The British Journal for the History of Science (2025), 1–17
doi:10.1017/S0007087424001523

RESEARCH ARTICLE

Meteorology, weather and war in South East Asia: Malaya c.1940–1960

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Abstract

This article interrogates the positioning of British colonial meteorology in Malaysia and Singapore from the 1940s to 1960. This period spanned a global conflict and an internecine war, effecting profound sociopolitical changes from which neither Malaysia nor Singapore would emerge the same. The meteorological services were essential to Britain's armed conflicts, providing vital weather information to the army, navy and, especially, the air forces, as well as supporting the aviation and shipping industry often in difficult and dangerous circumstances. This article argues that British military policy in South East Asia and the specific concerns of the colonial government in Malaya directly commanded the meteorological agenda on the ground during this period, with a secondary but significant impact on tropical climate and weather research. It thus addresses the interplay of science, colonialism and military interest from the perspective of a region that has featured little in the history of science.

In 1996, Paul Forman and José M. Sánchez-Ron noted that it was rare for intellectuals to register the systematic, codependent relationship between the 'national scientific establishment and the national military establishment'. The assumption has been that the two institutions have had only an intermittent relationship, heightened during times of war, rather than an ongoing, enduring historical partnership.[1] As M. Susan Lindee later writes in her exploration of science and technology in modern warfare, the reasons why countries or institutions pursue specific epistemological pathways are largely determined by national politics. These choices translate into assumptions and policies as to what forms of knowledge are valuable, consequently funding the research and the organizations that generate that knowledge. Essentially, politics directs the generation of scientific knowledge.[2] This connection has been made explicit in Aitor Anduaga's study of the development of Spain's Servicio Meteorológico Nacional, which argues that the nature and role of meteorology within this ostensibly civil institution were a direct result of military interests during the Spanish Civil War from 1936 to 1939, which structure and direction endured far beyond the end of the war. Anduaga also argues that the meteorologist had a dual identity which was at once civil and military, which was 'intrinsic to the construction of a new "sphere

[1] Paul Forman and José M. Sánchez-Ron (eds.), *National Military Establishments and the Advancement of Science and Technology: Studies in 20th Century History*, Dordrecht: Kluwer Academic Publishers, 1996, pp. ix–x.

[2] M. Susan Lindee, *Rational Fog: Science and Technology in Modern War*, Cambridge, MA: Harvard University Press, 2020, p. 5.

of practices and knowledge" in Francoist Spain'.[3] Kristine C. Harper, too, makes this dual relationship clear in her explication of accelerating meteorological growth in the US context, especially from the 1930s to the 1950s. In the late 1930s, for example, the choice of the US Weather Bureau's new director was Francis Reichelderfer, then executive officer onboard the battleship USS *Utah*, appointed through a consortium of interests that included top US naval officers, such as chief of naval operations Admiral William D. Leahy, along with renowned physicist Robert Millikan, largely irrespective of the then undeclared war to come. Soon after, the war heralded the most significant uptick in training and hiring then known, an event that Harper describes as 'an extraordinary event in the history of science', but, moreover, one that would affect the service for many years to come.[4]

The Second World War had, of course, governed the agenda of many scientific agencies, fast-tracking areas of research that were imperative to the war effort. After the war had ended, a post-war ethos of the ability of science to solve or enhance human problems, especially ones that involved the environment, continued to be prioritized, but, altruism aside, the quest to control the weather for the good of humanity remained closely tied to national economic development and military needs. As Ruth A. Morgan notes of this era, quoting the words of US scientist Roger Revelle, 'the society which knows the most about its environment and how to turn it to account, is going to be the more likely to win the next war'.[5] Thus, building on Harper's account of US post-war meteorology, the guiding principles of the scientific services remained tightly joined to the political and foreign-policy agenda of the host country, which, in the case of the US or indeed the UK, became quickly mired in the Cold War.[6] The situation of Malayan meteorology between 1940 and 1960 is a clear example of the entwined interests of these national politics and the military establishment in science, where the daily activities, budgets and interests of the meteorological service were governed directly by military needs and constraints, and the meteorologist comprised a tangled persona with civil and military origins. This article therefore builds on this scholarship, highlighting the enduring embeddedness of military interests in the local scientific agenda, and sees in the example of British Malaya an explicit claim to understanding epistemology and politics as determinants of tropical weather science.

The case of Malayan meteorology also offers a different take on what Joseph Hodge and Martin Mahony have referred to as an immediate post-war era of British socio-technical colonial developmentalism, which had its roots in Joseph Chamberlain's interventionist approach toward colonial development.[7] While this trend was clearly manifested in government's proactive stance to professionalize scientific services in Malaya – from agriculture to meteorology – in the late 1920s and the 1930s, the deep dislocation that the Second World War had wrought in Malayan society, followed by continued political and military unrest, impeded further socio-technical or institutional development until well into the 1950s and beyond. The history of meteorology in this difficult period thus reveals another angle to the war and end-of-empire narrative in colonial South East Asia. Scholarly and popular accounts of this period of Malaya's colonial past are largely political, military or social – for

[3] Aitor Anduaga, 'Towards a new sphere of practices and knowledge: the militarization of meteorology in Francoist Spain', *Science in Context* (2013) 26(1), pp. 31–59.

[4] Kristine C. Harper, *Weather by the Numbers: The Genesis of Modern Meteorology*, Cambridge, MA: MIT Press, 2008, pp. 70–1.

[5] Ruth A. Morgan, *Climate Change and International History: Negotiating Science, Global Change, and Environmental Justice*, London, New York and Dublin: Bloomsbury Academic, 2024, pp. 30–1.

[6] Harper, op. cit. (4), pp. 91–2.

[7] Joseph Hodge, *Triumph of the Expert: Agrarian Doctrines of Development and the Legacies of British Colonialism*, Athens: Ohio University Press, 2007, p. 11; Martin Mahony, 'Weather, climate, and the colonial imagination: meteorology and the end of empire', in Martin Mahony and Samuel Randalls (eds.), *Weather, Climate, and the Geographical Imagination: Placing Atmospheric Knowledges*, Pittsburgh: University of Pittsburgh Press, 2020, pp. 168–90, 171.

example, the classic account of 1940s interracial politics in Cheah Boon Kheng's *Red Star over Malaya* or Noel Barber's account of the Malayan Emergency, *War of the Running Dogs*.[8] Later texts on the twentieth-century history of Malaya tend to follow the same themes, not overtly engaging with science in this era, despite offering critical new perspectives on war, colonial politics and society during this time.[9] Even the robust literature on twentieth-century wartime science or the smaller, but still conspicuous, literature that touches on weather and climate sciences during twentieth-century conflicts have not turned to colonial Malaya. This is despite the country's strategic positioning within the US and UK's Pacific arena throughout the world war and the Cold War.[10] Thus the history of science acts as an alternative lens into Malaya's narrative, revealing how the political situation and continued military presence influenced the playing out of technical development in ways slightly different to that which was apparent in other parts of the world.

Based on a range of primary sources gleaned from the national archives of Britain, Singapore and Malaysia, which include official military, government and meteorological reports, newspaper articles and oral history, the article moves chronologically through three decades of immense sociopolitical change in colonial Malaya. The story begins on the eve of the Japanese occupation and briefly explores the situation of the meteorological service during Japanese rule from 1942 to 1945. It moves on to consider the post-war era in more depth, arguing that the war had created such a high level of dislocation in the country that processes of recovery were stalled and then complicated further by the 1948 declaration of the Malayan Emergency, an internal political struggle that redirected scientific resources into a new military effort. It is not a military or a political history per se, but an exploration of the symbiotic partnership of scientific epistemology, British foreign policy and colonial politics.

Meteorology during the Second World War and Japanese occupation

The Malayan Meteorological Service (MMS) was established in 1929, creating a dedicated and professional service in response to the development of an aviation industry, replacing what had previously been a series of ad hoc provisions lodged under the ostensibly arbitrary umbrella of (in chronological order) the Medical Department, the Survey Department and

[8] Cheah Boon Kheng, *Red Star over Malaya: Resistance and Social Conflict during and after the Japanese Occupation of Malaya, 1941–46*, Singapore: NUS Press, 1983; Noel Barber, *The War of the Running Dogs: How Malaya Defeated the Communist Guerrillas, 1948–60*, London: Cassell, 1971.

[9] Wen-Qing Ngoei, *Arc of Containment: Britain, the United States, and Anticommunism in Southeast Asia*, Ithaca, NY: Cornell University Press, 2019; Rebecca Kenneison, *The Special Operations Executive in Malaya: World War II and the Path to Independence*, London: Bloomsbury, 2019; Christopher Bayley and Tim Harper, *Forgotten Wars: The End of Britain's Asian Empire*, London: Penguin, 2008; Karl Hack, *Defence and Decolonisation in Southeast Asia: Britain, Malaya, and Singapore, 1941–1967*, London: Routledge, 2013; Matthew Foley, *The Cold War and National Assertion in Southeast Asia: Britain, the United States and Burma, 1948–1962*, London: Routledge, 2010. For a concise overview of the historiography of the Cold War in Malaya see Bernard Z. Keo, 'A small distant war? Historiographical reflections on the Malayan Emergency', *History Compass* (2019) 17, e12523.

[10] For example, Lindee, op. cit. (2); Zuoyue Wang, 'The Chinese developmental state during the Cold War: the making of the 1956 twelve-year Science and Technology Plan', *History and Technology* (2015) 31(3), pp. 180–205; Sarah Bridger, *Scientists at War: The Ethics of Cold War Weapons Research*, Cambridge, MA: Harvard University Press, 2015. On weather science see James R. Fleming, *Fixing the Sky: The Checkered History of Weather and Climate Control*, New York: Columbia University Press, 2010; Kristine C. Harper and Ronald E. Doel, 'Environmental diplomacy in the Cold War: weather control, the United States, and India, 1966–1967', in J.R. McNeill and Corinna R. Unger (eds.), *Environmental Histories of the Cold War*, Cambridge: Cambridge University Press, 2010, pp. 115–38; Klaus Gestwa and Boris Belge, 'Weather warfare and climate change: meteorology in the Cold War', *Osteruopa* (2009) 10, pp. 15–42. Spencer R. Weart, 'Global warming, Cold War, and the evolution of research plans', *Historical Studies in the Physical and Biological Sciences* (1997) 27(2), pp. 319–56.

https://doi.org/10.1017/S0007087424001523 Published online by Cambridge University Press

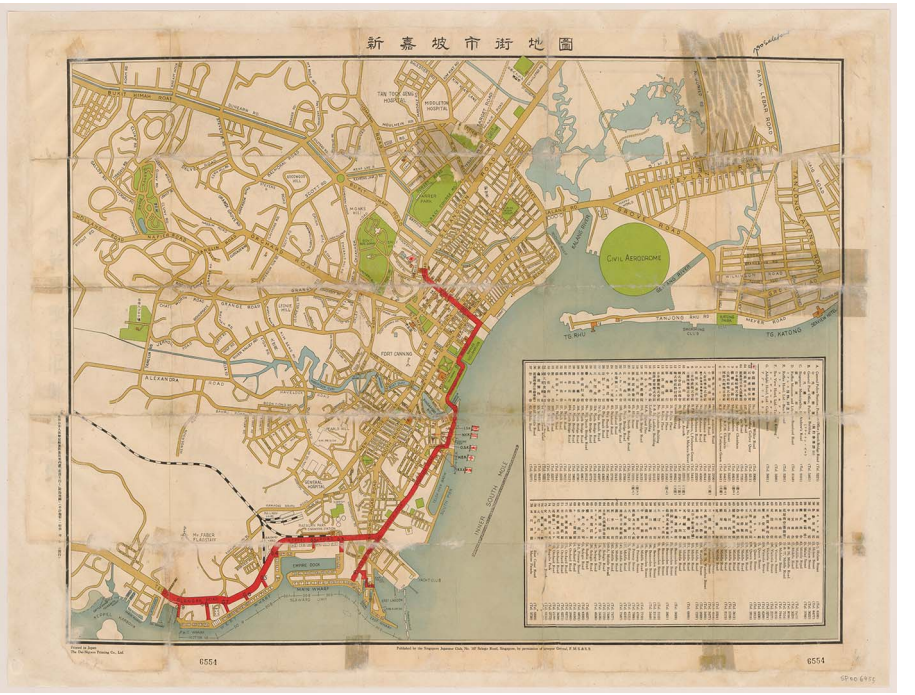

Figure 1. Singapore Town Districts *c.*1938, with key areas translated into Japanese. The Fullerton Building is marked as a letter 'B' on the coast south of the Singapore river. The Kallang airfield is marked clearly as a large green circle to the east of the Kallang river. National Archives of Singapore, Singapore Town Districts *c.*1938, Media Image Number 20120001623 – 0001, published by Singapore Japanese Club by permission of Surveyor General, F.M.S & S.S.

the Museums Department.[11] Malaya's new service was headed by a superintendent, Mr C.D. Stewart, and a meteorological officer, S.G.G. Kelliher. Between them, they developed a new reporting system for the Harbour Authorities and a nascent forecasting service for the new aviation industry, starting with Imperial Air Mail Service flights into Singapore. Over the next decade, the MMS became a small player in a global research arena with the election of Stewart, by now renamed director, to the International Meteorological Organisation (IMO), and the service was split into two, with a headquarters at the Fullerton Building in downtown Singapore, and climatological research, inquiries and forecasting shifting to a newly established office at the Kallang airfield in 1937 (Figure 1).[12]

Stewart was replaced in December 1938 by Hercules Moorhead, previously head meteorologist in Bermuda after his retirement from the Royal Navy in 1932.[13] Moorhead had

[11] Report submitted by Samuel G. Ebling, vice consul in charge 14 September 1927, National Archives of Singapore (hereafter NAS), M712/14–15, ff. 84–5; *Straits Settlements Government Gazette*, 17 April 1930, p. 660; *Annual Report of the Malayan Meteorological Service, 1949*, Singapore: Government Printing Office, 1950, Appendix, 'History of the Malayan Meteorological Service'. See also Fiona Williamson, 'Weathering the British Empire: meteorological research in the early nineteenth-century Straits Settlements', *BJHS* (2015) 48(3), pp. 475–92.

[12] *Malayan Meteorological Service, Annual Report 1948*, National Archives of Malaysia (hereafter NAM), Federal Secretariat (hereafter FS), 13173/1949, pp. 1–2, 4; Straits Settlements Government Gazette (hereafter SSGG), *Annual Report on the Survey Department, Straits Settlements for the Year 1932*, pp. 1–3, 2; *Annual Report of the Malayan Meteorological Service, 1949*, Government Printing Office: Singapore, 1950, Appendix.

[13] H.B.F. Moorhead, 'Storm and hurricane warnings', *Royal Gazette and Colonist Daily*, 23 August 1935, p. 9; anon., 'Malaya's new weather chief was in navy', *Straits Budget*, 15 December 1938, p. 13.

https://doi.org/10.1017/S0007087424001523 Published online by Cambridge University Press

had less than a year to get used to his new position when war broke out in Europe. In Singapore, although there was a sense that the war was being staged at a distance for that first year or so, the MMS was, for reasons of national and imperial security, quickly put on a war footing. All staff working at the Forecasting Office at Kallang were mobilized into the Malayan Volunteer Air Force under Mr A. Grimes, head of forecasting and now wing commander at Air Headquarters Far East. This sudden move begins at least two decades of a shifting identity as Malayan meteorologists moved between civilian and military roles or worked alongside migratory military meteorologists under the auspices of the Far East Air Force (FEAF). One of the first tasks for the meteorologists in 1939 was to learn confidential forecasting for the Royal Air Force (RAF) and to cease public weather broadcasts.[14] From now on, all daily activities of the MMS would be redirected into the war effort and the airfield-based services would become forecasting hubs for military operations. In a Radio Malaya broadcast in 1940, Moorhead described how meteorology was critical to wartime operations, with MMS officers providing air forces with information on 'upper winds, cloud types to be encountered, dangerous zones for ice accretion on aircraft, and general visibility conditions' before setting out on a mission.[15] The new position of the MMS as a military asset was in response to a shift in British Far East defence, away from naval power towards air warfare and reports of Japanese forces gathering strength across South East Asia. The MMS – situated at Britain's most prominent air base in the region – was thus propelled to the centre of the action.[16]

In 1941, US intelligence stationed in Bangkok suggested that the Japanese would mount a terrestrial incursion into Malaya from the Thai border, thereafter establishing 'forward bases' as they moved south from which to stage attacks on Malaya's key towns and ports, including Singapore.[17] Kota Bharu, a small town on the east coast bordering Thailand, hosted the northernmost Malayan aerodrome, so became the focus for British RAF forces to prepare an air defence which, even the most conservative estimates assumed, would need to be at least tripled in strength to be successful.[18] It was here that air defence policy created a new opportunity for the MMS. Lacking adequate long-range forecasting or radiosonde technologies, it was necessary to establish a regional forecasting centre to support the air forces with daily weather reports and advisories. The MMS thus moved some of its trained operatives from Singapore to Kota Bharu to launch the colony's second forecasting office and the only one for the northern region.

Unfortunately for these operatives, the Kota Bharu airbase was one of the first places to be attacked by the Japanese when they crossed the border on 8 December 1941. The meteorological stations across the peninsula suddenly became dangerous places to be. Nine of the sixteen 'first-order' meteorological stations were situated on, or near to, aerodromes and thus all were targets of strategic importance.[19] The Japanese, however, focused on a stealth strategy, moving over land through dense jungle and terrain that cloaked visibility from the air, and as the invading forces continued a steady southward advance by February 1942, the meteorological stations down the peninsula were evacuated as far south as Singapore, with retreating staff operating a scorched-earth policy, destroying instruments and records

[14] *Annual Report of the Malayan Meteorological Service, 1949*, Appendix.

[15] Anon., 'Weather forecasts vital in modern warfare', *Malaya Tribune*, 18 June 1940, p. 5.

[16] Ngoei, op. cit. (9), pp. 19–20.

[17] Paul H. Kratoska, *The Japanese Occupation of Malaya and Singapore, 1941–45: A Social and Economic History*, Singapore: National University of Singapore Press, 2018, p. 30.

[18] Kratoska, op. cit. (17), pp. 31, 34.

[19] Annual Report of the Malayan Meteorological Service, 1949, p. 3.

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that could not be carried with them.[20] Eight meteorological officers were killed during this offensive, as they continued to issue meteorological telegrams for the RAF's anti-aircraft operations until the literal 'last hour' of surrender to Japan on 15 February 1942.[21]

Over the next three years, MMS facilities and their local staff were requisitioned by Japan's military administration. The Japanese Air Force HQ and their meteorological service took over a base at Siglap in Singapore, with meteorology placed under the command of Adjutant Kunitaro Ueda. His base became the foremost site for regional forecasting and for meteorological research in Japanese-occupied South East Asia. All Japanese meteorological operatives were sent to Singapore for training, and from there were sent out in teams of fifteen to twenty to peninsular Malaya, Burma, Sumatra and Java from 1942 to 1945. Many of them, Ueda recalled, simply disappeared without a trace.[22]

Post-war recovery?

On 15 August 1945, the Japanese surrendered Singapore. From then until the resumption of civil government on 1 April 1946, Malaya was essentially recolonized by the British under the British Military Administration (BMA), an interim martial government with support from the Malayan Planning Unit (MPU), which had been set up in London in 1943 to prepare for the task of reoccupation and the rebuilding of essential services.[23] But the MPU found themselves dealing with a populace scarred physically and mentally from the hardships of war and had to base all their planning on sporadic and often contradictory intelligence reports that had been their only source of information since 1942.[24]

The broken state of the MMS and its staff could be held up as a metaphor for this experience. Director Hercules Moorhead and head of forecasting A. Grimes had both been prisoners for the past three years. Moorhead had seen the inside of at least three internment camps in Indonesia and in Singapore, and had spent a terrifying week in the jungle with Lieutenant Fiennes of the Malayan Royal Naval Volunteer Reserve having escaped their first camp in Muntok.[25] While all the meteorological stations and observational posts had survived the war (bar one in Kluang, Johore, which had been destroyed), many exited the war in a poor state of repair, missing equipment and staff.[26] This attrition had been started by the British in 1942, when they had enacted the scorched-earth policy during their rapid retreat, but was compounded by the destruction of records for 1942–5 on the surrender of the Japanese. The Japanese had also replaced any surviving British equipment with Japanese-made instruments which the returning British colonial officers and staff then could not use.[27] It would take around four years to reinstall new British-made equipment in its place, due to the exigencies of staff time, money and supply chain disruptions.[28] To illustrate, while the government had awarded a $10,000 grant to fund equipment to reanimate the main scientific stations in Singapore, it took until 1947 to be fully installed,

[20] Kratoska, op. cit. (17), pp. 31, 34. Despite the scorched-earth policy, prior reconnaissance had enabled Japanese meteorologists to gain a great many observations and much information on Malayan weather. Oral history of UEDA Kunitaro, Japanese Occupation of Singapore, NAS, Accession Number 001444.

[21] Annual Report, op. cit. (19), Appendix.

[22] Oral history of UEDA Kunitaro, op. cit. (20).

[23] Oswald Gilmour, *With Freedom to Singapore: A Social and Administrative Assessment of Post-war Singapore 1945–1950*, reprinted from the original 1950 text, Aylesbury: Hunt, Barnard & Co. Ltd, 2020, online edn.

[24] Gilmour, op. cit. (23).

[25] Hercules Bradshaw Forbes Moorehead, Comdr., RN, The National Archives, UK (hereafter TNA), Royal Navy (RN) M.I. 9/JAP/no. 15007. The author wishes to thank Michael Pether for sharing his knowledge of this escape from his research on HMS *Dragonfly*, and the above reference.

[26] *Malayan Meteorological Services Annual Report 1948*, p. 6, NAM, FS, 13173/1949.

[27] *Malayan Meteorological Services Annual Report 1948*, op. cit. (26), p. 7.

[28] J.M. Taylor, 'Weather men back at work in Malaya', *Straits Times*, 29 June 1947, p. 6.

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and it was not until 1949 that auxiliary stations and hospital or voluntary observational stations began to be re-equipped with even the most basic instruments for recording precipitation and temperature.[29] To put the grant into perspective, a normative sum for new instruments and their installation for the whole colony was around $6,500, an annually renewable expense. Thus $10,000 to refurbish an entire country's equipment was a negligible amount. This lack of investment created significant challenges in providing weather forecasting services, let alone freeing up time or money for other meteorological tasks, including research. This is patently apparent in the request for research monies in 1938 as compared to 1948, at $2,700 and $316 respectively.[30] The one bright point on the horizon was that the Japanese had started to develop a completely new airfield at Changi Road, which the RAF quickly adopted and completed. This site would become Singapore's modern Changi Airport and meteorological office.[31]

These constraints meant that anything but essential forecasting had to be put to one side, and even this service was dominated by the necessity of providing meteorological support for the RAF. Returning MMS staff – such as Moorhead and Grimes – no longer had official military roles but the service continued to be the main forecast provider for the RAF and had to cooperate with the Air Ministry and the RAF to cover the transitional period under the BMA government and beyond. But the post-war regional situation added another layer of complication for the already stretched service. Until 1948, the MMS's ability to apply detail and point density to the synoptic maps used for forecasting, for instance, was restricted due to disruptions in receiving information from shipping and from regional stations. This was especially problematic for longer-range forecasting in areas of highly volatile weather, such as the Bay of Bengal, as well as the tropical atmospheres above the Malayan peninsula.[32] There was also no way for the MMS to make upper-air observations without meteorological flights – there was no radar or radiosonde in Malaya until the mid-1950s – and the flights could only be provided by the RAF, who were in turn facing their own resources crisis. The RAF's No. 18 Burma Squadron operating from Butterworth, northwest Malaya, were the only planes making meteorological flights for the peninsula. They were disbanded in December 1947 and No. 84 Squadron based at Tengah, Singapore, took over their role, flying between Singapore and Butterworth.[33] The committee responsible for this decision comprised Air Ministry, Transport Command, and navy officials under the assistant chief of the air staff (ACAS Ops), and it is telling that the representative for Air Command Far East (ACFE) reported that No. 84's commitment could only be temporary as they no longer had the resources to maintain the squadron, and that the 'poor condition of the airfields and hard standings at Butterworth and Singapore' was taking a high maintenance toll on the planes. It was decided that the priority area for the region ought to be the Bay of Bengal, due to the 'lack of any other means of getting the upper air information', and No. 84 Squadron was to limit its service in Malaya to daily flights on only three months of the year.[34]

[29] Taylor, op. cit. (28), p. 6; Annual Report, op. cit. (19), p. 5.

[30] See, for example, Straits Settlements Government Gazette for 1938, Colonial Estimates, 1938, p. 167; and *Malayan Meteorological Services Annual Report 1948*, op. cit. (26), p. 12, Appendix 2.

[31] Gilmour, op. cit. (23).

[32] *Malayan Meteorological Services Annual Report 1948*, op. cit. (26), preceding notes ff. 6–7r.

[33] Letter from G. Needham, chief meteorological officer, Air Command, Far East, to the director, Meteorological Office, Air Ministry, London (M.O.5), 26 April 1948, f. 123A, TNA, BJ 5/173.

[34] Minutes of a meeting held … 23 April 1948, to discuss the locations of the meteorological Brigand aircraft, f. 128A; letter from G. Needham, chief meteorological officer, Air Command, Far East, to the director, Meteorological Office, Air Ministry, London, 16 April 1948, f. 123A, TNA, BJ5/173, Royal Air Force, *The Malayan Emergency 1948–1960* (Ministry of Defence, 1970), p. 159, TNA, AIR41/83.

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Just like the rest of the civil administration at that time, there was also a severe shortage of trained meteorological staff and observers. To put this into perspective, in 1948 there was one director (Moorhead), one assistant director (Dr C.A. Lea) and five scientifically trained meteorological officers covering the whole of Singapore and the Federation of Malaya. Prior to the war, the service had employed ten. For staff at the level of assistants, cadets and technical assistants combined there were only sixty-eight, when there ought to have been 114. Most of these staff were based at the HQ in Singapore, leaving the rest of the region woefully short of expertise, and making Kallang the only base issuing the forecasts for aviation across an area of 3,500 square miles.[35] Officers working in Singapore were also occasionally transferred overseas to assist at military-run meteorological stations in a two-way transfer of staff and knowledge between military and civilian operations. In 1948, for example, the main meteorological officer working at Tengah (Singapore) was requisitioned to work for a month at the FEAF HQ in Negombo, Sri Lanka, due to their shortage of trained scientists.[36] But, simply to undertake the basics of a forecasting service – preparing the synoptic forecasts for early-morning flights at Malayan airfields – it was necessary to maintain a twenty-four-hour service. The long hours and sustained night working at airfields and observational posts led to staff becoming ill, and when, for example, new hires were made there were spates of resignations, such as in 1949 when three hires and five resignations took place – a suggestion perhaps of the difficult conditions under which the staff were working.[37]

The close relationship between the RAF and the civilian meteorological services may have helped support the latter in some ways, then, but also complicated the MMS's situation with military difficulties. Their relationship had been expected to be gradually scaled back, but in 1950 the British Meteorological Office noted that the MMS would continue to be responsible for meeting the requirements of the RAF for the foreseeable future.[38] Indeed, political circumstances in the country meant that the transition from military to full civil control was to be delayed and anything beyond essential forecasting – such as tropical climate research – was suspended until into the 1950s.[39]

Military and civilian meteorology during the 'emergency'

The Second World War had heightened Britain's fear that communism would threaten their national interests, which, nurtured by their close post-war relationship with the United States, set the agenda for the Cold War playing field in Britain's Asian colonies.[40] The decolonization of Indian territories between 1947 and 1948 and Burmese independence in 1948 had also added fuel to pre-war calls for independence from South Africa to Malaya, and many of the left-wing political movements lobbying for independence were, rightly or wrongly, associated with communism, especially after the rise to power of the Chinese Communist Party (CCP) in 1949. In Malaya, these fears were directed toward the pre-war majority ethnic Chinese Malayan Communist Party (MCP), who, having been encouraged by the British military to carry out guerrilla operations against Japanese forces during the occupation, were then suspected of using this experience to organize resistance against the British colonial government through Chinese-majority schools and trade

[35] *Malayan Meteorological Services Annual Report 1948*, op. cit. (26), p. 3; Annual Report, op. cit. (19), p. 1.

[36] Letter from G. Needham, chief meteorological officer, Air Command, Far East, to the director, Meteorological Office, Air Ministry, London (M.O.5), 8 September 1948, f. 136, TNA: BJ5/173.

[37] *Malayan Meteorological Services Annual Report 1948*, op. cit. (26), p. 8; Annual Report, op. cit. (19), p. 6.

[38] Annual Report of the Director of the Meteorological Office (Great Britain), 1950, p. 17, TNA: MO 533.

[39] For example, anon., '$80,000 a year to test winds', *Straits Budget*, 14 September 1950, p. 9.

[40] Ngoei, op. cit. (9), pp. 17–19, 25.

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unions in Malaya. In 1945 the MCP, with much popular support from local Chinese communities, had flowed into a power vacuum left by the Japanese surrender and the slow return of British officials in any number. The British government's intention to create a Malayan Union as a new form of government in 1946 was deeply unpopular and racially divisive, and incentivized the MCP to progressively engage in often violent 'acts of intimidation' at British-run plantations and in some of the main towns, run from rural or jungle base camps.[41] While not ostensibly a meteorological concern, the attacks placed extra pressure on observation staff located at remote outposts, who already had challenging jobs due to night shifts and isolation.[42] However, the situation would soon become a focus for the MMS when the MCP was declared illegal and an 'emergency' situation was declared. Malaya once more became an active war zone under the Malayan Campaign, aimed at supressing communist insurgency.[43] This situation would last officially until 1960.

The new internal war's needs inspired, but also drew from, changes in military aviation strategy, which was then was moving away from the large-scale mobilizations common in the Second World War in favour of smaller, mobile strike units based out of navy aircraft carriers and airbases in the Middle East and the Far East. This shift partly reflected the loss of many of Britain's terrestrial airbases in the East after 1945, but also the military's stretched resources with the new war in Korea (1950–3) and then in Suez (1956), as well as the simple demands of working in the tropical climate and dense jungle, where defeating 'the enemy' required responsive guerrilla tactics.[44] Small aircraft, swift air strikes and frequent air reconnaissance missions were well suited to waging the predominantly jungle-based Malayan campaign, a fact not lost on the director of operations from 1950, General Henry Briggs. Influenced by the anti-guerrilla tactics employed by South East Asia-based US and Australian forces at the start of the Cold War, Briggs also had limited air power to fight the campaign, having been rebuffed by Air Vice Marshal Robert L. Ragg in his request to reassign a squadron of Lincolns from the UK, Sunderlands then based in Korea, and Harvards then stationed in Malaya to the campaign on the grounds of a lack of resources.[45] Nonetheless, air power was deemed essential to running an effective jungle campaign. As can be seen in Figure 2, the Malayan peninsula was, except for a developed strip running the length of the west coast, mostly hard to access by road, but it was estimated that a majority of the Malayan 'communists' were living in these inaccessible regions.[46]

The air force thus had a key role in supporting ground operations, bringing the MMS back into the military realm. The main air campaign was known as 'Operation Firedog'. This was a collaboration between the RAF, the Malayan Auxiliary Air Force (MAAF), the Royal

[41] Richard Mason, 'Revisiting 1948 insurgencies and the Cold War in Southeast Asia', *Kajian Malaysia* (2009) 27(1–2), pp. 1–9, 4.

[42] *Malayan Meteorological Services Annual Report 1948*, op. cit. (26). Annual Report, op. cit. (33), p. 7.

[43] Karl Hack, 'The origins of the Asian Cold War: Malaya 1948', *Journal of Southeast Asian Studies* (2009) 40(3), pp. 471–96, 471–2; Jeffrey Grey, 'Naval operations in peripheral conflicts: the Malayan Emergency (1948–1960) and confrontation (1962–1966)', in Bruce A. Elleman and S.C.M. Paine (eds.), *Naval Power and Expeditionary Wars: Peripheral Campaigns and New Theatres of Naval Warfare*, Taylor and Francis, 2011, pp. 129–40, 130.

[44] *Malayan Meteorological Services Annual Report 1948*, op. cit. (26), pp. 1–2, 4; Ian Speller, 'Limited war and crisis management: Naval aviation in action from the Korean War to the Falklands conflict', in Tim Benbow (ed.), *British Naval Aviation*, London: Routledge, 2016, pp. 151–2.

[45] Speller, op. cit. (44), pp. 151–76, 151; Grey, op. cit. (43), p. 131; letter to the secretary, British Defence Co-ordination Committee, Far East, Singapore from Henry Briggs, director of operations, Office of the Director of Operations, Kuala Lumpur, Offensive Air Support – Malaya 13 February 1951, f. 21r, v, TNA, AIR23/8437; letter from Air Vice-Marshal R.L. Ragg HQ Far East Air Force to Air Vice-Marshal R.S. Blucke, Air HQ, Malaya, 8 February 1951, ff. 20r, v, TNA, AIR 23/8437.

[46] TNA, AIR 41/83, p. 39.

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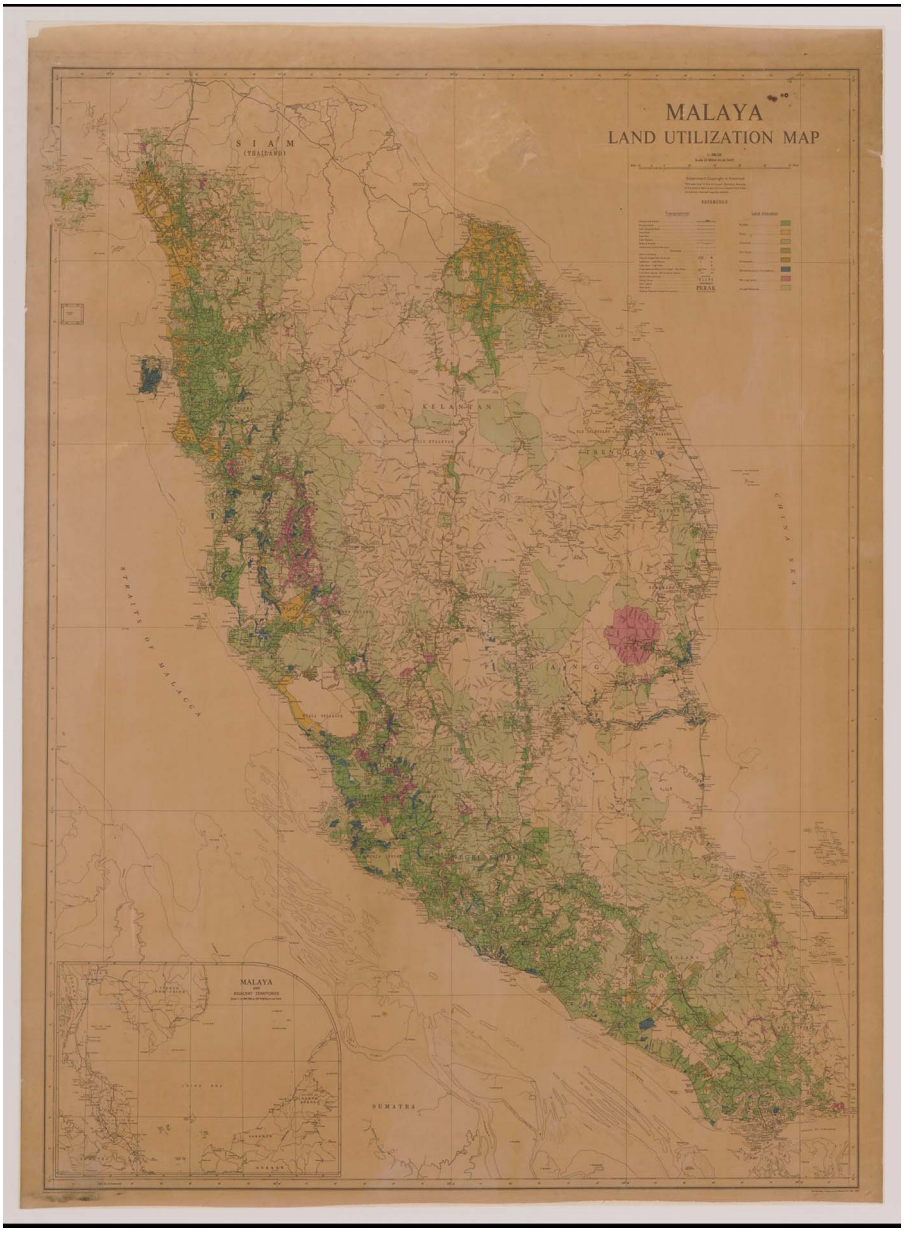

Figure 2. Survey Department, Land Utilisation Map of Malaya, 1953, reproduced by kind persmission of the Singapore Land Authority (SLA). National Archives of Singapore, Singapore Land Authority, Survey Department, Federation of Malaya No. 29_1953: Land Utilisation Map of Malaya, 1953 20050000696 - AccNo876_1.

Australian Air Force (RAAF), the Royal New Zealand Air Force (RNZAF) and FEAF. The local FEAF HQ was located at Changi Airport (Singapore), with offices at the airbases at Tengah (Singapore), Kuala Lumpur (Selangor, Malaysia) and later Butterworth (Perak, Malaysia). FEAF's HQ was controlled by the air commander-in-chief, Air Marshal Sir Hugh Lloyd, from 1947. These forces operated in conjunction with the civilian MMS under the direct supervision of G. Needham as the Air Ministry's chief meteorological officer, followed by

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E. Evans in 1950.[47] FEAF also continued to provide some meteorological services, including the continuation of the regular meteorological flight for Singapore, and ad hoc flights for the peninsula on request from 1949.[48] The relationship between the military and civilian meteorologists was clarified in 1951 in a meeting that combined RAF and civilian meteorological scientists. It was agreed that the Air Ministry would utilize meteorological services delivered by the MMS but only if certain conditions were met. These included the provision of suitable staff and telecommunications, but also, most importantly, a gradual transfer of responsibility to the RAF, retention of the post of chief meteorological officer FEAF and the incorporation into the armed forces of all MMS personnel concerned with briefings on the RAF during the war.[49] Thus large sections of the MMS and their scientists and operatives became subsumed within a military engine once more.

Meteorologists were expected to provide forecasts for Operation Firedog activities, from 'trooplifting', reconnaissance, supply dropping and casualty evacuation to psychological warfare and even crop spraying to injure 'enemy' food supplies on jungle bases.[50] Any of these activities necessitated precision timing, target identification, high-grade intelligence and, importantly, speed.[51] Even though a forecast might have been issued at the start of a day, new information on an enemy camp might be received at any time and deployment of aircraft took at least three to four hours from the receipt of an initial report to authorization of a strike. Weather conditions could change significantly in this amount of time, and while the problem of poor visibility was somewhat alleviated by the introduction of radar target marking in 1955, the exigencies of tropical weather caused delays, aborted missions and bombing miscalculations.[52] A typical offensive flight under Operation Firedog would entail a regional forecast issued first thing in the morning from the RAF base at Kuala Lumpur and transmitted to the closest airbase to the operation. Weather conditions would continue to be monitored and, if new information of impending poor weather was received by 11.45 a.m., the operation would be cancelled.[53] However, during December and early January, the north-east monsoon contributed to the quick formation of convective cloud in the late afternoon, even when morning conditions had been clear. This resulted in the possibility of extreme turbulence. In special cases or in emergencies, pilots could be issued a special 'green card', but such missions could be inherently dangerous.[54] Low cloud and mists also caused significant challenges in identifying jungle targets. On only the second strike of Operation Firedog in the cloud-covered mountainous region of Pahang, for example, pilots were unable to recognize their targets and had to abort their mission.[55] The problem of low-lying mists and cloud could not be resolved in Malaya as they had been in wartime Britain, with the fuel-hungry system that had been developed to clear airport fogs known as the

[47] *The Air Force List, April 1949*, London: HMSO, 1952, p. 324; *The Air Force List, April 1952*, London: HMSO, 1952, p. 354. See, for example, observational records made at Tengah by RAF officers, not the MMS, filling the gap of local weather knowledge: TNA, AIR 28/1278 Tengah 1952–55.

[48] Letter from G. Needham, chief meteorological officer F.E.A.F to the director, Meteorological Office, Air Ministry, London 8 November 1949, Minute 151a, TNA, BJ5/173.

[49] Notes on a meeting held in … Victory House on 19th September 1951, to discuss meteorological arrangements for the R.A.F. in F.E.A.F and for Civil Aviation in Ceylon, f. 1r, TNA, BJ5/173.

[50] Hansard, Commons, 6 April 1950, Commons Chamber, Malaya (Situation), Column 1397; TNA, AIR 41/83, pp. 29–30, 78.

[51] TNA, AIR 41/83, p. 39.

[52] Force Requirements for Pinpoint Bombing in the Malayan Emergency, Operational Research Branch, F.E.A.F, December 1955, p. 14, TNA, AIR 23/8739.

[53] See, for example, Operation Coombe, scheduled 28 February 1949. TNA, AIR 23/8699, p. 28.

[54] Letter from G. Needham, chief meteorological officer, Air HQ, Air Command Far East, Changi, Singapore to the director, Meteorological Office, Air Ministry, London, 10 April 1948, f. 124A, TNA, BJ5/173.

[55] Report on the Royal Air Force Operations in Malaya, June 1948–March 1949, Air HQ, RAF Malaya, 9 May 1949, p. 6, TNA, AIR 23/8699.

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Fog Investigation and Dispersal Operation (FIDO). Such methods were simply not practical or appropriate for the wide and inaccessible areas that planes would be required to fly from, or over.[56] As Grimes had noted in 1947, 'the only uncertain quantity that can crash an aircraft was the weather'.[57]

The quick changeability of weather of Malaya made the dangers for pilots even more acute the further an operation was from a forecasting and observation station. For operations in northern Malaya, for example, weather conditions would be very different from those in Singapore, where the main forecasting office was located. Sudden, localized bad weather might tip the balance into a disaster, such as that which had happened in November 1950, where a technical fault combined with bad weather resulted in the release of bombs six hundred metres short of their intended target, killing twelve civilians and injuring twenty-six more.[58] The first night strike of the campaign, expected on 19 August 1950 in Kelantan, was also aborted due to storms.[59] The best time of the day to fly was deemed to be mid-morning. Then there was a small window after the morning mists had lifted but before the build-up of cumulus that started forming rapidly from midday to generate the late afternoon storms so characteristic of the tropical climate.[60] Of course, this timing did not always suit the needs of the campaign, as intelligence reports on current enemy whereabouts were not always conveniently matched with appropriate weather. Thus the role of the air force, whether it was a means to strike and kill or simply to harass, was under debate for much of the campaign, so much so that, by 1959, the main role of the air force was in providing cover for army transport conveys and defensive, rather than offensive, operations.[61] Even then, for basic manoeuvres such as dropping supplies, weather had to be taken into account and supply drops usually had to be scheduled between mid-morning and early afternoon.[62]

Weather conditions were noted during these military flights, but the recording of detailed upper-air observations was only possible using dedicated meteorological flights and radiosonde.[63] Radiosonde technology was considered easier, cheaper and less dangerous than meteorological flights and had been available for more than a decade in many national meteorological services.[64] Nonetheless, unlike in other countries, the unmanned radiosonde method had not been widely adopted in Malaya, except for small-scale work at Penang, Kota Bharu and Klang, Selangor (Port Swettenham).[65] This was largely due to the fact that, even by the 1950s, the MMS and FEAF were struggling with their lack of people, money and resources to recruit and train enough new officers in using the equipment.[66] This was not exceptional; the transition from manned meteorological flights to

[56] For the development of FIDO and its practical considerations see James R. Fleming, *The Callendar Effect: The Life and Work of Guy Stewart Callendar, 1898–1964*, Boston, MA: American Meteorological Association, 2007, pp. 51–60. Interestingly, the man responsible for FIDO, Guy Callendar, was also involved in research into technologies for clearing forest during tropical terrestrial warfare, largely unsuccessfully. See Fleming, op. cit. (56), p. 61.

[57] Quoted in Taylor, op. cit. (28), p. 6. See also TNA, AIR 41/83, p. 32.

[58] TNA, AIR 41/83, p. 54.

[59] TNA, AIR 23/8699, p. 11.

[60] TNA, AIR 41/83, pp. 29–30.

[61] TNA, AIR 41/83, p. 41.

[62] TNA, AIR 41/83, p. 79.

[63] See, for example, Air Recce Report from RAF Kuala Lumpur, 2 December 1948, TNA, AIR 23/8699, p. 33.

[64] For a concise history of the early introduction of the radiosonde see Chihyung Jeon, 'Flying weather men and robot observers: instruments, inscriptions, and identities in US upper-air observation, 1920–1940', *History and Technology* (2010) 26(2), pp. 119–45, 133–5. See also Morley K. Thomas, *Metmen in Wartime: Meteorology in Canada, 1939–45*, Toronto: ECW Press, 2001, p. 17.

[65] Annual Report, op. cit. (19), Appendix. Thomas, op. cit. (64), writes of the meteorologists in Canada, for example, who were already using radiosonde during the 1930s.

[66] Notes on a meeting held in … Victory House on 19th September 1951, op. cit. (49).

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radiosonde was shaky across the whole FEAF region due to a lack of trained technicians and operatives. In Sri Lanka (Ceylon), for example, at FEAFs regional HQ, a radiosonde station had been established in 1951. However, the government had not yet employed any British-trained radar technicians or started to train local operatives.[67] Thus, due to the emergency, FEAF was obligated to provide an additional meteorological flight from Seletar (Singapore) using a Hornet WB901 fighter aircraft from 1951. The pilot was expected to undertake measurements of temperature and humidity up to 40,000 feet, to report on cloud structure and high-level turbulence, and to measure upper winds.[68] After only a year, however, the Hornet was temporarily withdrawn and sent to FEAF HQ to be utilized for training military pilots in making meteorological flights and for repairs.[69] This incident says much about the lack of alternative planes or technologies – and pilots – available at that time, as the observations stopped for the few months of the plane's absence. FEAFs chief meteorological officer in Changi, E. Evans, and his senior staff used this time to discuss the future of the Hornet as a provider of their upper-air measurements as the plane only seated a single occupant, meaning that the pilot had to fly, navigate and make weather observations.[70]

Their conversation connected with the wider issue of the competing availability of radiosonde technology. The continuation of meteorological flights across the FEAF region, from the Maldives, to Sri Lanka (Negombo), to Singapore, had been placed under review in 1951, the same year as Singapore's newest flights had started, pending the 'installation of radio-sonde wind finding equipment' that was expected to eventually provide an alternative. Apart from the cost and dangers involved in the flights, it was considered important to improve upon the current lack of information on flight path weather conditions across monsoon-affected regions, in addition to establishing general rules for teleconnections across the upper airs.[71] There was also a strategic military reason for installing radiosonde equipment. It was hoped that the planes could be repurposed to instead serve the ongoing 'offensive action against the bandits in Malaya' instead of being used for science. In 1952, for instance, one Brigand aircraft from the 1301 regional reconnaissance squadron (Air HQ Ceylon) was taken out of meteorological service to be refitted for the jungle campaign.[72] One of the reasons for the continued lack of resources in Malaya was the Korean War that the British were fighting simultaneously between 1950 and 1953. When the Malayan Emergency had been declared in 1948, it had not been expected to last for more than a year or two, so when the Korean War began, British resources had to be stretched between defence commitments in Europe and the developing situation in Asia, further complicated by the rise of tensions in the Middle East that would erupt in the Suez crisis of 1956.[73] When a new

[67] Secret loose minute, Meteorological Reconnaissance Flights – Negombo, undated, 1951, TNA, BJ5/173.

[68] Letter from the Meteorological Office London, to the chief meteorological officer, F.E.A.F, 252a, 6 December 1951, TNA, BJ5/173.

[69] Letter from E. Evans, chief meteorological officer FEAF HQ, Singapore, to the director of the Meteorological Office, Air Ministry, London, 20 May 1952, TNA, BJ5/173; Minute 269A, extract from Changi Report of Work, February 1952, TNA, BJ5/173.

[70] Evans had transferred over from FEAFs AIR HQ Ceylon (Sri Lanka) at Negombo in 1952: *The Air Force List, April 1952*, London: HMSO, 1952; letter from E. Evans, chief meteorological officer FEAF HQ, Singapore to the director of the Meteorological Office, Air Ministry, London, 25 August 1952, BJ5/173.

[71] Minute 237 24 August 1951, Minute 245 19 October 1951, BJ5/173.

[72] F.E.A.F Establishment of Meteorological Flights, Minute 214 No. 1301 Met. Flight, 9 June 1951, Minute 256 15 January 1952, TNA, BJ5/173.

[73] Souchou Yao, *The Malayan Emergency: Essays on a Small, Distant War*, Copenhagen: NIAS Press, 2016, pp. 4–5; J.A. Williams, 'Korea and the Malayan Emergency: the strategic priorities', *Journal of the Royal United Services Institute* (1973) 118(2), pp. 80–9, 81.

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radiosonde station at Singapore was opened in 1953, it was hoped that this would pave the way towards ending the Hornet's meteorological flights.[74]

This new radiosonde installation was part of a three-year pilot study to establish an upper-air observatory for combining radar wind and radiosonde ascents, supported by a Colonial Development and Welfare grant of $425,000.[75] Despite delays caused by a British equipment scarcity, the service was opened in July at the new Paya Lebar airfield in Singapore, though it would be a few more months before the radiosonde was operational. Upper-air observations were made using hydrogen-filled balloons with attached radiosonde and radio targets, which rose at around six hundred to a thousand feet per minute. Eventually the expansion of the balloon at height would lead to its bursting and falling safely to the ground by means of a cloth parachute.[76] The pilot scheme was expected to generate data for the World Meteorological Organization (WMO) as well as the Civil Aviation Organization for regional airlines, and Dr Lea, by then director of the MMS, was confident that the success of the pilot would determine a more permanent facility for the region.[77]

In 1954, the military's air operations were relocated to a new Joint Operations Centre for army and air defence with the Air Control Centre located at Kuala Lumpur's airfield.[78] Then, in 1955, the British Commonwealth Far East Strategic Reserve (FESR) comprising combined British, Australian and New Zealand forces was created and based in Singapore as the main Far East quick-deployment force for Malaya, but also for elsewhere in the East as needed.[79] Significantly, it has also been noted that the FESR was a 'tangible means by which Britain, and the Commonwealth, could wield influence in US strategic planning … [as the] regional command structure … would fit within US direction should the Cold War turn hot'.[80] None of this would have been feasible without the opening of the new upper-air observatory and the introduction of the radiosonde, which had reduced the need to rely on meteorological flights and enhanced the ability to provide improved forecasts and for wider areas. Dr Lea's 1953 forecast for the upper-air observatory's fate was closely tied to its strategic importance in military operations, further proved in 1956, when the Malayan government took over the permanent financial administration of the upper-air research centre, in order not to rely on ad hoc grant funding. The situation was still entangled with the military, however, as in the late 1950s improvements to long-range forecasting in the north of the country drew from strategic demands. Drawing from the experience of the Japanese invasion in late 1941, the Thai–Malayan borderlands had continued to be a contested and strategic defensive position across the 1950s as the armed wing of the MCP – the

[74] Letter from E. Evans, chief meteorological officer FEAF HQ, Singapore to the director of the Meteorological Office, Air Ministry, London, 25 August 1952, letter to Director Meteorological Office from the chief meteorological officer, HQ F.E.A.F, 13 July 1951, TNA, BJ5/173.

[75] In 1945, the British government had provided £120 million to the colonies until 1956, by way of the Colonial Development and Welfare Act, with Malaya receiving £5 million of the share. Hansard, Written Answers (Commons) Malaya, Development and Welfare Allocation, 19 December 1945, Vol 417, c1465w. Anon., 'They'll test upper air', *Singapore Free Press*, 30 July 1953, p. 3.

[76] Anon., 'No paper for these chutes', *Singapore Free Press*, 3 November 1954, p. 7; anon., 'They'll test upper air', op. cit. (75).

[77] *Annual Report of the Malayan Meteorological Service, 1953*, Singapore: Government Printing Office, 1954; anon., '3-years weather tests', *Straits Times*, 22 July 1953, p. 8; anon., 'They'll test upper air', op. cit. (75).

[78] Grey, op. cit. (43), p. 129. The Fleet Air Arm would have been very familiar to Moorhead, who had been an officer with them before becoming director of the Bermuda Weather Service in 1932. See anon., 'Malaya's new weather chief was in navy', op. cit. (13), p. 13.

[79] Tristan Moss, 'Planning for war in Southeast Asia: the Far East Strategic Reserve, 1955–66', in Peter Dean and Tristan Moss (eds.), *Fighting Australia's Cold War: The Nexus of Strategy and Operations in a Multipolar Asia, 1945–1965*, Acton: Australia University Press, 2021, pp. 95–114, 95–7.

[80] Moss, op. cit. (79), p. 98.

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Malayan Races Liberation Army (MRLA) – chose this remote and mountainous spot to hide from the Commonwealth patrols.[81] In 1958, a long-range storm-warning radar was installed at Kota Bharu airfield and meteorological station, which had the ability to detect rain clouds some 250 miles away,which had the dual purpose of providing for military flights but also helping the local fishing industry.[82]

By the late 1950s, however, Britain's military commitments in South East Asia were lessening. Malayan independence in 1957 had effectively ended the rationale for the internecine war based on the premise of an anti-colonial struggle, although the combined British, Australian and New Zealand air forces remained *in situ* until the Royal Malaysian Air Force were able to take over operations in July 1960.[83] The civil service had also grown progressively across the latter part of the decade, with a more centralized state apparatus and a new Economic Secretariat that had consolidated many of the pre-war siloed departments and removed some of the private-entrepreneur ethos so common within the pre-war civil service.[84] This allowed departments like the MMS to regain and even surpass their pre-war staff numbers through a post-1955 accelerated decolonization plan prior to anticipated self-governance in 1957. The plan focused on filling roles that had previously been held by an elite of European staff, with scientifically trained local recruits. A further impact of an ample staffing body was to free up senior scientists to become more research-active after 1956, including at the upper-air research centre in Singapore's newest observatory. In 1957, the MMS were able to take part in the International Geophysical Year, contributing their weather observations to a new International Meteorological Data Centre.[85]

In terms of their relationship with the military, the mid-1950s were also a critical period for the MMS to shift the balance toward more autonomy, taking over more of the forecasting for the RAF's jungle campaign as well as focusing more on regular peacetime activities, such as answering public queries about air conditioning, 'cold storage' (refrigeration) and insurance claims.[86] Nonetheless, the close ties between the military and the meteorological services were by no means severed. According to Colonel Mancharan Singh Gill, for instance, who started work at the MMS in 1957, any potential officer without a degree in meteorology had to undertake six months' training in the UK conducted by the Air Ministry (not the Meteorological Office).[87] It was probably only in 1965, when Malaysia and Singapore became independent of one another, and the Meteorological Service Singapore and the Malaysian Meteorological Department were formed in Singapore and Kuala Lumpur respectively, that their role as solely civilian agencies within the wider civil service and civil aviation became clearly defined.[88]

Concluding remarks

Quoting minister for communications and works Mr Francis Thomas, the *Singapore Free Press* had announced in 1956 that Singapore was close to being recognized as a leading research

[81] Thomas Richardson, 'The Malayan Emergency', in Dean and Moss, op. cit. (79), pp. 105–6, 115–35, 118.

[82] Anon., 'Storm warning radar at Kota Bharu', *Straits Times*, 13 June 1958, p. 2.

[83] Hansard, Commons Chamber, Air Estimates, 1958–9, Vote a Number for Air Force Service, Vol. 584, 10 March 1958, col. 42.

[84] Nicholas J. White, 'The frustrations of development: British business and the late colonial state in Malaya, 1945–57', *Journal of Southeast Asian Studies* (1997) 28(1), pp. 103–19, 107–8.

[85] *Annual Report of the Malayan Meteorological Service, 1957*, Singapore: Government Printing Office, 1958, p. 4.

[86] *Annual Report*, op. cit. (85), p. 3.

[87] National Archives of Singapore, Oral Histories Collection, Mancharan Singh Gill, (Colonel, Retired), The Public Service, Accession Number 002663.

[88] Anon., 'Separation causes S'pore to spend extra $6.4m', *Straits Times*, 14 December 1965, p. 15.

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centre for upper-air observation in South East Asia.[89] While the mid-1950s had concluded post-war rebuilding and seen investment in new technologies, including the introduction of the radiosonde and the upper-air observatory in Singapore, Thomas's statement was more than a little tinged with hyperbole. As late as 1948, for example, the director of the MMS noted in his annual report that 'the dislocation owing to the war period has virtually made it necessary to restart from the beginning, while the expansion of the air services, both internal and external, has at the same time called for greatly increased meteorological facilities'.[90] In 1946, an inter-territorial committee comprising members from Singapore, the Federation of Malaya, North Borneo, Sarawak and Brunei, had been formed to consider the organization of a regional meteorological service. Their report, compiled by Dr Lea and Moorhead of the MMS, was delayed by two years due to the staffing disruptions of the immediate post-war period.[91] The report proposed a new regional station in each territory, answering to the main HQ in Singapore, and recruitment of twenty-three trained officers to provide a joined-up service for aviation, along the lines of regional organizations then extant in Africa and the Caribbean for meteorology, but also for other techno-scientific services, including broadcasting, telecommunications and the Geological Survey. The report also made clear the continued linkages to the military, costing out finances for the three main areas of operations: (1) a regional service for local needs, (2) an additional service required to meet Royal Air Force needs, and (34) a trunk route service with locally recruited technical officers and staff making up the bulk of people required to support the service and civilian meteorological officers replacing Air Ministry meteorologists by 1949. However, these proposals were drawn up before the declaration of an emergency state in 1948, which put on hold, or altered, many of these ambitious plans. The establishment of a colonial meteorological advisory board was also brushed off as 'merely a further piece of machinery for the performance of functions already adequately provided for by the existing organisation', as also was the appointment of a special adviser on meteorology on grounds of cost and duplication of resources, despite the recommendation of such a post at the meeting of Colonial Meteorological Services in Washington in 1947.[92] The committee's recommendations were, however, translated into the two radiosonde stations established in the mid-1950s, as result of the Colonial Development and Welfare Act that had been pegged to support 50 per cent of the financial costs of the plans for the upper-air observatory and service development.

Despite the British obsession with the weather, investment in their tropical weather services in Malaya was limited and subservient to the ongoing consumption of resources by military aviation. The appeal of Singapore as Britain's main military outpost in the Far East – which had been called into question immediately following the Second World War – had been revitalized by the outbreak of the Korean War in 1950, creating a demand for rubber and tin not seen since 1942 and keeping alive Anglo-American ideas that Indo-China could be communism's gateway into South East Asia.[93] As the civilian arm of the MMS had gradually rebuilt capacity, the ongoing local and regional politics had complicated the position of science in Malaya. The attitude of the colonial government toward the tropical weather and the financing of an appropriate service dedicated to research, or even simply to better forecasting, had always been ambiguous. Even before the war, the government had only made

[89] Anon., 'Government to pay for upper air centre', *Singapore Free Press*, 30 April 1956, p. 3.

[90] H. Moorhead, Annual Report of the Malayan Meteorological Service, 1948, p. 1, NAM, FS, 1317/1949.

[91] TNA, FCO 141/17069, Meteorological Department, pp. 90–100.

[92] Op. cit. (93), pp. 185 and 84. Circular from the Acting Governor General of Malaya on the Establishment of a Colonial Meteorological Advisory Board, 11 January 1948 and, Letter from the Secretary of State for the Colonies on the Appointment of an Advisor on Meteorology, 11 February 1948 and Memorandum 1a.

[93] Malcolm Murfett, *In Jeopardy: The Royal Navy and British Far Eastern Defence Policy 1945–1951*, Oxford: Oxford University Press, 1995, pp. 65–72; Ngoei, op. cit. (9), p. 28.

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an investment in a forecasting service when the rise of aviation demanded it, and when Far Eastern defence had necessitated an improved forecasting service. Even then, scientific progress was slow and often piecemeal, overshadowed by a lack of money and the continual reappropriation of resources, both financial and physical, after 1945.[94] Maintaining political stability and security within the colony was the uppermost concern of the colonial government in this era and, as a result, science came second.[95] The MMS had effectively remained on a war footing for almost two decades, first at the outbreak of the Second World War in 1939, through the BMA interim military government, and all the way through the emergency until Malayan independence in 1957. MMS meteorologists had occupied a transitional space from civilian to military officials, and had also continued to work closely with, or provide services for, military meteorologists after 1945. The result was a scientific service that could not escape the battle in the air to focus energies on a proper research agenda until the more prosperous and peaceful late 1950s.

[94] For more on this ambivalence see Fiona Williamson, 'An ocean apart: meteorology and the elusive observatories of British Malaya', *Isis* (2023) 114(4), pp. 710–24.

[95] Columns 471, 484, 487–8, 494; Hansard, Lords, 27 February 1952, Lords Chamber, The Situation in Malaya, Columns 316–17, 324–9.

Cite this article: Williamson Fiona, 'Meteorology, weather and war in South East Asia: Malaya *c.*1940–1960', *The British Journal for the History of Science* (2025), pp. 1–17. https://doi.org/10.1017/S0007087424001523