

Chapter 11

Heinrich Berghaus's Map of Human Diseases

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The first major atlas of worldwide thematic maps was completed in 1848, consisting of some 90 maps in two volumes. Created by Heinrich Berghaus at the Geographische Kunstschule in Potsdam, the *Physikalischer Atlas* (*Physical Atlas*) reflected the intense interest and activity in mapping a wide range of natural phenomena in the first part of the nineteenth century. The intent of this essay is to contextualize Berghaus's 1848 map of diseases, the earliest world map in an atlas showing the geographical distribution of epidemic and endemic human diseases (Figure 1).¹ This world map of human diseases is a well-known landmark in the history of medical cartography, representing both a synthesis of the early period of medical mapping and a source from which popular and increasingly focused epidemiological maps developed.² In situating the Berghaus disease map in the context of its makers and of the history of thematic cartography, I will argue that the map participated in a major shift in how natural phenomena were studied. This shift in conceptualizing and representing the natural world has been confounded with the notion of "Humboldtian science", and I hope to begin here to put Humboldt, Berghaus, and mid-nineteenth-century medical mapping in a larger perspective.³

In spite of the interest in place, climate, and disease dating back to the Hippocratic era (450–350 BC), the use of geographic maps to enhance the understanding of disease did not emerge until the late eighteenth century, with rapid development by

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¹ Heinrich Berghaus, *Physikalischer Atlas, oder Sammlung von Karten, auf denen die hauptsächlichsten Erscheinungen der anorganischen und organischen Natur nach ihrer geographischen Verbreitung und Vertheilung bildlich dargestellt sind*, 2 vols, Gotha, Justus Perthes, 1845, 1848.

² Helmut J Jusatz, 'Die Geographisch-Medizinische Erforschung von Epidemien', *Petermanns Geographische Mitteilungen*, 1940, **86**: 201–4; Saul Jarcho, 'The Contributions of Heinrich and Hermann Berghaus to Medical Cartography', *Journal of the History of Medicine and Allied Sciences*, 1969, **24**: 412–15; Arthur Robinson, *Early Thematic Mapping in the History of Cartography*, Chicago, University of Chicago Press, 1982, pp. 170–81.

³ Rupke proposed the term "Humboldtian medicine" to describe a "modest body of literature on medical geography", with the Berghaus disease map as its pictorial culmination; Nicolaas Rupke, 'Humboldtian Medicine', *Medical History*, 1996, **40**: 293–310.

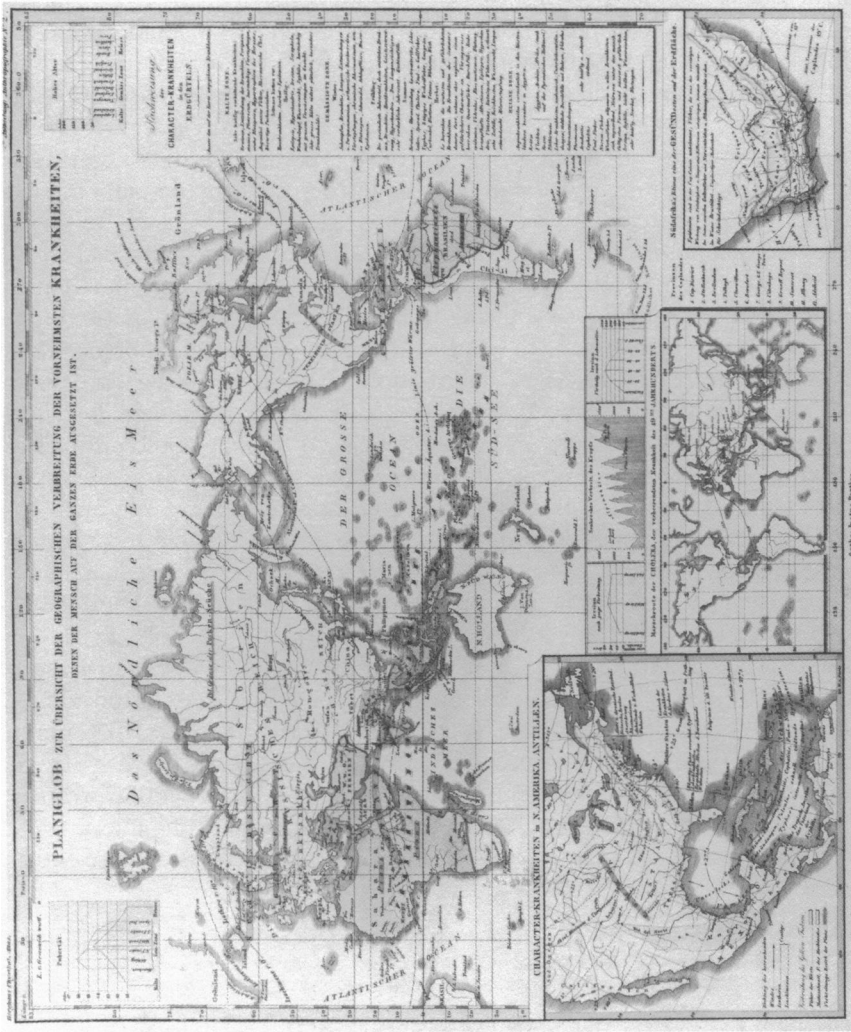


Figure 1: Berghaus's world map of diseases from the *Physikalischer Atlas*, seventh *Abtheilung*, Anthropography, no. 2. Original 36.5 x 29.5 cm. Copperplate engraving, hand-coloured, from the author's collection.

the mid-nineteenth century.⁴ The geographic orientation of Hippocratic medicine in its early-nineteenth-century form of topographic medicine resulted in mapping only when both administrative and cartographic infrastructures made it possible to map the course of epidemics and other illnesses. These “infrastructures” were a necessary but insufficient condition for the production of disease maps, and for thematic maps more generally. The compelling cause for disease mapping was the active public, governmental, and medical concern for controlling the course of epidemics, once local, regional, national, and international maps were available and reproducible for mapping the course of epidemic diseases. The majority of medical maps published before that of Berghaus were maps of epidemic diseases, especially yellow fever and cholera.⁵ But epidemics did not result in maps before this period; it is not a coincidence that the history of medical mapping parallels the history of thematic mapping in a broader sense.

A complex combination of changes and interests more or less coincided in the latter part of the eighteenth century and the first quarter of the nineteenth century which resulted in a cascade of new thematic maps in the physical, natural, and human sciences.⁶ Over the course of the nineteenth century, medical mapping, along with many other specialized kinds of distribution mapping, became increasingly common as the various sciences reconfigured into recognizable modern fields, including epidemiology. As laboratory sciences became more dominant and productive, and the sciences became increasingly specialized and professionalized, mapping quietly became an established tool. Questions about how, when and why maps (as well as other visual forms such as graphs and photographs) became incorporated into various sciences and how they are used in practice have become a focus of inquiry in social scientific and humanistic studies. As both instruments and ends of knowledge-making, maps played versatile and multiple roles in the sciences.

An understanding of Berghaus’s map of diseases involves a synthesis of analytic tools from the histories of science, medicine, geography, and cartography in the nineteenth century. One of the broadest theses to date is that of Susan Cannon, whose notion of Humboldtian science has provided a heuristic framework for understanding the character of a wide range of nineteenth-century scientific practices. She used “Humboldtian science” as a term for a complex of scientific interests and geographical activities that characterized a new wave of professional scientists,

⁴ A translated selection of *Airs, Waters, and Places* is found in G E R Lloyd, *Hippocratic Writings*, London and New York, Penguin, 1950. Robinson, op. cit., note 2 above, pp. 170–81; Gilles Palsky, *Des Chiffres et des Cartes: Naissance et développement de la cartographie quantitative française au XIXe siècle*, Paris, Comité des Travaux historiques et scientifiques, 1996, pp.178–87.

⁵ E W Gilbert, ‘Pioneer Maps of Health and Disease in England’, *The Geographical Journal*, 1958, 124 (pt 2): 172–83; Lloyd G Stevenson, ‘Putting Disease on the Map: the Early Use of Spot Maps in the Study of Yellow Fever’, *Journal of the History of Medicine and Allied Sciences*, 1965, 20: 226–61; Saul Jarcho, ‘Yellow Fever, Cholera, and the Beginnings of Medical Cartography’, *Journal of the History of Medicine and Allied Sciences*, 1970, 25: 131–42; Gary W Shannon, ‘Disease Mapping and Early Theories of Yellow Fever’, *Professional Geographer*, 1981, 33: 221–7; maps of endemic diseases, although far fewer in number than those of epidemics, are discussed in Robinson, op. cit., note 2 above, pp. 174–5.

⁶ Robinson, op. cit., note 2 above, passim; Jane R Camerini, ‘The Physical Atlas of Heinrich Berghaus: Distribution Maps as Scientific Knowledge’, in R Mazzolini (ed.), *Non-Verbal Communication in Science Prior to 1900*, Florence, L S Olschki, 1993, pp. 479–512.

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especially in the second quarter of the nineteenth century. Their key interest was the “accurate, measured study of widespread but interconnected real phenomena in order to find a definite law and a dynamical cause”, as was Humboldt’s when he set out in 1799 to measure the geographical phenomena of Spanish America.⁷ Cannon repeatedly emphasized this concern with measurement, instruments, mapping (especially iso-mapping), and the need for world-wide observations. Hers was a provisional yet sweeping thesis for revising our perspective on a seemingly disparate array of scientific activities, based particularly on the physical sciences of astronomy, meteorology and oceanography, but inclusive also of virtually all the natural sciences.

The concept of Humboldtian science has continued to attract the attention of historians since Cannon’s 1978 publication. It has been used to analyse Humboldt’s physical description of the earth, to characterize particular schools of both plant geography and medical geography, and as a shorthand for various nineteenth-century scientific trends especially in the physical sciences. In fact, it has been extended even more broadly to describe most of the period’s field practices.⁸ There are many, largely unexamined, reasons why it has been tempting for many historians to locate in Humboldt the man, or in Humboldt the symbol, much of what was distinctive about nineteenth-century science. Not only are historians and their readers drawn to constructing individual heroes, but heroes themselves often play a major part in creating their role. Humboldt was described as someone who “peddles the wares of his knowledge with much ado”.⁹

The problem with the term “Humboldtian science” is that while it can be aptly applied to specific practices such as a short-lived offshoot of medical cartography or to a more enduring school of plant geography, it would be overreaching to consider all, or even most, of nineteenth-century medical cartography or plant geography as Humboldtian. The frequent use of Cannon’s term tends to do just that—sweep all of the practices of nineteenth-century science that he exemplified and promoted under its label. The pervasive and profound influence of Humboldt is a historical problem in its own right. The need for labels to describe the big picture notwithstanding, the term “Humboldtian science” seems to confound at least four

⁷ Susan F Cannon, *Science in Culture: the Early Victorian Period*, New York, Dawson and Science History Publications, 1978, p. 105.

⁸ Jack Morrell and Arnold Thackray, *Gentlemen of Science: Early Years of the British Society for the Advancement of Science*, Oxford, Clarendon Press, 1981; Malcolm Nicolson, ‘Alexander von Humboldt, Humboldtian Science and the Origins of the Study of Vegetation’, *History of Science*, 1987, 25: 167–94; Peter J Bowler, *The Norton History of the Environmental Sciences*, New York and London, W W Norton, 1993; David N Livingstone, *The Geographical Tradition*, Oxford and Cambridge, MA, Blackwell, 1992; R W Home, ‘Humboldtian Science Revisited: An Australian Case Study’, *History of Science*, 1995, 33: 1–22; Michael Dettelbach, ‘Humboldtian Science’, in N Jardine, J A Secord, and E C Spary (eds), *Cultures of Natural History*, Cambridge, Cambridge University Press, 1996, pp. 287–304; Malcolm Nicolson, ‘Humboldtian Plant Geography After Humboldt: The Link to Ecology’, *British Journal for the History of Science*, 1996, 30: 289–310; Rupke, op. cit., note 3 above, pp. 293–310.

⁹ The quotation is from a letter by Wilhelm von Humboldt’s fiancée, Caroline von Dachröden, and is quoted in Douglas Botting, *Humboldt and the Cosmos*, London, Sphere Books, 1973, p. 22. A similar sentiment was expressed later by Augustin de Candolle, the noted botanist and contemporary of Humboldt in Paris, who wrote in his autobiography that Humboldt “affected to pass as the creator of geographical botany”, in Augustin de Candolle, *Memoires et Souvenirs de Augustin-Pyramus de Candolle*, Geneva and Paris, Joel Cherbuliez, 1862, p. 167.

different phenomena: a world-view of terrestrial physics, or a physics of the earth,¹⁰ a set of graphic and rhetorical practices; a description of the professionalization of science in the nineteenth century; and the “great hero” phenomenon. If we remove the umbrella of “Humboldtian science” from our view, and examine the distinctive ways of doing science that emerged in the course of the nineteenth century, I think we will create a larger screen on which the world-views, literary and graphic practices, and the phenomenon of Humboldt himself, can be better understood. Before the term becomes further entrenched as a standard description for most sciences, or as an explanation of any and all nineteenth-century maps, I encourage a reconsideration of its usefulness.

This essay presents an analysis of Berghaus’s map of diseases in four parts: the first describes Berghaus’s professional background, his relationship with Humboldt, and the creation of his cartographic school; the second focuses on his map of human diseases and its place in the atlas. The third section deals with the translation of the Berghaus atlas into English by Alexander Keith Johnston, the subsequent transformations of the disease map, and the mapping activities in Britain of August Petermann, Berghaus’s star student. We then step back and look at the atlas in its historical context, reflecting on the growth of medical mapping in the first half of the nineteenth century in relation to other sciences, and on the growth of graphic representations in their role as both instruments and ends of scientific thought.

In describing Berghaus’s world map of human diseases, and its progeny in the works of Johnston and of Petermann, the emphasis will be on the kinds of geographic relationships that were highlighted by these mapmakers. The Berghaus and Johnston maps present a repository of ideas about disease and climate in their portrayal of isothermal lines, winds, climatic zones, race, and diet, as well as endemic and epidemic diseases. We see most clearly in Petermann’s cholera map and its accompanying discussion that it was the careful isolation and then correlation of regional mapped distributions that allowed medical maps to play an important role in understanding disease transmission. It would be misleading to attribute this kind of cartographic correlation to any particular mapping school: comparing one distribution to another is fundamental to thematic mapping. I suggest that the turn to medical mapping in the nineteenth century is part of a transformation of civic, scientific, and graphic processes larger, more complex, and yet less sweeping than the notion of Humboldtian science. This essay can only point to this transformation, which involved the increasing centralization of the western European nation states; the administration and management of their populations, products, and industries; the growing synthesis of knowledge produced by colonialism; and the changes wrought by emergent industrialization.

¹⁰ Dettelbach, *op. cit.*, note 8 above, pp. 288–99, provides a lucid account of Humboldt’s terrestrial physics, based on Humboldt’s “*physique du monde*” or “*Physik der Erde*”.

Berghaus and the Geographische Kunstschule at Potsdam

Heinrich Berghaus was born in 1797 in Cleve, soon to be part of French Westphalia.¹¹ From an early age, he showed special talents for mathematics and geography. At the age of fourteen, he began working for the French civil engineers on a variety of surveying, mapping and canal-building projects. By the time he was seventeen, he studied geography and mathematics in Marburg (1814), but when war broke out with France in 1815, he volunteered for military service in the Prussian army. As a Prussian cavalry officer on a military campaign near Paris, Berghaus met with his former French supervisors, and through them managed to get an introduction to Alexander von Humboldt. Berghaus met with Humboldt, and they spoke of distrust of the German princes, and Humboldt, then fifty-six years old and a flourishing figure in Parisian science and society, tried to convince the young geographer to remain in France. It appears that Berghaus was torn between French and Prussian service, between family and work loyalties on one side, and his politics on the other.

He chose to return to Germany, where he studied in Berlin from 1816 to 1817, and then worked as an engineer-geographer for the Prussian Army. In 1821 he became a professor of technical drawing and geometry at the Berlin Bauakademie, an office he held for thirty-four years. Soon after, in 1825, Berghaus and Humboldt entered into a personal and professional correspondence which lasted until Humboldt's death; the published letters exchanged between them comprise over 1000 printed pages.¹² With Humboldt's return to Berlin in 1827, the two friends and collaborators were in frequent communication.

Although Berghaus was one of the most productive geographical writers of the period, his enormous publication record did not result in lasting financial security. His remarkable output includes 28 books on geography in 50 volumes, 9 history books, dozens of maps and atlases, and the editing of 9 (some rather short-lived) geography journals. Several of the large atlas projects that never reached completion (his Prussian maritime atlas, and a Hindu school atlas) contributed to his life-long financial difficulties. There is a sad refrain that runs through his life, from his early war-torn conflict, to a divorce, the death of his son, the suicide of August Petermann, his foster son, and eventually to his politically induced forced retirement in 1848. As nationalist liberals, he and Humboldt shared an underlying political orientation, but Humboldt played a rather different role as statesman scientist in King Wilhelm's court. Before 1848, Berghaus actively participated in democratic endeavours, serving as a city delegate and on civic commissions fighting poverty and cholera. Berghaus benefited from Humboldt's influence with the Prussian state, but after the 1848 revolution, even that could not sustain Berghaus's peripheral standing.

Humboldt admired Berghaus as a cartographer, a quick and skilled processor of

¹¹ This biographical summary is based on Hanno Beck, 'Heinrich Berghaus und Alexander von Humboldt', *Petermanns Geographische Mitteilungen*, 1956, 100: 4–16, and on Gerhard Engelmann, *Heinrich Berghaus: Der Kartograph von Potsdam*, *Acta Historica Leopoldina*, 1977 (cover bears date of 1976), no. 10.

¹² *Briefwechsel Alexander von Humboldt's mit Heinrich Berghaus*, 3 vols, Jena, Hermann Costenoble, 1869.

geographical-statistical information, and turned to him when he sought an atlas to accompany his compendium of geography, the *Kosmos*. The creation of the *Physikalischer Atlas*, its emphases and themes, reflect Humboldt's original request to Berghaus in 1827 to make an atlas of physical geography with "maps for the world-wide distribution of plants and animals, for rivers and oceans, for the distribution of active volcanoes, for magnetic declination and inclination, intensity of magnetic energy, for the ebb and flow of ocean currents, air currents, the course of mountains, deserts and plains, for the distribution of human races, as well as for the representation of mountain heights, river lengths etc."¹³ Humboldt provided not only the original idea for the atlas, he also contributed data as well as editing some of the maps in the first volume of the atlas. Arduous and non-productive negotiations between Berghaus and Humboldt's publisher, Cotta, delayed production of the atlas maps, which were eventually published by Justus Perthes in Gotha. When it came to the last three sections of the atlas on zoology, anthropography, and ethnology in the second volume, Humboldt's input had diminished (he was seventy-six years old when the first volume was completed in 1845). Berghaus relied far more on his own efforts and those of his students in compiling and designing these maps.¹⁴

To better appreciate the local context of the atlas, and in particular the disease map, let us look more closely at Berghaus's Geographische Kunstschule at Potsdam. Berghaus was especially interested in the problems of copperplate engraving, and hoped to improve the professional training of engravers in Germany by institutionalizing a geographical art school.¹⁵ He knew several skilled engravers at various publishers in Germany, and hoped to attract them to train students in professional engraving. He managed, with some support from Humboldt in the background, to secure ministerial support to found his Geographische Kunstschule at Potsdam. The school was in operation from 1838 to 1848, its funding disrupted by the Revolution. Without on-going government support, the school could not survive. Berghaus must have been involved with things that made him suspect, for in the reactionary period that followed, he was fined and subject to a political investigation, and was forced into retirement in spite of Humboldt's efforts to protect him.

Berghaus and four engravers were already hard at work on the map sheets for the physical atlas to accompany the *Kosmos* when the school opened its doors to its first three students in 1839. The building was purchased with an interest-free loan, but the cost of running the school and making mortgage payments was a continual problem. The duration of the apprenticeship of the students was set at five years, during which time they studied surveying, astronomy, geodesy, geography and mathematics, as well as workshop training in drawing, lettering, engraving and other

¹³ Ibid., letter from Humboldt to Berghaus, 20 December, vol.1, p. 118: "Karten für die Vertheilung der Pflanzen und Thiere über die Erde, für Meer- und Flussgebiete, für Verbreitung der thätigen Vulcane, für Declination und Inclination der Magnetnadel, Intensität der Magnetischen Draht, für Meeresströme und Ebbe und Fluth, Luftströmungen, für Züge der Gebirge, Wüsten und Ebenen, für Verbreitung der Menschenrassen, ferner für Darstellung der Gebirgshöhen, Strömlängen u.s.w."

¹⁴ Engelmann, op. cit., note 11 above, p. 122, citing a letter from Berghaus to Perthes, 1844.

¹⁵ Information about the Geographische Kunstschule is based on Gerhard Engelmann, 'August Petermann als Kartographenlehrling bei Heinrich Berghaus in Potsdam', *Petermanns Geographische Mitteilungen*, 1962, 106: 161–82.

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aspects of map construction. The organization of the school was outlined in a document that Berghaus prepared in 1837 which provided details of the entrance requirements, tuition, the remuneration of the students for their labour, and their obligations to the school upon termination. Berghaus's publisher, Justus Perthes of Gotha, collaborated in providing map projects and honoraria for the students.¹⁶

The number of students in the school was never very large, but three of them went on to noteworthy careers in map-making and geography. One of these was Hermann Berghaus, Heinrich's nephew, who took over many of Berghaus's projects, including late editions of the *Physical Atlas*. Two other students in the school's very first year concern us because they worked on some of the maps for both the German and the later English version of the *Physical Atlas*, namely, Heinrich (later Henry) Lange, and Berghaus's first and most accomplished student, August Petermann. Petermann's father had requested money from the government ministry for his son to attend the Geographische Kunstschule and was refused. When Berghaus learned of this, he told Petermann senior that he was willing to take August to live with his family for free, and was able to get a small government stipend for him. Berghaus was eager for students, and was impressed by the map of South America that the young Petermann had presented with his application.¹⁷ Thus August Petermann became a foster son, showing great talent and enthusiasm as a student, and shared with Berghaus a joyful dedication to his work. At the Geographische Kunstschule he learned the skills of map compilation, design, engraving, reproduction, and publishing. These served as a basis for the skills and interests he avidly acquired in Britain, which are discussed after the next section.

Berghaus's World Map of Human Diseases

The disease map is one of four map sheets in the 'Anthropography' section of Berghaus's *Physical Atlas*. The other maps in this section include: a map of human races, with several insets including a world map of population density; the distribution of clothing; and human life from four views—work, religion, government, and morality (the lighter areas are more enlightened). The anthropographic maps are found near the end of this large collection of thematic maps. The atlas maps and their accompanying texts were published as they were completed, beginning in 1837; when the atlas was bound it appeared in two volumes. The first volume, published in 1845, consisted of five sections: meteorology (13 plates), hydrography (16 plates), geology (15 plates), earth magnetism (5 plates), and botanical geography (6 plates). The second volume, published in 1848, included 12 plates in zoological geography, 4 in anthropography, and 19 in the last section, ethnography.¹⁸

¹⁶ *Ibid.*, pp. 162–4.

¹⁷ *Ibid.*, Tafel 23 is a reproduction of Petermann's map of South America.

¹⁸ Of the several copies of the Berghaus atlas I have seen, no two are exactly the same. Because the map plates were issued as they were completed, some copies of the so-called first edition are a set of 90 maps, with no title page or text apart from that on the map plates; some copies are bound in two volumes with the text bound separately; other copies are bound in three volumes, one of which contains 204 pages of text. The second edition of the atlas (1852) was published in two volumes, with the text bound at the back of each volume. The text in both editions refers to each of the maps by section (*Abtheilung*) and number, but the arrangement of the text is confusing. It consisted of two volumes bound together, divided

The full title of Berghaus's disease map, 'Planiglob zur Übersicht der geographischen Verbreitung der vornehmsten Krankheiten, denen der Mensch auf der ganzen Erde ausgesetzt ist', translates as 'Planisphere [flat map of the globe] toward a survey of the geographical distribution of the principal diseases to which man is exposed over the whole world'. The engraved map is typical of the format of many of the world maps in the *Physikalischer Atlas* (Figures 1, 2, and 3). The sheet is rather busy, with numerous inset maps and graphs around a large central world map. Coloured regions and bands, each labelled with the name of a particular disease, indicate in an approximate way the geographical occurrence of various diseases.

Several diseases occur in more than one region, such as the green zones in Africa and South America showing the range of elephantiasis. On the portion of the map enlarged in Figure 2, one can see the distribution of *Kropf* (goitre) in two locations in Europe, two in Africa, one in Russia; three additional locations in the New World may not be legible in Figure 1. Goitre, according to the map, had a widespread distribution not bound by any of the isolines or climatic zones. Thus, the map presents two ways of viewing disease simultaneously: the distribution of a disease as an entity that varies over geographical space, and the characteristic diseases of each particular region. This conflation of themes is typical of many early thematic maps, and is more a reflection of the novelty of such representations and a paucity of data rather than of any confusion on the part of the map-maker.¹⁹ Indeed, in his brief textual description, Berghaus begs for a lenient judgement of the map, more than for any other in the atlas, because of the lack of data available in this field of research. Not only did he find relatively little source material for the disease map, but he vehemently declined to cite his sources, as he had done for the bulk of the atlas which had already been published. The reason, he wrote, was the shameless imitations and fabrications based on his own work by engravers, printers, and booksellers.²⁰

The diseases are mapped together with another geographical feature—isothermal lines, one of the earmarks of Humboldt's approach. Four isolines appear on the map: one, just north of the equator, depicting the line of greatest warmth, and three near 60 degrees north latitude. The three latter depict the 0° Centigrade isothermal (the line along which the average annual temperature is 0°C), the 10°C isotherm (the

into 18 instalments (*Lieferungen*) numbered and dated consecutively. Each of the instalments explains the maps in the order in which they were issued, *not* the order in which they appear in the atlas. Moreover, in some copies the text is paginated differently at the top and bottom of each page (one set of page numbers for the original issues of the *Lieferungen*, another for the binding of that copy.) For example, the textual explanations of the six botanical plates are found in four different *Lieferungen* in the first volume of text. The two indexes for the text, if you can locate them, are essential for finding the appropriate pages for the explanation for each of the maps.

¹⁹ Berghaus was well aware of the distinction; in his explanation of zoological distributions, he distinguished general geography, i.e., characteristic animals of each region, from special geography, i.e., how each class of animals is distributed. Berghaus, *op. cit.*, note 1 above, Text to vol. 2, *Lieferung* 12, pp. 135–6; see also Camerini, *op. cit.*, note 6 above, pp. 502–4.

²⁰ Berghaus, *op. cit.*, note 1 above, Text to vol. 2, *Lieferung* 18, pp. 65–6. Gerhard Engelmann, 'Der Physikalische Atlas des Heinrich Berghaus und Alexander Keith Johnstons Physical Atlas', *Petermanns Geographische Mitteilungen*, 1964, 108: 133–49, cites several sources (p. 145) available to Berghaus, including maps by Schnurrer, Isensee, and Weiland. See also Rupke, *op. cit.*, note 3 above, pp. 300, 303.

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Figure 2: Part of Berghaus's disease map from the *Physikalischer Atlas*, seventh *Abtheilung*, Anthropography, no. 2. Original 36.5 × 29.5 cm. Copperplate engraving, hand-coloured, from the author's collection.

line along which the average summer temperature is 10°C), and the 0°C isochimene (the line along which the average winter temperature is 0°C). There are here no obvious patterns or correlations of disease with these isotherms. One might say that the intent of the map is Humboldtian in a restricted sense, in that it belonged to an

atlas that Humboldt once proposed, and, like the plant geographical maps in the Berghaus atlas, it was trying to compare disease distributions with climatic variables. But its execution hardly reflects the precision of measurement or accuracy for which the method is known.

The inset to the right of the world map lists the diseases other than those shown on the map that were considered characteristic of the major climatic zones (cold, temperate, and hot). The temperate zone diseases are organized by season, another sign of the map's Hippocratic heritage. The major climate zones are depicted on the map by straight dotted lines drawn at 23 and 66 degrees north and south, "climata" that had been part of geography and cartography since Aristotle's *Meteorologica*.²¹ The inset, in line with the tradition of medical topography, is another indication of the broad-stroke effort by Berghaus to map whatever information was available, imprecise though it may have been. This was the case with many thematic maps in the early nineteenth century. The point is not to condemn Berghaus for a bad map, nor praise him for his boldness, but rather to recognize the degree to which the map presents a graphic synthesis of several strands of medical-geographical approaches to understanding diseases.

Berghaus's inset map of the characteristic diseases of North and Central America in relation to isotherms and winds is in the same style as the main map, with disease names grouped according to climate. He noted that unlike other diseases he tried to map, yellow fever and smallpox could be portrayed with some precision (Figure 3).²² The same can be said for cholera, as the route of the cholera plague beginning in India in 1819 had been mapped numerous times before 1840, including in several world maps of cholera published in the 1830s.²³ The other insets include a world map portraying the route, with dates, of cholera; and one focusing on the healthfulness, or lack of disease, of South Africa, also mapped with isotherms and winds. A small vertical profile illustrates the occurrence of goitre in mountainous regions. In addition, the map includes graphs depicting the frequency of insanity in relation to location in Europe, insanity according to age of onset, age of onset of puberty according to climate and location, and variations in the oldest age reached correlated with climate and nationality. Berghaus included these graphs with this map plate, explaining that there had not been enough space to incorporate them on the preceding one, which dealt with geographical variations of human populations.²⁴

The Atlas in Great Britain

Both Lange and Petermann wished to learn of mapmaking techniques outside Germany after their five-year apprenticeship at the Geographische Kunstschule. On

²¹ Germaine Aujac, 'The Foundations of Theoretical Cartography in Archaic and Classical Greece', in J B Harley and D Woodward (eds), *The History of Cartography: vol. I. Cartography in Prehistoric, Ancient, and Medieval Europe and the Mediterranean*, Chicago, University of Chicago Press, 1987, pp. 130–47, see pp. 143–5.

²² Berghaus, op. cit., note 1 above, Text to vol. 2, *Lieferung* 18, p. 66.

²³ Jarcho, op. cit., note 5 above, pp. 139–42, lists some 36 cholera maps published between 1820 and 1838, including world maps of the disease by Schnurrer (1827), Brigham (1832), and Tanner (1832); see also Brömer, Chapter 10 in this volume.

²⁴ See Rupke and Wonders, Chapter 9 in this volume.

Humboldt's repeated urgings, Berghaus pursued the possibility of an English version of the physical atlas. Gustav Kombst, a German geographer practising in Edinburgh, mediated a correspondence between Berghaus and the map-printing firm of William and Alexander Keith Johnston, brothers from a venerable Scottish family.²⁵

The firm was launched with a hand-press, steel-plate, and copper-plate printers in 1825 by William Johnston, and took a decidedly more geographic direction when his brother Alexander Keith joined the business. A K Johnston, having shown interest in geography from an early age, studied geography and physical science at the University of Edinburgh, and was apprenticed, as was his elder brother, to a copperplate engraver.²⁶ They painstakingly worked for many years on the *National Atlas*, a collection of 45 engraved maps, which earned them an appointment as Geographers to the Queen for Scotland.²⁷ This would be the first of many accomplishments and honours that Keith Johnston achieved as a map-maker and geographer.²⁸ It was fairly early in his career that Johnston visited Berghaus at the Geographische Kunstschule in 1842, and complicated arrangements with Perthes, Berghaus, and Johnston eventually resulted in several English language versions of the *Physical Atlas*.

Thus, in 1844, when Lange and Petermann had completed their apprenticeship in Germany, an opportunity was ripe for them to work on the *Physical Atlas* in Edinburgh.²⁹ Initially, Johnston published four of Berghaus's maps as part of his celebrated *National Atlas* in 1843, followed by a joint publication of a *Physical Atlas* with Henry [sic] Berghaus in 1845.³⁰ Meeting with success, Johnston went ahead with plans to produce his own *Physical Atlas*, having Lange and Petermann in his employ and use of the map plates from the first five sections of Berghaus's atlas. Nearly half of the 30 maps in the first English edition (1848) were drafted by Lange and Petermann. The title page bears the attribution: "Based on the *Physikalischer Atlas* of Professor H Berghaus". In addition, some eight scientists are named for their co-operation along with a dedication to Humboldt, by then the patriarch of physical geography. Subsequent editions—a scaled-down version of the first edition

²⁵ Engelmann, op. cit., note 20 above, pp. 138–40.

²⁶ Keith Johnston was undoubtedly exposed to a rich tradition in natural history and geography at the University of Edinburgh, yet the effects of the Scottish Enlightenment on his outlook and his work are difficult to specify. See, for example, Charles W J Withers, 'Geography, Natural History and the Eighteenth-Century Enlightenment: Putting the World in Place', *History Workshop Journal*, 1995, 39: 137–63.

²⁷ Alexander K Johnston, *The National Atlas of Historical, Commercial and Political Geography constructed . . . by Alexander Keith Johnston . . . accompanied by maps and illustration of the physical geography of the globe, by Heinrich Berghaus . . .*, Edinburgh, J Johnstone, W and A K Johnston, 1843.

²⁸ T B Johnston, *In memoriam of the late A. Keith Johnston, LL D, Geographer to the Queen for Scotland*, privately printed in Edinburgh by T B Johnston, 1873; W and A K Johnston, *One Hundred Years of Map Making*, Edinburgh, W and A K Johnston, 1923.

²⁹ According to Engelmann, op. cit., note 15 above, p. 182, Lange went to Edinburgh in the fall of 1844, Petermann in April of 1845.

³⁰ Johnston, op. cit., note 27 above; Henry Berghaus and Alexander Keith Johnston, *The Physical Atlas: a series of maps illustrating the geographical distribution of Natural Phenomena*, Edinburgh, John Johnstone, W and A K Johnston, 1845.

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in 1850, and a revised second edition in 1856—do not explicitly acknowledge Berghaus, for which some criticism and controversy has ensued.³¹

In Johnston's 1848 edition of the physical atlas, Berghaus's map sheets were reformatted to produce a more uniform visual effect, and a revised and expanded text was incorporated into the atlas rather than issued separately, as in the Berghaus atlas. In the second folio-sized edition of 1856, seven of the 35 map plates were completely redrawn, making use of new data syntheses, such as the map of zones of marine life by the British naturalist Edward Forbes. The map of health and disease was also one of the maps newly created for the second edition (Figures 4 and 5). The resemblance of this sheet to Berghaus's map is evident, both in its labelling of major diseases for each region, and in the inclusion of isothermal lines, as well as in the large inset map of parts of north and central America. The large coloured areas of the map indicate the three zones of climate and disease: one, the torrid zone, characterized by high temperatures and dysentery, yellow fever, malaria, and afflictions of the liver, corresponding with the bilious or summer season, and coloured brown originally; two, the temperate zone, represented by inflammatory diseases such as typhus, corresponding with spring, and coloured green on the map; and three, the sub-arctic zone, characterized by a winter season with colds and catarrhs, and coloured blue on the map. Finally, another feature was mapped as dark blue lines along the coasts, these none other than the foreign commands of the British Navy. The inset graphs are different from those of Berghaus, such as one showing a statistical analysis of the value of life based on the number of deaths per 10,000 people according to location and to nationality.

The fusion, and in some ways confusion of political, social, climatic and biotic delineations (for instance the inclusion of the northern limit of oak trees) make this map a repository of British scientific mapping in its inextricably political context. Disease is indicated by the colour of the zone, by name, by verbal indications of frequency, and by line in the case of the route of cholera. Diet as well as temperature are indicated. In the insets, the statistics are distinguished by race, such as the frequency of consumption in Jamaican blacks versus whites, or the frequency of rheumatism among natives versus Europeans in India.

These statistics are discussed in detail in the six folio-sized pages of text that accompany the map. The lengthy text summarizes reports from scientific journals, travel accounts, colonial reports and British naval medical records. The dearth of sources in Berghaus's text for his disease map stands in sharp contrast to Johnston's well-documented essay. As already mentioned, Berghaus purposely left the sources for his disease map unnamed, using the plagiarism of his maps as a defence for this omission. Clearly, others were using less than honest means to "cash in" on the growing market for thematic maps in Germany in 1848; by 1856 in Edinburgh, Johnston held a secure enough position as printer, geographer and mapmaker to publish his voluminous sources.

³¹ Engelmann, *op. cit.*, note 20 above, p. 147, refers to Peschel's criticism of Johnston; Alexander Keith Johnston, *The Physical Atlas . . . Based on the Physikalischer Atlas of Professor H. Berghaus*, Edinburgh, Blackwood, 1848; *The Physical Atlas of Natural Phenomena*, Reduced . . . for the use of Colleges, academies, and families, Edinburgh and London, Blackwood, 1850; enlarged edition, 1856.

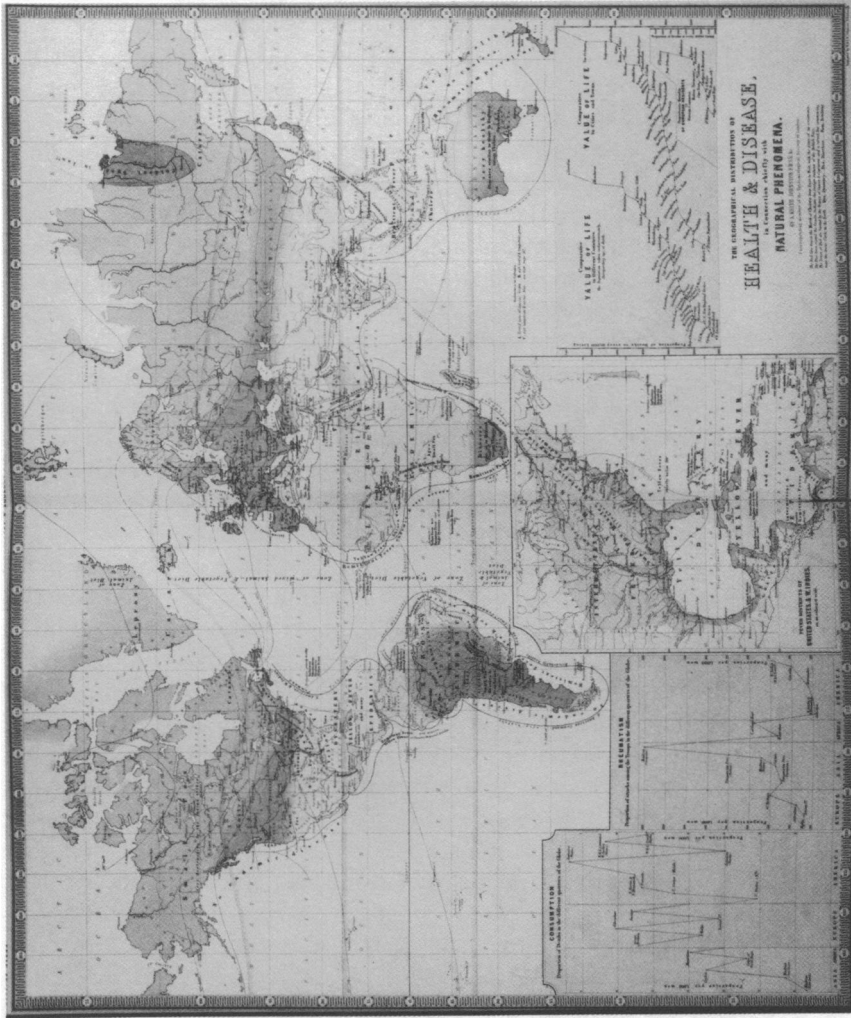


Figure 4: A K Johnston's map of health and disease from the revised edition of his *Physical Atlas*, 1856, Plate 35. Photographed courtesy of the Milwaukee Public Library.

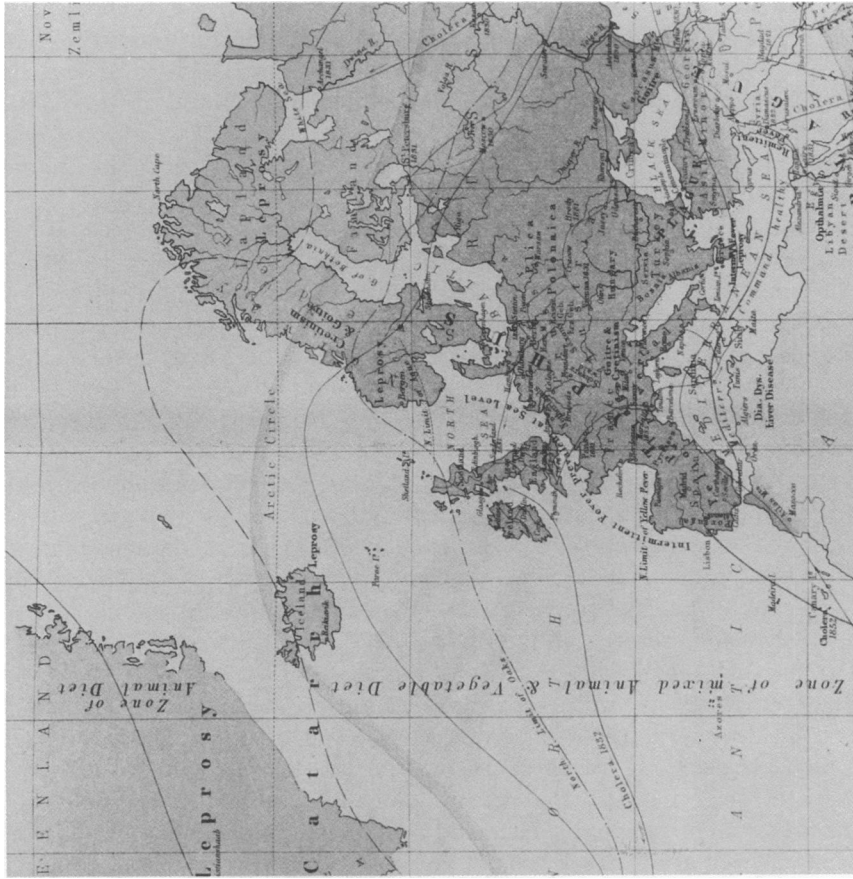


Figure 5: Part of A K Johnston's map of health and disease from the second edition of his *Physical Atlas*, 1856, Plate 35. Photographed courtesy of the Milwaukee Public Library.

Johnston's *Physical Atlas*, from its earliest days, was recognized in Britain as an important resource for geographers and naturalists. By making physical geography available in an accessible form, the atlas reflected Johnston's belief that maps, more than any written description, would clearly communicate the character of natural phenomena of the world. The success of Johnston's *Physical Atlas* was acknowledged not only in Britain, where it secured his fellowship to the Royal Society of London, he also became a member of the geographical societies of London, Paris, Berlin, Vienna, Russia, America, and Bombay. His work became well-known to the elite naturalists of London as well as to readers of natural history journals. In spite of Humboldt's stamp of approval and its international reputation, the atlas, unlike other atlases the family firm produced, was not a financial success. This was probably due to the high level of time and labour that went into its production, and the relatively small sales due to its focus on scientific subjects.³²

To get a wider view of contemporaneous mapping practices, let us focus on the mapping projects of August Petermann in Britain as he became established as an independent geographer. Petermann worked in Edinburgh for Johnston for two years on the first English edition of the *Physical Atlas*. Many of the geological and zoological maps in the work were by his hand, as were the accompanying explanatory essays for these two sections.³³ He then moved to London, where he spent seven years actively engaged in geography and mapmaking. He participated in events at the Royal Geographical Society, becoming a foreign fellow in 1847, and published numerous atlases and maps, earning the title "Physical Geographer and Engraver on Stone to the Queen".³⁴ Subsequently, Petermann became an illustrious geographer and mapmaker in his own right in Britain. His medical mapping, discussed in the next section, is but a small sample of his enormously productive career as a geographer. At the Geographische Kunstschule he learned the skills of map compilation, design, engraving, reproduction, and publishing. In Scotland and in England he not only continued to expand these skills to include lithography, but he also developed sophisticated literary, social, professional, and institutional talents. Petermann became infused with the spirit and necessity of geographical exploration, and became an ardent advocate of global travels of discovery. Upon his return to Germany in 1854, he worked for Perthes and founded the *Geographische Mitteilungen*, then as now a premier journal of geography. He made Gotha a centre of geographic activity and publishing as well as a pivotal node of knowledge and influence in Germany's colonization of Africa. He was far more successful than was Berghaus in his voluminous production of maps and periodicals which shaped popular as well as learned and governmental geographical knowledge. Petermann's breathtaking

³² According to W and A K Johnston, op. cit., note 28 above, pp. 13–16, the school atlases and other inexpensive atlas editions the firm produced were more remunerative. In addition, the firm adopted colour printing by lithography in 1865 which lessened their costs, and engraved banknote plates for Scottish banks. The firm continued to expand after A K Johnston's death in 1871.

³³ H E Weller, *August Petermann*, Leipzig, Otto Wigand, 1911, pp. 18, 241–2.

³⁴ In London, Petermann published atlases of physical geography as early as 1849, as well as school maps, a biblical atlas, and scores of maps of African and polar explorations; see the carto-bibliography in Weller, op. cit., note 33 above, pp. 241–83.

productivity was perhaps the other side of a depressive turn in his character. He committed suicide in 1878 at the age of fifty-six, four months into his second marriage.³⁵

Perhaps the earliest of Petermann's maps after he founded his own business in London, and among his earliest efforts in lithography, is a cholera map of the British Isles, in which he used variable shading to indicate density of the disease (Figure 6).³⁶ This 1848 map is accompanied by statistical notes and tables and a discussion of the map and its meaning. Petermann described how at a cursory glance, his map seemed to corroborate the current belief that cholera rarely penetrated mountainous regions, never even reaching the tops of low hills. The cholera districts in the British Isles "seemed to lie all in the lower ground and valleys".³⁷

Although he might have gone on to delineate elevation more clearly in the map, a more careful investigation suggested to him that the reason certain districts exhibited a high cholera density was, "not so much in consequence of their low situation, as from the great amount of population they contain".³⁸ In that same year, 1848, Petermann reported on the population of Great Britain and Ireland to the Statistical Section of the British Association for the Advancement of Science. The report included the presentation of an engraved, hand-coloured map, dated 1849, the first of several maps he would make of the population of the British Isles.³⁹ A few years later he produced another population map using lithography and crayon to produce a similar effect of shading to indicate the degree of concentration. Figure 7 shows this 1852 population map of England and Wales.⁴⁰ On both population maps, 1849 and 1852, Petermann employed the same variable shading technique in representing population density as he had used for the cholera map.⁴¹ When he looked carefully at each of the two distribution maps—population and cholera—he saw clearly that the densely populated areas were proportionately the most severely "attacked" by cholera, and that the correlation of cholera with elevation did not hold up, noting that

³⁵ *Ibid.*, p. 27., Weller suggested that a hereditary taint explains Petermann's suicide, the disposition to melancholy and suicide having been common in male members of his family.

³⁶ August Petermann, 'Cholera Map of the British Isles, Showing the Districts Attacked in 1831, 1832, and 1833', with an accompanying text, London, 1848. Petermann's cholera map is discussed in Jusatz, *op. cit.*, note 2 above, p. 202 (a facsimile of the original map in Table 23); and in Robinson *op. cit.*, note 2 above, pp. 180–1.

³⁷ Gilbert, *op. cit.*, note 5 above, p. 178.

³⁸ *Ibid.*, pp. 178–9.

³⁹ August Petermann, 'On the Distribution of the Population of Great Britain and Ireland; illustrated by maps and diagrams', *Report of the Eighteenth Meeting of the BAAS* (Swansea, August 1848), Notices and Abstracts, p. 113. A portion of the map, dated 1849, is reproduced in Robinson, *op. cit.*, note 2 above, p. 123.

⁴⁰ August Petermann, '[Map of the] Distribution of the Population', in *Census of Great Britain, 1851*, London, 1852, map in vol. 1, facing p. xlvi.

⁴¹ Arthur Robinson, 'The 1837 Maps of Henry Drury Harness', *Geographic Journal*, 1954, 121: 440–50, discusses on pp. 448–8 the symbolization techniques Petermann employed in his cholera and population maps; Robinson also points out that in 1831 Quetelet had used this technique of variable shading to show variation in a distribution (*op. cit.*, note 2 above, pp. 180, 235, note 329), while Jusatz, *op. cit.*, note 2 above, p. 202, mistakenly attributed the invention of this technique to Petermann.

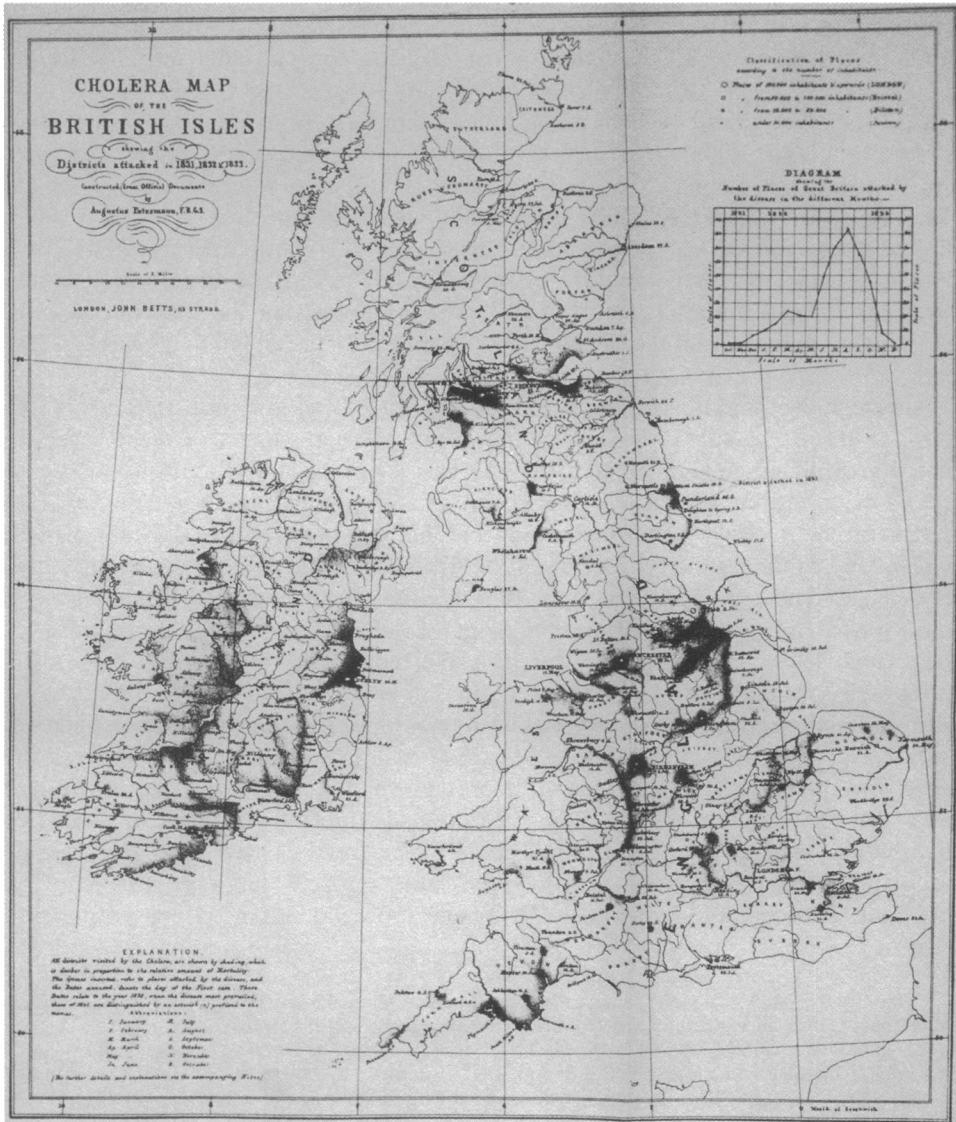


Figure 6: Petermann’s 1848 lithographed ‘Cholera Map of the British Isles, Showing the Districts Attacked in 1831, 1832, and 1833’. Original at the British Library, photographed from a facsimile reproduction in *Petermanns Geographische Mittheilungen*, see Jusatz, op. cit., note 2, above.

the “great level of the Fens” did not suffer much from cholera, while the “elevated land of Birmingham, forming a pretty extensive plateau of 500 feet mean elevation” was one of the most severely afflicted. This proved to Petermann that

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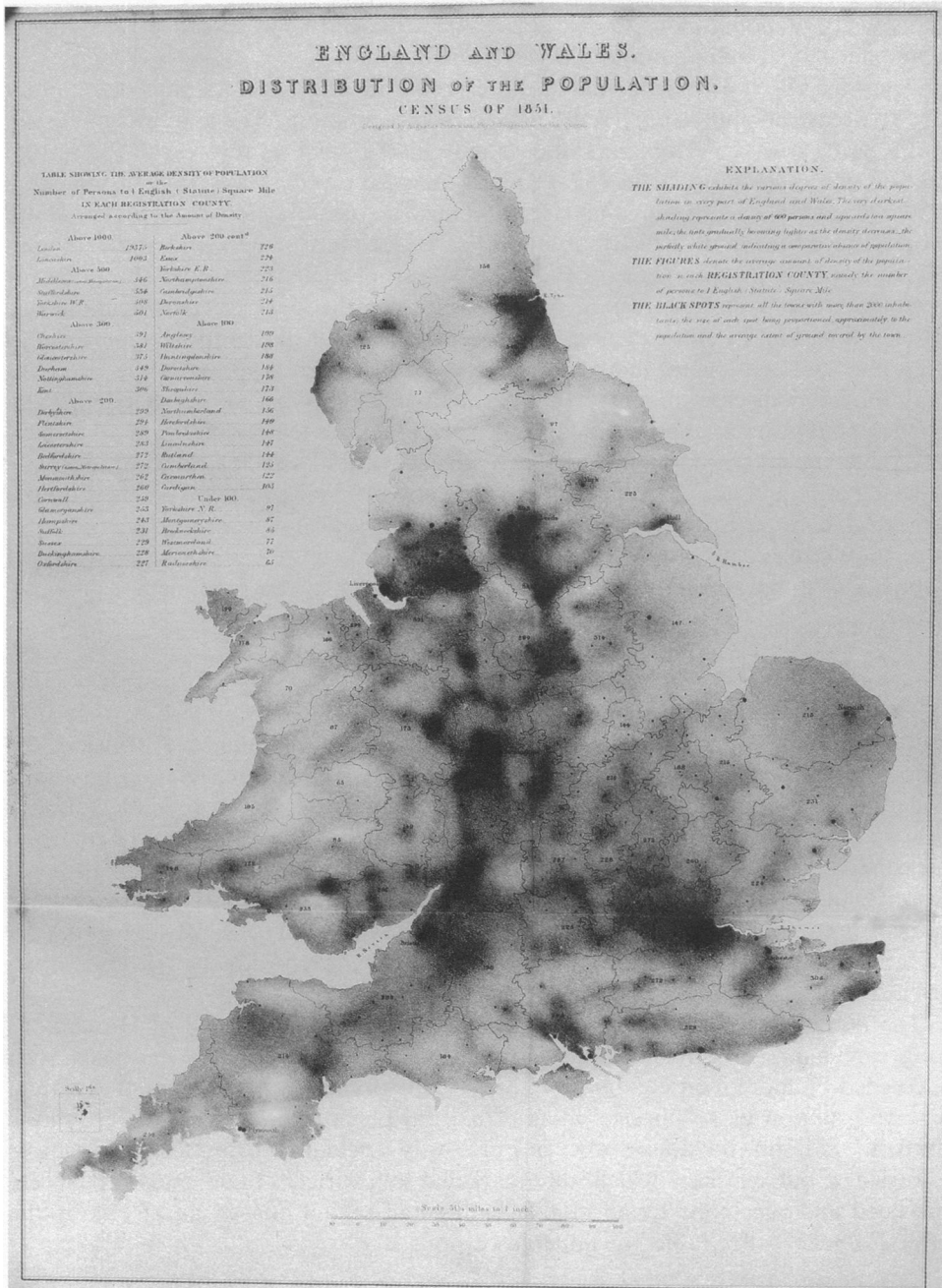


Figure 7: Petermann's 1852 lithographed 'Distribution of the Population', from the *Census of Great Britain, 1851*.

the density of population was of greater importance in the spread of the disease than the more popular notion of elevation.⁴²

Petermann's cholera map and its interpretation illustrates an important point about disease mapping and "Humboldtian" representations. The map was published in the years between Berghaus's disease map in 1848 and its revision in the second edition of Johnston's atlas in 1856. Rather than the proliferation of environmental, political, and social themes that are combined in the Johnston map, Petermann's work shows the value of distribution mapping in a more serious and analytic light. He focused on the character of the distribution of cholera, and did the same for population in a limited region. His attention to the detailed portrayal of one distribution, and its subsequent correlation with another distribution, stands out as a graphic and analytic technique rather different from that reflected in the Berghaus and Johnston disease maps. The "Humboldtian" approach of the Berghaus and Johnston atlas maps emphasized multiple correlations in the search for general laws, and the maps portrayed a variety of geographical variables such as latitude, altitude, winds, and temperature. Unlike these atlas maps, Petermann's maps focused on the character of a single distribution in a limited region, and were uncluttered by a profusion of other geographic variables. This enabled him to use the maps as critical forms of evidence in the search for understanding the spread of cholera.

The Larger Context

The Berghaus and Johnston physical atlases, as wholes, may indeed be viewed as part of Humboldt's programme. These atlases do reflect Humboldt's vision, his search for a physics of the earth through the study of the interrelationships of a wide range of natural phenomena. However, many of the maps, such as the disease maps, do not and could not meet the standard of careful, focused, detailed measurements that Humboldt tried to foster. And of course many of the maps have histories quite independent of Humboldt's programme. The worldwide disease maps present a combination of iconographic and thematic traditions that are part of a larger set of historical phenomena than contained in the notion of "Humboldtian science".

The atlases were published initially in 1845 and 1848 at the end of Humboldt's long career, and like *Kosmos* itself, his vision had in many scientific fields been succeeded by more focused and more historically oriented programmes of research. The very notion of a "physical atlas of natural phenomena" was relatively short-lived. In addition, the atlases were not primarily original contributions to scientific knowledge, but syntheses which were marketed to a variety of audiences. They were preceded and succeeded by affordable family and school atlases, as well as by the large-format, "coffee table" or imperial editions.

⁴² Petermann also included some remarks about a diagram showing that more places were attacked by cholera from May to November than in the colder months. He discussed a small map of London on which six shades of red were used to show mortality rates. Most of Petermann's discussion of his cholera map is provided by Gilbert, *op. cit.*, note 5 above, pp. 178–9; Gilbert includes a misleading redrawing of Petermann's maps.

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Petermann's work provides a slightly distanced vantage point from which to view the world maps of disease in the atlases of Berghaus and Johnston. Petermann's cholera and population maps reflect the growth of statistics, of public health, and of thematic cartography in the second quarter of the nineteenth century. They bear little resemblance to Humboldt's world-view or the graphic and cartographic productions for which he is known. Although Petermann learned his trade as geographer in contexts specifically connected to Humboldt, his own work proceeded in distinctly different directions. Placing the atlas maps alongside those of Petermann, we can see them all as part of a historically embedded set of transformations.

The "large-screen" explanation for the development of disease mapping lay in its simultaneous emergence with that of national censuses and increasing state involvement with the economic, social and moral activities of its peoples. While the roots of these phenomena differ from country to country—with moral arithmetic and national mapping programmes thriving in Britain and France, and cameralist administrative traditions and "Staatenkunde" (the study of statecraft, a school of thought developed most intensively at Göttingen in the latter half of the eighteenth century) active in Germany—the larger social, political and economic changes in western Europe go a long way in explaining the underpinnings of early thematic mapping.⁴³ Thus, while Petermann's early career was built through his work on physical atlases, the comparison he made between cholera and population has much to do with Britain's rise as a nation growing in prominence and power, and with measurements of social statistics.

It is noteworthy in this regard that Petermann's first published map is an economic-geographic map of Germany made just before he left Berghaus's employ for Scotland.⁴⁴ Maps of moral behaviour, populations, alcoholism, education, and so on, developed at a rapid pace in the same period that medical maps flourished, roughly the second quarter of the nineteenth century. At the same time that Cannon's "Humboldtians" were laying down the paths of colonial expansion as they mapped the currents, coastlines, mountains and plants of the globe, civil servants, social theorists, and naturalists of various stripes were at work throughout Europe mapping the gamut of physical, biological, and social phenomena for a variety of scientific, industrial, social, and governmental reasons. It would be misleading to call all of their work Humboldtian. Cannon herself was keenly aware that nascent developments in social statistics presented difficulties for her outline of Humboldtian science.⁴⁵ Cannon

⁴³ Robinson, *op. cit.*, note 2 above, pp. 26–43; Janet Browne, *The Secular Ark: Studies in the History of Biogeography*, New Haven and London, Yale University Press, 1983, pp. 48–52; Theodore M Porter, *The Rise of Statistical Thinking 1820–1900*, Princeton, Princeton University Press, 1986, especially pp. 18–39; Henry E Lowood, *Patriotism, Profit, and the Promotion of Science in the German Enlightenment: The Economic and Scientific Societies, 1760–1815*, New York and London, Garland, 1991; Theodore M Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*, Princeton, Princeton University Press, 1995.

⁴⁴ Robinson, *op. cit.*, note 2 above, p. 141.

⁴⁵ Cannon, *op. cit.*, note 7 above, pp. 241–5, "These three examples I have given in increasing detail—the problem of Gauss; the great magnetic undertaking; the foundation of social-statistics institutions—show, I think, the need for detailed narratives before we are able to construct an outline of the development of science in the period. That narrative, at any adequate level, is largely missing" (p. 245). Portions of that narrative have been produced since Cannon's day; for a discussion of early maps of social statistics see Robinson *op. cit.*, note 2 above, pp. 155–88, see also note 43 above.

argued that Humboldtian science is a term that does not imply originality in the engagement with global measurements and their graphic representation, but rather the relatively greater centrality of these concerns for a larger number of people, and with their increasing professionalization as scientists. The label none the less masks a dauntingly large set of issues, ranging from the various roles that Humboldt played, both in his time and beyond, to the complex strands of historical impetus for an array of mapping programmes that flourished in the first half of the nineteenth century.

At one level, the disease maps discussed here bear a fairly close tie to Humboldt the man and his work. However, when the maps are closely examined, we find not only Humboldt's imprint, but also intellectual and graphic traditions from earlier periods, as well as significant innovations in graphic and analytic techniques. When we step back and look at the maps of Berghaus, Johnston, and Petermann in perspective, we see that they are part of a broad change in geographical awareness which participated in mid-nineteenth-century attitudes towards and practices of colonialism, nationalism, statistics, and science. The growth of distribution mapping in this period is part of something larger than the Humboldtian science that Cannon defined and her followers reified. The Berghaus and Johnston maps mark a major shift that began around the turn of the nineteenth century. By 1800, the geographical base map of the world was more or less filled in, and people began to use maps to understand the entire range of phenomena that were seen to vary geographically. The very notion of "distribution" took on new graphic and conceptual significance in this period. As we have seen, the *Physikalischer Atlas*, inspired by Humboldt, was brought to fruition through the labour of a relatively small group of map-makers and publishers, who synthesized the research of countless others. It is not only a landmark of classical geography, but in bringing together an enormous wealth of knowledge, it was a capstone for shifting understandings of "distribution" and of "natural phenomena". That Humboldt promoted these new approaches is not in dispute, but the extent to which all the mapping projects that participated in these novel graphic and conceptual transitions are usefully understood primarily in Humboldtian terms remains an open question.