural, but nature induced. The rapid urbanisation that often comes with development and/or colonisation is associated with poor infrastructural capacities, land-use change, poverty, overcrowding and limited mitigation for extreme weathers. Combined with centralised disaster risk management that is predicated on limited or reactive planning, governmental failings can disenable communities and individuals from becoming resilient in the face of one, or multiple, extreme events. The coupling of human systems and natural processes renders places and inhabitants more vulnerable to complex, systemic risk, leading, potentially, to the increased likelihood of a cascading disaster across different spatial and temporal scales.[1] This coupling, often termed a human–climate–environment nexus, situates human interposition in the natural world firmly within a hazard causation narrative and can, at its most extreme, compromise ecosystem and human

1 Amir AghaKouchak et al., 'How Do Natural Hazards Cascade to Cause Disasters?', *Nature* 561 (2018): 458–460, doi.org/10.1038/d41586-018-06783-6; Jakob Zscheischler et al., 'Future Climate Risk from Compound Events', *Nature Climate Change* 8 (2018): 469–77, doi.org/10.1038/s41558-018-0156-3.

resilience. Ultimately, this nexus has shaped human societies over times past and will continue to do so into our future.[2] As John McNeill states, 'human history has and always will unfold within a larger biological and physical context'.[3]

Recent work points to the necessity of bringing a historical lens to the discussion of environmental processes and human development as an essential part of resilience and vulnerability studies.[4] This is a call that several of the articles in this special issue take seriously and, similar to Marco Lagman's study of Philippine typhoons and the account of drought in Unyanyembe by Philip Gooding et al., this article likewise uses a historical lens to explore how the human–climate–environment nexus can drive an extreme weather event into a disaster. A key component of this nexus is resilience. This comprises multiple factors, including the state of the local economy, social equality, cohesion and adaptability, infrastructure and land use, scientific innovation, policy, planning and preparedness. Thus, this article pays attention to reconstructing past disaster scenarios as an exploration of vulnerability, a method increasingly recognised as important for recreating and understanding disaster risk today.[5]

As climate and environmental change accelerate in the 'Anthropocene', increasing numbers of environmental historians have been unpicking the dynamics of the human–nature interaction. They have built on the works of scholars, such as Tom Griffiths, who have argued with Humboldtian pathos that historians have a responsibility to reveal how environmental problems are also human ones.[6] Some of the earliest examples of this genre have also combined studies of climatic events with colonial studies, such as this article intends to do here. Richard Grove and Mike Davies have penned well-known examples in this genre, examining the role of the colonial state in creating situations of vulnerability.[7] More recently, Chris Courtney has explored how extreme rainfall events triggered by intense La Niña conditions combined with land reclamation, deforestation and new hydraulic schemes all led to a decline in social resilience that exacerbated the severity of floods in Mao-regime China.[8] Looking

2 Christopher B. Field and Anna M. Michalak, 'Water, Climate, Energy, Food: Inseparable and Indispensable', *Daedalus* 144, no. 3 (2015): 7–17, doi.org/10.1162/DAED_a_00337.

3 John R. McNeill, 'Observations on the Nature and Culture of Environmental History', *History and Theory* 42 (2003): 6, doi.org/10.1046/j.1468-2303.2003.00255.x.

4 I. Kelman et al., 'Learning from the History of Disaster Vulnerability and Resilience Research and Practice for Climate Change', *Natural Hazards* 82 (2016): 129–43, doi.org/10.1007/s11069-016-2294-0.

5 Bashir Ahmad et al., 'Retracing Realistic Disaster Scenarios from Archival Sources: A Key Tool for Disaster Risk Reduction', *International Journal of Disaster Risk Science* 12 (2021): 635–48, doi.org/10.1007/s13753-021-00363-5.

6 Tom Griffiths, 'The Planet Is Alive: Radical Histories for Uncanny Times', *Griffith Review* 63 (2018), www.griffithreview.com/articles/planet-is-alive-radical-history, accessed 27 October 2022; Bruno Latour, 'Fifty Shades of Green', *Environmental Humanities* 7 (2016): 219–25, doi.org/10.1215/22011919-3616416; Mike Hulme, 'Reducing the Future to Climate: A Story of Climate Determinism and Reductionism', *Osiris* 26 (2011): 245–66, doi.org/10.1086/661274.

7 Richard Grove and George Adamson, *El Niño in World History* (London: Palgrave Macmillan, 2018); Mike Davies, *Late Victorian Holocausts: El Niño Famines and the Making of the Third World* (London: Verso, 2001); Richard H. Grove, 'Global Impact of the 1789–93 El Niño', *Nature* 393 (1998): 318–19, doi.org/10.1038/30636.

8 Chris Courtney, 'Governing Disasters: A Comparative Analysis of the 1931, 1954 and 1998 Middle-Yangzi Floods in Hubei', in *Governance, Domestic Change, and Social Policy in China: 100 Years after the Xinhai Revolution*, ed. Jean-Marc F. Blanchard and Kun-Chin Lin (London: Palgrave Macmillan, 2017), 67–102.

more specifically at typhoons, James F. Warren's study of the colonial Philippines in the atmospherically turbulent 1860s–1920s period asks similar questions in regard to governance and resilience, and Robert Rouphail explores how agrometeorology and post-typhoon reconstruction efforts by the British colonial government in Mauritius created new stories of human climatic/environmental response and adaptation.[9]

Historians are also examining the present and even the near future to explore how the problems created during the historic phases of this nexus may evolve as we move further into the 'Anthropocene'. Sunil Amrith, for instance, has written extensively on the hydrological cycle and the dynamics of ecosystems, politics, culture, science and technology in the Indian Ocean World.[10] In Australasia, Ruth Morgan and others are examining relationships of water, human culture and ecological welfare as they advance through population and environmental change.[11] What such studies reveal is that the boundaries between environmental and climate history—and, most recently, policy—have become increasingly porous. As Tirthankar Roy's study of institutional responses to natural disasters in India's history shows, the macro-view of the past can inform policy in the present with its long view on risk, land and infrastructural management.[12] As our climate becomes progressively more unpredictable, such studies are attracting increasing attention across multiple fields.[13]

This chapter contributes to this broader discussion by exploring the circumstances surrounding two typhoon-induced disasters in early twentieth-century Hong Kong. Like the study by Gooding et al. in this special issue, it interprets physical evidence of the strength of the natural event against human factors, including structural and social vulnerabilities and governance. The 1906 and 1937 typhoons are considered two of the deadliest to have hit Hong Kong's shores since formal records began in

9 James F. Warren, 'The Great Ilocos Flood of 1867', in *Droughts, Floods, and Global Climatic Anomalies in the Indian Ocean World*, ed. Philip Gooding (Cham: Palgrave Macmillan, 2022), 199–229; Robert M. Rouphail, 'Disaster in a "Plural Society": Cyclones, Decolonisation, and Modern Afro-Mauritian Identity', *Journal of African History*, 62, no. 1 (2021): 79–97, doi.org/10.1017/S0021853721000189; Robert M. Rouphail, 'Cyclonic Ecology: Sugar, Cyclone Science, and the Limits of Empire in Mauritius and the Indian Ocean World, 1870s–1930s', *Isis* 110, no. 1 (2019): 48–67, doi.org/10.1086/702729.

10 Sunil S. Amrith, *Unruly Waters: How Rivers, Coasts, and Seas Have Shaped Asia's History* (New York: Basic Books, 2018).

11 Ruth Morgan, 'Climate, Weather, and Water in History', *WIREs Climate Change* 10, no. 1 (2019): 1–13, doi.org/10.1002/wcc.561; Jessica Cattelino et al., 'Water Flourishing in the Anthropocene', *Cultural Studies Review* 25, no. 2 (2019): 135–52, doi.org/10.5130/csr.v25i2.6887; Ruth Morgan, 'The Continent without a Cryohistory? Deep Time and Water Scarcity in Arid Settler Australia', *Journal of Northern Studies* 13, no. 2 (2019): 43–69.

12 Tirthankar Roy, *Natural Disasters and Indian History* (New Delhi: Oxford University Press, 2012). See also, for example: Zozan Pehlivan, 'El Niño and the Nomads: Global Climate, Local Environment, and the Crisis of Pastoralism in Late Ottoman Kurdistan', *Journal of the Economic and Social History of the Orient* 63, no. 3 (2020): 330–4, doi.org/10.1163/15685209-12341513; Gooding, ed., *Droughts, Floods, and Global Climatic Anomalies*.

13 I-I. Lin et al., 'ENSO and Tropical Cyclones', in *El Niño Southern Oscillation in a Changing Climate*, ed. Michael J. McPhaden et al. (Hoboken, NJ: Wiley, 2020), 377–408; Yoo-Geun Ham, 'El Niño Events will Intensify under Global Warming', *Nature* 564, no. 7735 (2018): 192–3, doi.org/10.1038/d41586-018-07638-w; Yen Li Loo et al., 'Effect of Climate Change on Seasonal Monsoon in Asia and Its Impact on the Variability of Monsoon Rainfall in Southeast Asia', *Geoscience Frontiers* 6, no. 6 (2015): 817–23.

1884, resulting in the loss of around 15,000 and 11,000 lives, respectively.[14] While there were advances in both storm warning systems and typhoon defences during this period of 30 years or so, this article notes that patterns of vulnerability played a major part in turning the typhoon of 1937, in particular, into a disaster. Thus, with our close lens and with hindsight, we can extrapolate the many factors that contributed to decreased resilience during the earlier time period, potentially learning from each disaster as a window into understanding risk elsewhere today. This article starts with an exploration of each event's impact and strength and a brief examination of the state of typhoon science—especially prediction—before moving on to look at contemporary emergency preparedness. This discussion implicates an examination of policy, infrastructure and planning. Finally, the discussion moves onto social factors contributing to vulnerability, especially social inequalities and poverty.

The typhoons

Hong Kong is situated off the south China coast within the north-western Pacific Ocean typhoon basin, one of the most active storm basins in the world. There are on average 20 tropical storms every year, concentrated across the peak season of June to October, generally developing in the south-east and passing the Philippines, before hitting the China coast.[15] In 1906 and 1937, however, there were two typhoons that are considered amongst the strongest and deadliest twentieth-century events.[16] In the early hours of 18 September 1906:

> there was to be heard in every direction, above the howling of the wind, the sound of banging shutters and falling glass and tiles. On the hillside huge branches were being torn from the big trees while scores of smaller trees were being uprooted. In the streets, rickshaws were overturned and the light sedan chairs were being blown about like feathers. Pedestrians were whirled off their feet or were clinging tenaciously to anything that afforded them a holding.[17]

Hong Kong's Royal Observatory—the main institution responsible for monitoring local and regional weather—recorded wind speeds of up to 124 km/h (77 mph) and the tidal surge—a force often more destructive than the winds themselves—was reported to have peaked at 3.35 m (11 ft) above chart datum.[18] The centre of the

14 Pui-Yin Ho, *Weathering the Storm: Hong Kong Observatory and Social Development* (Hong Kong: Hong Kong University Press, 2003), 70.
15 Si Gao et al., 'Western North Pacific Tropical Cyclone Activity in 2018: A Season of Extremes', *Scientific Reports* 10, no. 5610 (2020): doi.org/10.1038/s41598-020-62632-5.
16 Ho, *Weathering the Storm*, 76.
17 *The Calamitous Typhoon at Hongkong 18th September, 1906: A Full Account of the Disaster* (Hong Kong: Hong Kong Daily Press, 1906), 8.
18 Hong Kong Observatory, 'Significant Storm Surge Events in Hong Kong before 1954' (Victoria Harbour), www.hko.gov.hk/en/wservice/tsheet/pms/stormsurgedb_notes.htm, accessed, 27 October 2022; *Meteorological Observations Made at the Hongkong Observatory in the Year 1906* (Hong Kong: Noronha & Co., Government Printers, 1907), 2; P. Peterson, *Storm Surge Statistics*, Hong Kong Observatory Technical Note (Local) No. 20 (1975), Table III.

storm hit the Hong Kong coast at the Tolo Harbour in the east, where many small villages and farms around Sha Tin and Tai Po in the New Territories were destroyed by the surging waters.[19] In the central Praya area:

> from the Harbour Office, going West, the scene was a pathetic and deplorable one, piles of boards, spars, beams, boxes and sails literally formed a barrier right across the road, for hundreds of yards, testifying to the immense, the almost incalculable number of sampans and junks that had been destroyed beyond all redemption.[20]

The exact number of fatalities is unknown but has been estimated at 5 per cent of the population of 320,000, with 15,000 deaths and 1,349 people missing. Many of these were fishermen unable to reach a safe harbour.[21]

Three decades later, approximately 11,000 lives were lost during the 2 September 1937 typhoon. At least 30 large vessels were damaged or destroyed after being driven ashore, almost a mile of rail embankment was washed away in the New Territories and there were three major landslips.[22] Again, it was the fishing population and the small villages of the Tolo Harbour area that were the worst hit, with a high-water mark estimated to be 6 m above chart datum.[23] The sea level in Victoria Harbour rose to 1.98 m (6.5 ft) above high tide and a 3.8 m (12.5 ft) tidal surge hurtled through the Tolo Channel and into the low-lying Shatin Valley.[24] At Tai Po and Sha Tau Kok, this meant that squatters' huts and small houses had been almost entirely swept away.[25] In the main town, there was also significant damage from flooding and a large area of wooden tenement buildings in Connaught Road caught fire, killing several people who had been trapped inside.[26] The Royal Observatory stated that the minimum barometer reading of 29.298 in Hg (992.144 mb) was the lowest recorded since their records had commenced in 1884:

> Mr A. C. Jeffreys, the Director [of the Royal Observatory], told the China Mail that he estimated the velocity of certain gusts at 150 miles per hour [240 km/h], and a reading taken on an instrument at the Hong Kong Electric Installation at North Point showed one gust of 160 mph [260 km/h]. The minor damage runs into millions of dollars. Everywhere is wreckage and confusion. More than forty ships found themselves in difficulty during a night of wild fury … shop fronts were battered to pieces in Gloucester Road this morning by the huge dashing waves which completely flooded the whole road. Several tenants have lost all their furniture which was washed away at the height of the gale.[27]

19 Michael J. Jones, *A History of Hong Kong Typhoons: From 1874* (Hong Kong: PPP Company, 2018), 42.

20 *Hong Kong Telegraph*, 18 September 1906, 5.

21 Ho, *Weathering the Storm*, 76.

22 Colony of Hong Kong, 'Typhoon's Toll: An Authentic Record of the Disastrous Typhoon Which Struck the Colony on 2nd September, 1937' (poster); 'Report of the Director of Public Works for the Year 1937', Appendix Q 7, 44.

23 In other words, this meant a tidal surge of 3.8 m. Tsz-Cheung Lee and C. F. Wong, *Historical Storm Surges and Storm Surge Forecasting in Hong Kong* (Hong Kong: HKO Publications), 2.

24 Lee and Wong, *Historical Storm Surges*, 3; Jones, *Hong Kong Typhoons*, 65, 68.

25 Ho, *Weathering the Storm*, 89.

26 'Report of the Director of Public Works for the Year 1937', Appendix Q 7, 41; *China Mail*, 2 September 1937, 11.

27 *China Mail,* 2 September 1937, 1.

The impact of both these events on Hong Kong's society was immense. In both 1906 and 1937, landslips and floods blocked roads and railways, disrupting transport services and communications. People and deliveries were stranded for days, resulting in a short period of supply chain problems, especially for fresh produce. In the more medium-term, agricultural production locally—largely in the New Territories—and in terms of the inward supply from mainland China, was impacted by the high winds, torrential rain and floods. In combination, the supply chain disruption and agricultural damage pushed regional staple food prices up steeply, especially for rice. A report compiled by the Typhoon Relief Fund Committee set up in 1907 noted how almost HK$35,000 was needed to feed people who had been left destitute as a result of the immediate damage and resultant problems, many of whom were widows and orphans.[28] People living in the New Territories, who had suffered some of the worst losses both as result of the typhoon surge and loss of crops, received a large proportion of this relief money, around HK$12,000, again chiefly women who had lost male relatives.[29] The Typhoon Relief Fund Committee was, through the establishment of a sub-committee, also responsible for investigating losses to the fishing and maritime industries which had been severely affected.[30] For the whole of Hong Kong and the New Territories, the estimated total cost of loss and damage across all areas, including rebuilding and relief, amounted to HK$20–30 million.[31] In 1937, the equivalent sum was just under HK$366,000 for immediate repairs directly related to the typhoon, and a further HK$220,000 to cover wider economic losses.[32]

Quite obviously, in 1906 and in 1937, the typhoons had been significant nature-induced disasters. Nevertheless, this article argues that the scale of their impacts was not caused solely by the strength of the typhoons but by the many underlying scientific, social and infrastructural contexts and issues that worked together to undermine the colony's ability to be resilient in the face of extreme weather.

Atmospheric knowledge and the evolution of the storm warning system

As a major port and point of entry into Asia, colonial Hong Kong's economy, power and status were intimately related to maintaining successful and vibrant international trade. Weather reports and storm warnings were critical to the safe operation of this trade by sea and, by the 1930s, the nascent aviation industry. Nonetheless, it was a surprisingly slow business to create a reliable storm-warning service, despite its obvious importance, partly due to the contemporaneous state of the sciences of weather and

28 All sums are given in old Hong Kong dollars, a form of silver currency introduced by the British Government to Hong Kong and the Straits Settlements after 1895.

29 'Report of the Typhoon Relief Fund Committee, laid before the Legislative Council, 12 April 1907', 278.

30 Ibid.; 'Report of the Sub-Committee of the Hongkong Typhoon Relief Fund General Committee', 282.

31 Ho, *Weathering the Storm*, 89.

32 Ibid., 107.

communications—especially in 1906. For the first few decades of British rule, from 1841, weather observations were compiled at different government-run facilities, including hospitals, prisons and public works sites, subsequently published in the local press for the benefit of the maritime community and the general public. These observations reflected *past* weather conditions, however: they were not predictions of what might be to come. For *contemporary* conditions, the Harbour Master's Office would monitor the current state of the weather and make use of observations made at sea that ships coming into port would make available. These might tell of stormy conditions or typhoons that could help raise a warning to ships then intending to leave dock.

In 1884, the establishment of an observatory was expected to improve the situation, and certainly it became the central point for meteorological study and the study of typhoons from then through to the modern day. By the late nineteenth century, underwater telegraph cable technology also meant that Hong Kong would benefit from becoming telegraphically linked to the well-established observatories at Manila and Shanghai, and thus also to the monumental China Maritime Customs Service meteorological station network that covered thousands of miles of the Chinese coastline. The stations would cable real-time information to the observatories, whose staff could then transmit current weather information and storm warnings across the network.[33] By the early twentieth century, an efficient system was in place to receive coded telegraphed observations at the Hong Kong observatory. These were then decoded by meteorological assistants and entered in a statistical register. The resultant data could then be used to plot synoptic charts, identifying areas of high or low pressure, and therefore also potential storm tracks.[34] A warning could then be telegraphed from Hong Kong to the areas most likely to be affected. If the storm was imminently expected at Hong Kong, a coastal signal system of cones and drums—or lanterns at night-time—would be raised to alert residents and nearby shipping.[35] In 1906 then, a fair warning of the typhoon could have been given out. However, the fact that notice was only given out an hour or so beforehand opened the institution to heavy criticism of its methods and preparedness for disaster.[36]

The first storm warning had been given at 8 am on the morning of 18 September. By 9 am, the wind had already reached force 10 and it had been obvious to many experienced mariners then on shore that a typhoon was on its way.[37] Lawrence Gibbs,

33 Robert Bickers, '"Throwing Light on Natural Laws": Meteorology on the China Coast, 1869–1912', in *Treaty Ports in Modern China: Law, Land and Power*, ed. Robert Bickers and Isabella Jackson (London: Routledge, 2016), 183, 185.

34 For a short introduction to late nineteenth-century American forecasting, see: Mark S. Monmonier, *Air Apparent: How Meteorologists Learned to Map, Predict, and Dramatize Weather* (Chicago: University of Chicago Press, 1999), especially Chapter 1.

35 Wai Man-Kui, 'The Early Tropical Cyclone Warning Systems in Hong Kong, 1841–1899', *Hong Kong Meteorological Society Bulletin* 14, nos.1–2 (2004), 70–1.

36 'Report of Committee Appointed to Enquire Whether Earlier Warning of the Typhoon of September 18th, 1906, Could Have Been Given to Shipping', supplement to the *Hong Kong Gazette*, 22 March 1907, 54.

37 'Report of Committee … 1906', 49, 68.

for example, a British engineer and part-time meteorologist then based in Hong Kong, had argued that the observatory had not been doing its job properly.[38] This attitude was adopted by the press and the public, who hastily called for an inquiry into what had gone wrong. After an investigation mounted by colonial officials and senior members of the maritime community, the observatory was exonerated from responsibility, but not before the reputation of the director, William Doberck, was irrevocably tarnished. He stepped down the following year aged only 55.[39] The investigation had hinged on whether the typhoon had been unusual; contemporary evidence suggested that it had had an unusually small diameter, thus making it difficult to detect far in advance. This was indeed the case, as has been confirmed by more modern scientific analysis of the event. Having said this, we need to consider the observatory's actions in the light of the scientific capacity of the time. Gibbs himself admitted that the typhoon had been unusually 'compact' and may well have passed by other stations without being noticed and, indeed, this is exactly what had happened.[40] The Hong Kong Observatory had not received warning from the Manila Observatory as it might normally have done, as the typhoon's track had passed far to the north of the observatory and, except for a slight depression being noted, there was little evidence to suggest a typhoon was on its way.[41] As such, it was almost impossible within the scientific capabilities of that time to have known that a typhoon was about to bear down on the colony. Doberck knew this very well and was entirely pragmatic in reference to the powers of existing scientific understanding. 'Meteorology is not an exact science', he argued during the inquiry: 'Nothing can be predicted with certainty'.[42]

While this was a terrible disaster, the event has been said to have had a positive outcome in the sense that it helped push the Hong Kong Observatory and its regional counterparts into better communications and towards improving the extant typhoon warning system.[43] In 1906, the series of locally and non-locally used signals were not well aligned, though they had developed far beyond the systems in place during the nineteenth century, especially with the standardisation of the China Coast Code in Shanghai, the Chinese coastal ports and Hong Kong.[44] Despite many and in-depth discussions, it was to be 1917 before innovations were introduced, however. The delays were due to disagreement between the different regional services—

38 Lawrence Gibbs, 'The Hongkong Typhoon, September 18, 1906', *Quarterly Journal of the Royal Meteorological Society* 34, no. 148 (1908), 293–4; 'Obituary, Mr. Lawrence Gibbs, A.M.I.C.E.', *Quarterly Journal of the Royal Meteorological Society* 68, no. 296 (1942): 241–2.

39 P. Kevin Mackeown, *Early China Coast Meteorology: The Role of Hong Kong* (Hong Kong: Hong Kong University Press, 2010), 197.

40 P. Kevin Mackeown, 'William Doberk—A Stormy Career Founding the Hong Kong Observatory', *Journal of the Royal Asiatic Society Hong Kong Branch* 44 (2004): 31.

41 'Report of Committee … 1906', 52; Li Woon Yee, *The Typhoon of 18 September 1906* (Occasional Paper 36) (Hong Kong: Royal Observatory, 1976), 10; see also: 'Hong Kong 1906 Track' (of typhoon), commons.wikimedia.org/wiki/File:Hong_Kong_1906_track.png, accessed 27 October 2022.

42 'Report of Committee … 1906', 49.

43 Li, *Typhoon of 18 September 1906*, 9.

44 W. H. Lui et al., 'Evolution of the Tropical Cyclone Warning Systems', *Hong Kong Observatory Technical Note No. 109* (Hong Kong: Hong Kong Observatory, 2018), 5.

stretching from Indochina to Japan—as to how and what should be changed, though there was a general consensus that more standardisation was needed. In 1912, for example, the then director of the Hong Kong Observatory Thomas Folkes Claxton left correspondence that hinted at a difficult set of negotiations between Shanghai, Hong Kong and Hanoi, much of which hinged on what Claxton termed a one-sided alignment between Hanoi and Shanghai, resulting in an impasse.[45] However, the need for a new code was considered essential. Claxton himself had noted in 1914 how the system then in use at Hong Kong was 'unsatisfactory'. It 'constitutes an insurance', he argued, 'not against typhoon damage, but against extra damage likely to be caused by want of warning … it is possible in very exceptional circumstances for a typhoon to strike the Colony with little or no warning'.[46] Adopted before the China Coast Code had been introduced in 1906, the Hong Kong system had originally been intended as a compromise between local and non-local signals, but had in effect failed, as it introduced contradiction and uncertainty to a subject that should not have allowed any margin for error. It also represented a failure in predicting typhoons that followed less usual patterns, such as in 1906. At the same time, Claxton also argued that the current system was hampered by the lack of stations available to send meteorological information. Using the case of 1906, for example, he argued that 'no observatory can give adequate warning of typhoons which strike the colony suddenly from a quarter from which no meteorological observations are received'.[47] Additionally, in 1906, there were a limited number of points around the coastline at which cone signals were raised, thus ships already out at sea had limited capacity to see them. Supplementary cones were added in 1907, probably in response to the previous year's event, including at offshore locations on small islands that were more visible to the wider seafaring community.[48]

The China Coast Code was adapted in 1931 on the recommendation of the Conference of Directors of Far Eastern Weather Services, which was, coincidentally, hosted by the Hong Kong Observatory in 1930.[49] The bulk of this meeting was devoted to the subject of storm warning signals and transmission codes, the premise being to design a synchronous system suitable for the tropics and East Asia that would quickly detect and communicate atmospheric changes.[50] It was recommended that the China Coast Code become the predominant system, due to its simplicity and already wide adoption. As the Reverend Louis Froc, director of the Zikawei Observatory in Shanghai, noted,

45 Correspondence Relative to Local Storm Warning Signals, 1906–1916: Report on the Negotiations for the Adoption of a Uniform non-local storm warning code for Shanghai, Hong Kong and Hanoi, T. F. Claxton, Royal Observatory, 21 December 1916. HKRS356 1-2-2, Hong Kong Public Records Office.

46 Correspondence Relative to Local Storm Warning Signals, 1906–1916: Memorandum on the code of local storm warning in use at Hong Kong, and a proposed new local code, T. F. Claxton, 28 August 1914, fol. 1. HKRS356 1-2-2.

47 Ibid., fol. 3.

48 Lui et al., 'Tropical Cyclone Warning Systems', 4.

49 Ibid., 6.

50 Royal Observatory, *Conference of Directors of Far Eastern Weather Services, Hong Kong, 1930. Report of Proceedings with Appendices and List of Delegates* (Hong Kong: Royal Observatory, 1930), 7.

a uniform system of symbols was being used, but problems arose from the division of the region into areas with their own codes. This meant the position of a storm had to be looked up in reference to the code of a specific area, adding unnecessary time and allowing increased potential for error. It was envisaged that the addition of two extra symbols would permit the use of latitude and longitude, rather than area codes.[51] Essentially, knowing the meaning of the symbols along with latitude and longitude would obviate the need to refer to a book for an area code, making it far quicker and easier, especially if at sea. In addition, ships were to be given a standardised template for transmitting information to local stations using short-wave radio, which was less subject to atmospheric interference.[52] Ultimately, all these measures were designed to bring speed and cohesion to storm tracking and warning.

Emergency preparedness: Engineered and natural solutions?

In 1937, then, there existed a far improved system of storm warning than there had been in 1906 and, due to advances in other technologies such as the wireless receiving service on board ships, there was swifter messaging and a wider coverage of areas potentially affected by typhoons.[53] On land, there had also been significant engineered infrastructural solutions for typhoon mitigation. In 1906, the mercantile community had relied on natural harbours and bays to provide their ships with protection from storms, shored up with some additional engineering works, such as sea walls, including those at Causeway Bay. During the mid-1880s, this natural harbour had been embanked by a stone breakwater to mitigate violent seas.[54] Many rightly assumed that far more was needed and so, by the first years of the twentieth century, there had been multiple calls to create 'a new and thoroughly sufficient harbour of refuge for small craft'.[55] Ironically, this statement came just a few months before the 1906 event catapulted the inadequacy of contemporary defences into the limelight. During the typhoon, areas thought to provide safe harbour naturally, the private Boat Club lagoon for instance, were opened to provide protection to small sampans. In this instance, the strategy ended in tragedy. A nearby bridge, dislodged by the typhoon-force winds, flew across the lagoon, smashing all boats in its path, finally getting caught at the lagoon entrance and blocking the way out.[56] As a result,

51 'Appendix 10: Note by the Rev. Father Froc, Zi-ka-wei Observatory, Shanghai, on the Non-Local Storm Signal Code in Use Along the China Coast', in ibid., 57.

52 Ibid., 58–9.

53 Lui et al., 'Tropical Cyclone Warning Systems', 7.

54 G. F. Bowen, 'Speech of His Excellency the Governor at the Opening of the Session for 1884 of the Legislative Council of Hong Kong', in *Papers Laid before the Legislative Council of Hongkong, Feb. to June 1884* (Hong Kong: Noronha & Co., Government Printers, 1884). See also A. J. S. Lack, 'Yaumatei Typhoon Shelter, Hong Kong, 1903–1915', *Journal of the Hong Kong Branch of the Royal Asiatic Society* 13 (1973), 28.

55 'Typhoon Shelter', *Hong Kong Telegraph*, 29 March 1906, 5.

56 'A False Haven', *Hong Weekly Press*, 22 September 1906, 6.

calls for more efficient and better protection increased, resulting in Hong Kong's Legislative Council requesting HK$1,400,000 for a proper typhoon shelter to be constructed at Mongkok-tsui on the Kowloon peninsula.[57]

This scheme had been proposed back in 1903 but had gone nowhere due to doubts over how such a costly project would be funded—from the colony's reserves, or from new taxes—and where it ought to be built.[58] The 1906 typhoon provided the catalyst for this and other projects to finally be put in motion.[59] Starting with a deepening of the shallower areas of Causeway Bay to allow more ships to shelter during typhoons, the Mongkok-tsui breakwater project was eventually completed in 1915.[60]

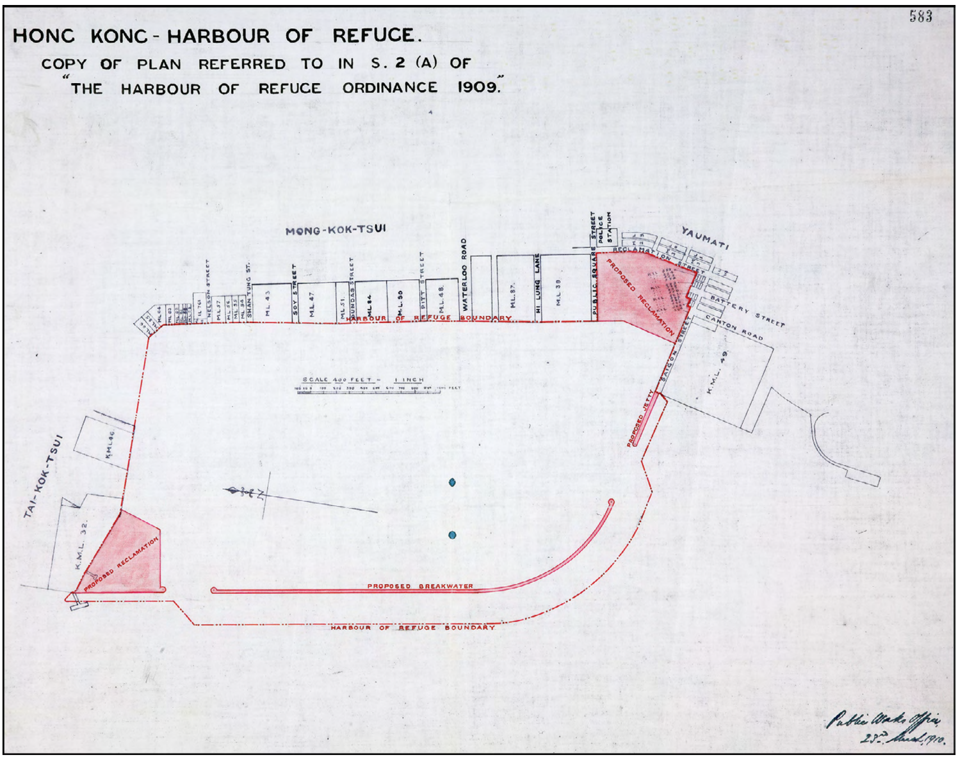

Figure 1: Hong Kong Harbour of Refuge, 1910.

Source: CO 129/365, The National Archives, Kew, London. Image Library Reference: MPG 1/1209 (9).

57 'Hongkong's Budget. Full Discussion in Council. Unofficial Criticisms. Messrs Hewett and Osborne on the War-Path', *Hong Kong Telegraph*, 4 October 1907, 15.

58 First proposed by Mr Gershom Stewart on 14 December 1903 but not actually completed until 1915. See: *Hong Kong Hansard*, 14 December 1903, 65–6. See also: 'Report of the Director of Public Works', *Hong Kong Administrative Reports* (Hong Kong, Noronha & Co., Government Printers, 1916), Q74; 'The New Typhoon Shelter', *China Mail*, 9 October 1907, 4; 'Expensive Scheme Proposed', *China Mail*, 10 April 1908, 5.

59 Speech by Mr Osborne and response by the Director of Public Works: 'Hongkong's Budget: The Typhoon Shelter', *Hong Kong Telegraph*, 4 October 1907, 16–17.

60 'Correspondence Regarding the Typhoon Shelter at Mongkoktsui and the Proposed Temporary Increase in Light Dues', in *Papers Laid before the Legislative Council of Hong Kong 1908* (Hong Kong: Noronha & Co., Government Printers, 1908), 507. For more on the project, see 'Report on the Proposed Boat-Shelter at Mongkoktsui by Mr J. F. Boulton, Laid before the Legislative Council &c., 25 Feb. 1909' ([Hong Kong, 1909]).

The colonial government had also invested in building sea walls along many of the most urbanised areas of coastline, though their chief purpose was to prevent erosion rather than protect against typhoon-related tidal surges.[61] Sea walls stretched along the Praya and its wharves on Hong Kong Island from North Point to Causeway Bay, for example, protecting large parts of the civic area. Such defences were gradually increased over the 1920s and early 1930s to include Mongkok-tsui, the Gunpowder Depot area of Green Island and the coastline adjacent to Tseung Kwan and Tai Po on the eastern side of Hong Kong. After the development of the Mongkok-tsui typhoon shelter, further construction and extension of existing measures took place at Hung Hom Bay, Belcher Bay and Yau-Ma-Tei, near Kowloon.[62] On land, there were storm-water drains and *nullahs* (steep water channels) to divert flood waters, and retaining walls to prevent landslips. In addition to the engineered solutions, a dedicated standing typhoon committee had been appointed in 1920 to consider and advise on how best to protect lives and property during such events.[63]

The complexity of the town's infrastructural changes and engineered mitigation solutions by the late 1930s is revealed in the list of public works repairs compiled after the 1937 typhoon. The costs for Hong Kong, Kowloon, New Kowloon and the New Territories amounted to around HK$365,734.[64] Telephone lines, electric lighting and wiring (in addition to gas lamps) needed replacing, in addition to the usual silting up of *nullahs* and culverts, landslips and damage to civic buildings, piers and so on. Many roads that were not made from the usual asphalt or concrete had had their surfaces scoured or had been washed away entirely. The list of repairs to public works is significant for other reasons too. It reveals another side to the story, one that answers why, with all the changes and advances of the twenties and thirties, there had still been a massive death toll of around 11,000 people during the 1937 typhoon. The answer is in the interlinked issue of environmental and social vulnerability.

Environmental and social vulnerability

By 1937, there is no doubt that Hong Kong had become more complex as a colony in ways not limited simply to the introduction of technology and infrastructure. The population had risen from 404,814 (including part of the New Territories) in 1906[65]

61 'Legislative Council No. 13. Wednesday, 20th January 1886', in *Papers Laid before the Legislative Council of Hong Kong, October 1885 to May 1886* (Hong Kong: Noronha & Co., Government Printers, 1886), 33.

62 Public Works Department, 'Director's Report for 1924, Annexe L: Harbour Developments, Q187; Report of the Committee Appointed to Consider the Question of Making Provision for the Protection of Life and Property in the Harbour during Typhoon Weather, Laid before the Legislative Council, 17 June 1920', ([Hong Kong, 1920]), 55–8.

63 Ibid., 55–8.

64 'Report of the Director of Public Works' in *Hong Kong Administrative Reports 1937*, Q14, Q24, Q29.

65 'Report on the Census of the Colony for 1906', *Papers Laid before the Legislative Council of Hong Kong, 1907* (Hong Kong: Noronha & Co., Government Printers, 1907), 257–76. This 'partial census' taken 'on the night of Tuesday, 20th November 1906' excluded 'the portion of the New Territories North of the Kowloon Range' (ibid., 257).

to more than 1,006,982 in 1937.[66] Around 80 per cent of the population inhabited the Kowloon peninsula and Hong Kong Island in 1906 and in 1937, with a high concentration within the urbanised areas.[67]

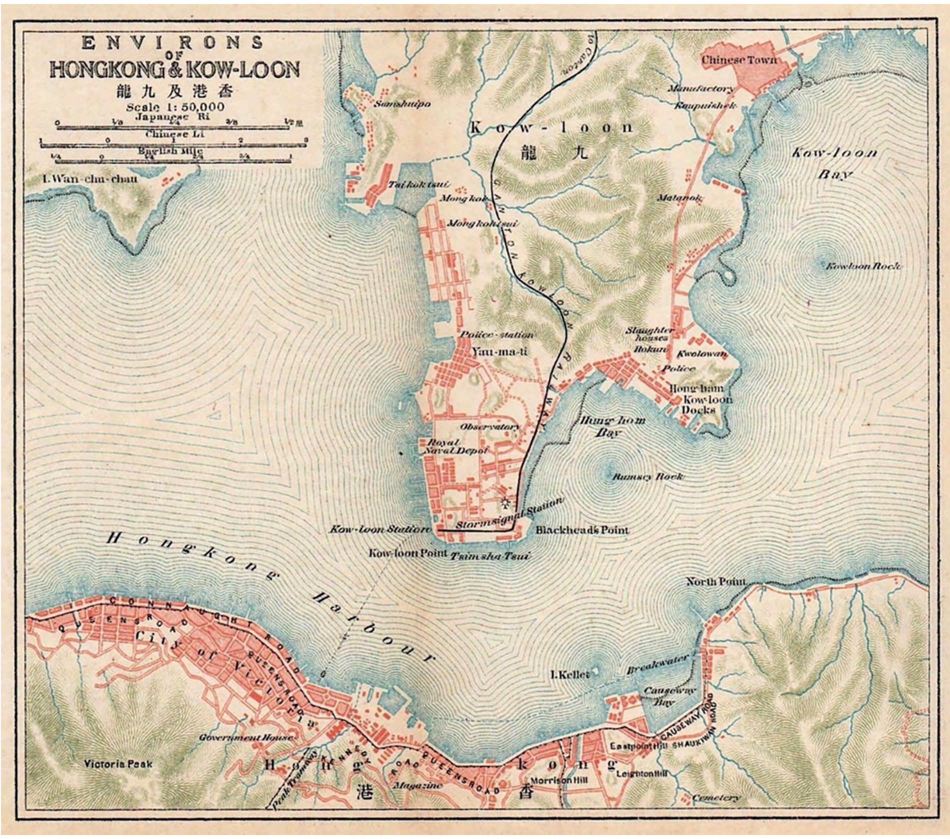

Figure 2: Hong Kong Island, with the City of Victoria and Kowloon, 1915.

Source: 'Environs of Hongkong & Kow-Loon' (1915), 1:50,000. From *An Official Guide to Eastern Asia*, vol. 4: *China* (Tokyo: Imperial Japanese Government Railways, 1915), reproduced in Y. L. Lucy Wang, 'From Garrisoned District to Chinese Town: Land and Boundaries at the Kowloon Walled City, 1898–1912', *Architectural Histories* 10, no. 1 (2022): 12, Figure 8, doi.org/10.16995/ah.8292.

Early twentieth-century Hong Kong was a highly socially stratified society with a large discrepancy between rich and poor. The latter, many of whom were of Chinese origin, made up the bulk of the population. It is a well-known fact in disaster literature that those with the lowest socioeconomic status are the most vulnerable, and thus they are

66 Figures extracted from *Hong Kong Administrative Reports 1937*, 5. These figures did not account for an influx of refugees in Hong Kong who arrived after the outbreak of the Sino-Japanese war in 1937 (see below). The real number may have been closer to 1,300,000.

67 The total 'civil' population in 1906 was 319,803: 'Report on the Census of the Colony for 1906', 257; *Hong Kong Administrative Reports 1937*, 5.

disproportionately hit by any natural disaster.[68] The reasons for this entail a dynamic of several interwoven factors including land inequality, low-quality housing, access to education, access to communications about impending disasters, and access to insurance and/or disaster relief after an event. While there is a limited literature on this in Hong Kong—past and present—there is no reason to assume that the vulnerabilities noted among populations of other typhoon-prone countries, then and now, should not also apply here. Contemporary estimates suggest that of the deaths in 1906, 15 were Europeans but more than 5,000 were Chinese.[69] This statistic is not a simple reflection of the ratio of Europeans to Chinese in the population but is representative of the inequality of land ownership and poorer living conditions of many of the latter.[70] This statistic can be explained further by the social segregation within urban Hong Kong.

In 1888, a European District Reservation Ordinance had been issued by the colonial government. This designated a 'European District' in Victoria on Hong Kong Island and prohibited Chinese people from building homes within its boundaries.[71] In 1904, the passing of the Hill District Reservation Ordinance built on this foundation, specifying that no Chinese settlements were to be permitted 'above the 788 feet contour', an area that included Mount Cameron, Mount Gough, Mount Kellett and Victoria Peak on Hong Kong Island.[72] These inland hills offered their residents some of the best protection from typhoon-related tidal surges and floods. The ordinances—while aimed at racial segregation—had the secondary effect of privileging the wealthy, as opposed to Europeans per se. Not all Europeans could afford to live in this area of Hong Kong Island; around 70 per cent of them inhabited the Chung Wan and Wan Chai districts of Victoria and in Kowloon on the mainland, employed in white- and blue-collar jobs.[73] It was noted in 1906 how:

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68 There is an extensive literature on Philippine and US cases. See Danilo C. Israel and Roehlano M. Briones, 'Disasters, Poverty, and Coping Strategies: The Framework and Empirical Evidence from Micro/Household Data—Philippine Case', *PIDS Discussion Paper Series*, No. 2014-06, (Mataki: Philippine Institute for Development Studies, 2014); James Francis Warren, 'Typhoons and the Inequalities of Philippine Society and History', *Philippine Studies: Historical and Ethnographic Viewpoints* 64, no. 3–4 (2016): 455–72, doi.org/10.1353/phs.2016.0036; Colin Walch, 'Typhoon Haiyan: Pushing the Limits of Resilience? The Effect of Land Inequality on Resilience and Disaster Risk Reduction Policies in the Philippines', *Critical Asian Studies* 50, no. 1 (2018): 122–35, doi.org/10.1080/14672715.2017.1401936; W. G. Peacock and Chris Girard, 'Ethnic and Racial Inequalities in Hurricane Damage and Insurance Settlements', in *Hurricane Andrew: Ethnicity, Gender, and the Sociology of Disasters,* ed. Walter Gillis Peacock et al., (New York: Routledge, 1997), 171–90.

69 'General Observations' *Hong Kong Blue Book for the Year 1906* (Hong Kong: Noronha & Co., Government Printers, 1907), 173.

70 When mapped onto contemporary population statistics, the simple probability of a non-Chinese dying during the 1906 typhoon was 0.00121, which was more than 13 times lower than that of a Chinese (0.0163). The author wishes to credit Joshua Goh Ngee Chae for providing these data.

71 'An Ordinance for the Reservation of a European District in the City Victoria', *Hong Kong Government Gazette*, 21 April 1888, 375–6.

72 'An Ordinance for the Reservation of a Residential Area in the Hill District', *Hong Kong Government Gazette*, 29 April 1904, 752.

73 H. J. Lethbridge, 'Condition of the European Working Class in Nineteenth Century Hong Kong', *Journal of the Hong Kong Branch of the Royal Asiatic* Society 15 (1975), 98–9; 'Report on the Census of the Colony for 1906', 261–2, 266.

> one of the principal reasons for the popularity of Kowloon as a residential quarter is that a number of small houses have been built there, which meet the requirements of a large section of the European population which is unable to afford the high rents obtaining on the Peak and the upper levels of the City of Victoria.[74]

The governor of Hong Kong had also reserved the privilege to exempt wealthy Chinese from the Hill Ordinance measures on application, though these applicants might be considered the exception and not the rule.[75] For the majority of Hong Kong's residents then, the coastal land offered more affordable housing with the opportunity to live at, or adjacent to, places of work.[76] It is perhaps no surprise then that the press were to report in 1937 that 'thousands have been brought to the verge of destitution; huge crowds wait at the mortuaries and police stations searching for relatives' as many of these low-lying areas had been engulfed by the tidal surge.[77]

Additional to the land inequalities was the fact that many of Hong Kong's least wealthy residents lived in poorly constructed and frequently overcrowded houses.[78] In 1937, a housing report for the medical department noted how the 'vast majority of the houses occupied by the labouring classes are built back-to-back with narrow frontages … often with conservancy back-lanes six feet or more in width … the lower storey is often a shop'. Worse still, 'means of access to upper floors (and escape in case of flood) … is very unsatisfactory'.[79] Many houses, especially those referred to as *tong lau*, also tended to be old and had been—or so it was reported—built by unscrupulous contractors using poor-quality materials to save costs.[80] Often lime mortar was used instead of cement mortar, for example, and while it can be incredibly durable, contemporary authorities noted how it did not always stand up well to 'flood, typhoon or fire'.[81]

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74 'Report on the Census of the Colony for 1906', 262.

75 See G. Alex Bremmer and David P. Y. Lung, 'Spaces of Exclusion: The Significance of Cultural Identity in the Formation of European Residential Districts in British Hong Kong, 1877–1904', *Environment and Planning D: Society and Space* 21 (2003): 245, doi.org/10.1068/d310; Lawrence W. C. Lai, 'Discriminatory Zoning in Colonial Hong Kong: A Review of the Post-War Literature and Some Further Evidence for an Economic Theory of Discrimination', *Property Management* 29, no. 1 (2011): 50–86, doi.org/10.1108/02637471111102932; John Mark Carroll, *A Concise History of Hong Kong* (Plymouth: Rowman and Littlefield, 2007), 74–5. For contrary views on the significance of the exemptions granted to Sir Robert Ho, see Cecilia Louise Chu, 'Speculative Modern: Urban Forms and the Politics of Property in Colonial Hong Kong' (PhD diss., University of California, Berkeley, 2012), 47.

76 'Report of the Medical Department for the Year 1937', *Hong Kong Administrative Reports 1937*, M30.

77 'Typhoon Sweeps Hong Kong Clean', *Hong Kong Daily Press*, 3 September 1937, 16.

78 Stephen Selby, 'Henry Thomas Jackman (1874–1928), Engineer, Public Works Department, Hong Kong', *Journal of the Hong Branch of the Royal Asiatic Society* 26 (1986), 46; 'Report of the Medical Department for the Year 1937', *Hong Kong Administrative Reports 1937*, M31.

79 'Report of the Medical Department for the Year 1937', M30.

80 On *tong lau*, see Chu, 'Speculative Modern', 47. See also: Pui-Yin Ho, *Making Hong Kong: A History of Its Urban Development* (Cheltenham: Edward Elgar, 2018), 63.

81 'Report of the Commission Appointed by His Excellency The Governor to Enquire into and Report on the Administration of the Sanitary and Building Regulations Enacted by the Public Health and Buildings Ordinance, 1903, and the Existence of Corruption Among the Officials Charged with the Administration of the Aforesaid Regulations', *Sessional Papers Laid before the Legislative Council of Hong Kong, 1907* (Hong Kong: Noronha & Co., Government Printers, 1931), 185.

The same report also quite specifically noted how the 'death and destruction [that] followed in the train of the typhoon' was crueller to the poor. 'In one block of tenements', where overcrowding was the norm, an 'electricity meter fused and the gas exploded; 20 bodies were recovered, but it is feared that many more [were] still entombed in the ruins'.[82] Overcrowding had of course been an issue in 1906 (ranging from 5.1 to 8.9 persons per floor of a house)[83] but in 1937 population expansion had been further driven by the Sino-Japanese War in the months prior to the typhoon. A steady stream of migrants and refugees had fled China into Hong Kong, and the British Government had little idea who they were or where they were living.[84] The population census figure mentioned earlier for 1937 of 1,006,982 did not include the new refugees. Contemporary estimates suggested that these migrants had added around 30 per cent to the population at the time the typhoon struck, many of whom were unregistered and were subsequently unaccounted for.[85] As well as driving overcrowding in existing housing, in some cases it had also meant the 'conversion of dwelling houses into factories and schools' to accommodate the new arrivals' needs.[86]

The social pressures on urban Hong Kong in 1937 may account, in part, for why the death toll was similar to that of 1906, despite all the advances in warning and protection. For example, in 1906, at least 90 per cent of the fatalities had been Chinese boat people who had not received warning of the impending typhoon or were already too far out at sea to gain safe harbour when the storm had hit.[87] According to the 1906 census, this equated to around 5,000 boat people, representing nearly 11.7 per cent of this particular community. In 1937, the estimated death toll was roughly half that: 2,565 boat people, or around 2.57 per cent of the by then much larger marine community.[88] Thus, while we can see clear progress in the form of a more comprehensive, earlier warning helping the seafarers, the overall death toll was amplified by people who died on land.

82 'Typhoon Sweeps Hong Kong Clean', *Hong Kong Daily Press*, 3 September 1937, 1.

83 'General Report of the Principal Civil Medical Officer and the Medical Officer of Health for the Year 1906', *Papers Laid before the Legislative Council of Hong Kong, 1907*, 390; 'Report of the Medical Department for the Year 1937', *Hong Kong Administrative Reports 1937*, M30.

84 Jones, *Hong Kong Typhoons,* 65, 68.

85 *Hong Kong Administrative Reports 1937*, 5.

86 'Report of the Medical Department for the Year 1937', M31.

87 W. Doberck, 'Report of the Director of the Hong Kong Observatory: For the Year 1906', *Hong Kong Government Gazette*, 1907; Li, 'The Typhoon of 18 September 1906'. On the Chinese boat people community, see Tsang Tze Ying Tweetie, 'The Disappearing Intangible Cultural Heritage of the Boat Dwellers: Case Studies of a Fishing Family and a Barge Operating Family at the Yau Ma Tei Typhoon Shelter' (MSc diss., University of Hong Kong, 2019); Pauline Chan Po-Lin, 'Social Action in Practice: Yaumatei Boat People as a Case Study' (MSc diss., University of Hong Kong, 1981), 27–29.

88 'Report of the Harbour Master and Director of Air Services for the Year 1937', *Hong Kong Administrative Reports 1937*, D6, 5.

Humans versus the weather: The complexities of colonialism and disaster responses

The tidal surges that accompanied the 1906 and 1937 typhoons are considered two of the worst of the twentieth century.[89] As has been argued above, it is doubtful whether, within the scientific and technological contexts of each event, much more could have been done to have given adequate warning of the storm (1906) or to protect the vulnerable, often unknown, population (1937). However, it *was* within the capabilities of the age to have improved provision of sea walls and typhoon shelters, especially in areas that historically suffered most severely from storm surges, such as on the eastern coast of the New Territories (especially Shatin and the Tolo Harbour) that had been leased to the British Government since 1898.[90] This region had a population of around 100,000 people, scattered across 423 villages, whose main industries related to the sea, such as fishing, fish drying and salting, and pearl fishing or farming. The majority of these communities lived in 'simply-constructed dwellings' which did not readily withstand a tidal surge or flood.[91]

It is clear from the surviving official literature—legislative council minutes and reports especially—that although the will to improve was there, the money to fund projects was either contested or simply not available within the colony. The combined nexus of extreme weather and unequal land use, coupled with the failings of the government to adequately house or protect the most vulnerable, was a major factor contributing to the scale of losses in both events, especially the latter. We can see this most clearly by looking at modern-day Hong Kong, which is, in contrast, incredibly typhoon resilient. Super Typhoons Hato (2017) and Mangkhut (2018), for example, were far stronger events than those of 1906 and 1937, yet the former resulted in only 26 deaths and the latter none.[92] The difference is in part technological, since the present ability to build typhoon-resilient structures simply was not available in the early twentieth century, but it is also accounted for by a more holistic, proactive and well-funded governmental approach. The government also has better reactive capabilities. After the devastating Typhoon Mangkhut, for example, it adopted and implemented new storm-defence systems which had already been in the planning

89 Lee and Wong, 'Historical Storm Surges', 1–2; T. T. Cheng, 'Storm Surges in Hong Kong', *Hong Kong Observatory Technical Note No. 26* (1967).

90 'Extracts from a Report by Mr Stewart Lockhart of the Extension of the Colony of Hong Kong, 8 October 1898', *Extracts from Papers Relating to the Extension of the Colony of Hongkong, Laid before the Legislative Council &c. 1899* ([Hong Kong, 1899]), 187–8.

91 Ibid., 187–8; J. W. Hayes, 'A Chinese Village on Hong Kong Island Fifty Years Ago—Tai Tam Tuk, Village under the Water', in *Hong Kong: A Society in Transition*, ed. J. C. Jarvie (Abingdon: Routledge, 1969), 33.

92 Chun Wing Choy et al., 'Super Typhoons Hato and Mangkhut, Part II: Challenges in Forecasting and Early Warnings', *Weather* 77, no. 9 (2020): 324–31, doi.org/10.1002/wea.3746.

stages, in marked contrast to the piecemeal approach of the colonial government of the early twentieth century.[93] However, not all countries today have such resources at their disposal.

Today's governments are expected to provide adequate disaster risk reduction (DRR), the tool by which nations and cities can create disaster responses that appreciate the complexities of human–environmental–climate interaction. DRR's success, however, is dependent on many factors, not least financial capability, infrastructural and political cohesion, and solid policy. What many historians, social scientists, geographers and disaster specialists have argued, therefore, is that studying disaster responses over time can be a lesson in managing risk. As Roy and others have argued, seeing what worked and what did not, and, importantly, considering *why*, offer a cogent lesson for improving modern DRR.[94] In the case of typhoons, while many developed nations have excellent warning and mitigation systems in place—Hong Kong being one obvious example—there are still valuable learning opportunities for both less developed and developed nations facing the reality of climate change and the possible increased intensity and frequency of typhoons in the future.[95] Even developed nations will need to reconsider and improve their current strategies in the light of what may come in order to avoid a situation that could be termed path dependency or technological lock-in.[96] These early twentieth-century examples provide case studies for how and where things go wrong and starkly highlight the complex problem of social, environmental and climatic inequality.

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93 'New Storm Defences for Hong Kong after Experiences of Typhoon Mangkhut—and as Climate Change Threatens Even Worse', *South China Morning Post*, 28 March 2019.

94 Roy, *Natural Disasters and Indian History*; Alan D. Ziegler et al., 'Flood Mortality in SE Asia: Can Paleo-Historical Information Help Save Lives?', *Hydrological Processes* 35, no. 23704 (2020), doi.org/10.1002/hyp.13989. See also: Katie Holmes et al., 'Doing Environmental History in Urgent Times', *History Australia* 17, no. 2 (2020), 230–51, doi.org/10.1080/14490854.2020.1758579; George C. D. Adamson et al., 'Re-Thinking the Present: The Role of a Historical Focus in Climate Change Adaptation Research', *Global Environmental Change* 48 (2018): 195–205, doi.org/10.1016/j.gloenvcha.2017.12.003.

95 Thomas Knutson et al., 'Tropical Cyclones and Climate Change Assessment: Part II: Projected Response to Anthropogenic Warming', *Bulletin of the American Meteorological Society* 101, no. 3 (2020): E303-22, doi.org/10.1175/BAMS-D-18-0194.1.

96 Robert Wasson et al., 'Flood Mitigation, Climate Change Adaptation and Technological Lock-In in Assam', *Ecology, Economy and Society—The INSEE Journal* 3, no. 2 (2020): 83–104, doi.org/10.22004/ag.econ.303982.

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