

38°C: Fever, Thermometry, and the Coming into Being of a Global Norm, ca. 1868–1890

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It was no longer “sufficient to ascertain the warmth of the skin with one’s hand,” as the Brazilian physician-author João Vicente Torres Homem informed his readership in his *Elementos de Clinica Medica*, published in Rio de Janeiro in 1870, for “the physician might easily deceive himself.” Ever since Ludwig Traube, Felix von Baerensprung, and Carl Wunderlich in Leipzig and Berlin had “reached results of such value, such precision, in relation to pyrexia” some ten years prior, “physicians in all countries” had “accepted their practical principles,” including that of a normal core body temperature—“37 degrees on average”—and the “fact observed by every doctor” that temperature would “rise constantly in a feverish state, reaching 38” or more degrees centigrade. There was now a “profound conviction that the thermometer was an essential instrument for the physician, that without it, exact diagnosis was impossible.”¹

Few numerical standards are as ubiquitous as that for “normal” body temperature—37°C or 98.6°F—and the attendant idea that if the thermometer read 38°C, “one need not be afraid” to speak of a fever, as another one of clinical thermometry’s early advocates, Charles Garcin, put it in 1871.² Indeed, 37°C and 38°C, the threshold for fever, have become so habitual and ordinary since the time of Torres Homem’s writing, the assumptions underlying it—that of the “diagnostic and pathological significance of temperature”³ in particular—so generally agreed upon in societies all over the world, that historians may be excused for neglecting to ask how and why thermometry and its numerical standards actually became a global norm: “profound conviction” far beyond Leipzig and Berlin, with physicians like Torres Homem.

This article traces the global “biography” of the idea of a “normal” body temperature of 37°C, and of 38°C as indicating “a feverish state.” In a first part, the article reassembles how a fever was

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¹ João Vicente Torres Homem, *Elementos de Clinica Medica* (Rio de Janeiro: Nicoláo A. Alves, 1870), 98–101.

² Charles Garcin, *La fièvre typhoïde étudiée par le thermomètre* (Montpellier: L. Cristin, 1871), 18.

³ Christopher Hamlin, *More Than Hot: A Short History of Fever* (Baltimore: Johns Hopkins University Press, 2014), 165–6.

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diagnosed before the mid-1800s, reviewing the extant literature on how the idea of fever as quantifiable temperature and the related numerical standards first came into being in the city hospitals of mid-nineteenth-century Leipzig and Berlin: the creation of “normalized” and pathological body temperature, as Volker Hess put it in his foundational, Canguilhem-ian, monograph on the subject.⁴ In the main part, the article traces these numerical thresholds’ dissemination across the globe over the 1870s and 1880s and endeavors to *explain* their ready and swift acceptance in places like Rio de Janeiro. Apart from the German territories, Japan, and the United States,⁵ we know little about how, let alone why 37°C and 38°C took hold. While a comprehensive global picture is not possible in so short a piece, this essay adopts a panoramic, macroscopic viewpoint, abstracting from local historiographies and a wide range of sources to identify the overarching, broader structures and principles that contributed to establishing these numerals, initially quite controversial, on a worldwide scale.

The positivist founders of the discipline of history of science would have dismissed the question—of *why* 37°C and 38°C became a global norm—since they would have thought the answer to be self-evident: Both travelled to distant societies because they were a truth revealed, “hidden nature” brought to light, based on mathematical reasoning and as such “ecumenical” and of universal validity.⁶ Present-day historians of science would beg to differ, of course. Not only is there reason to doubt that thermometry reveals a universal truth: Studies conducted since the 1990s have found that the normal, oral temperature of adults is lower than the 37°C established in the mid-1800s, either because historic measurements were flawed or because human body temperature has decreased since the Industrial Revolution, when inflammatory levels were higher than today.⁷ More importantly, ever since scholars began to argue in the 1970s that the validity and the credibility of a proposition are not one and the same—that truth does not shine by its own light, as Steven Shapin put it, that it is not its own sufficient recommendation—the field has made it one of its central tenets to account for how and why something becomes a collectively held knowledge, or norm, “regardless of [its] truth and falsity.”⁸ One need not go quite so far; indeed, the truth—as well as the accuracy and practical utility—of thermometry’s early propositions were in some measure relevant to their credibility, as the following argues; they were, however, but one, and not a *sufficient* reason for 38°C becoming a medical fact on a global scale.

THE COMING INTO BEING OF A NUMBER

Long into the nineteenth century, a fever was not reducible to heat, let alone an exactly quantifiable temperature. Though warmth was a reasonably typical sign of fever, it was not, as historians of medicine have argued, by itself sufficient to diagnose a fever. A fever was, instead, known by a proliferation of signs or symptoms: a quick pulse and heartbeat, a “general debility,” weariness, “pain in the head,” possibly delirium and “wasting of the flesh,” and either heat or shivering

⁴ Volker Hess, *Der wohltemperierte Mensch: Wissenschaft und Alltag des Fiebertmessens (1850–1900)* (Frankfurt: Campus Verlag, 2000), 12, 119.

⁵ On the German states, see Hess, *Wohltemperierte Mensch*. On the US and Japan, see Edward A. Dominguez et al., “Adoption of Thermometry into Clinical Practice in the United States,” *Reviews of Infectious Diseases* 9, no. 6 (1987): 1193–1201, <https://doi.org/10.1093/clinids/9.6.1193>; and Akinobu Takabayashi, “Medical Technology in Use: A History of Clinical Thermometry in Modern Britain and Japan,” *East Asian Science, Technology and Society* 13, no. 1 (2019): 17–37, <https://www.muse.jhu.edu/article/720130>.

⁶ Kapil Raj, “Beyond Postcolonialism . . . And Postpositivism. Circulation and the Global History of Science,” *Isis* 104, 2 (2013), 338–339, <https://doi.org/10.1086/670951>.

⁷ Myroslava Protsiv et al., “Decreasing Human Body Temperature in the United States since the Industrial Revolution,” *eLIFE* (2020): 1–11, <https://elifesciences.org/articles/49555.pdf>, on 6.

⁸ Steven Shapin, “Cordelia’s Love: Credibility and the Social Studies of Science,” in *Never Pure*, ed. Shapin (Baltimore: Johns Hopkins University Press, 2010), 256.

and chills.⁹ The signs of a fever—then a disease in its own right rather than a symptom—varied not only over its distinctive temporal course, but also between the various kinds, or *genera*, of fever that contemporaries distinguished.¹⁰ Those “attended with . . . Derangement of the Senses,” for instance, were named nervous fevers, while a “bilious remittent fever” attacked uncommonly suddenly and in a sequence of remissions and accessions that entailed “chills down the back,” a tightness in the chest, “bilious vomiting,” and a hard pulse.¹¹ Contemporaries would have agreed that any proper diagnosis involved an intricate, complex process that required the physician’s expert hand—which had to feel the pulse, or excessive bodily warmth—and his close observation of the sufferer’s urine, sweat, vomit, expression, and demeanor,¹² but also extensive conversations with the patient. For many of the sensations that physician-authors recorded in their writings—weariness, “chills down the back,” tightness in the chest—were wholly subjective, not necessarily noticeable from the outside, and had to be inquired after and related by the sufferer. As historians have argued, before a fever came to be “measured, [it was] spoken about,” diagnosed through a lengthy conversational routine between the physician and the sufferer.¹³

From the 1830s and 1840s, fever became “recognizably modern,” as Christopher Hamlin has put it. It not only ceased to be a disease in its own right, to become the symptom of various, discrete diseases;¹⁴ it was also redefined to refer to internal temperatures higher than 38°C. Whereas earlier physicians had seen heat as but one, and often a secondary, aspect of fever, within a few decades, the new, clinical medicine came to be preoccupied principally with the “diagnostic . . . significance of temperature.”¹⁵ The earliest tides of that change are perceptible from the beginning of the nineteenth century, when various physicians in France, England, the German territories, and the United States began to conduct systematic temperature measurements, out of a new interest in determining the mean or “normal” temperature of the healthy body.¹⁶ Though various authors had previously found that human body temperature varied little in healthy individuals, it was the German physician Carl Wunderlich who was, and is, generally credited with the idea of a “normal” body temperature: 37° in a “well-closed armpit.”¹⁷ A series of near contemporaneous large-scale experimental studies subsequently examined the variation of body temperature in a state of illness.¹⁸ It were physicians from Leipzig and Berlin who would eventually, premised on the “fact of the constancy of body heat in the healthy” and that of its variation in the sick, come to use *elevated* temperature “for diagnostic and prognostic inferences,” that is, as an index of sickness.¹⁹ Any rise of temperature above 37.5°C was “suspicious,” a deviation from the “norm,” as Carl Wunderlich wrote in 1868, and thus an unmistakable sign of illness; any rise above 38°C signified a fever, its severity increasing gradually with the elevation of temperature.²⁰ The new

⁹ Hamlin, *Hot*, 4, 17; and Hess, *Wohltemperierte Mensch*, 31–32. Terms from: William Buchan, *Domestic Medicine* (London: Strahan, 1772), 174.

¹⁰ Hess, *Wohltemperierte Mensch*, 19, 26, 34.

¹¹ Thomas Dancer, *The Medical Assistant; or Jamaica Practice of Physic* (Kingston: Aikman, 1801), 86; and Jose Pinto de Azeredo, *Ensaio sobre algumas enfermidades d'Angola* (Lisboa: Regia Officina Typografica, 1799), 5–7.

¹² Michael Stolberg, *Homo Patiens. Krankheits- und Körpererfahrung in der Frühen Neuzeit* (Köln: Böhlau, 2003), 196.

¹³ Hess, *Wohltemperierte Mensch*, 282–283.

¹⁴ Hamlin, *Hot*, 199; and Hess, *Wohltemperierte Mensch*, 11–12, 61–2.

¹⁵ Hamlin, *Hot*, 165–166, 252.

¹⁶ Dominguez, “Adoption,” 1195. On the French tradition: Garcin, *Fièvre typhoïde*, 8–9.

¹⁷ Carl Wunderlich, *Das Verhalten der Eigenwärme in Krankheiten* (Leipzig: Otto Wigand, 1868), 3. On Wunderlich being credited, see Hess, *Wohltemperierte Mensch*, 69, 272; and Philip A. Mackowiak and Gretchen Worden, “Carl Reinhold August Wunderlich and the Evolution of Clinical Thermometry,” *Clinical Infectious Disease* 18, no. 3 (1994): 458, <https://doi.org/10.1093/clinids/18.3.458>.

¹⁸ Hess, *Wohltemperierte Mensch*, 72.

¹⁹ Wunderlich, *Eigenwärme*, 8.

²⁰ Wunderlich, 4, 12.

interest in temperature was not owing to new technical possibilities, for thermometers had technically been available from the late 1600s; they had, however, had little relevance for diagnosis prior to the mid-1800s. Rather, as Volker Hess has argued, the ascent of thermometry in Leipzig and Berlin in the mid-1800s was owing to changes in the understanding of bodily warmth, a series of cultural and social factors, especially the rise of the modern hospital, and a turn to “quantifying objectification” that the new experimental, physiological medicine had taken in the German states.²¹

A GLOBAL CAREER

For some time, there was the possibility that thermometry and its numerical thresholds might remain a local oddity. Indeed, both were initially met with skepticism. In the 1862 edition of the *American Medical Monthly*, Mark Blumenthal referred to the use of the thermometer as proposed by Wunderlich in passing, as a “curious and ingenious means of diagnosis in typhoid fever,” but did not follow “the subject further, as we hardly think a safe diagnosis or prognosis could be based upon such a test alone.” It was, as Blumenthal put it, “a refinement which will never come into general use. . . . After all, patient examination and. . . conservative practice” would safely guide practitioners.²² Other physicians, both in the German states and abroad, protested in a similar vein that there was “no advantage gained by the use of the thermometer” to make the “inconvenience”—instruments initially had to remain in place for up to half an hour to yield reliable results²³—worthwhile.²⁴ Like critics of other instruments translating physiological actions into the language of machines—the spirometer or the sphygmograph—contemporaries initially regarded the thermometer but as a “crutch to the feeble.”²⁵ The thermometer showed nothing a skilled practitioner could not tell by the “general appearance of the patient,” his or her “hot skin,”²⁶ indeed, the hand, some thought, was “a more sensitive and delicate instrument than the thermometer.”²⁷

Blumenthal and other sceptics would be proven wrong eventually, of course, in that the thermometer and the attendant numbers did “come into general use.” Already by the 1860s, “clinical thermometry had broken ground in Holland, Russia, France, Italy and England as well as North America,” according to Wunderlich and other contemporary observers;²⁸ by the 1870s and 1880s, European (–trained), university-educated physicians in the urban hospitals and practices of Zanzibar,²⁹ Mexico,³⁰ Portugal,³¹ India, and Brazil, were, seemingly routinely, taking their patients’ temperature. From that period onwards, medical sources abound with evidence that the most diverse persons—native domestic servants in British India,³² Chilean artisans,³³

²¹ Hess, *Wohltemperierte Mensch*, 12.

²² Mark Blumenthal, “Quarterly Reports on Medical Progress,” *The American Medical Monthly* 17–18 (1862), 118–119.

²³ Hess, *Wohltemperierte Mensch*, 175–176. By the mid-1870s, Spanish medical writings judged fifteen minutes sufficient. Rodríguez y Abaytua, *Nociones*, 7.

²⁴ Robert de Latour, *Thermométrie médicale de la mensuration instrumentale de la température organique comme élément de diagnostic* (Paris: Félix Malteste, 1874), 3, 8.

²⁵ Stanley Joel Reiser, *Medicine and the Reign of Technology* (Cambridge: Cambridge University Press, 1978), 95.

²⁶ Domínguez, “Adoption,” 1198; and Hess, *Wohltemperierte Mensch*, 275.

²⁷ Ferdinand-André Fouqué, *De l’emploi du thermomètre en médecine: Thèse pour le doctorat en médecine* (Paris: Rignoux, 1858), 11.

²⁸ Wunderlich, *Eigenwärme*, 52; and Pedro Francisco da Costa Alvarenga, *Précis de Thermométrie Clinique Générale* (Lisbon: Mattos Moreira & Cardosos, 1882), 16–18.

²⁹ James Christie, “On Epidemics of Dengue Fever,” *Glasgow Medical Journal* 3 (1881), 163.

³⁰ Felipe Brachetti, *La termometría clínica por un nuevo procedimiento* (Mexico: Juan Flores, 1891), 11.

³¹ Da Costa Alvarenga, *Précis*, vi.

³² Joseph Fayrer, *On the Climate and Fevers of India* (London: Churchill, 1882), 88.

³³ José Mariano Macedo and Leonardo Villar, “Informe sobre la Fiebre Amarilla en el Callao” in *Vida y obras de José Mariano Macedo* (1823–1894), ed. Sociedad Peruana de Historia de la Medicina (Lima: Sanmarti, 1945 [1885]), 95.

Portuguese farmworkers³⁴—took their temperature, or had it taken, to ascertain whether or not they were sick with a fever.

There is no denying that, at a basic level, the period's imperial, western-Europe-bound political order and scientific community facilitated thermometry's worldwide acceptance. The adoption of thermometry in British imperial locales like Canadian Montreal or Madras in British India by the late 1800s, for instance, may seem to require little explanation, since in the British metropole, as T. Lauder Brunton put it in 1891, a thermometer was "now to be found in every doctor's waistcoat pocket."³⁵ Unlike with the meter and other standards, however, there is no evidence that thermometry was "pressed upon their colonies by metropolitan administrators,"³⁶ let alone upon formally independent states like Japan or Brazil. Rather, thermometry likely benefited from becoming widely available during the 1870s: the decade during which the prestige attached to western European science is generally thought to have been at its highest among modernizing states around the world, a partiality that created the conduits for the adoption of both technology and the attendant norms.³⁷ Modernizing elites around the world admired and sought to replicate the European and American postal systems, shipbuilding and, indeed, thermometry, of their own volition, as epitomes of technological progress, civilization, and modernity. In Japan, for instance, the adoption of thermometry was closely tied to Meiji Restoration, and owing, as Akinobu Takabayashi has shown, to temperature measurements' association with modernity, progress, and civilization. Japanese entrepreneurs began to craft domestic mercury thermometers from 1883 and by the 1920s, "civilized men [had] a clinical thermometer rather than a watch," as one Japanese attempt at an advertisement for the local market put it.³⁸ In Mexico, thermometers were but some of the many instruments—sphygmographs, stethoscopes, and cardiographs—that flooded Mexican classrooms of clinical medicine at the National School of Medicine and, after 1889, the National Institute of Medicine. The latter imported over 120 clinical artefacts in less than five years, as part of a concerted, politically orchestrated "technification" of medicine, an effort to produce "normality" and modernity, as Laura Cházaro has argued.³⁹ As one Mexican author, Demetrio Mejía, put it in 1872, clinical thermometry was an advance proper of a civilized era, a debt owed to "the cultured Germany (*la Alemania culta*)."⁴⁰ Indeed, thermometry's particular association with German medicine may well have been relevant to its esteem in some countries, too. In Brazil, for example, the reception of thermometry and its numerical standards after 1870 was part and parcel of a wider reform that sought to remake Brazilian medicine in the image of the German model, rendering it more "precise," experimental, and "truly scientific."⁴¹

The appeal to epistemic ideals such as "precision," and "accuracy"—other authors wrote of the "mathematical precision" of the results yielded by thermometry, the "exact" criteria that

³⁴ Torres Homem, *Elementos*, 686–689.

³⁵ Takabayashi, "Medical Technology," 22. On Montreal: Denis Goulet, *Histoire de la Faculté de Médecine de L'Université de Montréal (1843–1993)* (Montréal: VLB, 1993), 53.

³⁶ Alder, *Measure*, 343.

³⁷ Jürgen Osterhammel, "Hierarchien und Verknüpfungen. Aspekte einer Globalen Sozialgeschichte," in *1750–1870: Wege Zur Modernen Welt*, ed. Sebastian Conrad and Osterhammel (München: C. H. Beck, 2016): 673–676, 718–719.

³⁸ Takabayashi, "Medical Technology," 27–28, 30.

³⁹ Laura Cházaro García, "Trade in Medical Instruments and Colonialist Policies between Mexico and Europe in the Nineteenth Century," in *How Scientific Instruments Have Changed Hands*, ed. A. D. Morrison-Low, Sara J. Schechner, and Paolo Brenni (Leiden: Brill, 2016), 213, 217; and García, "Clínica y Laboratorio: Políticas para la constitución material de la medicina en siglo XIX," in *Piedra, Papel y Tijera: Instrumentos en las Ciencias en México*, ed. García, Miruna Achim, and Nuria Valverde (Ciudad de México: UAM, Cuajimalpa, 2018): 212–226, on 153, 167.

⁴⁰ Demetrio Mejía, *Estudio sobre la termometría clínica en México* (México: Escalante, 1872), 13.

⁴¹ Flavio Coelho Edler, "O debate em torno da medicina experimental no segundo reinado," *Maguinhos* 3, no. 2 (1996): 284–229, <https://doi.org/10.1590/S0104-59701996000200005>, 292–294; Torres Homem, *Elementos*, 686–689.

measurements furnished for diagnosis⁴²—points to yet another patent reason for the rise of 38°C: the fact that thermometry, as Wunderlich himself put it, gave “objective” results that could “be *measured*, signs that [could] be *expressed in numbers*.”⁴³ The late 1800s saw a general trend toward quantification, a growing regard for and “trust in numbers,” also in medicine,⁴⁴ that not only enabled thermometry’s inception in the German states, as Volker Hess has shown,⁴⁵ but also, to all appearances, its acceptance on a global scale. Its relevance is particularly conspicuous in how physicians initially quantified various signs associated with fever. Over the late 1800s, doctors from London to Rio de Janeiro, and from Montevideo to Calcutta, began to express in numerals not just temperature but several symptoms that had long defined febrile disease: the pulse, breathing—reduced to respiratory rate—and bowel movements.⁴⁶ Indeed, unlike Wunderlich, who did not entirely discount pulse and respiration rates but unmistakably singled out temperature,⁴⁷ many early adopters of thermometry globally accorded equal or comparable significance to various signs and symptoms. For Torres Homem, for instance, even by 1870, a fever was “a morbid state” characterized “by an accelerated pulse and an increase in the peripheral heat” of “between one and seven degrees” above 37°C;⁴⁸ other physicians, too, long into the 1880s, cited temperature and pulse rate as equivalent signs of fever.⁴⁹ One reason why temperature eventually gained prevalence over other symptoms to become *the* sign of fever, may well be the fact that, while “normal” temperature did appear to be a universal base value, relatively standard across gender and race among adults, resting and febrile pulse rates varied from person to person.⁵⁰ At any rate, as historians have suggested, the close association of fever with excessive warmth was not a precondition for, but likely a consequence of, the trend towards (temperature) measurements.⁵¹

The rise of 37°C and 38°C evidently was one consequence of modern societies’ general imperative of standardization—of procedures, dosage, forms, or commodities⁵²—but also, more particularly and less evidently, of the rise of *global* standards in the 1870s and 1880s. Indeed, there is evidence that physicians were eager to join a wider, global trend towards regulation and the creation of common standard measures that was ongoing in various fields. As the French-born, New

⁴² Torres Homem, *Elementos*, 99; Garcin, *Fièvre typhoïde*, 8; and Nicolás Rodríguez y Abaytua, *Nociones de termometría aplicada al diagnóstico, pronóstico y tratamiento de las enfermedades febriles* (Madrid: Moya y Plaza, 1876), Prólogo.

⁴³ Carl Wunderlich, *On the Temperature in Diseases: A Manual of Medical Thermometry* (London: New Sydenham Society, 1871), 48.

⁴⁴ Theodore M. Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton: Princeton University Press, 1995); on quantification in medicine, see Gérard Jorland and George Weisz, “Introduction: Who Counts?” in *Body Counts*, 13.

⁴⁵ Hess, *Wohltemperierte Mensch*, 12.

⁴⁶ Fayrer, *Climate*, 89; Macedo, “Informe sobre la Sintomatología de la Fiebre Amarilla,” in *Vida y obras de José Mariano Macedo (1823–1894)*, ed. Sociedad Peruana de Historia de la Medicina (Lima: Sanmarti, 1945 [1857]), 70; Torres Homem, *Elementos*, 698; Jacob Steere-Williams, *The Filth Disease. Typhoid Fever and the Practices of Epidemiology in Victorian England* (Rochester: University of Rochester Press, 2020), 41; and Carafí, *Manual*, 122.

⁴⁷ Wunderlich, *Eigenwärme*, 111, 139.

⁴⁸ Torres Homem, *Elementos*, 101, 312–313. For many authors, aberrant pulse was the most important designator of fever into the 1870s; see Hamlin, *Hot*, 72–73.

⁴⁹ Macedo & Villar, “Informe,” 94.

⁵⁰ For observations of these differences, see, for instance, Macedo, “Informe,” 70. On variation of pulse, see also Torres Homem, *Elementos*, 312. See also Ramón Carafí, *Manual de termometría médica o guía para las familias en asistencia de las enfermedades febriles* (Montevideo: Renaud, 1882), 47.

⁵¹ Hess, *Wohltemperierte Mensch*, 19.

⁵² Susan Leigh Star and Martha Lampland, “Reckoning with Standards,” in *Standards and their Stories: How Quantifying, Classifying, and Formalizing Practices Shape Everyday Life*, ed. Star and Lampland (Ithaca and London: Cornell University Press, 2009), 4.

York-based physician-author Édouard Séguin, another one of clinical thermometry's early advocates, put it in his 1876 treatise on medical thermometry,

glovers, shoemakers, gas-fitters, have agreed to common standard measures upon which their work may be duplicated, mended, adjusted all over the world . . . ; astronomers and seafaring people want a *meridian unique* and a common nautical almanac. . . . Indeed, savants, chemists, manufacturers, mechanics, seamen, all strive to establish a standard measure of their work; all but physicians, who agree only to continue to disagree.⁵³

Not only did temperature measurements become more coherent, comparable, and standardizable from the mid-1800s on a technical level with the advent of general theoretical principles: of set-points, measurement conventions, and thermodynamic laws.⁵⁴ As such they also appealed to physicians eager to join a global conversation, premised upon common standards suitable for communication across oceans and continents. The international rise of 38°C during the 1870s and 1880s was roughly contemporaneous with that of the metric system, Greenwich Mean Time, and the gold standard. The rise of thermometric norms thus ensued not only within a growing international medical-scientific community—medical authors constantly appealed to a community of peers around the globe, “physicians in all countries”—but also along with the advent of other commensurable international standards. It partly followed a dynamic, or drift, that was a feature of the period, one in which 38°C could flourish and become—like the meter or Greenwich Mean Time—a largely unquestioned standard against which societies “strike agreements and make distinctions,” including that most important one between health and illness.⁵⁵

Like the sphygmomanometer and other medical instruments, the thermometer also came into general use as an “objective” device offering solutions to problems of both communication and trust within modern societies.⁵⁶ When physicians had used the thermometer prior to the 1840s, the measurement did not devalue the sufferer's perception, as historians have shown; rather, both were regarded as equivalent. If they disagreed, physicians often believed the sufferer rather than the thermometer, since they assumed that there were “sorts of warmth” the thermometer could not register.⁵⁷ It was only from the 1840s, with the rise of both “mechanical objectivity,” the belief that nature could and ought to be depicted without human intervention, and sensory physiology, a field that revealed the relativity of the human senses, that both the physician's and the sufferer's subjective experience of illness came to be regarded by physicians as subordinate and inferior to the number the thermometer showed.⁵⁸ As such, temperature became a “clinical divining rod for ferreting out true disease,” as historians have argued since the 1990s: for revealing a state of illness that a person was not aware of, but also health where a person was pretending to be ill.⁵⁹

⁵³ Edward Séguin, *Medical Thermometry and Human Temperature* (New York: William Wood, 1876), 258.

⁵⁴ Hasok Chang, *Inventing Temperature: Measurement and Scientific Progress* (New York: Oxford University Press, 2004).

⁵⁵ This quote is adapted from one on the meter: Ken Alder, *The Measure of All Things: The Seven-Year Odyssey that Transformed the World* (London: Abacus, 2002), 2. On how normal values, including that of normal temperature, are rarely questioned, see Volker Hess, “Standardizing Body Temperature: Quantification in Hospitals and Daily Life, 1850–1900,” in *Body Counts: Medical Quantification in Historical and Sociological Perspective*, ed. Gérard Jorland et al. (Montreal: McGill-Queen's University Press, 2005), 111.

⁵⁶ Porter makes that argument about the sphygmomanometer: Theodore M. Porter, “Life Insurance, Medical Testing, and the Management of Mortality,” *Biographies of Scientific Objects*, ed. Lorraine Daston (Chicago: University of Chicago Press, 2000), 235.

⁵⁷ Hess, *Wohltemperierte Mensch*, 42–44, 49–50.

⁵⁸ Hess, “Standardizing Body Temperature,” 117; and Hess, *Wohltemperierte Mensch*, 61. On mechanical objectivity: Lorraine Daston and Peter Galison, *Objectivity* (Boston: Zone Books, 2010 [2007]), 4–6.

⁵⁹ Mackowiak and Worden, “Wunderlich,” 458; Hess, *Wohltemperierte Mensch*, 217, 267, 282; and Hamlin, *Hot*, 259.

In that way, thermometry would have appealed to industrializing societies, with their growing state bureaucracies, health insurances, and administrations, in which, as Wunderlich himself suggested, workers, schoolchildren, or soldiers might be “feigning” a fever.⁶⁰ As a technology that obviated a sufferer’s account, thermometry was even more appealing at a time when the clientele of doctors was changing fast. The rise of the modern hospital, and, in some countries, health insurance, brought physicians into contact with a multitude of lower-class patients, very unlike the few social peers who could have afforded a university-trained doctor a few decades earlier. As Volker Hess has shown for the German territories, thermometry, in rendering close conversation less relevant, appealed to physicians who often thought their lower-class patients incapable of articulating symptoms.⁶¹ The same occurred elsewhere. Nineteen-year-old Pierre, for instance, a charcoal laborer “of zero intelligence,” as the French medical student Abel Sutils put it dismissively, could give no account of his disease and its previous course; it was “only the thermometer which revealed” his illness, as Sutils wrote, and allowed the physicians at Paris’s Charité Hospital to diagnose an intermittent fever.⁶² This presumed inability to communicate is likely to have been relevant for thermometry’s ready adoption in imperial, postcolonial, and settler or migrant societies, too, with their stark “racial” and cultural cleavages, blunt power gradients, and barriers of language. University-trained, elite doctors in countries like Peru, British India, or Brazil did not absolutely omit to record perceptions that had to be inquired after — a ‘frontal headache’, thirst, or ‘burning eyeballs.’⁶³ The social, cultural, and linguistic distance between them and their patients — the “young Italian [immigrant] Lorenzina Solesi,” an “East Indian” with “no occupation,” the “free black, African” Emiliana, to name but a few — were considerable, however,⁶⁴ and the difficulties resulting from that distance surely enhanced the appeal of recording externally observable, quantifiable signs, like temperature.

From the late 1800s, thermometry spread beyond hospitals and medical practices partly because physicians began to delegate temperature measurement — repetitive, nocturnal, and, initially at least, protracted — not only to subordinates such as nurses and assistants, but also to laypersons, especially mothers.⁶⁵ During the 1870s and 1880s, family magazines, booklets, and manuals for home nursing educated mothers, in countries like Britain, Uruguay, the German empire, the United States, British India, or Italy in the “use of family thermometers” and the attendant numerical thresholds, including the “general norme of the Caucasian race,” that is, “98.6° Fahrenheit . . . [or] 37° centigrade,” the “standard” by which “all sickly temperatures [were] judged.”⁶⁶ By the early twentieth century, even in Japan, where brochures and newspapers had popularized thermometry, being able to properly apply the clinical thermometer marked out the good wife.⁶⁷ This is not to

⁶⁰ Hess, *Wohltemperierte Mensch*, 266–267; Hamlin, *Hot*, 259; and for the original quote (‘temperature can neither be feigned nor falsified’: Wunderlich, *Temperature*, vi. On how to detect soldier impostors with the aid of the thermometer: Abel Sutils, *Thèse pour le doctorat en médecine: Contribution à l’étude de la thermometrie clinique* (Paris: Parent, 1872), 17.

⁶¹ Hess, *Wohltemperierte Mensch*, 214–215; and Hess, “Standardizing Body Temperature,” 113.

⁶² Sutils, *Thèse*, 32–33.

⁶³ Torres Homem, *Elementos*, 738; and Fayer, *Climate*, 89.

⁶⁴ Torres Homem, *Elementos*, 737–751; Fayer, *Climate*, 88–151; and Macedo and Villar, “Informe,” 96–7.

⁶⁵ On doctors delegating measurements to hospital staff, and the transition into the private realm in Germany: Hess, *Wohltemperierte Mensch*, 229–241, 248.

⁶⁶ On German thermometrical advice literature, see Hess, *Wohltemperierte Mensch*, 241–245. On Japan, see Takabayashi, “Medical Technology,” 26; on the United States, see Edward Seguin, *Family Thermometry: A Manual of Thermometry, for Mothers, Nurses, Hospitalers* (New York: Putnam’s Sons, 1873), 14, 22; Deanna Day, *Fevers, Fertility, and the Patient Labor of American Medicine* (PhD diss., University of Pennsylvania, 2014), 101–103; for Uruguay, see Carafi, *Manual*; and on thermometry among Anglo-Indian *Memsahib* in British India, see Flora Annie Steel and Grace Gardiner, *The Complete Indian Housekeeper and Cook* (Oxford: Oxford University Press, 2010 [1888]), 166.

⁶⁷ Takabayashi, “Medical Technology,” 29–31.

say that doctors were ready to relinquish their recent, hard-won monopoly on medical expertise, policing, and authority. Rather, the very idea that thermometry depicted nature without human intervention made it a practice that could be delegated without diminishing the physician's orbit. Indeed, mothers were constantly reminded to "recognize their limitations."⁶⁸ While medical authors closely instructed women on how to use a thermometer, they also expected them to "call a physician as soon as they . . . found that the temperature of some one of their family" reached a critical threshold. A woman ought to go only "as far as her comprehension goes," as the author of one such manual for the American market reminded his readership; she was, after all, "only a mother, a nurse, an ignorant of what is called science."⁶⁹ As Deanna Day has argued for the United States, physicians were comfortable delegating "the authority for collecting data" because they were "maintaining the authority to interpret" it.⁷⁰

The emphasis on drifts, pulls, and circumstances is not to imply that thermometrical numbers had no validity in relation to the objects they described nor is it to deny their clinical relevance. Many clinicians insisted on the usefulness of thermometry in assisting prognosis—to determine the relative severity, or "degree," of a fever—and differential diagnosis, that is, the theory of specific temperature patterns for specific diseases propagated by Wunderlich and other contemporary physician-authors,⁷¹ at least before the advent of bacteriology. Torres Homem convincingly detailed, for instance, how he and his peers in Rio de Janeiro had been prevented from misdiagnosing a "paludic," remittent febrile disorder as typhoid fever by Wunderlich's temperature charts, according to which a temperature of 40° on the first or second day together with the absence of tympanism ruled out the latter.⁷² Indeed, though many found fault with Wunderlich's method for differential diagnosis, regarded it as a disutility for practitioners who, unable to "divine the curve," were required to take immediate action,⁷³ or adopted temperature measurements as a gesture without actually heeding their results,⁷⁴ there can be no denying the broad consensus that Wunderlich's propositions were consistent, accurate, and, in many cases, useful. This is relevant because instrument-driven, standardized quantification did not *per se* or necessarily win out in the period. As Rebecca Jackson has shown, the drop, despite its evident variability, was never replaced by the "minim," a unit introduced early in the nineteenth century as a uniform substitute; this was partly because the minim was difficult to reliably produce by a physical device, partly because it did not communicate adequately to its practical audience, which favored the alternative heuristic inherent in the drop: of gradual administration, the judging of effects, and patient observation.⁷⁵ Not only did temperature seem reliably reproducible, it did have evident advantages over the hand, not least in its ability to adequately communicate, both in numerals and "in graphic form."⁷⁶ As scholars in historical epistemology have argued, a statement's plausibility, consistency, or truth

⁶⁸ Day, *Fevers*, 18; and Rima D. Apple, *Perfect Motherhood: Science and Childrearing in America* (New Brunswick: Rutgers University Press, 2006), 17.

⁶⁹ Seguin, "Family," 14, 32.

⁷⁰ Day, *Fevers*, 4, 63–64.

⁷¹ E.g. Christian Rauschenberg, "The Origin, Nature, and Treatment of Fever in the Light of Modern Physiology," *Medical and Surgical Journal* 11, no. 6 (1873): 309–310; and Carafi, *Manual*, 56–57.

⁷² Torres Homem, *Elementos*, 105–106.

⁷³ Latour, *Thermométrie*, 9–10.

⁷⁴ In the yellow fever reports written 1857–1885 by the Peruvian physician José Mariano Macedo, for instance, the observation of externally felt "febrile heat" gave way to the stating of temperature over time, but this did not affect his diagnosis. Compare Macedo and Villar, "Informe," 95, to Macedo, "Informe," 68–81.

⁷⁵ Rebecca L. Jackson, "The Uncertain Method of Drops: How a Non-Uniform Unit Survived the Century of Standardization," *Perspectives on Science* 29, no. 6 (2021): 802–841.

⁷⁶ Carafi, *Manual*, 52.

is not the only nor a sufficient, but often yet *another* important reason for its acceptance.⁷⁷ In thermometry, the new technique's clinical usefulness and accuracy was another element among several—its association with modernity and objectivity, or its suitability for standardization—to explain its acceptance on a global scale.

CONCLUSION

Thermometry's acceptance was, of course, vastly incomplete. Even by the early 1900s, many of the world's sick would never have seen a clinical thermometer or been familiar with the attendant numerical standards. In China, for instance, where Western physicians had limited influence prior to 1911, neither the disease concept of fever nor thermometry had taken hold beyond a few enclaves.⁷⁸ And even in (post-)colonial territories like India, Brazil, or Zanzibar, there is little doubt that thermometry, while it was used in urban hospitals, was often unknown beyond. Moreover, there is evidence that the quantifying, physiological view embodied in the thermometer did not outright abolish the practice of close observation of the sufferer's sensations, bodily functions, and the "qualities of symptoms."⁷⁹ As outlined above, into the late 1800s, medical reports on "typhoid," yellow and "remittent" fever written in London, Calcutta, Rio de Janeiro, or Lima continued to accord several quantifiable signs and even subjective sensations like languor, "stupor," wheezing, loss of appetite, and headaches diagnostic significance alongside temperature.⁸⁰ The thermometer did not fully displace the feeling hand, from New York to Sholapur, for various reasons, both practical and heuristic: in part because one did not always have a working thermometer at hand,⁸¹ but also out of the belief that the hand could reveal "qualities"—like moisture, for instance—that were "beyond the reach of philosophical instruments."⁸² Even though, however, as with the meter and other standards, the "actual on-the-ground implementation" of thermometry and its attendant values took a gradual, nonlinear, and, at the time, by no means yet irreversible course, in hindsight, the 1870s and 1880s laid the basis for thermometry to become prevalent in much of the modern world. The methodological difficulties involved in declaring a historical, and even more so, a global historical, process or trend "dominant" are legion and one cannot be too careful not to overstate its directionality on account of one's knowledge of its end—in this case, the global hegemony of thermometry.⁸³ And yet, as Ken Alder put it for the meter, one can observe new epistemic practices and ideals radiate "out from schools, cities and railway lines," discern how they gradually come to feel "as natural . . . as the old . . . once did," how they become "the only possible system," with contemporaries forgetting "that there has ever been any other."⁸⁴ The world of touch and the sensitive hand, of talk of burning eyeballs and chills down the back, was slowly dying by the late 1800s and early 1900s. Today, thermometry and the attendant quantification of illness feel natural, and neutral, for many people around the world, like the only possible way of telling whether one *really* has a fever; indeed, most people are barely aware that there has ever been any other.

⁷⁷ Andrea Albrecht et al., "Zum Konzept Historischer Epistemologie," *Scientia Poetica* 20, no. 1 (2016), 138 <https://doi.org/10.1515/scipo-2016-0108>.

⁷⁸ Marta Hanson, *Speaking of Epidemics in Chinese Medicine: Disease and the Geographic Imagination in Late Imperial China* (London: Routledge, 2011), 8.

⁷⁹ Steere-Williams, "Filth Disease," 42; and Bynum and Bynum, "Object Lessons," 359.

⁸⁰ Fayer, *Climate*, 95; Steere-Williams, "Filth Disease," 40; and Macedo and Villar, "Informe," 96–97.

⁸¹ Christie, "On Epidemics," 163. On medical officers continuing to examine with the hand in Indian Sholapur, David Arnold, *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth-Century India* (Berkeley: University of California Press, 1993), 314.

⁸² Seguin, "Family," 6.

⁸³ Jan C. Jansen, "Tacit Directionality: Processes, Teleology and Contingency in Global History," in *Rethinking Global History*, ed. Jürgen Osterhammel and Stefanie Gänger (Cambridge: Cambridge University Press, 2024).

⁸⁴ Alder, *Measure*, 330.