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Diversion

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1831: the map that launched the idea of global health

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Abstract

Today we take for granted the idea of global health, of disease as an international event. Increasingly, we assume as well that the international spread of disease can be traced to human travel patterns as well as to recurring environmental conditions. Perversely, the idea of 'global health' and its inverse, global disease, owes little to the three-dimensional imaging of the planet and almost everything to the two-dimensional plane of the map. Here the idea of global disease is traced from its beginnings in the 18th century to its 19th-century introduction in maps of the first cholera pandemic. This global perspective, and the responsibilities it promoted among civil officials, can be seen in modern studies of cancer, influenza and other conditions with both environmental foundations and international presence.

Key words: Cholera, mapping, global health, public health, yellow fever

Introduction

Some talk about global health as if it were 'public health' writ large, a simple matter of scale.[1] Others insist it is a new phenomenon based upon 'the recent affirmation that a population's health reflects more than a simple aggregation of the risk-factor profile and health status of its individual members.'[2] Certainly public health historically has been about far more than the aggregate of health realities and risks of individuals. But from its earliest conception, global health has been distinguished from public health in its insistence on states of disease as dynamic, internationally constituted phenomena. It may affect specific populations, and thus individuals in populations, but its effective scale denied by definition the idea of disease as a matter of individual responsibility. Rather, the very idea of global health emphasized the broadly public nature of disease and the civic nature of its address.

Perversely, perhaps, the idea of global health owes little to the three-dimensional construction of the world and everything to the two-dimensional plane of the map. Indeed, we may date the origin of global health as an idea—at once clinical, geographical and political—through maps of the first cholera pandemic produced in the 19th century. The definition of disease states as supranational, peripatetic and yet observable events signalled the recognition of complex disease ecologies—biogeographical, economic, medical and political—that owed little to the specifics of individual or even local disease incidence and everything to an increasingly international perspective brought forth in maps. The traces of those early insights—and the responsibilities they presented—can be easily read today in popular and public perceptions of late 20th- and emerging 21st-century disease states.

Public health: yellow fever

If one takes public health as 'the art and science of preventing disease, promoting health, and extending life through the organized efforts of society',[3] then it is as old as Hippocrates' insistence in *Air, Water and Places*[4] that stagnant waters and filthy air were breeding grounds for disease. Because air quality and community water sources were about communal rather than individual health determinants, they demanded civic action by responsible, public officials. In this tradition, as Rosen writes, the aqueducts and bathhouses built by Roman officials were public health initiatives designed to secure a healthy environment for all citizens.[5]

A focus on the environmental and the social underlay 18th-century perceptions of a then evolving new disease, yellow fever. As it spread from the Caribbean to US port cities—Boston, Charleston, New York City and Philadelphia[6]—authorities assumed it to be naturally miasmatic, 'that it springs from a corruption of the air, and that its violence is in proportion to the continuance of the heat and moisture.'[7] In affected cities, where the mortality was severe, sanitarians assumed those 'corruptions' originated in the foul odours of stagnant ponds and unsanitary streets where human and animal wastes were left uncollected for days. Contagionists, on the other hand, believed yellow fever was not locally generated but imported in the cargo holds of trading ships that brought slaves and raw goods to American ports.

In either case, public health demanded a communal response. If epidemic outbreaks were the result of inferior sanitary infrastructures, then civic and communal attention to sanitation was required. If yellow fever was imported in coastal trading ships, then quarantine procedures curtailing trade and travel from affected regions was the only palliative. In fact, the opposition was not truly binary.[8] Most experts accepted the likelihood of 'predisposing conditions' (whose nature was unknown) being carried from affected regions to cities where their production would be promoted by foul, stagnant, urban airs.

The miasmatic argument was advanced in two extraordinary copper plate maps—the first of their kind—that sought to prove that 'no yellow fever can spread, but by the influence of putrid effluvia'.[9] Published in 1796 in *The Medical Repository*, Dr Valentine Seaman's maps of a New York City outbreak attempted to correlate the location of yellow fever cases with those of odorous waste sites in the city's streets.[10] In thus identifying the apparent origins of the outbreak, he at once defined the nature of the disease (miasmatic) and the scale of response required by public officials to prevent recurrent epidemics. In the 19th century, mapping would be a principal means of surveying the incidence of public disease and, on that basis, arguing the potential source of an outbreak on one or another scale, and thus the best public response to disease incidence.

Cholera: 1830s

In 1819 a new and violent epidemic disease, *cholera morbus*, was reported in the British army barracks of Peshawar, India.[11] Over the next decade this new cholera—the noun was used to describe what today we recognize as several kinds of diarrhoeic disease—spread to the Middle East, Russia and from there through Europe. In an unsigned review article published in 1831, when cholera arrived in England, the *Lancet* mapped 'The progress of the Cholera in Asia, Europe, Africa.'[12] In constructing the map (Figure 1), the authors boasted they had 'traced the pestilence through 700 irruptions, and shown it ravaging nearly 2000 towns.' Each of those 'irruptions' was presented on the map as a circle with a dot inside to designate a cholera-reporting city. In every case, the authors assumed—and the map asserted—that the *cholera morbus* in each case was the same disease as that reported in every other city. In the mapping of this geography, the extent of the disease as a single thing (as late as the 1850s, death certificates identified 15 different kinds of 'cholera') was constructed.

For the first time, a wealth of international data from a variety of public and professional sources were collected and organized in a manner describing the international geography of a disease whose progress could be literally seen. The *Lancet* map was not 'global' only because at the time of its publication cholera had yet to be reported in either Canada or the USA. In 1831 cholera was presented, therefore, as an international but not yet global—by which is meant universal—epidemic. Within months of cholera's introduction to England, however, health officials in North America were reporting cholera outbreaks. At that point *cholera morbus* became a truly global pandemic and thus a health problem globally.

In 1832, American physician Amariah Brigham published *A Treatise on Epidemic Cholera* in which he included a world map of its diffusion (Figure 2).[13] Brigham mapped the location of reported outbreaks in all major cities—from India to the USA—and for each outbreak included in the map the date of first report. To this Brigham added red lines describing major sea and land travel routes. This 'geographical notice' joined the temporality of the disease over time with the geography of

Figure 1. The 1831 map of cholera published in a *Lancet* article provides a convenient birth date for the birth of global health as a concept. In it over 700 reports of cholera were aggregated and presented, each city similarly symbolized to describe the evolving pandemic.

outbreaks to indict, at least in theory, international travel and trade as the pandemic engine driving cholera internationally.

Mapped arguments

The idea of epidemic diseases as progressive, moving from town to town and country to country, was not new. Quarantines were first employed in 14th-century Italy in a largely futile attempt to stop the widely observed progress of plague from city to city.[14] In Holbein the Younger's *Dance of Death*, first published in 1538, death is seen as carrying disease, presumably plague, in the oxcarts of merchants and bales of goods stowed in sailing ships.[15] At the end of the 17th century, provincial administrator Filippo Arrieta mapped a sophisticated system of containment for Bari, Italy, to stop the introduction of plague by coastal traders.[16]

The *Lancet*'s 1831 map, and others like Brigham's, were proofs of what had earlier been proposed but not demonstrated, the relation between human travel and transported disease. 'The geographical notice we gave of the progress of cholera,' the authors explained, demonstrated 'with single clearness, the consistency with which the disease followed the track of ships, armies, pilgrims, caravans, and individuals, from one country to the other.'[17] Whereas the active agent of the disease was uncertain, its geography strongly suggested a human rather than a natural mode of transmission. Regional studies, like one of cholera in Poland by Alexander Briere de Boismont, made similar arguments on a finer scale.[18] Like Brigham's map, De Boismont's included the date of the first cholera case reported in each mapped

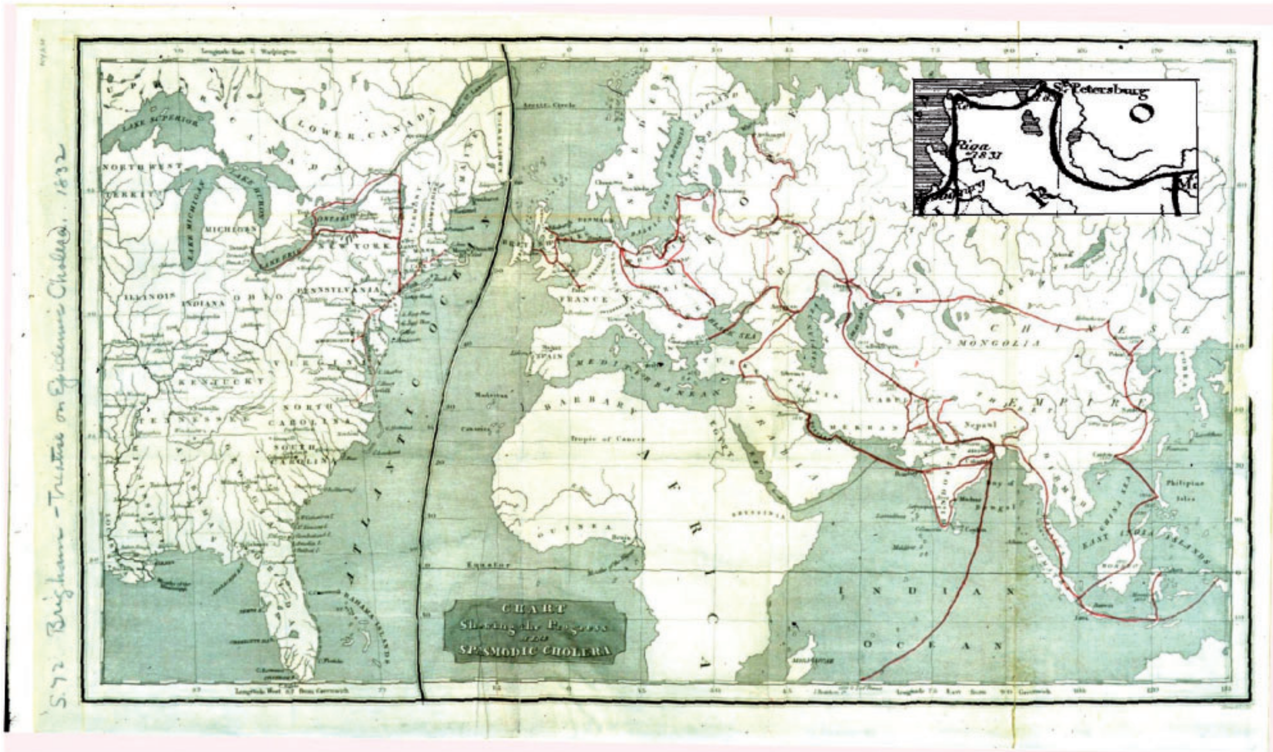

Figure 2. This detail from Amariah Brigham's map of cholera is, perhaps, the first to self-consciously argue a global disease state. In it cholera's progress is demonstrated by a red line joining cholera-affected nations over time along existing trade routes.

city. And, similarly, red lines along roads joined travel routes to temporal data to implicate trade and travel pathways in cholera's temporal progression.

None of this, the *Lancet* authors insisted, supported arguments for coastal quarantine procedures introduced by the Board of Health in early 1831, only to be later withdrawn in the face of violent opposition from the business community. Where quarantine had been tried (look at the map! See Malta!), the authors wrote, it had failed. And the sheer profusion of outbreaks across a range of internationally diverse geographies (700 irruptions!) made its progress appear unstoppable. Clearly, it originated in India but trade alone, the authors said, could not explain its broad diffusion. They thus proposed a broadly miasmatic explanation. 'We can only suppose the existence of a poison which progresses independently of the wind, of the soil, of all conditions of the air, and of the barrier of the sea,' the authors concluded.[19] Public health preparations might include sanitation (assumed to be a healthy thing), but officials could in reality do nothing to prevent cholera's spread to England and from there elsewhere in its trading world.

Source and application

Four separate innovations made possible this new idea of global disease. First, technological advances in printing and lithography permitted the inexpensive production of books and journal articles, including those with ever more detailed maps.[20] Second, a range of health-related bureaucracies active at every level of government—national and international—were created to collect health data and make them broadly available to researchers. Third, systems of low-cost distribution—the evolving mail service—facilitated the transmission of disease reports around the world. Finally, the introduction of basic health statistics presented a medium in which the increasing wealth of data could be succinctly described, summarized and thus argued.

Maps provided two, perhaps three, critical functions in the resulting reports. The sheer volume of data collected by health officials and medical researchers demanded a medium in which global health data could be organized, synthesized and then presented in a coherent argument. Maps like the *Lancet*'s answered this necessity. The use of a single symbol (the circle with a dot inside it) for all members of an event class (cities reporting cholera) took the reports of disparate international incidences and made them into a single-event class. The increasing use of colour in health maps, beginning in the 1840s, permitted additional data fields, including the statistical, to be correlated with disease incidence. The resulting 'geographical notice' made possible progressively detailed, increasingly sophisticated arguments about the nature of disease events and the specific environments or health policies assumed to promote or impede their progress.

Global diseases: cancer

Across the rest of the 19th century, two distinct types of global 'epidemic' were evidenced. There were those like the *Lancet*'s cholera that were 'in the wind' and had no relation to local geographies. The 1918 influenza epidemic would be a later example of this. And, too, there were epidemics like Seaman's yellow fever in which repeated outbreaks could in every case be traced to a common set of local conditions. In the first little was to be done, but in the second case public sanitation was typically promoted as the best possible public response.

In 1868, Dr Alfred Haviland used a map to advance a biogeographical explanation for higher cancer rates in certain areas of England than in others. The idea was not simply to map relative disease rates, but to do so in a way permitting that 'perchance some light might be thrown upon the aetiology of that fatal class of malignant diseases.'[21] Haviland's work, although limited and regional, sparked a series of studies and reports that identified an increasing and indeed repeated incidence of varying cancers in the UK, some but not all tied to specific biogeographies.[22]

Those reports sparked similar studies across the Commonwealth and elsewhere,[23] transforming anomalous regional incidence into a global health challenge: the cancer epidemic. Within this international frame, the challenge for researchers was to identify specific biogeographical profiles that might explain its unusual incidence in towns, districts or regions. In the early 20ieth century, there were cancer 'towns' and indeed cancer 'streets' in which disease incidence was abnormally high. The question for researchers was what, if anything, did those cancer hotspots share.[24] Was it a specific soil type, proximity to an industry, or some accepted social practice (tobacco use) that could explain cancer's specific pattern of occurrence?

In the 1975 *U.S. Cancer Atlas*, 'hotspots' —so named because high incidence typically was coloured red—identified elevated rates in areas with coastal shipyards whose workers were exposed to asbestos, for example.[25] Elsewhere, high rates of cancer revealed widespread arsenic air pollution from a copper smelter.[26] These and other similar findings highlighted environmental and social variables that seemed to promote cancers wherever they were found. They informed maps of global cancer incidence, identifying triggers to specific cancers, arguing for public health responses wherever cancer-promoting causes were identified.

There were also general cancer environments that, like the *Lancet*'s cholera, could not be so easily tied to a set of locally specific conditions. In 1980, for example, physicians Cedric and Frank Garland proposed an inverse relationship between sunlight, a natural source of Vitamin D, and colon and then other cancer mortalities.[27] The theory was grounded in the realization that maps of US temperature gradients seemed inversely correlated to the incidence of specific cancers in the USA. If substantiated, the general correlation (Figure 3)—less natural vitamin D, more cancer—argued for public health interventions providing vitamin D supplements to at-risk populations to lower the incidence of certain cancers worldwide in areas where sunlight is limited.[28]

Conclusion

The notion of 'global health' required, first, the idea of the world as a necessarily related, interactive environment. Second, it required a wealth of reliable, locally and regionally collected data be made generally available. Third, those data of necessity reflected both shared disease definitions (*cholera morbus*, for example) and a set of analytical methodologies in which locally, regionally and nationally reported health states could be individually considered and then aggregated in a manner that argued one or another theory of disease. All these elements were critical to the idea of disease or health as international outcomes that could be studied through local outbreaks.

Once these preconditions were met, the idea of global health was constructed—invented is not too absurd a word here—in world maps of first cholera and later other disease states. In the post-war period of the 20th century the United Nations, World Health Organization (WHO) and the U.S. Centers for Disease Control (CDC) all became repositories for international health data that were progressively analysed cartographically and statistically. Of course, the immensity of those data caches does not assure that their analysis will be any more correct than were miasmatic theories of cholera and yellow fever. Maps and statistics are only as good as the theories that underlie them, organizing the type of data chosen and the means of their analysis.

Because the resolution of world maps provides the opportunity for only coarse descriptions of potentially causal environmental conditions (broad temperature isobars, for example) the global map often served and serves today as a thesis generator promoting local and regional studies based on specific, map-generated theories. If proven in local and regional studies, those theories became the subject of new global maps in a manner arguing interventions that might be generally deployed.

Recently, some researchers have come to talk about this approach as 'spatial ecology' or 'spatial

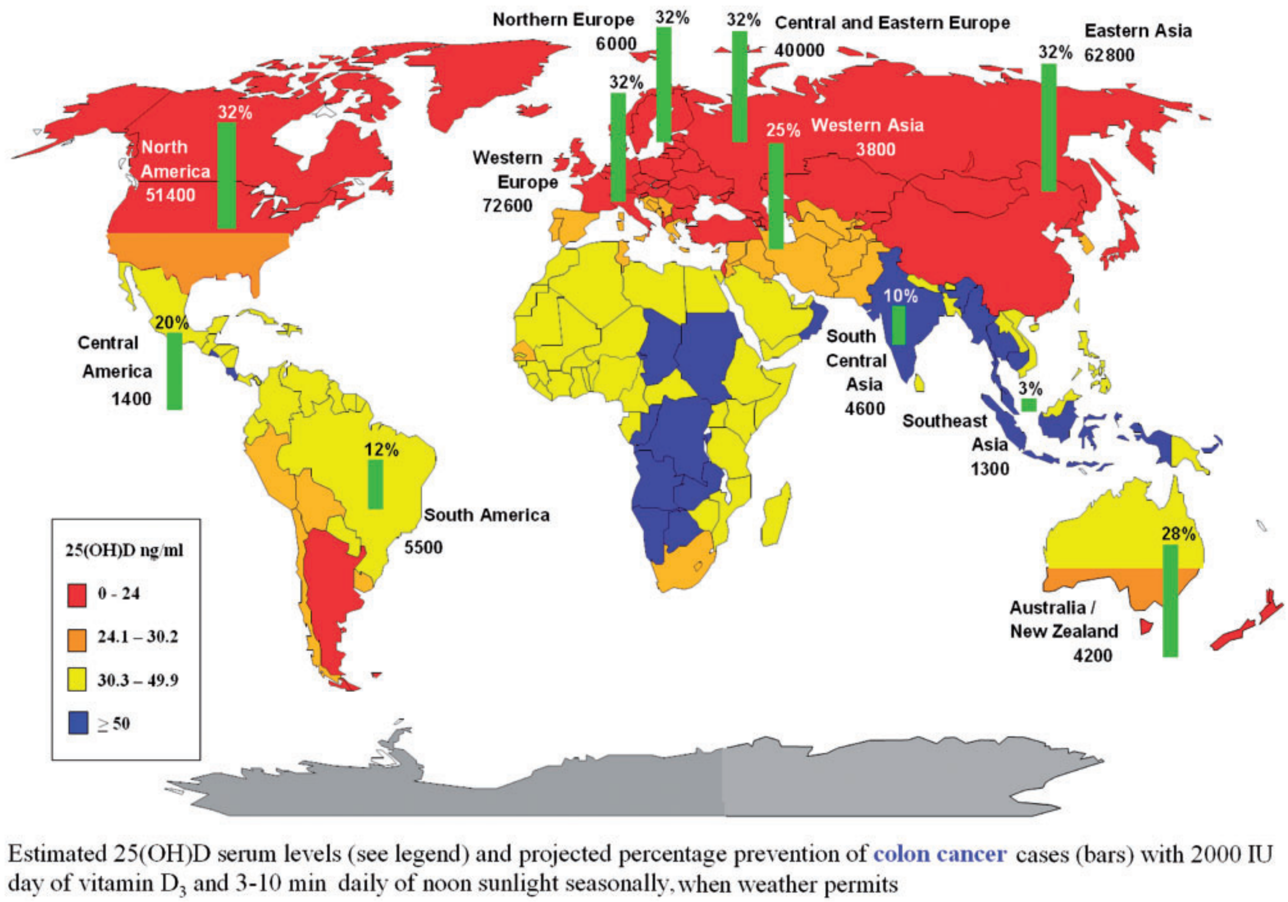

Figure 3. The correlation between sunlight and its natural product, vitamin D, and specific cancers argued for a global initiative in which vitamin D supplements could reduce worldwide incidence of certain cancers. The reduction would be most marked in areas with less sunlight Tom Koch, Disease Maps: Epidemics on the Ground (Chicago, IL: University of Chicago Press, 2011).

epidemiology'.[29] This newer body of work relies on modern methods of data collection, statistical analysis and dissemination, and computerized mapping. In 2009, for example, Kahn and colleagues mapped airline flight populations, tracing the global spread of H1N1 influenza and at the same time determining the airplane passenger loads required to spread H1N1 city to city.[30] The use of digital international travel data and their subsequent analysis were certainly innovative. But the availability of new technologies—from the electronic spreadsheet to the computer-generated map—should not obscure the historical base on which this kind of contemporary work is grounded. Khan's mapping was, in effect, Brigham's red line across sea travel routes updated to the age of air. Global health, global ecologies and the relation between them was a creature born of necessity first in the yellow fever outbreaks of the late 18th century and then in the 19th century cholera pandemics that spread in three successive waves across the industrial and industrializing world. We, in the end, are their inheritors.

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