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It's probably in the Air: Medical Meteorology in Denmark, 1810–1875

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Introduction

This article charts the rise and fall of medical meteorology in nineteenth-century Denmark, describing how interest in the subject developed, the optimism that sprang from the possibility of having access to accurate meteorological measurements, and the decline in interest as the data failed to support the medical meteorologists' claims. Within this framework, I also attempt to place the Danish experience in a wider western context, and relate the fate of medical meteorology to other medical developments that were occurring at the same time. At the centre of this discussion are the qualified medical practitioners who acted as proponents of medical meteorology.[1]

One notable finding of this research was that medical meteorology has tended to be overlooked in general accounts of nineteenth-century medical science. The dominating narrative has been concerned with themes later labelled as "modern". Contagionism and the sanitary movement have become synonymous with nineteenth-century medical science, with the result that other theories such as medical meteorology have tended to be ignored.[2]

A neighbouring field, medical geography, has received significant attention in recent years and does, in a wider context, include medical meteorology.[3] Scholars have traced how the mapping of diseases became an important field of research in Germany and France from the 1850s, which resulted in visually powerful "noso-geographical" world

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[1] Research into these individuals' ideas and aspirations was undertaken through a search of the literature on epidemics, medical meteorology and medical topography, which included sixty-five reports on raging acute epidemics in the Danish kingdom including the colonies in the North Atlantic and the Caribbean. The principal journals used are: *Bibliotek for Læger* (hereafter *BFL*) 1809–1875, *Ugeskrift for Læger* (hereafter *UFL*) 1839–1875, and *Hospitals Tidende* (hereafter *HT*) 1858–1875. This study does not analyse differences between reports from the colonies and the Danish mainland.

[2] See, for example, Roy Porter, *The greatest benefit to mankind*, London, Harper Collins, 1997, pp. 410–15, 428–42; W F Bynum, *Science and the practice of medicine in the nineteenth century*, Cambridge University Press, 1994, pp. 59–60, 66–91, 127–32; the absence of medical meteorology is also evident in Erwin Ackerknecht's famous and often cited article 'Anticontagionism between 1821 and 1867', *Bull. Hist. Med.*, 1948, **22**: 562–93, p. 568.

[3] Most scholars conceive the concept of "medical geography" in a broad sense as "the study of large-scale distribution patterns of human diseases as a function of environmental conditions". See Ronald L Numbers, 'Medical science before scientific medicine: reflections on the history of medical geography', in Nicolaas A Rupke (ed.), *Medical geography in historical perspective*, *Med. Hist.*, Supplement No. 20, 2000, pp. 217–20, on p. 217.

maps of diseases in different climatic regions, but these accounts are primarily about places and diseases.[4] A further area of medical geography has to do with European colonization and American westward expansion, and how climate played a crucial role for the newcomers and their ideas about health, disease and racial differences in these new, exotic places.[5] Some of these studies are concerned with medical meteorology, in particular Conevery B Valenčius's study of nineteenth-century American settlers and their preoccupations with environment and health in the unexplored far-West. Valenčius discusses the ideas held by both professionals and laypeople about the air, its miasma and its influences on the human body, and shows how environmental investigation also formed part of a political mission that should "amalgamate the foreign with the indigenous" as the physician Daniel Drake phrased it.[6]

It is also true that medicine and medical institutions play a significant role in the history of how meteorology, as a natural science, was transformed in the nineteenth century. James R Fleming shows how the American Army Medical Department contributed substantially to the development of meteorology as a natural science from the 1820s by organizing an observation system that covered the eastern half of the United States. The reason for this endeavour was the common belief that climate was a major cause of disease and death among soldiers. Fleming's American history also shows how meteorology developed from an individual and qualitative undertaking in the eighteenth century to a more instrumental, collective and statistical field of inquiry in the second half of the nineteenth century.[7] Meteorology experienced a similar development in relation to medicine, as this article sets out to demonstrate.

Most texts investigating the history of medical meteorology focus on the development of early quantitative meteorology in the seventeenth and eighteenth centuries. In Britain, France and Holland ambitious Hippocratic medico-meteorological programmes evolved with the use of new instruments, daily recordings of the weather and a search for connections between the weather and human diseases, although it became apparent, at least in the Netherlands, that it was almost impossible to agree upon any laws about the weather

[4] See, for example, Nicolaas A Rupke, 'Humboldtian medicine', *Med. Hist*., 1996, **40**: 293–310, pp. 297–9, 307–9; Michael Osborne, 'The geographical imperative in nineteenth-century French medicine', in Rupke (ed.), op. cit., note 3 above, pp. 1–50, on pp. 37–43.

[5] See, for example, Annemarie de Knecht-van Eekelen, 'The debate about acclimatization in the Dutch East Indies (1840–1860)', in Rupke (ed.), op. cit., note 3 above, pp. 70–85; Mark Harrison, 'Differences of degree: representations of India in British medical topography, 1820–*c*.1870', in Rupke (ed.), op. cit., note 3 above, pp. 51–69.

[6] Conevery Bolton Valenčius, *The health of the country*, New York, Basic Books, 2002, pp. 74–8, 109–32, on p. 168; John Harley Warner, writing from the perspective of the medical profession, shows how interest in the weather flourished among private practitioners, at hospitals and in medical societies in the second third of the nineteenth century and how medical meteorology helped to cultivate regional medicines that were different from the universal systems of medicine invented by Europeans, see *The therapeutic perspective: medical practice, knowledge, and identity in America, 1820–1885*, Princeton University Press, 1997, pp. 72–8.

[7] James R Fleming, *Meteorology in America, 1800–1870*, Baltimore and London, Johns Hopkins University Press, 1990, pp. 13–16, 68–73; see also Edgar Hume, 'The foundation of American meteorology by the United States Army Medical Department', *Bull. Hist. Med*., 1940, **8**: 202–38. Although medical meteorology is not part of Katharine Anderson's broad history about British meteorology, science and the public sphere in the nineteenth century, she does mention that astrological almanacs included weather predictions as well as comments on health issues: *Predicting the weather*, Chicago and London, University of Chicago Press, 2005, p. 76.

and its impact on the human body.[8] Some evidence of medical meteorology in the nineteenth century comes from Vladimir Jankovic, whose work considers the medical and cultural meaning of winds in the United Kingdom. He describes how, at the beginning of the nineteenth century, Hippocratic rules of thumb about the harmful influence of the weather dominated a colloquial meteorology built on anecdotal evidence that praised fresh air. But this interest waned as the winds lost their medical significance when medical scientists, interested in chemistry and physics, began to analyse humidity, electricity and ozone levels, so reducing winds from singular forms to measurable physical entities.[9] For other countries, such as France and Germany, there seem to have been almost no studies of medical meteorology in the nineteenth century.[10] Thus, despite some attention to nineteenth-century investigations of the weather in medicine, medical meteorology as a field with its own characteristics has not had the attention it deserves.

In Denmark, the focus of this paper, there is sufficient material to demonstrate that new ideas about medical meteorology arose and changed throughout the 1800s. During this period, several kinds of medical studies initiated specific investigation of the weather and disease. First, studies of medical topography investigating the environment in a specific geographical site, and studies of specific epidemics framed investigations into medical meteorology. Second, studies of the "epidemic constitution", and, from the 1840s, statistical studies began to involve examination of the weather. In the literature the term "medical geography" began to be used, primarily when reference was made to the French and German tradition of mapping diseases on a large scale. In Denmark itself this field of investigation appears to have remained on the periphery.[11] Finally, the term "medical meteorology" was also used.[12]

[8] Huib J Zuidervaart, 'An eighteenth-century medical-meteorological society in the Netherlands: an investigation of early organization, instrumentation and quantification', Part 1, *Br. J. Hist. Sci*., 2005, **38** (4): 379–410, and Part 2, ibid., 2006, **39** (1): 49–66; concerning British medical meteorology, see Andrea Rusnock, 'Hippocrates, Bacon, and medical meteorology at the Royal Society, 1700–1750', in David Cantor (ed.), *Reinventing Hippocrates*, Aldershot, Ashgate, 2002, pp. 136–53; Jan Golinski, 'Sensibility and climatic pathology', in *idem*, *British weather and the climate of Enlightenment*, Chicago and London, University of Chicago Press, 2007, pp. 137–69; for France, see Caroline Hannaway, 'The Société Royale de Médecine and epidemics in the ancien régime', *Bull. Hist. Med*., 1972, **46**: 257–73. James C Riley is also concerned with medical meteorology in his broad survey of a medicine of the environment: *The eighteenth-century campaign to avoid disease*, New York, St Martin's Press, 1987, pp. xv, 45–8.

[9] Vladimir Jankovic, 'Gruff boreas, deadly calms: a medical perspective on winds and the Victorians', *J. R. Anthropol. Inst*., 2007, **13**: 147–64; for medical meteorology in Britain, see also J Burton, 'Meteorology and the public health movement in London during the late nineteenth century', *Weather*, 1990, **45**: 300–7.

[10] Jean-Pierre Besancenot states that French medical meteorology of the first half of the nineteenth century was a "fashion" (*vogue*) and nothing more than a remnant of the ambitious programme at the Société Royale de Médecine in Paris that had taken place before the French Revolution: 'La climatologie biologique et médicale en France: 1853–2003', *Presse Thermale et Climatique*, 2003, **140**: 63–84, pp. 65, 63–8. Alexandra Henneberger very briefly lists some of the important German investigators and their works in 'Einfluss definierter Wetterparameter auf die körperliche Leistungsfähigkeit herzkranker Patienten während standardisierter Belastung', PhD thesis, Ludwig-Maximilians Universität zu München, 2004, pp. 5–6.

[11] For comments upon medical geography, see, for example, Frederik Trier, *Undersögelser angaaende den typhoide Febers Udbredning og Oprindelse i Kjøbenhaven i Aarene 1842–1858*, Copenhagen, Bing & Sön, 1860, pp. 49–51 ("*medicinsk Geographie*"); Frederik Bremer, 'Om Koldfeber-Epidemierne i Danmark i Aarene 1825–34', in *De permanente Comiteers Arbeider i Aarene 1846 og 1847*, Copenhagen, Reitzel, 1848, pp. 125–38, esp. pp. 125–8.

[12] Joakim Frederik Schouw, 'Nogle Bemærkninger, henhørende til Meteorologien og sammes Forhold til Lægevidenskaben', *Nye*

Concerning the early history of quantitative medical meteorology, it is worth referring to the work of the Danish astronomer Tycho Brahe, who believed in a Paracelsian correspondence between the micro- and macro-cosmos according to which the planets and the weather could influence the human body and its diseases. Tycho Brahe and his assistants kept a meteorological diary from 1582 to 1597.[13] Another notable meteorological diary was that of the physician Rasmus Bartholin who kept notes on the winds and the sun for the year 1671. From the 1760s continuous meteorological observations were made in Copenhagen, and after 1800 medical practitioners began to use these data.[14] This was when medical meteorology became a field of investigation with its own characteristics in Denmark and at one point was even regarded as one of the most promising areas of research in the battle against epidemics, and in the general progress of medical science.

For clarity, this story of medical meteorology in Denmark is divided into three periods. From 1810 to 1840 the atmosphere represented the primary explanation for epidemic outbreaks and was mainly studied by medical practitioners without the use of instruments. From 1840 to 1860 quantification and statistical analysis were brought in to the field and raised serious doubts about a link between the weather and epidemic disease. Between 1860 and 1875 medical meteorology declined as other explanations of epidemic disease gained importance.

A Qualitative Medical Meteorology

Around 1800 several medico-meteorological investigations had been carried out in Europe, as mentioned earlier, without much success. At that time the weather in the capital of Denmark had been recorded for four decades, so some groundwork had been laid for a Danish effort in the field. Furthermore, the Danish health authorities had begun to take an interest in the environment and public health. They were inspired by the German physician Johan Peter Frank's ideas of medical police and in 1803 demanded that all doctors, both private and public, should send a medical report once a year to the Royal College of Health.[15] The first and most important part of each report tracked the prevailing epidemics. In 1818 this legislation was reinforced and a surge of epidemic reports followed, which were published in *Bibliotek for Læger,* a newly established Danish-language medical journal.[16] These reports played a significant role in the development of Danish medical meteorology at this period.

Hygæa, 1826, **7**: 235–47, p. 236 ("*medicinsk Meteorologie*").

[13] Helge Kragh, *Fra middelalderlærdom til den nye videnskab*, Aarhus Universitetsforlag, 2005, pp. 234–8.

[14] A survey of medical meteorology from the late sixteenth century to the early nineteenth century in Denmark appears in Johan Wendt, 'Bidrag til meteorologiske Bemærkninger, især over den Indflydelse, Vindene i vort Climat have som Sygdoms-Aarsager', *Nye Hygæa*, 1826, **8**: 79–101, pp. 87–98; see also Anon., *Meteorologisk Institut gennem hundrede år 1872–1972*, [Copenhagen], Det danske meteorologiske Institut, 1972, pp. 15–16.

[15] In 1803 the Royal College of Medicine and the Royal College of Surgery were amalgamated to create the Royal College of Health. It functioned as an advisory board for the King and had ten members.

[16] Gerda Bonderup, *Det medicinske politi: Sundhedspolitikken i Danmark 1750–1860*, Aarhus University Press, 2006, pp. 54–9, 69–71; Nick Nyland, *De praktiserende læger i Danmark 1800–1910*, Odense, Forskningsenheden for Almen Medicin, 2000, pp. 227–9.

Most of the reports included analyses of the possible causes of the epidemics. In these analyses, framed by the Galenic six non-naturals and their broad range of external causes, there would be a description of the weather. For example, in 1826 one doctor analysed the possible aetiology of an epidemic of dysentery that had raged across part of the country. He described cases spreading from one person to another. He also described the soil of the area and a drained village pond, where the digging of a well may have caused a leakage of effluvia at the beginning of the epidemic. The weather had also been remarkable:

> However, this much is certain that as long as the weather with its prevailing humidity moved from one extreme to the other, so that every day we had several kinds of weather: frost, sunshine—rain, storm—drifting snow, frost—glazed frost, hail—mild weather and thaw, etc., etc., whilst the predominant wind was from the south, mostly SW, with small brief gusts from the north, mostly NE winds, the dysentery epidemic persisted.[17]

This description of the weather, characterized as a "meteorological reportage" by Vladimir Jankovic, was combined with an interpretation of its medical significance.[18] Most of these meteorological reportages were written in a characteristic style and their length could vary from two lines to one page. Such accounts were one of the tools most frequently used to analyse the cause of an epidemic throughout the 1820s and 1830s by practitioners in Norway and America, for instance.[19] Originating in the Hippocratic writings, this kind of meteorological reporting was qualitative and built on observations made without the use of instruments. It focused on notable climatic conditions and linked the prevailing weather with an outbreak, a prolongation, a change in character or disappearance of an epidemic. It also meant that individual medical practitioners became the main interpreters of the causes of the epidemic that they were reporting.

Extraordinary Phenomena and Miasma

In such reports striking or extraordinary phenomena were related to different aspects of the climate. The reports frequently referred to unusual temperature, humidity or winds observed over a short period. For example, in 1830 "rainy and cold weather" was thought to have caused an outbreak of cold fever in July in Southern Funen, whereas "an extraordinary heat with much rain and thunder" prevailed in May at St Thomas, Danish West

[17] Jens Hübertz, 'Beretning om en Epidemie af Blodgang, observeret i den sydlige Deel af Hornsherred, Frederiksborg Amt, i Vinteren 1826–27', *BFL*, 1827, **7** (1): 149–205, p. 174. ("Saameget er imidlertid vist, at saalænge som Veiret med prævalerende Fugtighed kastede sig fra den ene Yderlighed til den anden, saaledes, at vi hver Dag almindeligt havde flere Slags Veir: lind Frost, Solskin—Regn, Storm—Snefog, Frost—Iisslag, Hagel—mildt Veir og Tøe o. s. v., o. s. v. imedens den herskende Vind var sydlig, meest S.V., med smaa, kortvarige Blaf af nordlig, meest N.O. Vind, saalænge dominerede de Blodgangen.")

[18] Jankovic's concept of "meteorological reportage" characterizes English writings about meteorology until the late eighteenth century. Meteorological reportage was a qualitative narrative about extraordinary, rare meteorological phenomena. In general such works were produced by upper-class amateurs who wrote in ordinary rather than technical language. See Vladimir Jankovic, *Reading the skies: a cultural history of English weather, 1650–1820*, Manchester University Press, 2000, pp. 33–6.

[19] May-Brith Ohman Nielsen, *Mennesker, makt og mikrober*, Bergen, Fakbokforlaget, 2008, pp. 113–14; Fleming, op. cit., note 7 above, p. 13.

Indies, when climate fever peaked.[20] Unusual weather conditions could last for months and produce an unusual season, as one doctor, indicated when "an early and rather severe winter" brought to an end an epidemic of typhus in Southern Funen.[21]

Another extraordinary occurrence often mentioned in the weather reports was a visible or invisible, at times smelly "something" that was produced in the atmosphere or emanated from the soil or water, often called "exhalations" (*Dunster*) or miasma. That this had pathogenic potential was obvious to one doctor who treated an epidemic of a hitherto unknown disease, which he named hiccup-sickness, that attacked a parish in Northern Jutland in 1811. He investigated the locality's food supplies, domestic animals, drinking water and the weather, and concluded that:

> The primary cause of the illness is most likely due to the sudden change in the temperature of the atmosphere and especially the persistent malodorous fog and possibly a subsequent absorption of harmful substances through the skin . . .[22]

It was thought that the harmful particles were produced by intense heat creating exhalations from swamps or from the sea.[23] In this way, striking climatic phenomena were linked to the emergence of harmful miasma.

Epidemic Constitutions

In some cases the medical meteorological reports included the idea of an epidemic constitution (*epidemisk Constitution*). This referred to a long-term state of the atmosphere that some doctors felt was more important than the observable weather. In the late seventeenth century this concept was introduced by the English doctor Thomas Sydenham, who believed that it was not always possible to use the seasons to explain the rise and fall of epidemics, and it found favour within the Danish medical community in the first half of the nineteenth century when it was discussed in medical books and journals.[24] Sydenham also believed that the epidemic constitution could generate a dominating epidemic disease. However, he was unable fully to explain the mechanism, and suggested that it might depend on "hidden" changes in the deeper structures of the earth contaminating the atmosphere with harmful "effluvia".[25]

[20] Carl Ørnstrup, 'Den herskende Sygdomstilstand i Svendborg og Distrikt i Aarene 1826, 27, 28 og 29 . . .', *BFL*, 1830, **12** (1): 1–69, p. 47; Peter Barclay, 'Bidrag til Kundskab om vestindiske Sygdomme med didhørende Bemærkninger, samlede paa St. Thomas i Aarene 1823–1826', *BFL*, 1830, **12** (1): 70–135, p. 84.

[21] Ørnstrup, op. cit., note 20 above, p. 54; Hübertz, op. cit., note 17 above, p. 171.

[22] Jacob Mikisch, 'Beskrivelse over et eget slags Hikkesyge', *BFL*, 1823, **3** (1): 11–19, p. 16 ("... Sygdommens første Aarsag nok ene og allene maatte tilskrives Dunstkredsens saa pludselig forandrede Temperatur, og især den vedholdende, ildelugtenede Taage, og at der mueligen ved Absorptionen gjennem Huden var optaget skadelige Stoffer . . .").

[23] Benjamin Gartner, 'Nogle practiske Bemærkninger om den saakaldte gule Feber', *BFL*, 1825, **5** (1): 270–96, p. 274; Poul Schlegel, 'Om den vestindiske Climat-Feber eller saakaldte gule Feber', *BFL*, 1822, **2** (1): 12–25, p. 14; Ørnstrup, op. cit., note 20 above, p. 8.

[24] See Morten A Skydsgaard, *Ole Bang og en brydningstid i dansk medicin,* Aarhus University Press, 2006, p. 150. The epidemic constitution also functioned as a merely descriptive concept concerned with all prevailing epidemics at a time and was, for example, listed in the minutes of the Royal Medical Society. Jørgen Genner, *The Medical Society of Copenhagen 1772–1972*, Odense University Press, 1972, pp. 129–41.

[25] Thomas Sydenham, *Medical observations concerning the history and cure of acute diseases*, in

The concept of an epidemic constitution could be interpreted in a number of ways. A doctor from Southern Funen, inspired by the Scottish physician John Brown and his ideas of "sthenic" and "asthenic" diseases, described a "sthenic" epidemic constitution that had caused various "typhus-like fevers" in 1826. These had been modified throughout the year by unspecified "climatic influences" on the prevailing epidemic constitution.[26] Another medical practitioner in the Danish West Indies stated that a prevailing "bilious" epidemic constitution emerged when unusual heat prevailed; while a doctor in the Faroe Islands emphasized that the common catarrhal epidemic constitution persisted in all kinds of weather.[27] Thus the relation between the weather and the epidemic constitution took various forms and was a debated issue in Danish medicine at that time. Generally speaking, there was no consensus about the nature of epidemic constitutions among Danish medical practitioners, just as practitioners in America carried a broad notion of the epidemic constitution that was subject to individual interpretation.[28]

A Variety of Aetiological Explanations

If we take a closer look at the hierarchy of epidemic causes in the reports from 1810 to 1840, a continuum of aetiological thinking emerges. In nine out of twenty-one epidemic reports the weather or a certain state of the atmosphere was viewed as the primary cause of an epidemic outbreak of an acute disease.[29] In five the weather figured as an important occasional or predisposing cause that needed to be combined with other causes such as a bodily disposition, contagions, bad food, bad sanitary conditions or neighbouring marsh land.[30] A contagious view was present in four reports.[31] Furthermore, two epidemics had an unknown aetiology, and one report cited the poisoning of drinking water as a primary

The works of Thomas Sydenham, MD, 2 vols, London, Sydenham Society, 1848–1850, vol. 1, pp. 34, 39, 33.

[26] Ørnstrup, op. cit., note 20 above, pp. 2, 9.

[27] Barclay, op. cit., note 20 above, pp. 75–6; Claus Manicus, 'Om den ondartede Catarrhalfeber, i flere nordiske Lande kaldet Landfarsot', *BFL*, 1828, **8** (1): 207–33, pp. 207–9, 218–20.

[28] Valenčius, op. cit., note 6 above, pp. 91, 98–100.

[29] Mikisch, op. cit., note 22 above, p. 16; Schlegel, op. cit., note 23 above, pp. 14–15; Svend Svendsen, 'Om en inflammatorisk Feber af en egen Art, som i de sidste fem Aar har jævnligen indfundet sig blandt det 2det Jydske Infanterieregiments Mandskab', *BFL*, 1825, **5** (1): 113–60, p. 150; Manicus, op. cit., note 27 above, p. 220; Ørnstrup, op. cit., note 20 above, p. 2; Carl Ørnstrup, 'Sygdomstilstanden i Svendborg District i Aarene 1830 og 1831', *BFL*, 1832, **16** (1): 216–41, pp. 216, 221; Christian Leth, 'Den epidemiske Feber i det søndre-sjællandske Landphysicat', *BFL*, 1832, **17** (1): 79–98, pp. 93–4; J Voigt, 'Medicinsk topographisk Beskrivelse af det danske Etablissement Frederiksnagor (Serampore) og Bemærkninger om de der herskende Sygdomme', *BFL*, 1833, **18** (1): 1–66, pp. 12–21; Johan Clemensen, 'Sygdoms-Tilstanden i Aalborg og tildels i dens nærmeste Omegn', *BFL*, 1837, **27**(1): 39–117, p. 40.

[30] Gartner, op. cit., note 23 above, p. 274; Hübertz, op. cit., note 17 above, pp. 171–6; Peter Dons, 'Kortfattet Beskrivelse af en Feber-Epidemi i St. Thomæ Havn i Aaret 1833 . . .', *BFL*, 1834, **21** (1): 1–113, p. 4; Anon., 'Den epidemiske Cholera i Etablissementet i Tranqvebar i Aarene 1818 og 1819', *BFL*, 1831, **15** (1): 63–72, pp. 69, 71–2; Eiler Kongsted, 'Nogle Bemærkninger om Epidemien 1831, saaledes som den viste sig i Ods-Herred', *BFL*, 1832, **17** (1): 275–84, p. 276.

[31] Nicolai Møhl, 'Beretning om den sidste Koppeepidemie i Kjøbenhavn', *BFL*, 1825, **5** (1): 161–204, p. 163; Børge Hoppe, 'Beretning om den i Kjøbenhavn fra Aaret 1828 til 1830 herskende Koppe-Epidemi', *BFL*, 1831, **15** (1): 1–25, p. 4; Oluf ("Ole") L Bang, 'Om de Febre, som kaldes Galde-Febre, Nerve-Febre, Typhus o. s. v.', *BFL*, 1831, **14** (1): 287–310, p. 297; Børge Hoppe, 'Beretning om den i Kjøbenhavn nu herskende Koppe-Epidemi fra dens Begyndelse 1832 indtil 1 Januar 1835', *BFL*, 1835, **22** (1): 411–25: p. 411.

cause.[32] More than ten different kinds of disease were mentioned in the reports from 1810 to 1840, with various fevers constituting the majority.[33]

Thus, the reports show that medical practitioners often looked at the atmosphere when they wished to account for the rise of an acute epidemic disease. Behind this general acceptance of the weather as an epidemic cause, a much more disparate view on epidemic causes reigned, as shown above. In the 1820s and 1830s medical meteorology was practised by a group of individually minded physicians, whose findings about the weather and disease were built on their experiences in a distinct locality and framed by a broad range of ideas coming from Hippocratic texts, and works by Galen, Sydenham and contemporary physicians.

Changing Weather and Changing Therapy

Weather was also regarded as capable of changing the nature of an epidemic and its treatment. Thus, changes in the weather and the epidemic constitution could make an epidemic disease "milder" (*mildere*), "malignant" (*ondartet)*, "dangerous" (*farlig*), or "modified" (*modificeret*) and influence the spectrum of acute diseases.[34] This linking of the prevailing climatic conditions and the observed epidemic diseases tended to follow Sydenham's theory, which meant that medical practitioners could propose treatments based on disease symptoms and weather conditions.[35] So, for example, in Southern Funen a surgeon reported that changes in the epidemic constitution in 1828 "demanded that most fevers in March got a cooling regime" combined with venesection and a mixture of cream of tartar and nitre. In June the epidemic constitution changed and made repeated emetics the best treatment in most fevers.[36] A more dramatic shift in therapy was overseen by a military medical practitioner who practised in France, Germany and Denmark during the Napoleonic wars. He argued that emetics had been crucial in the cure of most fevers until 1818. After 1818 these remedies had become harmful, as a rheumatic-inflammatory epidemic constitution had emerged in Northern Europe. As a consequence "all" fevers had changed and now required vast and copious bloodletting.[37]

Making such connections between atmospheric conditions and disease meant that medical practitioners needed to keep an open mind towards treatment. Such openness can be seen in most reports, and was supported by Ole Bang, the leading professor at

[32] Barclay, op. cit., note 20 above, p. 73; Christopher Arends, 'Den epidemiske Feber i det nordre-sjællandske Landsphysicat', *BFL*, 1832, **17** (1): 69–79, pp. 78–9; Vilhelm Willumsen, 'Om en paa Fregatten Bellona opstaaet Sygdom, formentligen foranlediget af Kobberoxid i det Vand, der anvendtes til Drik', *BFL*, 1837, **26** (1): 142–7.

[33] In alphabetical order: *Catarrhalfeber* (catarrh), *Climat-Feber* (climate fever), *Dysenterie/Blodgang* (dysentery), *Feber med betydeligt hang til Overgang i Typhus* (fevers with tendency to develop into typhus), *febris biliosa* (bilious fever), *Hikkesyge* (hiccup-sickness), *hydrocephalus acutus* (acute hydrocephalus), *inflammatorisk Feber* (inflammatoric fever), *Koldfeber* (cold fever), *Kopper* (smallpox), *Nervefeber* (nervous fever), *rheumatisk Feber* (rheumatic fever) *Synocha* (synocha) and *Typhus* (typhus).

[34] Schlegel, op. cit., note 23 above, pp. 18–19; Ørnstrup, op. cit., note 20 above, p. 18.

[35] Sydenham, op. cit., note 25, on p. 39.

[36] Ørnstrup, op. cit., note 20 above, pp. 19–20, 23.

[37] Svendsen, op. cit., note 29 above, pp. 148, 151–6.

the University of Copenhagen throughout the 1820s and 1830s. He introduced his students to the idea that epidemics could emerge "in new, previously unobserved forms".[38] This led to a situation in which medical practitioners experimented with a variety of remedies until they found one that worked, rather than sticking to a prescribed treatment for a specific disease. This was also true for their medical counterparts in the American South, who emphasized that the distinctiveness of the South and its diseases demanded environment-specific treatments.[39]

Developing a Science of Medical Meteorology

The broad and debated ideas about the atmosphere and its influence on disease reflected a diverse medical culture in western medicine with new medical authorities emerging every decade or two. From the eighteenth century, medical schools had been trying to systematize medicine around simple fundamental principles and particular therapies. In Denmark, these various approaches moved in and out of favour so, for example, in the first decade of the nineteenth century the Scottish physician, John Brown and his system *Elementa medicinae* attracted the attention of elite Danish physicians. Then in the 1820s the medical systems of the French physician, François Broussais and the German physician Samuel Hahnemann encouraged Danish physicians to reconsider their approach to medical theory and practice. Sometimes medical practitioners would use the changing climatic conditions and epidemic constitutions to explain the continuing emergence of new medical systems so, for example, one medical practitioner asked whether "the major part of the success of Hahnemann's method of cure" was related to an epidemic constitution favouring diseases that needed a homoeopathic treatment.[40]

At the same time, it was becoming clear to other medical practitioners that the existing knowledge of climatic conditions offered only a scant and insufficient explanation for the diversity of diseases and their treatments.[41] Epidemics remained an unsolved problem in medicine, and there was absolutely no consensus about classification, cure and the influence of the weather on these acute diseases. Epidemics persisted in an "impenetrable darkness", as one district surgeon commented in 1824.[42] In this prevailing darkness, the medical elite, nevertheless, shared a modest optimism that growing interest in measurement and empiricism, along with similar developments in the natural sciences, would eventually lead to a better understanding of disease and its management.[43]

This optimism extended to the more empirical methods being developed for monitoring the weather, and so medical meteorology entered a pioneering phase. The groundwork for this approach to medical meteorology had actually begun in Denmark

[38] Oluf L Bang, *Indlednings-Foredrag til de medicinsk-practiske Forelæsninger og Øvelser*, Copenhagen, 1836, p. 10.

[39] Valenčius, op. cit., note 6 above, pp. 179–81.

[40] Ørnstrup, op. cit., note 20 above, p. 13 ("Mon ikke ogsaa den Hahnemannske Lægemethode for størstedelen . . .."). Regarding the diversity of medical theories and their relation to epidemic constitutions, see also Warner, op. cit., note 6 above, pp. 162–84.

[41] Barclay, op. cit., note 20 above, pp. 81–2.

[42] Claus Manicus, 'Nogle Iagttagelser over de paa Færøerne herskende og de sammesteds manglende Sygdomme', *BFL*, 1824, **4** (1): 15–40, p. 40.

[43] Skydsgaard, op. cit., note 24 above, pp. 71–2, 120–4, 171–2.

between 1807 and 1809, when Heinrich Callisen (1740–1824), a powerful person and professor at the Academy of Surgery in Copenhagen, published a two volume medical topography of Copenhagen. It was the first Danish medical topography to include an analysis of the relationship between the weather and disease in a specific area of Denmark.[44] In this topography Callisen pointed to the climate as the "major cause" of disease in the capital.[45] The climate of Copenhagen had been systematically observed and recorded since the 1760s, even though the use of meteorological data in and outside Denmark had been "very incomplete and not very informative" and this added substance to his analysis.[46]

Callisen presented tables containing a wide range of meteorological data from Copenhagen and identified the inconsistent, ever changing weather of the capital, with its average of 71 days of cloudless sky, 131 cloudy days, 142 days with thick air, 26 days with snow, 28 foggy days, 6 days with hail and 102 rainy days, as a significant cause of medical problems. As a consequence of these climatic conditions, almost every citizen suffered from gout and cold. But, despite these problems, Callisen believed that the city environment was not totally unhealthy: its cool and windy climate purified the air and carried off corrupted "effluvia" (*Uddunstninger)* from the streets.[47]

Callisen argued that the aim of medical meteorology should be to set "general laws" that existed beyond the experience of the individual doctor. Hence, he called for the establishment of a society dedicated primarily to the study of climate and disease. The main purpose of the society would be to make precise, daily observations of temperature and barometric pressure, winds, moisture and drought, and to combine these with descriptions of the prevailing diseases and lists of mortality.[48] In time, it was hoped, meteorology would become useful for medicine. In the late eighteenth century Dutch and French medical meteorological societies had already tried to combine quantitative meteorology with epidemic data and demography, but they had not succeeded for several reasons as described later.

Callisen's topography was well received and widely read in the Danish medical community.[49] The call for a science of meteorology was heard, but it was ten years before the Royal Academy of Sciences in Copenhagen acted. In the 1820s the secretary of the society, the physicist Hans Christian Ørsted, successfully campaigned for more meteorological observations to be made in all parts of the Danish kingdom and proposed the establishment of a "permanent meteorological committee", which was eventually set up in 1827. Collected meteorological data were published in *Collectanea meteorologica I-IV* from 1829 to 1856.[50]

[44] Schouw, op. cit., note 12 above, p. 239. Only a few larger medical topographies were published in the next sixty-five years and added nothing new to the field of medical meteorology. See Voigt, op. cit., note 29 above; Peter Panum, 'Iagttagelser, anstillede under Mæslinge-Epidemien paa Færøerne i Aaret 1846', *BFL*, 1847, **1** (3): 270–344; Christian Fibiger, *Medicinsk Topographie af Silkeborg og dens Omegn*, Copenhagen, Eibes Forlag, 1863.

[45] Heinrich Callisen, *Physisk Medizinske Betragtninger over Kiöbenhavn*, 2 vols, Copenhagen, Frederik Brummers, 1807–9, vol. 1, pp. 121–2 ("Hoved-Aarsagen").

[46] Ibid., p. 131 ("meget ufuldstændige og lidet oplysende").

[47] Ibid., pp. 119–20, 128–30.

[48] Ibid., pp. 131–2.

[49] Anon., 'Physisk-medicinske Betragtninger over Kiøbenhavn', *BFL*, 1809, **1**: 151–6, and *BFL*, 1810, **2**: 202–11; Schouw, op. cit., note 12 above, p. 239.

[50] *Meteorologisk Institut*, op. cit., note 14 above, pp. 17–18. From the 1770s several European

Figure 1: It was not only physicians and scientists who showed a growing interest in the weather during the first half of the nineteenth century. At the Royal Academy of Fine Arts in Copenhagen, Professor Christoffer Vilhelm Eckersberg made his first studies of the visible atmosphere, i.e. skyscapes, in 1826 and began a meteorological diary that he kept for thirty years. At the same time, meteorology and its systematic investigation of nature influenced painters, who drew on scientific explanations in their quest for a deeper understanding of nature. Above is a study of a thunderstorm over the hills of Jutland by Vilhelm Kyhn (oil painting, 1879, Randers Kunstmuseum).

At this period the Royal Society of Medicine tried to enthuse its members about medical meteorology. At a meeting in 1826 the acknowledged climatologist and plant geographer Professor Joakim Frederik Schouw lamented that medical meteorology was a neglected area of medicine, a view supported by the fact that the Hippocratic *Airs, waters and places*—written before the advent of the "experimental sciences"—was still considered the best and most important work in the field. In order to make the most of the new science of meteorology, Schouw proposed that every medical practitioner in the country should spend just a few minutes a day keeping a diary of his patients. The material would be collected annually and related to the weather throughout each year. Alternatively, professor and chief physician Johan Wendt argued that doctors themselves should make meteorological observations and keep diaries of weather observations.[51]

scientific societies had attempted to collect and publish similar meteorological data primarily on national levels. A hundred years later, most European nations had established official weather services. Anderson, op. cit., note 7 above, pp. 45–6; James R Fleming, *Historical perspectives on climate change*, Oxford University Press, 1998, pp. 33–44.

[51] Schouw, op. cit., note 12 above, p. 236, 238–9; Wendt, op. cit., note 14 above, p. 101.

Judging from the few attempts made in the 1820s and 1830s, it was not easy to generate new knowledge about epidemics based on analysis of meteorological data. Ole Bang published a complete list of epidemic diseases and mortality rates from his private practice in 1822 and 1824 alongside tables of meteorological observations from the Copenhagen Observatory. He tried in vain to understand the halving of acute diseases between 1822 to 1824 by investigating winds, rain, temperature and mean barometric pressure.[52] A few other attempts to analyse the weather occurred in the 1820s and 1830s, when meteorological tables sporadically appeared in the medical journals.[53]

A New Generation of Doctors

Around 1840 the medical scientific scene began to change in Copenhagen when a group of mainly young doctors rebelled against the established medical institutions and declared that medical science in their homeland was characterized by "tepidity" and inactivity.[54] They founded the society "Philiatrien", which became an important medical forum for new areas of medical science and paved the way for changes in the established medical institutions. Some of its members established a new medical journal, *Ugeskrift for Læger*, which in a short time became the leading medical periodical in Denmark. Two principal figures in the society were Carl Emil Fenger (1814–84) and Carl Kayser (1811–1870), both inspired by French medicine and its innovative use of statistics.

In 1839 Fenger, having just returned from a three-year study tour of Europe, introduced the numerical method to a Danish audience and argued that all doctors should use statistics in every kind of scientific investigation.[55] He stated that medicine ranked below chemistry and physics because observations were not systematic and tended to be "sloppy". Furthermore, the extraordinary often took precedence over the normal, which was a mistake, because medicine, as a science, should "lay down rules". To praise the peculiar was the "worst enemy of science".[56] With these words Fenger emphasized that meteorological reportage, without counting and measurement, was a futile endeavour.

Fenger and Kayser were both influenced by the French statistician Jules Gavarret (1809–1890) and had attended one of his courses in 1838. Gavarret belonged to a group of French doctors and statisticians who believed that medical knowledge should be based on statistical methods. In 1840 Kayser published a Danish translation of Gavarret's *Principes généraux de statistique médicale* (1840), in which Gavarret, a disciple of Siméon-Denis Poisson, discussed the validity of meteorological knowledge in medicine. Gavarret deemed the widespread qualitative descriptions of the weather useless. The oft-cited Hippocratic *Airs, waters and places* was, in his opinion, no more than a historical

[52] Oluf L Bang, 'Iagttagelser over den epidemiske Constitution i Kjøbenhavn 1824', *BFL*, 1825, **5** (1): 22–41, p. 41; see also Bang's analysis of epidemics of typhus and winters with extreme cold in Oluf L Bang, 'Typhus i det kgl. Fred. Hospital 1837–39', *BFL*, 1840, **3** (2): 97–122, p. 107.

[53] As the only one, a rural surgeon reported on his investigations of a meteorological instrument. Emilius Frisch, 'I Anledning af et i America anbefalet meteorologisk Instrument', *Nye Hygæa*, 1826, **8**: 142–3.

[54] Anon., 'Om den medicinske Litteratur i 1839', *UFL*, 1840, **2** (1): 33–41, p. 40.

[55] Fenger also called the method "statistical". Carl Emil Fenger, 'Om den numeriske Methode', *UFL*, 1839, **1** (1): 305–15, 321–5, p. 307.

[56] Ibid., p. 306; Carl Emil Fenger, 'Modbemærkninger imod Dr. Djørups Critik af den numeriske Methode', *UFL*, 1840, **2** (1): 49–64, p. 55.

collection of claims, and medicine ought to act as if these early studies were "false" and had "never existed".[57] Gavarret's critical attitude towards earlier knowledge was also reflected in his comment that a "law, produced with the use of small numbers of facts, can be so misleading that it never deserves any credit".[58] Instead medicine should use "the beautiful theories of Poisson" and make "the law of large numbers" (*la loi de grands nombres)* the basis for statistical investigation in medicine.[59]

Fenger soon introduced these new ideas into medical meteorology, defending his licentiate degree, a "medical-statistical" investigation, in 1840. He analysed the influence of age and the seasons on the length and severity of diseases by studying a selected homogenous group of 1,000 adult men from the Danish navy, who lived in identical buildings and shared the same air, drinking water and food. In this way, Fenger, following Gavarret, tried to eliminate other influences like sex, living conditions, lifestyle and geography. In order to judge the influence of the seasons, Fenger argued, it was crucial not only to establish the frequency of a disease, but also its "mean duration time".[60]

Fenger's statistical study found that the seasons did indeed influence morbidity. Both the duration of certain diseases and the frequency of a variety of diseases varied with the seasons. Even the healing of inflamed abscesses depended on the time of year.[61] He also rejected the common belief that a raging epidemic suppressed or arrested the development of other acute diseases, an idea related to Sydenham's epidemic constitutions. Thus Fenger's investigations demonstrated that the seasons did have an influence on various diseases. But for Fenger and his colleagues the crucial question for medical meteorology still remained: what was pathological about the climate? And what was the disease-causing mechanism?

Fenger's study marked a new approach to the construction of medical knowledge. He investigated the effects of two phenomena, age and season, on a selected population using statistical concepts like *frequency* or *mean duration time* of a disease. This application of probability theory and its mathematical abstractions has been called a "revolution", because the idea of disease shifted from a deterministic model, in which the individual patient was crucial, towards a statistical model focusing on large quantities, a trust in numbers.[62] As described below, something similar was also happening in respect of the weather.

The Statistical Committee

In 1845 the Royal Society of Medicine set up a statistical committee with Fenger as chairman, and medical meteorology entered a productive phase. The focus of this

[57] Jules Gavarret, *Principes généraux de statistique médicale*, Paris, 1840, p. 165; Jules Gavarret, *Om Lovene for Statistikens Anvendelse i Medicinen*, transl. Carl Kayser, Copenhagen, Reitzel, 1840.

[58] Ibid., p. 246 ("peut être tellement éloignée de la verité que, dans aucun cas, elle ne mérit aucune espèce de confiance").

[59] Ibid., p. 43.

[60] Carl Emil Fenger, 'Hvordan alder og årstid påvirker hyppighed og varighed af sygdomme hos det voksne menneske', transl. Kirsten Jungersen, 2001, from *Quid faciant aetas, annique tempus ad frequentiam et diuturnitatem morborum hominis adulti, disquisitio medico-statistica*, Copenhagen, Quist, 1840, pp. 9–10.

[61] Ibid., pp. 59–68.

[62] Bernard Cohen, 'Scientific revolutions, revolutions in science, and a probalistic revolution 1800–1930', in Lorenz Krüger, Lorraine J Daston and Michael Heidelberger (eds), *The probabilistic revolution*, vol. 1, *Ideas in history,* Cambridge, MA, and London, MIT Press, 1987, pp. 23–44, on pp. 34–40.

committee's work was "medical topography". Within this remit a number of meteorological investigations were initiated, as the committee's view, which echoed Callisen's and Schouw's earlier criticisms, was that the influence of the climate remained an unsolved problem.[63] The studies concentrated solely on aetiology and did not address therapeutic questions about the weather.[64] One of the larger studies, made by Kayser in 1848, investigated the influence of the seasons on mortality. It became a crucial study, as he was the first to use sustained statistical analysis and to voice serious doubts concerning the weather as a fundamental explanatory mechanism.

By way of introduction, Kayser discussed previous smaller studies made by the Swiss physician Henri Lombard, the German physician Ludwig Moser and the Belgian mathematician Adolphe Quetelet and concluded that these statistical investigations of seasonal effects on mortality were limited and had not enriched science with "valuable results".[65] Instead, Kayser argued that medical science had to take advantage of the upsurge of statistical material in Europe in order to investigate the possible "general nature" of the seasonal impact. To this end, he had gathered material of monthly mortality rates from eleven European countries for periods of four to seventeen years, covering 4 million cases. It was a vast statistical work with numerous calculations systematized in forty-seven tables showing the mean monthly mortality rates throughout the year. He compared the data from the different countries, and the influence of the seasons on the mortality in large cities and rural districts, and he investigated the influence of the seasons on different age groups in Denmark. Kayser concluded that the seasons did influence mortality in all countries. In Nordic countries mortality peaked, with some variation, in spring and reached its lowest point in autumn.[66] In southern Europe the mortality pattern was less clear and peaked twice, at the beginning of the year and in late summer. But in spite of this large-scale study, Kayser concluded, no meteorological pathogenesis could be identified.

Kayser tried to point out one meteorological cause by investigating the influence of temperature on mortality in four places: Denmark, Königsberg, Berlin and Paris. In the case of Königsberg and Berlin, he re-analysed the data used in two German studies, one by the physician Johann Ludwig Casper and another by Moser, who had found a positive correlation between temperature and mortality. According to Casper, mortality peaked in Berlin in periods of extreme temperature. He had selected arbitrarily a number of months from every year in his analysis, and had not included all months, which made

[63] Carl Emil Fenger, 'Første Halvaarsberetning fra det kgl. medicinske Selskabs statistiske Comite', *BFL*, 1847, **1** (3): 32–83, p. 40.

[64] In the epidemic reports from the 1840s and later, the medical practitioners did not draw attention to either changes of the weather or epidemic constitutions that had influenced their specific treatment of epidemic diseases.

[65] Carl Kayser, 'Om Maanedernes og Aarstidernes Indflydelse paa Dødeligheden', in *De permanente Comiteers Arbeider i Aarene 1846 og 1847*, Copenhagen, Reitzel, 1848, pp. 72–124, on p. 72; Ludwig Moser's study consisted primarily of one table covering 293,000 deaths from Belgium and seven cities in Europe and America. It showed uneven standards of mortality (both relative and absolute) and covered various periods, e.g., "1725–1769" in Padua, "1811" in Turin and "1825–29" in Havana. Quetelet's investigation of Belgium 1815–26 was included in Moser's study: *Die Gesetze der Lebensdauer*, Berlin, Verlag von Veit und Comp., 1839, pp. 245–7. Henri Lombard's material included 18,000 deaths in Geneva over a period of twenty-four years: 'De l'influence des saisons sur la mortalité à différens ages', *Annales d'Hygiène Publique et de Médicine Légale*, 1833, **10**: 93–114.

[66] Kayser, op. cit., note 65 above, pp. 93–4.

his results "worthless", according to Kayser (Tables 1 and 2).[67] Moser had also not studied the material systematically and his analysis was characterized by "superficial reflections". The studies by Casper and Moser illustrate that there was a lack of consensus regarding method in the field of statistical medical meteorology.

Kayser concluded his analysis of all the available data from Königsberg, Berlin, Denmark and Paris by stating that it "seems to be proven" that temperature did not influence human mortality.[68] He then investigated the influence of rainfall on mortality by analysing ten years of rainfall in Denmark and Paris. Again his results were negative, as mortality decreased in Paris and increased slightly in Denmark in periods with rain. Kayser may have hoped to find an influence in temperature and rainfall, because these weather phenomena exhibited long-term seasonal variations, as did mortality, but he did not succeed.

What about the winds? Kayser refrained from investigating the influence of winds, because they changed constantly. Instead, another member of the committee, Frederik Bremer, tested the common belief that the winds carried miasma and were responsible for the spread of epidemics, in this case the assumption was that influenza moved west with winds from the east. He studied the routes of three epidemics and correlated them with the prevailing direction of the winds in different Danish cities. Bremer found that influenza moved from east to west no matter which way the wind blew, in fact it even moved west when the wind blew from the west.[69]

Kayser concluded that the seasons exerted a certain influence on mortality, but that this influence "seemed absolutely independent of meteorological phenomena".[70] This last statement suggests that he had severe doubts about the significance of the weather on human health. His own investigations had confirmed the seasonality of deaths, but he had not found any linkage between this seasonality and the seasonality of temperature and rainfall. His study, therefore, reflects the new critical attitude towards the production of knowledge. Kayser processed the data from different perspectives, for example, by using various age groups, and he examined other studies by re-analysing the data and discussing the results.

The weather was, therefore, undergoing a process of measurement and standardization in Denmark at this time. It was recorded with instruments, averaged by month and compared with similar standardized and averaged weather from other parts of Europe. Furthermore, Kayser concentrated on a sustained statistical analysis using extensive meteorological data available from several places in Europe in the 1840s. In this respect the circumstances for research into medical meteorology in the nineteenth century differed from those in the eighteenth century. Huib J Zuidervaart argues that the ambitious medico-meteorological programme in the Netherlands in the 1780s did not succeed because the organization of a team of observers and the collection and publication of data was a time-consuming and expensive process. Furthermore the theoretical framework for processing a large flow of meteorological observations was inadequate at that time.[71]

[67] Ibid., p. 116; Johan Casper, *Denkwürdigkeiten zur medicinischen Statistik,* Berlin, Duncker & Humblot, 1846, pp. 23–7.

[68] Kayser, op. cit., note 65 above, p. 119; Moser, op. cit., note 65 above, pp. 247–50.

[69] Frederik Bremer, 'Om Influenza-Epidemierne i Danmark i Aarene 1825 til 1844', in *De permanente Comiteers Arbeider i Aarene 1846 og 1847*, Copenhagen, Reitzel, 1848, pp. 213–26, on pp. 213–21.

[70] Kayser, op. cit., note 65 above, p. 124.

[71] Zuidervaard, op. cit., note 8 above, pp. 403–10.

Table 1

This is taken from the German physician Johann Ludwig Casper's study of temperature and mortality in Berlin 1833–39.

Sommer								Frühling und Herbst							
	Ueber 15 ° R. hatten		Es starben		Unter 15 ° R. hatten		Es starben		Ueber 12 ° R. hatten		Es starben		Unter 12 ° R. hatten		Es starben
1833	Juni	15,50	659	1833	Juli	14,51	632	1833	Mai	14,55	698	1833	Sept.	11,36	499
1834	Juni	15,48	621		Aug.	11,49	479	1834	Mai	13,09	606	1835	Mai	10,60	528
	Juli	19,34	844	1835	Juni	14,73	506		Sept.	12,62	816	1836	Mai	9,08	514
	Aug.	17,11	990	1836	Juli	14,43	606	1835	Sept.	13,03	538		Sept.	11,06	310
1835	Juli	15,88	527		Aug.	13,28	616	1838	Sept.	13,25	701	1838	Mai	11,24	703
1838	Juli	15,00	842	1838	Juni	13,94	657	1839	Sept.	13,64	635	1839	Mai	11,78	654
1839	Juni	15,09	571		Aug.	12,84	754								
	Juli	16,13	619	1839	Aug.	14,18	700								
			5673				4950				3994				3208

Table 2

Carl Kayser's re-analysis of Casper's data

Sammenlignende Oversigt over Forholdet imellem Temperatur og Dødelighed i Berlin 1833—39.

	Maaneder under Middeltemperatur.			Maaneder over Middeltemperatur.			Overvægt af Dødsfald.	
	Maanedernes Antal.	Middeltemperatur.	Middelantal af Dødsfald.	Maanedernes Antal.	Middeltemperatur.	Middelantal af Dødsfald.	i de koldere Maaneder.	i de varmere Maaneder.
Januar	2	—5,43 R.	714	5	0,58	699	15	—
Februar	2	—1,58	657	5	1,13	576	81	—
Marts	3	1,09	531	4	4,04	638	—	107
April	4	5,21	724	3	6,67	610	114	—
Mai	4	10,17	595	3	13,14	653	—	58
Juni	4	14,30	571	3	15,36	617	—	46
Juli	5	14,82	641	2	17,73	731	—	90
August	3	12,54	616	4	15,45	851	—	235
September . .	3	11,16	602	4	13,13	672	—	70
October	4	7,15	652	3	9,11	584	68	—
November . . .	3	1,56	607	4	3,74	551	155	—
December . . .	4	0,10	611	3	2,25	569	42	—
Hele Aaret	41	—	626	43	—	616	—	—

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Tables 1 and 2

In his initial analysis Casper picked out the months from May to September and found that the mortality (=5673) was higher in warmer summer months (> 15 degrees) than in the colder summer months (< 15 degrees) (=4950). Kayser's re-analysis included all months of the year and showed that the difference between the mean mortality during the months that were warmer than the mean monthly temperature (=626), and the mean mortality for months that were colder than the mean monthly temperature (=646), was of no significance. (Johan Casper, *Denkwürdigkeiten zur medicinischen Statistik,* Berlin, Duncker & Humblot, 1846, p. 24; Carl Kayser, 'Om maanedernes og aarstidernes indflydelse paa dødeligheden', in *De permanente Comiteers Arbeider i Aarene 1846 og 1847*, Copenhagen, Reitzel, 1848, p. 117.)

Additional methodical approaches to investigating the aetiology of disease in general were being introduced alongside the more accurate measurements of the weather in the 1840s. Thus doctors working on the statistical committee tried to identify a more specific aetiology for epidemics by studying causes one by one. Fenger argued that it was crucial "to force one's way into the phenomena" and establish scientific laws like the "exact sciences". He hoped that aetiology would soon escape its "childhood state" and become a real science. In the same breath he admitted that medicine had a long way to go. So, in medical meteorology for instance, it might be possible to collect a lot of data but it was difficult to isolate a single meteorological cause, because "cold air is mostly either dry or humid, it is still or moving, connected with a high or low showing of the barometer, with a certain amount of air electricity".[72]

Further Statistical Investigations: An Uphill Struggle in Medical Meteorology

The introduction of statistics to medicine created a lively debate that was played out in a series of meetings at l'Académie Royale de Médecine in Paris in 1837. In Denmark, debate surrounding the use of medical statistics followed Fenger's introduction of the numerical method in 1839.[73] The focus of these discussions was primarily the use of statistics in the evaluation of therapeutics, because these techniques necessarily meant that patients had to be grouped and could not be treated as individuals. Michael Djørup, a Danish opponent of the new method, argued that it was not possible to group ten patients with pneumonia without losing all the important "subtleties" of each patient. He stated that the numerical method added up "dissimilar entities" and would inevitably lead to "false" results.[74] Djørup criticized the idea of "the average man" (*l'homme moyen*) that Quetelet had introduced in the 1830s. For those with an interest in the weather, there were also concerns that calculating the mean monthly values of different weather

[72] Carl Emil Fenger, *Plan til en Forelæsnings-Cyclus over den almindelige Pathologie*, Copenhagen, 1843, pp. 65, 68, 83.

[73] Joshua Cole, 'The chaos of particular facts: statistics, medicine and the social body in early 19th-century France', *Hist. Human Sci.*, 1994, **7**: 1–27, pp. 14–20.

[74] Michael Djörup, 'Critik over den numeriske Methode med nærmest Hensyn til dens praktiske Anvendelse i Medicinen', *UFL*, 1839, **1** (1): 539–59, p. 542.

parameters underestimated the impact of the peculiarities of the weather of individual days. The effects of extreme weather were liable to be demoted in an average.[75]

Adolph Hannover, an empirically minded doctor, tried to overcome the limitations of approximations when averaging the weather into mean monthly values. In 1858 he published *Statistiske Undersøgelser*, in which he investigated the influence of the weather on acute diseases with a more precise method of analysing the weather on specific days than had hitherto been used. Over a period of five years (1843–48), he had studied the weather on the day of the onset of a specific disease. He managed to collect an enormous volume of data that included 19,000 patients, suffering from sixty diseases, who had been admitted to the three major hospitals in Copenhagen. For each disease he studied six conditions of the weather: temperature, barometric pressure, winds (divided into eight categories), condition of the air (foggy, misty, thick, mixed, clear), vapour pressure and precipitation (rain, snow, hail, glazed frost and drizzle).

A typical example from Hannover's study is his analysis of gastric fever, a major epidemic disease that struck more than 2,000 patients. He found that 65 days out of 1,825 were more diseased than others, meaning that four to eight patients were struck by gastric fever in these 65 days. Hannover could not, however, point to any meteorological phenomena that explained these clusters of diseased people. In general, the supposed epidemic hot spots were often absent, as the days of onset were evenly spread over weeks and months in relation to several epidemic diseases. Nevertheless, Hannover's investigations did undermine a number of widespread beliefs about weather and specific disease.[76] Thus, presumably to his own surprise, he disproved several aetiological theories concerning diseases such as apoplexy, bilious fever, bronchitis, catarrh, pneumonia and rheumatic fever. Most of his conclusions ran like this: "It is a common belief that winds from the north and east, especially in winter, cause inflammations of the chest. This belief has not been verified."[77]

Hannover's investigation, which included more than 120 tables and thousands of calculated statistics, illustrates a magnificent will to investigate a field systematically. At the same time, it represents a testimony to a state of medical thinking that was cutting the branch on which it was sitting. Hannover found some correlations between specific weather conditions and diseases, but they were ambiguous and sometimes related to a natural dispersion of data. Meteorology had difficulties producing anything constant and stable.

In 1860 the weather was taken into consideration during yet another investigation of a major typhus epidemic in Copenhagen. But, the author, Frederik Trier, concluded: "The influence of the weather in a particular place with its complex of diseases is, all taken into consideration, very obscure."[78] His statement illustrated the medical community

[75] Anderson, op. cit., note 7 above, p. 137.

[76] See a common textbook of medicine, Oluf L Bang, *Haandbog i Therapien*, Copenhagen, Gyldendal, 1852, pp. 100–1, 241–2, 256, 297.

[77] Adolph Hannover, 'Sygeligheden i Kjøbenhavn', in *idem*, *Statistiske Undersøgelser af lægevidenskabeligt Indhold*, Copenhagen, Gyldendal, 1858, pp. 177–347, on pp. 285, 192–202, 206, 213, 275, 292. ("Det er en meget Gjængse Mening, at nordlig og østlig Vind, især om Vinteren, fremkalder Brystbetændelser. Denne Anskuelse er ikke begrundet.")

[78] Frederik Trier, *Undersøgelser angaaende den typhoide Febers Udbredning og Oprindelse i Kjöbenhavn i Aarene 1842–1858*, Copenhagen, Bing & Sön, 1860, p. 49 ("De Virkninger, som Veirforholdene udøve paa den paa et bestemt Sted

of Copenhagen's disillusionment with medical meteorology, and marked the end of studies on the subject by the Danish medical elite. Their reaction is illustrated by the published epidemic reports. In the 1840s four out of fifteen epidemics were interpreted as climatic, four were viewed as contagious and two were related to the sanitary conditions.[79] In the 1850s only one out of eighteen epidemics was seen as purely climatic, five were seen as contagious and three were seen as the result of sanitary conditions.[80] From 1860 to 1875 one out of twelve epidemics was considered climatic, five were seen as contagious and one was affected by sanitary conditions.[81]

herskende Sygdomsbeskaffenhed, ere i det Hele saa dunkle . . .").

[79] Five epidemics had a mixed aetiology with the weather or sanitary conditions combined with other aetiological factors like contagiosity and/or a bodily disposition. E Haderup, 'Koldfeberepidemi i Vesterborg og Omegn i 1847–48', *BFL*, 1849, **5** (3): 336–61, pp. 337, 339–41; Christian Ditzel, 'Epidemien af Hydrocephalus acutus i Frysenborg-Lægedistrikt i Aarhus-Stift i Aaret 1845', *BFL*, 1846, **44** (2): 314–28, p. 323; Anon., 'Den epidemisk-catarrhalske Feber i October og November Maaned', *UFL*, 1847, **7** (2): 508–10, p. 510; Fenger, op. cit., note 63 above, pp. 61–3; P Schleisner, 'Om de islandske Epidemier', *BFL*, 1849, **5** (3): 276–99, p. 278; Panum, op. cit., note 44 above, pp. 342–4; Carl Kayser, 'Meddelelse om en Epidemi, som i Sommeren 1844 herskede ved Colonien Jacobshavn i Nordgrönland', *UFL*, 1846, **4** (2): 229–43, p. 240; August Manicus, 'Mæslingerne paa Færøerne i Sommeren 1846', *UFL*, 1847, **6** (2): 189–210, pp. 190–7; Heinrich Helweg, 'En heftig Petechialtyphus i Odense Tugthus i 1843', *BFL*, 1845, **13** (2): 12–13; Emil Hornemann, 'Tilfælde af Kloakmephitisme', *BFL*, 1847, **2** (3): 45–60, p. 60; Carl van Deurs, 'Beretning om den gastrisk-typhøse Feber-Epidemie blandt de Militære i Aalborg', *UFL*, 1840, **3** (1): 321–6, pp. 322–3; Johannes Müller, 'Om den gastrisk-typhøse Feberepidemi, der i Juni, Juli, August, September og October Maaneder 1845 har hersket i den 11te Linieinfanteri-Bataillon', *UFL*, 1846, **4** (2): 193–208, pp. 196–8; Bang, 'Typhus', op. cit., note 52 above, pp. 106–8; O F Beck, 'Epidemi af Croup og Angina faucium exsudativa iagttaget i Løgstør og Omegn i Vinteren 1846–67', *BFL*, 1849, **5** (3): 257–76, pp. 269–70, 273; Finn Adolph Frydensberg, 'Praktisk Iagttagelse af vesttropiske Febre', *UFL*, 1846, **4** (2): 245–65, p. 246.

[80] Four epidemics had a mixed aetiology and five had an unknown aetiology. Frederik Bremer, 'Febrene paa Augustenborg Lazareth i Feldttoget 1850–51', *BFL*, 1855, **7** (4): 47–70, pp. 50–1; Frederik Uldall, 'Bemærkninger om Diphteritis, med særligt Hensyn til Danmark', *BFL*, 1853, **2** (4): 168–77, p. 176; 'Den epidemiske Öienbetændelse', in 'Det kongelige medicinske Selskabs Forhandlinger i Vinteren 1852–53', *BFL*, 1853, **2** (4): 445–98, pp. 490–1; H Gradmann, 'Den militære Øiensygdom i Garnisonen i Altona', *BFL*, 1855, **6** (4): 81–210, pp. 202–10; Christian Fibiger, 'Tyfus', *HT*, 1858, **1** (1): 95–6, p. 95; P V Heiberg, 'Aalborg Lægeforenings Beretning om Skarlagensfeber-Epidemien i Aalborg By 1857–58', *BFL*, 1859, **14** (4): 90–148, p. 120; Carl Emil Fenger, 'Beretning om en Epidemi af Brystbetændelse', *BFL*, 1852, **1** (4): 434–7; J Boye, 'En lille Epidemie af typhoid Feber', *HT*, 1859, **2** (1): 26–7; 'Almindelig Hospitals Lemmeafdeling under Choleraepidemien' in 'Det kongelige medicinske Selskabs Forhandlinger i Vinteren 1852–53', *BFL*, 1853, **3** (4): 344–404, pp. 382–3, 399, 401; Frederik Bremer, 'Skarlagensfeberens og Mæslingernes Gang gjennem Danmark fra 1825 til 1853', *BFL*, 1856, **9** (4): 99–116, pp. 100, 104–5; Emil Hornemann, 'Lazarethfeberen på Augustenborg i Sommeren 1849', *BFL*, 1850, **8** (3): 195–219, pp. 197–8, 218–19; Daniel Cold, 'Koldfeberepidemien i 1856 i Frederiksværk og Omegn', *UFL*, 1857, **26** (2): 109–14, p. 113; Andreas G Sommer, 'Om Choleras Udbredelsesmaade i Kongeriget Danmark (med Undtagelse Kjöbenhavn) i 1853', *BFL*, 1854, **5** (4): 286–377, pp. 354–68; Carl Kayser, 'Om de epidemiske Sygdommes Hyppighed i Kjøbenhavn i Aarene 1836–49', *BFL*, 1851, **9** (3): 110–20, pp. 113–14; 'Typhus-Epidemien' and 'Choleratilfælde' in 'Det kongelige medicinske Selskabs Forhandlinger i Vinteren 1853–54', *BFL*, 1853, **3** (4): 344–404, pp. 345–6, 358–9; Samuel Ballin, 'Statisti[s]ke Opgivelser om Cholerahospitalet i Frue Arbeidshuus', *BFL*, 1853, **3** (4): 344–404, pp. 371–4; Anon., *HT*, 1858, **1** (1): 33.

[81] Three had a mixed aetiology and one an unknown aetiology. C Lange, 'Typhoidfeber-epidemierne i Aarene 1864 og 1865 paa Frederiks Hospitals medicinske Afdeling A', *UFL*, 1866, **1** (3): 313–30, pp. 325–6; Daniel Cold, 'Nogle Iagttagelser fra en Landpraxis angaaende den gastrisk-typhoide Feber, navnlig med hensyn til dens Udbredelsesmaade', *UFL*, 1860, **33** (2): 357–77, p. 359; Angelo Petersen, 'Koppeepidemien 1863–65', *BFL*, 1867, **14** (5): 1–99, p. 3; Christian Petersen, 'Skarlagensfeber, meddelt gennem Breve', *UFL*, 1871, **11** (3): 309–10; Giersing, 'En Skarlagens-feberepidemi', *UFL*, 1871, **11** (3): 57–76, pp. 70–1;

Scepticism and Challenging Epidemic Theories

From the 1840s onwards, medical meteorology was challenged by new epidemic theories and discoveries. In Denmark discussions about epidemics were influenced by the emerging awareness of public hygiene. The physician Emil Hornemann, influenced by the sanitary movement in England, became a strong advocate for sanitary reform and fresh, healthy air in cities. According to Hornemann, and the English medical practitioners who inspired him, epidemics were caused by overcrowding, filth and poor living conditions. People fell ill not because of the weather, but as a result of the gaseous substances given off by the noxious organic matter heaped up in most cities. Around 1850 in several publications, Hornemann predicted the cholera epidemic that would rage through the country's packed and filthy capital in 1853.[82] In 1856 Hornemann founded a new journal on public hygiene, *Hygieiniske Meddelelser*, and sanitation became an important part of Danish aetiological investigations, as can be seen in epidemic reports from the 1850s onwards.

By the 1860s, early investigations in bacteriology were also arousing interest amongst Danish medical practitioners. In 1867 Fenger, who had left medicine for a political career in the Danish parliament, could not resist publishing research on a new kind of "parasite", which the chemist Louis Pasteur, among others, had discovered was responsible for fermentation, putrefaction and perhaps human disease. Fenger was fascinated by the discovery of the French doctor, Casimir-Joseph Davaine, of so-called "bacteria" in the bodies of humans suffering from anthrax. He sincerely hoped that "younger doctors and medical students" would dedicate themselves to the study of these new organisms by learning the difficult art of microscopy: this, he felt, represented some of the most promising research in medicine and the natural sciences.[83]

Medical meteorology was presumably also affected by increasing scepticism of the Hippocratic tradition. By the 1860s experimental medicine was becoming an integrated part of Danish medical science. Peter Ludvig Panum founded the first physiological laboratory at the University of Copenhagen in 1867. Panum became a leading figure in Danish medicine and criticized doctors who did not accept that medical science must be founded on experimental medicine and not on knowledge handed down from antiquity. In his writings he clearly dissociated himself from the "rubbish" that medicine had inherited from the age of Hippocrates.[84]

G G Stage, 'Epidemiologiske Undersøgelser angaaende Mæslinger og Skarlagensfeber', *UFL*, 1874, **18** (3): 361–7, p. 366; Edvard Bjering, 'Til den tyfoide Febers Ætiologi', *HT*, 1873, **16** (1): 168–71; Anon., 'En Epidemi af ondartet Halssyge i Garnisonen i Slesvig', *UFL*, 1863, **38** (2): 449–60, pp. 455–6; Michael Djörup, 'Om de sanitære Forhold ved den danske Armee i 1864', *BFL*, 1865, **10** (5): 1–70, p. 19–20; M Gleerup, 'En Epidemi', *HT*, 1866, **9** (1): 27; Daniel Cold, 'Nogle Strøbemærkninger om den diphtheritiske Halsbetændelse', *UFL*, 1867, **3** (3): 433–46, p. 434; P V Heiberg, 'En lille Epidemi af den epidemiske Meningitis Cerebro-spinalis', *HT*, 1874, **1** (2): 737–46, 753–7.

[82] Emil Hornemann, *Den seneste Cholera-Epidemie i England efter Report of the General Board of Health on the epidemic cholera of 1848 & 1849, London 1850*, Copenhagen, 1851, pp. 2–3; Dorothy Porter, 'Public health', in W F Bynum and Roy Porter (eds), *Companion encyclopedia of the history of medicine*, 2 vols, London, Routledge, 1993, vol. 2, pp. 1231–61, on pp. 1242–3.

[83] Carl Emil Fenger, 'Om det Virksomme ved Gjæringen, Forraadnelsen og visse Arter af Sygdomssmitte', *Hygieiniske Meddelelser*, 1866, **5**: 127–230, pp. 228, 230.

[84] "Fyldekalk". Peter Panum, *Om Fibrinen i Almindelighed og om dens Coagulation i Særdeleshed*, Copenhagen, Reitzel, 1851, p. 11. As a very young physician, Panum had dedicated himself to the study of epidemic causes as a true Hippocratic doctor, when he published a medical topography that

By the 1870s it was clear that medical meteorology was no longer held in high regard amongst the medical elite. Peter A Schleisner, the City Medical Officer for Copenhagen, made a sarcastic comment in his report on epidemics of 1875, noting that many physicians still "adhered to climatic thinking". He went on to ask how the capital could have experienced severe and large epidemics of pneumonia, a disease associated with cold seasons, in 1874 when the city experienced one of the mildest winters in a hundred years.[85]

A Continued Tradition

Despite growing scepticism, activities concerned with medical meteorology continued in the Danish medical community after 1860, although meteorological reasoning became less frequent in reports on epidemics. Provincial doctors continued to emphasize the weather and have their meteorological data presented in the annual reports on epidemics published by the Royal College of Health.[86] Christian Fibiger, a scientifically minded district doctor, was one such example. He ran his own weather station and had recorded 50,000 observations by the 1860s, performing observations nine times a day. In 1870 he defended his doctoral dissertation with the ambitious title *Om Klimaets Virkninger paa Nosogenesen (*'On the Influence of Climate on the Genesis of Disease'), following the German geographer of disease, August Hirsch and his influential *Handbuch der historisch-geographischen Pathologie* from the 1860s.[87] Fibiger argued that most diseases were caused by either cold or heat, thereby making climate the primary cause of epidemic diseases.[88] The dissertation received a hard, but fair critique. One reviewer wrote that the period of investigation was too short, the disease frequencies unreliable and the arguments unconvincing.[89] Fibiger's statistical analysis appears far from the rigorous systematic studies made by the statistical committee in the 1850s and demonstrates that research into medical meteorology now took place at the periphery of Danish medical science.

Medical meteorology also changed its focus in the 1860s and 1870s. A literature on "climatic health resort" cures emerged.[90] The idea of climate therapy was not new, but the treatment of tuberculosis by sending patients abroad, primarily to health resorts situated in mountains, by the sea or close to natural springs, became popular. This ultimately

specifically investigated an epidemic of measles in the Faroe Islands. In this pioneering work of modern epidemiology, Panum showed, by case-tracing the disease from island to island, that measles was contagious and by no means caused by the weather or any kind of miasma, see Panum, op. cit., note 44 above, pp. 342–4.

[85] P Schleisner, 'Oversigt over Københavns fornemlig epidemiske Sygdomsforhold i 1874', *UFL*, 1875, **20** (3): 81–121, pp. 82–3.

[86] See the sections 'Meteorologiske forhold' and 'Veirforhold' in *Det kgl. Sundhedskollegiums Aarsberetning*, 1860–69.

[87] August Hirsch, *Handbuch der historisch-geographischen Pathologie*, 2 vols, Erlangen, F Enke, 1859–64.

[88] Christian Fibiger, *Om Klimaets Virkninger paa Nosogenesen*, Copenhagen, Iversens Boghandel, 1870, p. 57. Fibiger was the only doctor who carefully described his meteorological instruments, for example, a Reaumur's thermometer with mercury column, a barometer and an August's psychrometer. Fibiger, op. cit., note 44 above, pp. 48, 52, 55.

[89] Anon., review of Fibiger's dissertation, *UFL*, 1870, **9** (3) pp. 286–93.

[90] For articles about climatic cures, see 'Klimatiske Kursteder i Udlandet' and 'Klimatoterapi' in Oscar Preisler's bibliography *Bibliotheca medica Danica*, 7 vols, Lyngby, 1916–1919, vol. 2, pp. 226–7, vol. 6, pp. 232–3.

led to the opening of several Danish *kystsanatorier* (seaside sanatoria) for tuberculosis sufferers in the early twentieth century. So medical meteorology remained a part of medicine, although the idea of weather as an epidemic cause lost most of its significance within Danish medical science.

Conclusion

In the first third of the nineteenth century a doctor's knowledge of the local climate was crucial for his study of epidemic disease. His investigations of the weather were qualitative and built on rules of thumb about the harmful influence of the atmosphere on disease. This inclination in Danish medicine towards traditional ideas about the weather and disease created the milieu for new studies in medical meteorology, when an upcoming, critically minded young generation of doctors wished to "revolutionize" Danish medical science and carried out the extensive and innovative investigations of the weather that eventually contributed to the marginalization of Hippocratic ideas and medical meteorology.

Medical meteorology in the mid-nineteenth century differed from the medico-meteorological programmes of the eighteenth century. The Danish physician Carl Kayser, who performed some of the important studies of weather around 1850, had studied statistical theory at a high level in France, where a group of medical practitioners and mathematicians launched a new medical science based on statistical methods. In his work, Kayser reflected on designs of study—how to use quantitative data systematically—and demonstrated awareness of randomness. He also discussed different interpretations of his own and other contemporary studies of medical meteorology. Furthermore, Kayser could, unlike his eighteenth-century predecessors, spend most of his time on processing rather than measuring, collecting and presenting, raw data about climate and disease. In the mid-nineteenth century, statistics on weather and mortality were available from several European countries and were ready for statistical analysis. In fact, Kayser made a career in the field of statistics. In 1848 he left his position as a medical officer of health and became professor in statistics and economy at the University of Copenhagen.

To conclude, this article argues that medico-meteorological investigations remained an important issue in nineteenth-century medical science and that a turning point occurred in the 1840s and 1850s, when a new generation of Danish doctors' combined measurements of the weather with rigorous statistical inquiry. These investigations raised serious doubts about the weather as a fundamental explanatory mechanism in epidemic theory. The studies indicated that there was no connection between an epidemic disease and specific climatic conditions. From the 1850s other explanations of epidemic disease also gained importance, while medical meteorology became marginalized.