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Faith, empire, and weather: Missionary contributions to colonial climatology

In our times of climate crises, the history of climatology is one of the most rapidly growing research fields in the history of science. Traditionally, it has often emphasized the contributions of prominent male and white scientists, such as Julius von Hann, Eduard Brückner, Wladimir Köppen, and Vilhelm Bjerknes, presenting climatology as a narrative of scientific authority, rationalization, and linear progression toward the modern computer science it embodies today.[1] Recently, however, a new dimension has emerged in this narrative, as scholars increasingly explore the colonial history of the discipline. This shift has been fuelled by recent studies and archival discoveries that reveal the intertwinement of climatology with imperial and colonial frameworks.[2]

In a recent article, Harriet Mercer and Thomas Simpson provide an advanced overview of how imperialism and colonialism have shaped climate science, emphasizing themes such as the erasure of Indigenous knowledge, the development of imperial climate infrastructures, and the influence of colonial empires on data collection and theory formation.[3] The authors trace how empires like the British and French established meteorological networks to exert control, support econom-

1 See e. g. for an overview: James Rodger Fleming Fleming, *Inventing Atmospheric Science. Bjerkness, Rossby, Wexler, and the Foundation of Modern Meteorology* (Cambridge, MA/London: MIT Press, 2016); James Rodger Fleming, *Historical Perspectives on Climate Change* (New York/Oxford: Oxford University Press, 1998); Matthias Heymann, "The Evolution of Climate Ideas and Knowledge," *WIREs Climate Change* 1, no.4 (2010): 581 – 597; Robert-Jan Wille, "Colonizing the Free Atmosphere: Wladimir Köppen's 'Aerology', the German Maritime Observatory, and the Emergence of a Trans-Imperial Network of Weather Balloons and Kites, 1873 – 1906," *History of Meteorology* 8 (2017): 95 – 123; Philipp N. Lehmann, "Wither Climatology? Brückner's Climate Oscillations, Data Debates, and Dynamic Climatology," *History of Meteorology* 7 (2015); Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, MA: MIT Press, 2010).

2 David Livingstone, *The Empire of Climate. A History of an Idea* (Princeton/Oxford: Princeton University Press, 2024); Philipp N. Lehmann, *Desert Edens. Colonial Climate Engineering in the Age of Anxiety* (Princeton: Princeton University Press, 2022); Philipp N. Lehmann, "Average Rainfall and the Play of Colors. Colonial Experience and Global Climate Data," *Studies in History and Philosophy of Science* 70 (2018): 38 – 49.

3 Harriet Mercer and Thomas Simpson, "Imperialism, Colonialism, and Climate Change Science," *WIREs Climate Change* 14, no.6 (2023).

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ic ventures, and reinforce ideological narratives of racial and cultural superiority.[4]

While Mercer and Simpson highlight the growing body of literature on these intersections, their review also underscores significant gaps, particularly in the comparative analysis of different imperial contexts.[5] While the British developed a tight-knit network of meteorological stations in India in order to understand the tropical climate and its consequences for any kind of European rule and civilization since the middle of the nineteenth century, the establishment of a worthy meteorological observation network in the German African colonies took significantly longer for various reasons.[6] First, Germany became a colonial power notably later; it wasn't until 1884 that the first regions came under imperial rule. Furthermore, the German colonial administration, especially in the years leading up to 1900, was relatively weak, focusing mainly on military stations and coastal regions.[7] Additionally, colonial efforts were structurally underfunded, and the infamously brutal German colonial wars in German Southwest Africa (Namibia) and German East Africa (Tanganyika), along with costly infrastructure projects like building railways, consumed most of the limited budget, which was fiercely contested in the German Reichstag and among the public.[8] As a result, the German colonial administration was both structurally underfunded and understaffed. In some colonies, only a handful of German colonial officials were tasked with representing and managing imperial rule, and meteorological observations were not a priority for them. Although German meteorology soon became a focal point of meteorological research in Europe, hosting several international conferences, the collection of climate and weather data prior to the First World War was incomplete. The establishment of weather stations, where data was regularly gathered, occurred gradually in the German colonies, depending mainly on the commitment

4 See also: Martin Mahony and Georgina Endfield, "Climate and Colonialism," *WIREs Climate Change* 9, no.2 (2018): 1–16.

5 Heymann, "The Evolution of Climate Ideas and Knowledge."

6 Mark Harrison, *Climates & Constitutions. Health, Race, Environment and British Imperialism in India 1600–1850* (Oxford: Oxford University Press, 1999); Simon Schaffer, "Instruments and Ingenuity between India and Britain," *Bulletin of the Scientific Instrument Society* 140 (2019): 2–13.

7 On German colonialism: Sebastian Conrad, "Rethinking German Colonialism in a Global Age," *The Journal of Imperial and Commonwealth History* 41, no.4 (2013): 543–566.

8 Rebekka Habermas, "Protest im Reichstag: Kolonialskandale in der politischen Kultur des Kaiserreiches," in *Alltag als Politik – Politik im Alltag. Dimensionen des Politischen in Vergangenheit und Gegenwart*, ed. Michaela Fenske (Berlin: Lit Verlag, 2010), 281–303; Rebekka Habermas, *Skandal in Togo. Ein Kapitel deutscher Kolonialherrschaft* (Frankfurt a.M.: Fischer, 2016).

of individual volunteers. A significant group of these contributors to climate and weather research that has thus far been overlooked were Christian missionaries.

Missionaries collected weather and climate data at their mission stations and European research stations established in the colonies as part of and during their efforts to Christianize local populations. Their involvement illustrates how climatological knowledge was not only gathered but also actively produced through specific and powerful technological frameworks that shaped the tropical environment in ways that aligned with European scientific and religious worldviews. Furthermore, their measurements laid the groundwork for subsequent colonial development projects. Measuring and recording the environment was the basis for infrastructure initiatives and agriculture, while colonial knowledge production and science were fundamentally intended to enhance development.

The term *environing technologies*, as introduced by Sörlin and Wormbs (2018), refers to these instruments, practices, and systems through which environments are actively created, measured, and governed. In the context of colonial climatology, these technologies included barometers, rain gauges, and systematic weather observations, which enabled missionaries and colonial authorities to translate complex ecological conditions into data aligned with European categories of knowledge. This process was not neutral; it actively reshaped landscapes and weather patterns into forms that could be managed and utilized for colonial development and settlement projects.

Missionaries played a central role in this process by collecting weather data and integrating prediction and measurement practices into their daily mission work. Their ability to record and predict weather conditions became a tool of authority that influenced relationships with local communities and reshaped how space was used and controlled. Yet how did missionaries understand and use these practices? How did they navigate between European scientific frameworks and Indigenous weather knowledge? In what ways did their measurement practices support broader colonial ambitions while also serving religious aims? And how can these practices be seen as environing technologies that transformed both environments and social relations?

These guiding questions structure this article's analysis of missionaries as participants in climate research, showing how they contributed to colonial knowledge production and the technological shaping of environments, and how climate prediction itself became a form of power within the colonial context.

First, this chapter will explore the agendas of missionaries and their scientific roles across various disciplines before World War I, during the heyday of German colonialism. Next, the development of meteorological networks in the German colonies will be situated within the larger context of German climatological research. Thirdly, the contributions of missionaries to meteorological and climatological

studies will be examined, focusing on their impact on science and colonialism in relation to the missionary mandate. Finally, the chapter will center on the ethnological research conducted by missionaries. In this context, famous missionaries like David Livingstone and Bruno Gutmann attempted to describe the so-called "superstitions" held by the people they were missionizing to identify points of contact for their preaching. However, the so-called "rainmakers" extensive ecological knowledge was significantly diminished in this research. This interplay of science and religion suggests that missionaries considerably contributed to the erosion of Indigenous knowledge and the standardization of meteorological and climatological research.

1 The missionary endeavour and its contribution to science

At the end of the nineteenth century, Protestant and Catholic missions worked all over the world to convert others to Christianity. In order to convince others of Christianity, missionaries had to carefully navigate various encounters with those they sought to evangelize. The Protestant missionary endeavor started in the eighteenth century, when the Danish-Halle Mission came to the Danish colony and trade center of Tranquebar in 1706. The first missionaries, Ziegenbalg and Plütschau, and others soon founded churches, schools, and orphanages, and they ran a print business in order to print the first versions of the Bible translated into Tamil. Throughout the century, numerous missionary societies were founded within Protestantism, aiming to spread the Christian faith in various non-European, primarily colonially occupied regions, such as the Basel Mission, the North German Mission, the Rhenish Mission, the Leipzig Mission, and the Hermannsburg Mission. These societies were organized as associations and initially operated independently of the churches, despite a significant overlap in personnel. Many of these missionary societies, some with a long history, established mission stations in diverse colonial areas. Several Protestant missionary societies, including the Basel and Leipzig missions, first worked in India under British colonial rule before increasingly expanding into Africa.[9] However, most Protestant

9 Because of a growing interest in colonial and global histories, the history of missions has become increasingly important for historians (see e. g. Kirsten Rüther, *The Power Beyond. Mission Strategies, African Conversion and the Development of a Christian Culture in the Transvaal* (Münster: LIT, 2001); Rebekka Habermas and Richard Hölzl, "Mission global. Religiöse Akteure und globale Verflechtung seit dem 19. Jahrhundert," in *Mission global. Eine Globalgeschichte seit*

missionary societies did not perceive themselves as primary colonial actors; rather, the foremost task of their missionaries was not to promote German culture but to spread Christianity. Their religious mandate, based on the contemporary interpretation of the mission mandate, was – at least for the majority of German Protestant missionaries – their main impetus.[10] The "civilising mission" became a "secondary task," but nevertheless remained inseparably interwoven with the "formation of a Christian personality"[11].

Missionaries thoroughly studied the local culture, environment, and religion of their respective mission field. In order to convert as many people as possible and convince them of Christianity, it was considered an important missionary method to preach in the local language and find points of connection in local (religious) circumstances. With the help of interpreters and assistants, one of the first tasks of the missionaries was, therefore, to learn the local language and familiarize themselves with local religious conditions, study the local flora and fauna, and get to know the customs and traditions of the people among whom they were working. They looked for reference points for the sermons, defined prerequisites and levels of knowledge for baptism, or translated the Bible. Hence, missionaries and mission societies were key brokers of cultural contact, agents of cultural

dem 19. Jahrhundert, ed. Richard Hölzl and Rebekka Habermas (Köln/Weimar/Wien: Böhlau, 2014); Linda Ratschiller and Karolin Wetjen, eds., *Verflochtene Mission. Perpektiven auf eine neue Missionsgeschichte* (Köln/Weimar/Wien: Böhlau, 2018), 9–28. Significantly, the entanglements of colonialism and missions have attracted widespread interest. As suggested initially by Jean and John Comaroff in 1989, missionaries have been analyzed as colonial actors who, despite their apparent religious mandate, were essential factors in the so–called "civilization mission". Jean Comaroff and John Comaroff, *Of Revelation and Revolution. Bd. 1: Christianity, Colonialism, and Consciousness in South Africa* (Chicago: University of Chicago Press, 1991); Jürgen Osterhammel, "'The Great Work of Uplifting Mankind'. Zivilisierungsmission und Moderne," in *Zivilisierungsmissionen. Imperiale Weltverbesserung seit dem 18. Jahrhundert*, ed. Boris Barth and Jürgen Osterhammel (Konstanz: UVK Verlag, 2005), 363–426, predominantly because mission societies compiled more than any other colonial institution extensive and detailed archives. Further, recent works suggest that mission societies and their developing media empires were crucial transmitters of colonial imaginations and fantasies "at home," hence widely contributing to the popularization of empire (Susan Thorne, "Religion and Empire at home," in *At home with the empire*, ed. Catherine Hall and Sonya O. Rose (Cambridge, UK/New York: Cambridge University Press, 2006), 143–165; Rebekka Habermas, "Mission im 19. Jahrhundert. Globale Netze des Religiösen," *Historische Zeitschrift* 287 (2008): 629–679.

10 Karolin Wetjen, *Mission als theologisches Labor. Koloniale Aushandlungen des Religiösen in Ostafrika* (Stuttgart: Steiner, 2020).

11 Carl Paul, "Leistungen der Mission für die Kolonien u. ihre Gegenforderungen an die Kolonialpolitik. Vortrag von P. Paul auf dem Kolonial-Kongreß," *Evangelisch-lutherisches Missionsblatt* (1902): 496. Karl von Schwartz, *Mission und Kolonisation in ihrem gegenseitigem Verhältnis* (Leipzig: Missionsverlag, 1908), 9.

translation, and deeply involved with colonialism in various forms, although, and that has also become clear, mission societies and missionaries likewise acted as critics of the colonial rule or as "advocates of the local people."[12]

Missionaries were enthusiastic writers. Their observations and inquiries were not only integrated into their proselytizing efforts and Bible translations (one of their most essential tasks) but also into their depictions of everyday missionary life, which circulated in countless missionary publications for promotional purposes in the German Empire and even in scientific articles and monographs.[13] Recent studies in the history of knowledge have revealed that missionaries contributed to the establishment of various scientific disciplines like botany, ethnology, and linguistics, thereby playing a significant role in the development of a colonial knowledge system. [14]

2 Meteorology and climatology in the German-speaking world

By the end of the nineteenth century, climatology was emerging as a distinct subdiscipline of geography, seeking to establish itself as a natural science. This period marked a significant shift in the scientific approach to climate, often referred to as part of what Susan Faye Cannon described as "Humboldtian science," which was characterized by a growing emphasis on measurement, numerical analysis, and systematic comparison. [15] The term climatology, derived from the German *Klimatologie*, was also shaped by this evolution. Alexander von Humboldt, a pioneer of this method, proposed a methodology centered on mean temperatures and iso-

12 Richard Hölzl and Karolin Wetjen, "Negotiating the Fundamentals? German Missions and the Experience of the Contact Zone, 1850–1918," in *Negotiating the Secular and the Religious in the German Empire. Transnational Approaches*, ed. Rebekka Habermas (Oxford: OUP, 2019), 196–234.
13 Richard Hölzl, "Imperiale Kommunikationsarbeit. Zur medialen Rahmung von Mission im 19. und 20. Jahrhundert," *m&z* 2 (2016): 3–17.
14 Patrick Harries, *Butterflies and Barbarians. Swiss Missionaries and Systems of Knowledge in South-East Africa* (Oxford: Currey, 2007); Sara Pugach, *Africa in Translation. A History of Colonial Linguistics in Germany and Beyond, 1814–1945* (Ann Arbor: University of Michigan Press, 2012); David Chidester, *Savage Systems. Colonialism and Comparative Religion in Southern Africa* (Charlottesville/London: University Press of Virginia, 1996); Alexandra Przyrembel, "Wissen auf Wanderschaft. Britische Missionare, ethnologisches Wissen und die Thematisierung religiöser Selbstgefühle um 1830," *Historische Anthropologie* 19, no.1 (2011): 31–53; David Livingstone, "Scientific Inquiry and the Missionary Enterprise," in *Participating in the Knowledge Society. Researchers beyond the University Wall*, ed. Ruth Finnegan (Houndsmill: 2005).
15 Susan Faye Cannon, *Science in Culture: The Early Victorian Period* (New York: Dawson, 1978).

therms – lines connecting points with the same average temperature – as manifestations of natural laws. In his influential work *Kosmos*, Humboldt introduced the idea of a "comparative climatology," highlighting the statistical analysis of mean annual temperatures and their global patterns.[16] As a result, Humboldt's contributions advanced the development of systematic meteorological observations.[17] By the 1870s, most European nations had established national meteorological institutes, bringing a greater level of professionalism to weather observation. International collaboration began earnestly in 1872 with a meteorological conference held in Leipzig, which set the stage for the first World Congress of Meteorology in Vienna the following year. These meetings facilitated the standardization of meteorological practices, addressing matters such as uniform measurement units, instrumentation, observation schedules, and data sharing through telegraphy and print. This standardization solidified the quantitative nature of meteorology and its claims to scientific legitimacy, building on principles first articulated by the Societas Meteorologica Palatina, the first standardized network of weather observations, which operated thirty-nine stations across Europe and beyond in the eighteenth century.[18]

Climatology's dual focus emerged during this period: first, it aimed to generate knowledge on a global scale, as demonstrated by Humboldt's efforts to map isotherms around the world. Second, it fulfilled practical purposes by providing weather forecasts for navigation, agriculture, and public health. Unsurprisingly, these goals closely aligned with the interests of European colonial empires. Scholars like Katharine Anderson and Fiona Williamson have illustrated how the establishment of meteorological stations in colonial territories was motivated by economic and strategic reasons, particularly the desire to comprehend tropical cli-

16 Otto Ette and Oliver Lubrich, eds., *Alexander von Humboldt, Kosmos. Entwurf einer phhysischen Weltbeschreibung* (Frankfurt a. M.: Die andere Bibliothek, 2004); Birgit Schneider, "Die Sichtbarmachung von Klimazonen im Jahr 1817. Eine neue Visualisierung der Klimadaten Alexander von Humboldts," in *Bilder als Denkformen. Bildwissenschaftliche Dialoge zwischen Japan und Deutschland*, ed. Yasuhiro Sakamoto, Felix Jäger, and Jun Tanaka, Sichtbarmachung von Klimazonen (Berlin/Boston: De Gruyter, 2020), 79–90; Arthur Robinson and Helen Wallis, "Humboldt's Map of Isothermal Lines: A Milestone in Thematic Cartography," *The Cartographic Journal* 4 (1967): 119–123.

17 Karl-Heinz Bernhardt, "Alexander von Humboldts Auffassung vom Klima und sein Beitrag zur Einrichtung von meteorologischen Stationsnetzen," *Zeitschrift für Meteorologie* 34, no.4 (1984): 213–217.

18 Per Pippin Aspaas and Truls Lynne Hansen, "The Role of the Societas Meteorologica Palatina (1781–1792) in the History of Auroral Research," *Acta Borealia* 29, no.2 (2012): 157–176.

mates.[19] From its beginning, meteorology and climatology were deeply intertwined with colonial enterprises and attracted considerable public attention and scrutiny.

Gathering and producing meteorological data was, therefore, an integral part of all scientific expeditions. In the context of German colonial expansion during the late nineteenth and early twentieth centuries, scientific expeditions played a pivotal role in advancing climatological knowledge. These expeditions were not merely exploratory ventures but were often meticulously planned operations aimed at collecting empirical data on weather patterns, soil conditions, and other environmental factors and making the tropical environment.[20] German East Africa, Cameroon, and other colonial territories became key sites for such endeavors, as understanding the tropical climate was deemed essential for agricultural planning, infrastructure development, and addressing health concerns related to acclimatization.[21] Expedition leaders and participants, often funded by colonial administrations or scientific institutions, were equipped with standardized instruments for measuring temperature, rainfall, and atmospheric pressure.[22] Detailed instructions ensured that data collection adhered to established protocols, reflecting the broader efforts to professionalize and systematize climatological research, especially as a part of a subdiscipline of geographical research.[23] Beyond their scientific objectives, these expeditions also served as tools of colonial governance, legitimizing European dominance by framing the colonies as landscapes to be quantified and controlled. Additionally, a network of meteorological observations was gradually established in the German colonies. Although weather observations required particular precision and regularity, and weather data was espe-

19 Katharine Anderson, *Predicting the Weather. Victorians and the Science of Meteorology* (Chicago: University of Chicago Pressm 2005); Fiona Williamson, "Weathering the Empire. Meteorological Research in the Early British Straits Settlements," *The British Journal for the History of Science* 48, no.3 (2015): 475–492.

20 Iris Schröder, "Der deutsche Berg in Afrika. Zur Geographie und Politik des Kilimandscharo im Deutschen Kaiserreich," *Historische Anthropologie* 13 (2005): 19–44; Iris Schröder, *Das Wissen von der ganzen Welt. Globale Geographien und räumliche Ordnungen Afrikas und Europas 1790–1870* (Paderborn: Schöningh, 2011).

21 Helen Tilley, *Africa as a Living Laboratory. Empire, Development, and the Problem of Scientific Knowledge, 1870–1950* (Chicago/London: University of Chicago Press, 2011).

22 Jakob Vogel, "Public-private partnership. Das koloniale Wissen und seine Ressourcen im langen 19. Jahrhundert. Einführung," in *Von Käfern, Märkten und Menschen: Kolonialismus und Wissen in der Moderne*, ed. Rebekka Habermas and Alexandra Przyrembel (Göttingen: Vandenhoeck und Ruprecht, 2013), 261–284.

23 Philipp N. Lehmann, "Losing the Field: Franz Thorbecke and (Post-)Colonial Climatology in Germany," *History of Meteorology* 8 (2017): 152.

cially important for agriculture, the expansion of the observation network in the colonies progressed slowly.

For East Africa, the German Naval Observatory in Hamburg, known as the Deutsche Seewarte, the agency responsible for gathering data in the German Empire, recommended establishing two meteorological stations along the coast as late as 1889.[24] The situation in the colony seemed too delicate for the Hamburg scientists to justify the costs of acquiring and transporting sensitive instruments, including various thermometers, a barometer, and at least some rain gauges. After the turn of the century, the expansion progressed much more rapidly, and a main weather station was established in Dar es Salaam, where the only professional meteorologist in the colonial service worked. The situation was not much better in the other colonies either; in German South West Africa, it was mainly non-state actors who collected rainfall data; a full-time meteorologist's post was not authorized there, although many German farmers in this colony were particularly dependent on weather data. In the West African colonies, Togo and Cameroon, conditions were even worse. Therefore, the collection of weather data in the German colonies can be mainly credited to the initiative and dedication of private entities rather than professional meteorologists.[25] Undoubtedly, the recognition of weather observation as a bourgeois activity since at least the nineteenth century played a significant role in this development.[26]

Not least because of the difficult funding situation, as well as the constant workload, the data collection remained mostly unreliable and incomplete. Countless manuals were published to guide observers in taking precise measurements and correctly recording data in prepared measurement books. The Deutsche Seewarte, as the office responsible for overseeing meteorological data collection, emphasized strict adherence to standardized procedures. Observers were repeatedly reminded to diligently complete the forms provided and to exclusively use calibrated instruments to ensure consistency and reliability in their measurements. To reinforce compliance, the Seewarte regularly issued reminders and published detailed instructions, often in the official gazette, *Deutsche Kolonialblatt*. These instructions covered not only the operation of instruments but also specified their proper installation, ensuring uniformity across all observation sites. "Finally, the observer is earnestly requested not to make any inaccurate entries, as meteorology has already suffered much damage due to poor observations. One should al-

24 Jürgen G. Nagel, *Die Kolonie als wissenschaftliches Projekt. Forschungsorganisation und Forschungspraxis im deutschen Kolonialreich* (Habilitationsschrift FU Hagen, 2013), 368.

25 Nagel, *Die Kolonie als wissenschaftliches Projekt.*

26 Anderson, *Predicting the Weather.*

ways bear in mind that an empty space is far better than a dubious observation."[27]

In the colonies, it was primarily doctors who showed an interest in regularly observing weather data. Their scientific curiosity was influenced by longstanding and popular beliefs about the tropical climate and its effects on the body, psyche, and morals of Europeans.[28] However, doctors were mostly stationed at central locations in the colonies and typically arrived only after some colonial infrastructure had been at least partially established. In the hinterland, and even before or during the early days of colonial rule, it was missionaries who emerged as significant contributors to the collection of weather data and climate calculations.

3 Missionaries as climate researchers

As shown above, missionaries were interested in scientific research both as part of and in spite of their main missionary task. The missionaries of the Danish-Halle Mission at the end of the eighteenth century had already increasingly turned to scientific studies.[29] In their natural-theological mission concept, the missionaries assigned Indian nature and knowledge of it a central mediating and translating role between themselves and the Tamils they aimed to convert. Anne-Charlott Trepp argues that while the missionaries contributed to an intensified transfer of knowledge and culture between India and Europe, and although the contrasts between the different cultures tended to diminish at the macro level of a new kind of knowledge transfer, they seem to have deepened at the micro level of intercultural and direct exchange encounters.[30] In this tradition, it is not surprising that missionaries maintained a strong interest in scientific research in later years, especially when their activities aligned with the broader framework of surrounding technologies. Their meteorological studies were not only employed for climatological purposes but were also integrated into larger colonial development

27 Deutsche Seewarte, Instruktionen für meteorologische Beobachtungen in der Äquatorialzone, 73–86, 86; R 1001/6132, National Archives, Berlin Lichterfelde (BArch).

28 See e. g. the various letters in R 1001/6132, BArch; and David Livingstone, "Tropical Climate and Moral Hygiene. The Anatomy of a Victorian Debate," *The British Journal for the History of Science* 32, no.1 (1999): 93–110; Livingstone, *The Empire of Climate.*

29 Keyvan Djahangiri, "Die Dänisch-Englische-Hallesche Ostindien Mission," *South-Asia Chronicle* 2 (2012): 305–349; Ulrike Schröder, *Religion, Kaste und Ritual. Christliche Mission und tamilischer Hinduismus in Südindien im 19. Jahrhundert* (Halle: Verlag der Franckeschen Stiftungen, 2009).

30 Anne-Charlott Trepp, "Von der Missionierung der Seelen zur Erforschung der Natur. Die Dänisch-Hallesche Südindienmission im ausgehenden 18. Jahrhundert," *Geschichte und Gesellschaft* 36, no.2 (2010): 231–256.

strategies aimed at controlling and altering the environment for economic and infrastructural benefits. By incorporating their weather observations into colonial knowledge systems, missionaries actively influenced agricultural planning, settlement strategies, and the adaptation of European lifestyles to tropical climates, thereby reinforcing the interconnectedness of climate science and imperial development.

In the early years of the colony of German South West Africa, the origins of meteorological research lay entirely in the hands of the mission, which had already measured rainfall and temperatures through means of technology before the state took possession of the colony. The Rhenish Missionary Society had already founded the first missionary stations in the area that would later become German South West Africa in the 1840s and was therefore familiar with the environmental conditions of the subtropical colony and its rainfall and temperature conditions long before the German occupation. The Rhenish Mission Society opened its first mission station in Otjikango in 1844 under the leadership of Carl Hugo Hahn. Hahn was very interested in weather and climate records and descriptions, which he recorded in his diaries until around 1859. The detailed reporting system established by the mission also resulted in regular reports on weather and climate, at least regarding their effects on harvests and food security, and sometimes on the possibilities for mission work. His practice exemplifies "environing technologies" as missionaries actively participated in shaping the environmental understanding of the colonies through their structured documentation.

Station chronicles, monthly and annual reports, along with general descriptions of the station in mission papers, typically included references to weather and climate.[31] In later years, there were also missionaries like Johann Böhm (1833–1918), who were particularly invested in weather reports. Böhm first came to South Africa in 1867 and was stationed at a mission in what is now Walvis Bay from 1881 to 1904. After he had been promisingly provided with the usual instruments – various thermometers, a rain gauge, a barometer, as well as anemometer – by the Deutsche Seewarte, he recorded more or less reliable climatic measurement series, which were eventually also incorporated into climatological research and colonial policy considerations.[32] He was by no means alone in this.

Karl Dove, who undertook a study trip to South Africa in 1893, also makes significant reference to the (preliminary) work of the missionaries. In a letter to the

31 Stefan Grab and Tizian Zumthurm, "The land and its climate knows no transition, no middle ground, everywhere too much or too little: a documentary-based climate chronology for central Namibia, 1845–1900," *International Journal of Climatology* 38, no. 1 (2018): e643–e659.

32 Friedrich Stapf, "Notiz über das Klima von Walfischbay," *Deutsche Kolonialzeitung* 4 (1887).

Reichskolonialamt, the colonial office in Berlin, his father, Richard Dove, a church law professor from Göttingen, refers to this data, expressing his son's hope of being able to supplement it with precise calculations of the mean values. In a later publication, Karl Dove cited what he considered to be the flawed measurements made by the missionaries to advocate for an enhancement in the meteorological observation system. In doing so, he seems to consider it particularly important to take the practical aspects of colonization into account.[33] Karl Dove expressed specific concern regarding the proper use of instruments as well as their installation – a topic that was intensely debated in meteorology and climatology.[34] There is considerable evidence to suggest that Dove used data series from missionaries in his climate map of outer tropical Africa from 1888, but he obscured their exact origin.[35] In any case, he was aware of the measurements taken by Rhenish missionaries in Walvis Bay. Especially in the years before 1900, the supply of meteorological data from South West Africa was sparse and irregular. In some cases, the data only reached Hamburg via Berlin more than two years later.[36] This also seems to be a reason why an attempt was finally made to conclude an agreement with a member of the mission, the Rhenish mission "cultural engineer" Walter Borchardt-Ott. According to a contract, the mission representative was to be appointed "Head of Meteorological Observations," with the task of first setting up and then supervising this "branch of service" in the colony. His duties were also to include taking his own measurements. No salary was planned, only reimbursement of expenses, customs and tax benefits.[37] However, the governorate in Windhoek criticised his appointment because his place of work was too far away from Windhoek.[38] Freiherr Alexander von Danckelmann, the leading geographer and meteorologist at the Deutsche Seewarte, on the other hand, defended Borchardt-Ott's appointment, albeit more as a stopgap measure. A written declaration of consent from the Rhenish Mission So-

33 R1991/6139, S. 19 – 23, BArch.

34 Carl Jelinek, *Anleitung zur Anstellung meteorologischer Beobachtungen und Sammlung von Hilfstafeln. 2. Auflage* (Wien: Druck der kaiserliche-königlichen Hof- und Staatsdruckerei, 1876); Hugo Meyer, *Anleitung zur Bearbeitung meteorologischer Beobachtungen für die Klimatologie* (Berlin: Julius Springer, 1891); *Report of the Proceedings of the Meteorological Conference at Leipzig. Translated from the Official Report, Appendix to Vol. VII, Nr. 24, Zeitschrift für Meteorologie* (London, 1873).

35 Karl Dove, *Das Klima des außertropischen Afrikas mit Berücksichtigung der geographischen und wirtschaftlichen Beziehungen nach klimatischen Provinzen dargestellt* (Göttingen, 1888).

36 ,: Landeshauptmannschaft Südwestafrika an Reichskanzlei, 10.1.1896, R 1001, Nr. 6139, 26, BArch.

37 Vertrag, April 1898, R 1001, Nr. 6139, 39, BArch.

38 Gouv. DSWA an KA, 21.04.1898, R 1001, Nr. 6139, 43, BArch.

ciety was available in any case, even if a different solution was ultimately found, when a colonial official was appointed for the task.[39]

However, officials and scientists in other colonies also relied heavily on the help of mission members in order to even come close to meeting the standards of regular weather measurements. For instance, the missionaries of the Berlin Missionary Society for East Africa regularly took weather measurements and forwarded the results to their mission house. When the governor of the East African colony learned about this, he promptly suggested to the Imperial Colonial Office or the Naval Observatory that these values be utilized for scientific purposes.[40] Missionaries from the Leipzig Mission, for example, regularly supported the measurements at the scientific research station on Kilimanjaro in the colony of German East Africa. The advantage was obvious. The missionaries were stationed in one place for an extended period, were familiar with the local staff – even though their assistance with the measurements was not requested by the Deutsche Seewarte – so they took on this task, much like Borchardt-Ott, without any additional compensation. Their many years of experience also enabled them to better evaluate the typical or atypical nature of local weather events. Like the Rhenish missionaries, the Leipzig missionaries frequently reported home about the weather and climate in their updates. Accounts of drought, food scarcity, locust plagues, and floods during the rainy seasons provided essential information in the regular station reports, which aimed, among other things, to highlight the missionaries' significant readiness to make sacrifices. For instance, torrential rains did not deter Leipzig missionary Gerhard Althaus from celebrating Easter with several church services, nor did drought and rising prices compel him to cease his missionary efforts.[41]

As these examples have shown, missionaries made an important contribution to weather and climate measurement in the meteorological sense, especially in the early days of the development of meteorological research stations. Their engagement exemplifies how technology functioned as a means to form an environment, as they actively structured and mediated colonial climatic knowledge through systematic measurement practices, contributing to the further application of this knowledge in both scientific and practical environmental exploitation

39 Nagel, *Die Kolonie als wissenschaftliches Projekt*, 375.

40 Soden an Reichskanzlei, Daressalam 5.7.1892, R1001, 6135, 46–53, BArch.

41 Evangelisch-lutherisches Missionsblatt 1899, 307; Ostern in Mamba am Kilimandscharo, in: Lutherisches Missionsvolksblatt 18 (1906); Teuerung am Kilimandscharo, in: Lutherisches Missionsvolksblatt 21 (1909); Karolin Wetjen, *Das Globale im Lokalen. Die Unterstützung der Äußeren Mission im ländlichen lutherischen Protestantismus um 1900* (Göttingen: Göttinger Universitätsverlag, 2013), 75.

and development, particularly in agricultural initiatives, sometimes even undertaken by the mission societies themselves. At the same time, their contributions were not limited to collecting weather data or describing the climate. In their missiological research, weather and climate also played a role when they described the local ecological knowledge of the people they were trying to convert. In their research as well as their practices, they powerfully diminished local climate knowledge led by their Humboldtian vision of standardized numerical knowledge and rational epistemology.

4 Missionaries' ethnologies and the dismissal of local climate knowledge

Missionaries conducted comprehensive religious-ethnographic studies in which they sought references for sermons and lessons.[42] As a result, missionaries significantly contributed to the collection of ethnographic and religious studies materials, playing an important role in the formation of these sciences.[43] Especially before the First World War, missionaries had the opportunity to publish religious studies, as well as ethnographic or historical works about the people they missionized, through their missionary societies, which also functioned as agents in the (proto-)scientific community of these disciplines. Not all missionaries were as successful as the Leipzig missionary Bruno Gutmann, who earned two honorary doctorates for his ethnographic studies.[44]

42 This principle, which finds its starting point in the Areopagus speech, has been emphasised repeatedly by researchers. Altena, for example, asserts that missionaries were only interested in non-European religions to the extent that they could be exploited according to the quarry principle. Thorsten Altena, *Ein Häuflein Christen mitten in der Heidenwelt des dunklen Erdteils". Zum Selbst- und Fremdverständnis protestantischer Missionare im kolonialen Afrika 1884–1918* (Münster u. a.: Waxmann, 2003), 115–116; Wetjen, *Mission als theologisches Labor.*

43 A number of works have been published in recent years on the missionaries' research into religion. See, for example Rebekka Habermas, "Wissenstransfer und Mission. Sklavenhändler, Missionare und Religionswissenschaftler," *Geschichte und Gesellschaft* 36, no.4 (2010), 257–284; Chidester, *Savage Systems.*

44 Karolin Wetjen, "Entangled Mission: Bruno Gutmann, Chagga Rituals, and Christianity,1890–1930," in *Global Protestant Missions. Politics, Reform, and Communication, 1730s–1930s*, ed. Jenna Gibbs (London/New York: Routledge, 2020), 209–230; Klaus Fiedler, *Christentum und afrikanische Kultur. Konservative deutsche Missionare in Tanzania 1900–1940* (Gütersloh: Mohn, 1983); Ernst Jaeschke, *Bruno Gutmann – His Life, his Thoughts and His Work. An Early Attempt at a Theology in an African Context* (Erlangen: Missionsverlag, 1985).

Such studies were essentially collections of the customs and traditions of the people and other religious beliefs. Since the descriptions were essentially used to identify points of contact for doctrine, they followed European categories of religious studies when looking for a belief in God, for example.[45] In this sense, the missionaries often even "invented" religions when they pressed their mostly incomplete observations and reflections into a system of religious studies.[46] The category of superstition played an important role in this, characterising fetish practices, naturalistic belief in spirits or "idols." In the description of these religious practices, "rain-making" or "rain-binding" practices often played a role, which the missionaries dismissed as superstition in this context.[47]

Rainmaking has long been a central aspect of African traditional religious practices, deeply rooted in the careful observation of weather patterns, flora, fauna, and astronomical phenomena.[48] Rainmakers, often regarded as possessing sacred authority and unique knowledge, were believed to have the ability to influence or manipulate natural phenomena. Their expertise in rainmaking and rain prevention was built upon centuries-old climate knowledge, passed down through generations via proverbs, songs, and dances. This practice, varying across communities, remained shrouded in secrecy and held a prestigious status, often reserved for elite and powerful families.

The reliance on rainfall profoundly shaped the socio-political organization of African societies. Rainmaking rituals, believed to ensure the timely arrival of life-sustaining rains, were not only religious acts but also ways to exert control over the natural world. Anthropologist Todd Sanders has studied these rituals and their embedded gender concepts, focusing on the Ihanzu people of Tanzania, who lived in a semi-arid region of the German East African colony. Among the Ihanzu, the royal Anyampanda clan rainmakers held a position of immense influence within the regional rainmaking economy. Their climate expertise extended beyond rain rituals to preparing war medicine and mediating significant social and political matters. The prominence of the Ihanzu rainmakers even attracted

45 Wetjen, *Mission als theologisches Labor.*, 105–114 with further references.

46 See e. g. Geoffrey A. Oddie, *Imagined Hinduism: British Protestant Missionary Constructions of Hinduism, 1793–1900* (New Dehli/Thousand Oaks/London: Sage, 2006).

47 See for example: Johannes Ittmann, *Kameruner Manuskripte. Die Religion im vorderen Kamerun*, Chap. 1, https://www.johannes-ittmann.de/site/band3.htm.

48 N. G. Christian, 'The Impact of Climate Change on African Traditional Religious Practices', *Earth Science & Climactic Change*, 5 (2014); Onah, 'Rain-Making among the Igbo, with Particular Reference to Nsukka People', cited by A. Ossai and J. E. Madu, 'Exploring Rain-Making and Rain-Prevention as Instruments of Peace-Building in Ezimo Community, Nsukka Cultural Area of Igboland', *Ohazurume: Unizik Journal of Culture and Civilization*, 3 (2024): 31; J. S. Mbiti, *African Religion and Philosophy* (Ibadan: Heinemann, 1979), 181.

neighboring communities, who undertook pilgrimages to seek their assistance when their own rituals failed.[49]

One of the earliest and most groundbreaking descriptions of a missionary's encounters with a so-called rainmaker, who was confident in his local power, was written by David Livingstone.[50] Livingstone, a prominent nineteenth-century missionary and explorer, became one of the most iconic figures of his time. Renowned for his extensive expeditions across southern and central Africa, he pursued a dual mission: spreading Christianity and exploring the continent. Livingstone's detailed accounts of his travels captivated European audiences, shaping perceptions of Africa and its people.[51] In the 1840s, Livingstone converted the "rain doctor" Sechele to Christianity, with rainmaking being an important part of Sechele's life. Although Sechele eventually chose to abandon the practice in favor of Christianity, he initially sought to convince Livingstone of the effectiveness of his own practices and ecological knowledge. However, Livingstone, confident in his Christian faith and scientific training, insisted on a test, which Sechele vehemently refused. This dialogue revealed the clash between different cosmologies and rationales.

However, the resulting devaluation of rainmaking as superstition had two aspects: First, from a Christian missionary point of view, any form of magic seemed unacceptable. Secondly, by the nineteenth century, Christian missionaries were already highly trained in modern, scientific, rational methods. This was also reflected in the increasing devaluation of weather and land divination in Europe in the nineteenth century. This twofold rejection even led to missionaries presenting themselves as the "rain makers of a competing power," as Jean and John Comaroff show in their account of the introduction of irrigation systems by European missionaries among the Tsawana.[52]

49 T. Sanders, *Beyond Bodies. Rainmaking and Sense Making in Tanzania* (Toronto: University of Toronto Press, 2009), 74.

50 David Livingstone, *Missionary Travels and Researches in South Africa* (London: John Murray, 1857), 23–25; Brian Stanley, "The Missionary and the Rainmaker: David Livingstone, the Bakwena, and the Nature of Medicine," *Social Sciences and Missions* 27 (2014): 145–162; Jean Comaroff and John Comaroff, *Of Revelation and Revolution. Vol. 1: Christianity, Colonialism, and Consciousness in South Africa* (Chicago: University of Chicago Press, 1991), 206–213.

51 Anna Johnston, "British Missionary Publishing, Missionary Celebrity, and Empire," *Nineteenth Century Prose* 32, no.2 (2005): 32–47.

52 Jean Comaroff and John Comaroff, "The Colonization of Consciousness in South Africa," *Economy and Society* 18, no.3 (1989): 274.

As late as the 1930s, Catholic as well as Protestant missionaries still described rain magic as superstition.[53] The aforementioned Bruno Gutmann, for example, wrote a lengthy treatise on the "field cultivation customs of the Wadschagga," who lived on Kilimanjaro, the "highest German mountain" in the colony of East Africa. In the journal for ethnology, *Zeitschrift für Ethnologie*, Gutmann described the cultivation and irrigation methods alongside incantations against pests, and particularly addressed the practices of rainmaking associated with the rule, power and prestige of the Chagga:

> The art of rainmaking requires a great deal of preparation. More important to the rainmaker, however, is his oracle, which indicates when rain will come. To call upon his oracle, the rainmaker draws water from all the springs in the country into a pot that has been dug into the ground at the grave of his Yater. If bubbles rise, the father indicates rain. But if the water remains still, he says: 'The father does not want to announce anything.' However, the first cumulus clouds over the Pareb mountain are more reliable weather signs for him, indicating that rain will also fall on Kilimanjaro in a few days. He tries to delay the incantation until these first signs appear. If the chief, at the suggestion of his men, sends him gifts of beer and meat and asks him to bring the rain, then, depending on the signs, he will either quickly finish his preparations or try to extend them over as long a period as possible.[54]

The rainmaker, whose incantation is described in great detail, is exposed by Gutmann as a conjurer who, should the hoped-for rain fail to materialise, did not shy away from further accusations, demands for further sacrifices and lies.[55] Even sacrificing children for rain was not considered unlikely by Gutmann.[56] Such descriptions by missionaries were certainly effective narratives in the claim for colonial power and moral authority. Not only were the Germans already aware of the special power of the rainmakers and their claim to land and power during the colonial period, and therefore persecuted them particularly brutally as (supposed) instigators of uprisings.[57]

These descriptions of the knowledge of "rain magic" as a conjuring trick also had a long-term effect, not least because missionaries so clearly defamed the ecological understanding of rain, cloud formation, and climate, as well as the centuries-old observations of flora and fauna attributed to the "rain magicians." Such knowledge was not in line with the statistical and numerical measurements

53 Albert Aufinger, "Wetterzauber auf den Yabob-Inseln in Neuguinea," *Anthropos* 34 (1939): 277–291.

54 Bruno Gutmann, "Feldbausitten und Wachstumsbräuche der Wadschagga," *Zeitschrift für Ethnologie* 45, no.3 (1913): 486 [my translation].

55 Gutmann, "Feldbausitten und Wachstumsbräuche der Wadschagga," 487–488.

56 Gutmann, "Feldbausitten und Wachstumsbräuche der Wadschagga," 489.

57 Sanders, *Beyond Bodies*, 74.

based on measurement techniques in the Humboldtian tradition, which, with its emphasis on quantitative data, increasingly replaced qualitative weather observations. Hence, this knowledge found no justification in research into weather and climate through a Eurocentric epistemology, and it is only recently that this knowledge has been increasingly referenced, but it is still primarily used as a proxy in the IPCC's climate calculations.[58]

5 Conclusion: standardization, exclusion, and the layers of climatological knowledge

This chapter has demonstrated how climatology, emerging as a modern scientific discipline, became deeply entwined with the colonial agendas of European empires. German colonial territories serve as a compelling case of how missionary activities and the systematic collection of meteorological data intersected with both imperial ambitions and religious motivations. Missionaries, positioned at the nexus of colonial infrastructure and local communities, played a pivotal role in early climate research by establishing observation networks and contributing to climatological knowledge production. However, missionaries were not just passive observers but active participants in the construction of climatic knowledge through technological interventions. Their use of barometers, thermometers, and rain gauges at mission stations did not merely serve scientific ends but also functioned as tools of environmental control and colonial administration. The concept of *environing technologies* is crucial here, as it helps contextualize how mis-

58 Bianca van Bavel, Joanna Petrasek Macdonald, and Dalee Sambo Dorough, "Indigenous Knowledge Systems," in *A Critical Assessment of the Intergovernmental Panel on Climate Change*, ed. K. de Pryck and Mike Hulmes (Cambridge: Cambridge University Press, 2022), 116–125. Rainmaking practices have only recently been further acknowledged as part of discussions on the severe impacts of climate change on African communities. In this context, several academic papers refer to rain-making practices as a traditional solution for local climate change resilience, or rather an additional source of knowledge for climate science today. E. g. Sussy Gumo, "Praying for Rain. Indigenous Systems of rainmaking in Kenya," *The Ecumenical Review* (2017), 386–397; Timothy Marango, Joseph Francis, and Mushaisano A. Mathaulula, "Insights Into The Potential Of Indigenous Rain Making Practices in Combating the Negative Effects of Climate Change in Chimanimani District of Zimbabwe," *Indilinga. African Journal Of Indigenous Knowledge Systems* 15, no.2 (2016), 187–204; Anayo Ossai and Jude Emeka Madu, "Exploring Rain-Making and Rain-Prevention as Instruments of Peace-Building in Ezimo Community, Nsukka Cultural Area of Igboland," *Ohazurume: Unizik Journal of Culture and Civilization* 3, no.3 (2024), 26–43. On "resilience" as a focus: Dagomar Degroot et al., "Towards a rigorous understanding of societal responses to climate change," *Nature* 591 (2021), 539–550.

sionaries' scientific engagements contributed to the making of colonial climates, both materially and epistemologically. By mapping climatic patterns and defining what constituted reliable meteorological data, missionaries participated in the broader process of inscribing imperial authority onto the environment. This process also systematically excluded evidence-based practical climate knowledge from European scientific efforts to understand weather phenomena and climate patterns, creating a significant epistemological divide.

Rainmaking practices, a cornerstone of African societies' ecological knowledge, were a prime example of this marginalization. The intersection of missionary activities and local rainmaking practices often highlighted tensions between European and Indigenous knowledge systems. Missionaries like David Livingstone viewed rainmaking rituals as barriers to conversion and often sought to discredit them as superstitious or pagan practices. However, their efforts sometimes inadvertently documented the complexity and significance of rainmaking knowledge, as evidenced in the accounts of missionaries who recorded local practices while attempting to replace them with Christian rituals. Such interactions reveal the deep entanglement of climate knowledge with colonial and religious agendas. These agendas were shaped by missionaries' dual goals of promoting Christianity and supporting civilization. Missionaries influenced by enlightened, modern, and scientific thought, dismissed Indigenous practices, such as rainmaking, as superstitions incompatible with Christian teachings, framing them as obstacles to both religious conversion and civilization. This dynamic not only delegitimized Indigenous ecological expertise but also reinforced the broader power structures of imperialism.

German colonial authorities and missionaries, hence, actively sought to delegitimize these practices, framing them as incompatible with both Christian beliefs and modern scientific methods. At the same time, the climate expertise embedded in these traditions often found its way into missionary ethnographic accounts and colonial policy discussions, albeit stripped of its original context and significance.

The history of climatology cannot be disentangled from its colonial underpinnings. The discipline's reliance on standardized methods, calibrated instruments, and data infrastructures facilitated the centralization of Eurocentric knowledge systems while systematically excluding Indigenous ways of knowing. These processes shaped not only the scientific understanding of tropical climates but also the broader power dynamics between colonizers and the colonized, and they found their way into colonial development fantasies and dreams to alter the tropical environment through climate engineering.[59]

59 Lehmann, *Desert Edens*.