Pioneer Maps of Health and Disease in England

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PIONEER MAPS OF HEALTH AND DISEASE IN ENGLAND

E. W. GILBERT

AT THE PRESENT TIME there is a lively interest in medical geography. A great atlas of the distribution of diseases is being compiled under the auspices of the American Geographical Society. The International Geographical Union has established a Commission on medical geography, defined as "the study of geographical factors concerned with cause and effect in health and disease:" the Commission presented its first report at Washington in 1952. British geographers have published papers on the ecology of disease in such journals as the *Practitioner* and the *British Medical Journal*. In view of all this activity it is right that the work of the nineteenth century pioneers in the drawing of maps of health and disease should be remembered, especially as some of the leading medical cartographers were Fellows of the Royal Geographical Society. The object of this paper is to describe a few of the maps constructed by these pioneers and to explain the significance of their cartographic achievements.[1]

Much of the subject matter of what is now called medical geography is as old as Hippocrates and his 'De Aëre, Aquis et Locis.' Even the term "medical geography" is not new.[2] It has been current in England for at least sixty years, as it was used by Dr. Alfred Haviland in his 'Geographical distribution of diseases in Great Britain,' published in 1892. In the introduction to this book Haviland wrote of "medical geography," and on p. 286 he referred to "the medical geography of cancer." In 1891 he read a paper in London to the Seventh International Congress of Hygiene on "the influence of clays and limestones on medical geography; illustrated by the geographical distribution of cancer among females in England and Wales." But it appears that the term "medical geography" was preceded by "medical topography." For instance, in 1830 Dr. John Hennen published his 'Sketches of the medical topography of the Mediterranean,' which contains full and systematic geographical accounts of Gibraltar, Malta and the Ionian Islands. In this book the geography of the areas named, all of which were then occupied by British naval and military forces, is described in relation to health and disease. The author also prepared an elaborate scheme for publishing a series of 'Memoirs on medical topography,' but his plan was never carried out. He proposed that each memoir should describe the physical geography including the relief, climate and vegetation of selected areas, and that this description should be followed by an account of the population, its dwellings, bedding, clothing, furniture, diet, employment, amusements, customs, morals and so forth. A third part of each memoir was to be devoted to diseases, hospitals, longevity and vital statistics. His own book

[1] An outline of this paper was read at the Washington meeting of the I.G.U. to the Commission on Medical Geography on 11 August 1952, on behalf of the author, by Professor R. W. Steel, under the title "Some early English maps of the geography of health and disease."

[2] In Germany the term "medical geography" was used earlier than in England. A book entitled 'Medizinische Geographie' by C. F. Fuchs was published at Berlin in 1853. For the history of maps of disease in Germany see H. J. Jusatz, "Zur Entwicklungsgeschichte der medizinisch-geographischen Karten in Deutschland," *Mitt. Reichsamts Landesaufn.*, 1939, pp. 11–22.

contains material of this kind and is a valuable source of information about conditions then prevailing in Mediterranean lands.[1]

Books on medical topography appeared in many countries in the nineteenth century. Some of these dealt with single towns, for example, M. Murat, 'Topographie médicale de la ville de Montpellier' (1810); and R. H. Powell, 'A medical topography of Tunbridge Wells' (1846). Other books described provinces or districts: J. B. Pesétri y Vidal, 'Topografía médica de Valencia' (1878) was one of several similar works on the medical topography of Spanish provinces. In England, partly as a result of the efforts of Dr. (later Sir) James Clark (1788–1870), whose well-known book on 'The influence of climate in the prevention and cure of chronic diseases' was first published in 1829,[2] a considerable number of works on what might be called the "medical climatology" of English towns and districts began to appear. Notable among these was a detailed memoir on the medical topography of a part of Cornwall by Dr. John Forbes (1787–1861), a schoolfellow and life-long friend of Sir James Clark.[3] Other contributions were Dr. Thomas Shapter's 'The climate of the south of Devonshire; and its influence upon health' (1842); and Dr. A. L. Wigan's 'Brighton and its three climates with remarks on its medical topography' (1843). In his book on climate Dr. Clark praised the then unknown Ventnor in the Isle of Wight as a health-giving winter resort; his commendations sent up the price of building land at that seaside village from £100 per acre to £800 or £1000 in a very few years.

These early writers on "medical topography" did not include the mapping of the distribution of diseases as part of their studies. The great outbreaks of cholera in the first half of the nineteenth century seem to have been the factor which first stimulated cartographic work of this kind. It has been stated recently in the *Journal* that the period 1835–55 can be regarded as "a 'golden age' of the development of geographic cartography,"[4] and it is true to say that the mapping of diseases began in England during those years as did the mapping of the distribution of population.

Asiatic cholera reached Great Britain in October 1831 the first death occurring in that month at Sunderland.[5] During the epidemic of 1831–2 over 52,000 persons died of cholera in the British Isles, including nearly 22,000 in England and Wales, 21,000 in Ireland and over 9600 in Scotland. In 1848–9 a second epidemic of cholera caused over 53,000 deaths in England and Wales alone; while in 1853–4 there were over 20,000 deaths from this cause in the two countries; and over 14,000 in 1866. There were a few cholera deaths in 1873, and in 1893 there

[1] Dr. W. Arnold added an appendix on "Medical Topography of the different military stations in Jamaica" to his 'Practical treatise on the bilious remittent fever' (1840).

[2] Sir James Clark (as he had become) republished this book in 1841 under a new title: 'The sanative influence of Climate: with an account of the best places of resort for invalids in England, the south of Europe, etc.' As a young man Clark had assisted W. E. Parry, the Arctic explorer, to make some experiments on the temperature of the Gulf Stream.

[3] John Forbes, "Sketch of the medical topography of the Hundred of Penwith, comprising the District of the Landsend in Cornwall," *Trans. Provincial, Medical and Surgical Assoc.*, **2** (1834), 32–147; **4** (1836), 152–261. One of the aims of this Association was to promote the "increase of knowledge of the medical topography of England, through statistical, meteorological, geological and botanical enquiries," and its early volumes include a number of papers on medical topography.

[4] Robinson, Arthur H., "The 1837 maps of Henry Drury Harness," *Geogr. J.*, **121** (1955), p. 440.

[5] Underwood, E. Ashworth, "The history of cholera in Great Britain," *Proc. R. Soc. Med.*, **41** (1948), pp. 165–73.

were 135 deaths, this being the last year in which cholera gained a foothold in Britain.

It is well known that Dr. John Snow (1813–58), a famous London anaesthetist, was largely responsible for demonstrating the water-borne origin of cholera. In his short essay 'On the mode of communication of cholera,' published in 1849, he urged the necessity of providing sewage-free water for south and east London as a preventive of cholera: the second edition (1855) was a substantial enlargement of the original pamphlet.[1] Moreover, the second edition included a map of the dis-

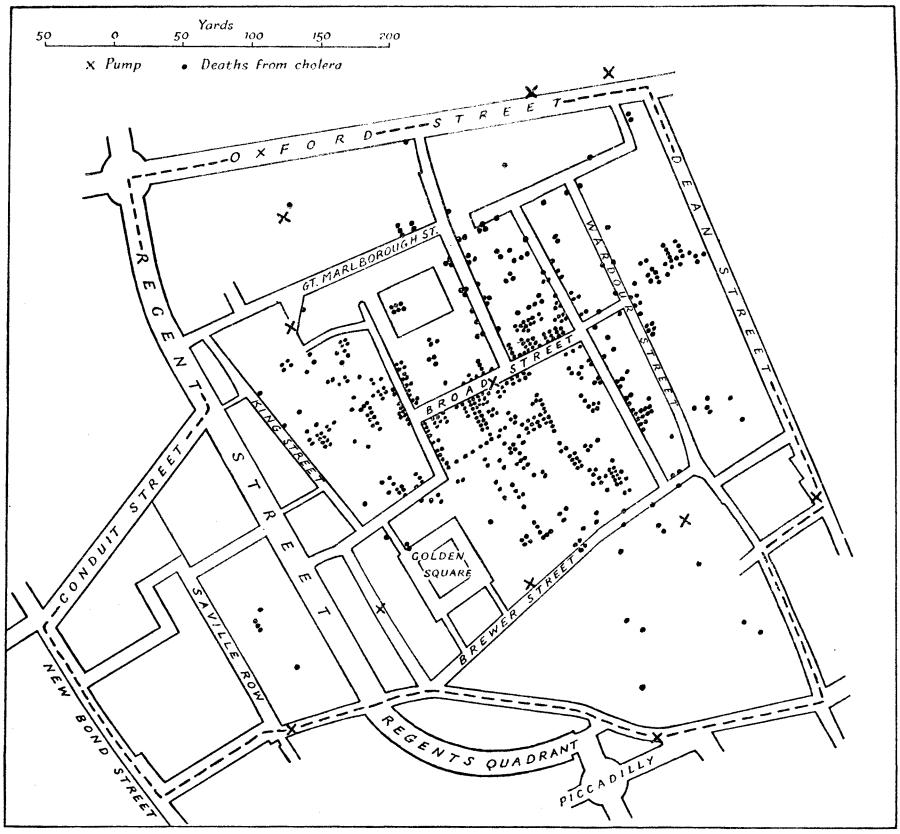

Fig. 1. Dr. John Snow's map (1855) of deaths from cholera in the Broad Street area of London in September 1854

tribution of deaths from cholera in the Broad Street district of London in 1854. The "cholera field," as Snow called it, had its centre at a pump in Broad Street near Golden Square, and the "field" was bounded roughly by Great Marlborough Street, Dean Street, Brewer Street and King Street. In this small space there were over 500 deaths in ten days of September 1854. The scale of the original map is 30 inches to 1 mile; deaths are shown by black rectangles and the pumps are also marked (Fig. 1). Snow proved "that the incidence of cholera was only among

[1] Snow's important papers have been reprinted in 'Snow on cholera, being a reprint of two papers by John Snow, M.D.' with a memoir by B. W. Richardson, and an introduction by W. H. Frost (New York, 1936). The Broad Street map is reproduced in this book.

persons who drank from the Broad Street pump." On September 8, at Snow's urgent request, the handle of the Broad Street pump was removed and the incidence of new cases in the area ceased almost at once. Snow's map of the distribution of deaths from cholera, first published in 1855, is a very significant document in the history of medical geography, but it is not the first map of its kind.

The 1832 outbreak of cholera was particularly severe in Yorkshire.[1] In Leeds, then a place of 76,000 people, there were over 1800 cases and 700 deaths between May and November of 1832. Dr. Robert Baker illustrated his 'Report of the Leeds Board of Health' (1833) with a "cholera plan," surveyed by Charles Fowler, on

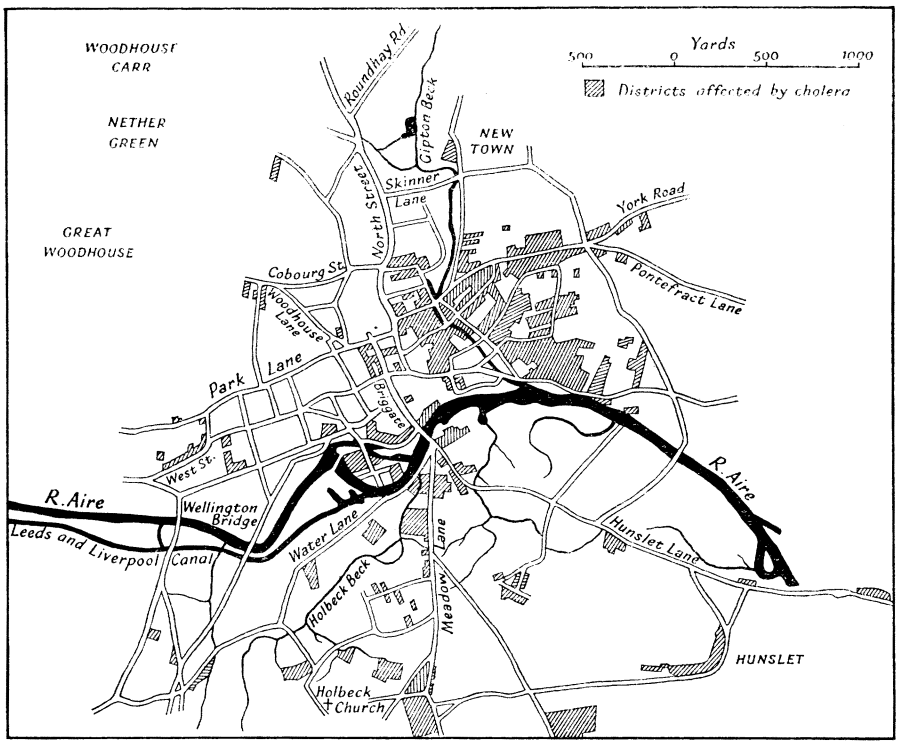

Fig. 2. Dr. Robert Baker's "cholera plan" of Leeds (1833)

which the parts of Leeds affected by cholera were marked and coloured red. Dr. Baker's map showed that the incidence of the disease was highest in the more densely peopled and north-eastern districts of the town and that comparatively small areas were affected in those parts of Leeds that lie south of the river Aire. The plan is on a scale of about 3^1_2 inches to 1 mile and indicates by hatching "the districts in which the cholera prevailed"; it does not mark individual cases or deaths (Fig. 2). Dr. Baker observed (p. 10) "how exceedingly the disease has prevailed in those parts of the town where there is a deficiency, often an entire want of sewerage, drainage, and paving."

In 1848 W. P. Ormerod in 'The sanatory condition of Oxford' included a rather

[1] Underwood, E. Ashworth, "The history of the 1832 cholera epidemic in Yorkshire," *Proc. R. Soc. Med.*, **28** (1935), pp. 603–16.

crude plan of the city on the scale of about 12 inches to 1 mile to show the districts visited by cholera and by fever in 1832. Localities of fever were marked by a cross and those of cholera by a dot, while the parts of the city "chiefly visited by disease generally" were slightly shaded. In 1849 Dr. Thomas Shapter (1809–1902), who had a reputation for his work in both geology and climatology as well as in medicine, published his 'History of the cholera in Exeter in 1832.' This admirably written account has been described by Dr. E. Ashworth Underwood as "one of the best descriptions extant of an historical epidemic." [1] Exeter, which then contained a population of about 28,000, had over 1100 cases of cholera with 402 deaths in 1832.

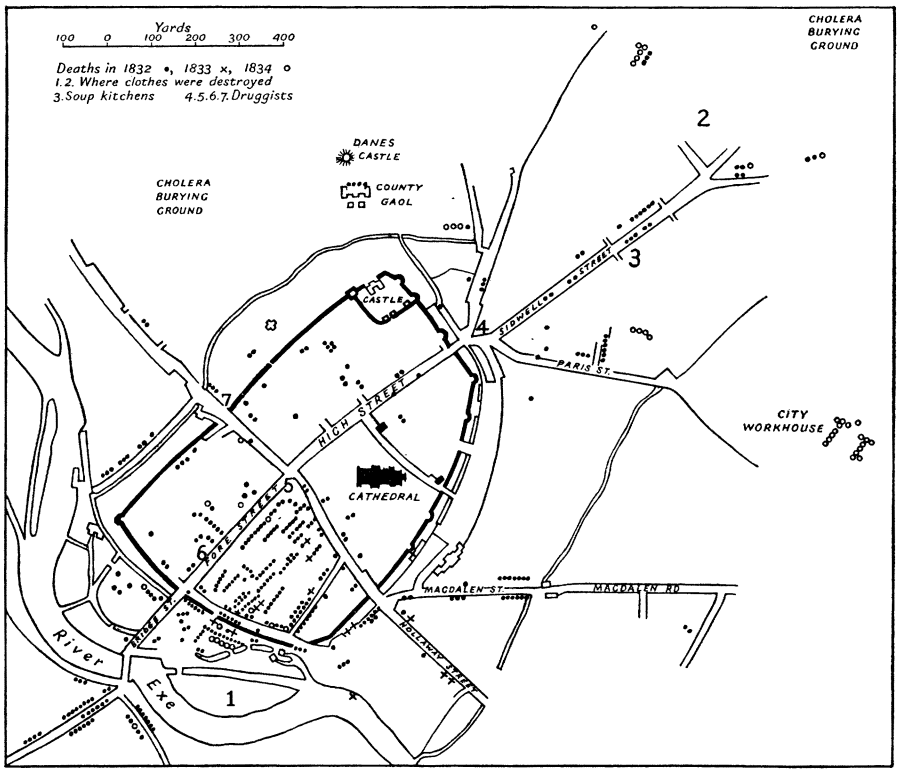

Fig. 3. Dr. Thomas Shapter's map (1849) of the deaths from cholera in Exeter 1832–34

Shapter's book is important in the history of medical geography because, six years before Snow's famous map was published, it included a dot map showing the distribution of deaths caused by cholera. The original map, drawn on a scale of 6 inches to 1 mile, distinguishes the deaths which took place in the years 1832, 1833 and 1834, by different symbols for each year. It also marks the places where clothes were destroyed, the cholera burying grounds, the druggists and the soup kitchens. A redrawing of this plan of Exeter is reproduced as Figure 3, and shows

[1] Underwood, E. Ashworth, "The cholera epidemic in Exeter, 1832," *Brit. Med. J.* 1933 (i), pp. 619–20. R. H. Mottram in 'Early Victorian England 1830–1865' (1934) (ed. G. M. Young), in his chapter on "Town life and London" (Vol. I, 155–66) quotes freely from T. Shapter's 'History of the cholera in Exeter in 1832' (1849).

that a large proportion of the deaths occurred in the low-lying south-eastern quarter of the old walled city. In 1853 Shapter published his 'Sanitary measures and their results,' as a sequel to his previous work on cholera in Exeter in 1832. He pointed out that Exeter suffered only 43 deaths in the epidemic of 1849 and attri-

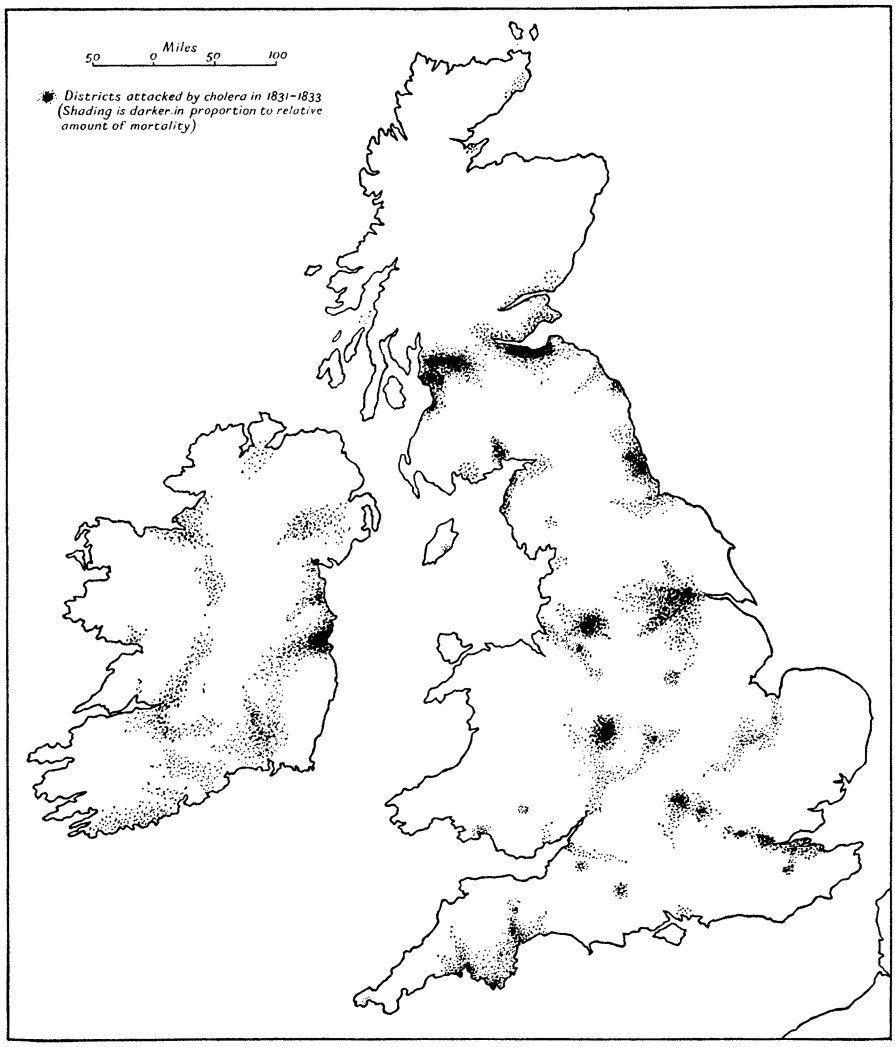

Fig. 4. Augustus Petermann's cholera map (1852) of the British Isles showing areas affected in 1831–3

buted the city's comparative immunity from the disease to the sanitary improvements carried out in the previous seventeen years.

In 1852, Augustus Petermann (1822–78), the distinguished German geographer, at that time resident in England, brought out a "Cholera map of the British Isles showing the districts attacked in 1831, 1832 and 1833." A redrawn copy of this

map is reproduced as Figure 4.[1] Petermann had worked with the firm of Berghaus at Potsdam from 1839 to 1845. He then migrated to Britain, first living in Edinburgh from 1845 to 1847, where he worked with Alexander Keith Johnston; and then in London until 1854.[2] He was elected a Fellow of the Royal Geographical Society in 1846 and in 1852 was described as "Physical Geographer and Engraver on Stone to the Queen." His cholera map, drawn on a scale of 1 : 2,200,000 shows "all districts visited by the cholera" by means of crude shading, "which is darker in proportion to the relative amount of mortality." The map is accompanied by a few pages of "Statistical Notes" which are of considerable geographical interest. Petermann's introduction to these notes is worth quoting in full: "While the means of intercourse between distant nations were in their infancy, the knowledge of the existence or development of remarkable diseases was necessarily limited, and consequently that department of science, which may be termed the *Geography of Diseases*, remained uncultivated. Now, however, as we live in a different era, we may indulge in the rational hope of seeing this science studied which, though comparatively new, is one of the most important branches of Geography.

"The object, therefore, in constructing Cholera Maps is to obtain a view of the Geographical extent of the ravages of this disease, and to discover the local conditions that might influence its progress and its degree of fatality.

"For such a purpose, Geographical delineation is of the utmost value, and even indispensable; for while the symbols of the masses of statistical data in figures, however clearly they might be arranged in Systematic Tables, present but a uniform appearance, the same data, embodied in a Map, will convey at once, the relative bearing and proportion of the single data together with their position, extent, and distance, and thus, a Map will make visible to the eye the development and nature of any phenomenon in regard to its geographical distribution."

Petermann then described the spread of the disease through the country in 1832. He pointed out that it travelled slowly from Sunderland along the inland lines of communication, but "more rapidly to the different seaports, so that all the coast line round the Isles was first attacked, and from thence the disease penetrated the inland parts of the country." He also discussed the relation of the disease to relief and observed that a cursory glance at his map apparently corroborated the current belief that cholera rarely penetrated mountainous countries and never reached the tops of hills. The cholera districts in the British Isles "seemed to lie all in the lower ground and valleys." When he began his geographical investigations Petermann was predisposed in favour of this general opinion, "and if such had proved to be the case, it would have been of great interest to ascertain the scale of perpendicular distribution of cholera, the relative amount of mortality in the different stages of elevation, and the point where (like the eternal snow limit which throws a bar against animal and vegetable life at large) the disease would altogether cease. But, by a more minute investigation, it appears with a considerable degree of

[1] A facsimile of the original of this map is in H. J. Jusatz, "Die geographisch-medizinische Erforschung von Epidemien," *Peterm. Geogr. Mitt.*, **86** (1940), pp. 201–4.

[2] In connection with Petermann's association with H. Berghaus and A. K. Johnston it is worth noticing that the first maps of the geographical distribution of diseases to appear in any German atlas were in Band II, Abt. VII, No. 2 (1847) of Heinrich Berghaus, *Physikalischer Atlas* (1837–48). The first similar map in England is in A. K. Johnston, *The Physical Atlas of Natural Phenomena* (second ed. 1856). The latter contains a world map of the geographical distribution of health and disease (plate 35) with text by A. K. Johnston; a red line traces the march of cholera from east to west, with dates of its occurrence. This map does not appear in the first edition (1848) of the atlas.

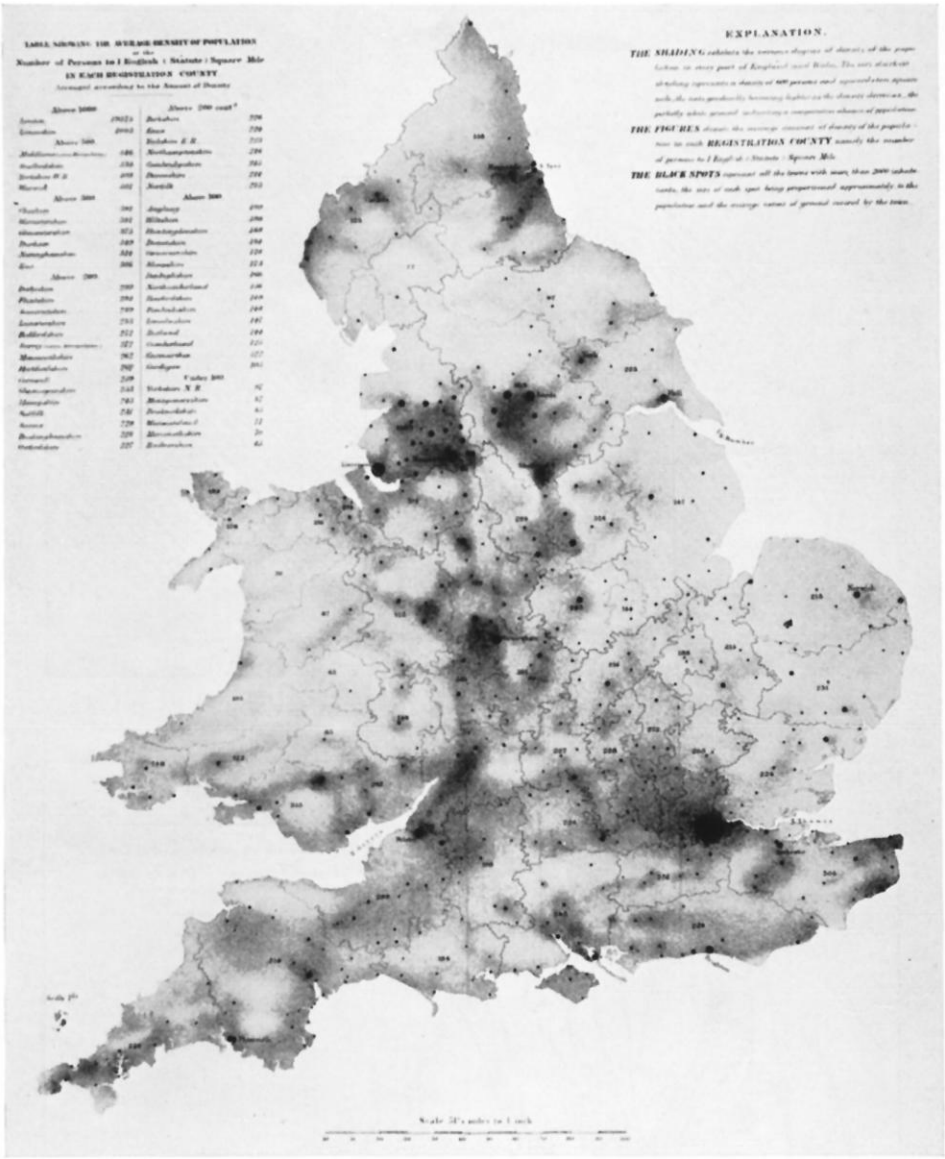

Fig. 5. Petermann's population map (1852) from 'Census of Great Britain, 1851'

The explanation in the right hand corner reads:

THE SHADING exhibits the various degrees of density of the population in every part of England and Wales. The very darkest shading represents a density of 600 persons and upwards to a square mile; the tints gradually becoming lighter as the density decreases—the perfectly white ground indicating a comparative absence of population.

THE FIGURES denote the average amount of density of the population in each REGISTRATION COUNTY, namely the number of persons to 1 English (Statute) Square mile.

THE BLACK SPOTS represent all the towns with more than 2000 inhabitants; the size of each spot being proportioned, approximately, to the population and the average extent of ground covered by the town.

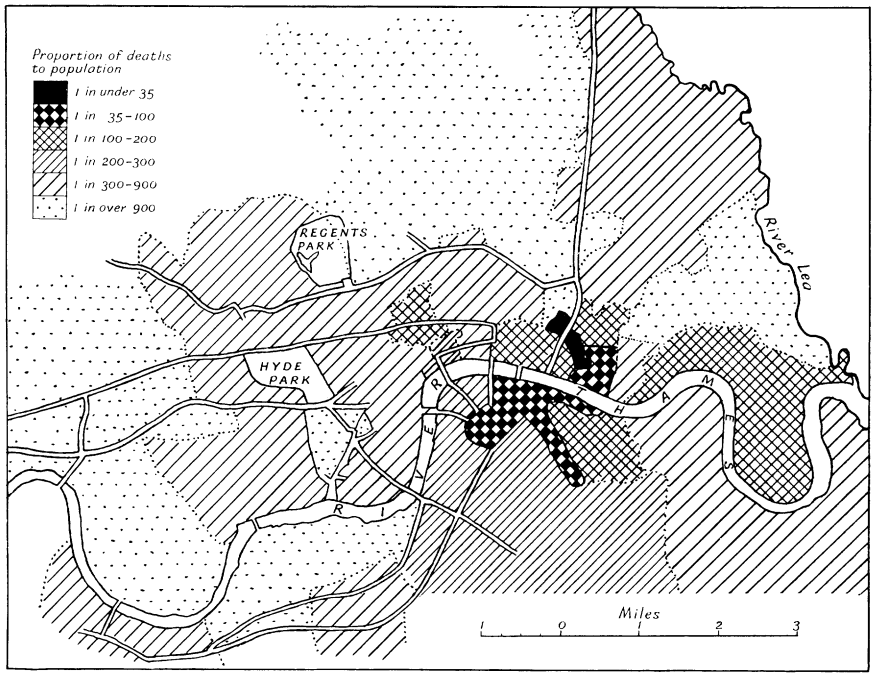

Fig. 6. Petermann's map of deaths from cholera in London in 1832 (1852)

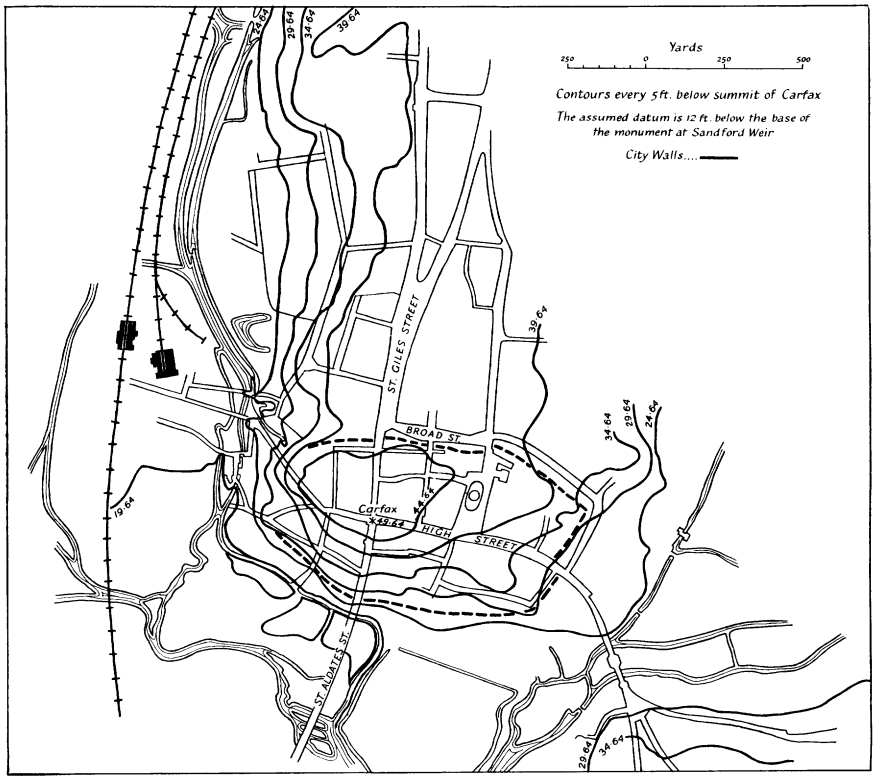

Fig. 7. H. W. Acland's contoured plan of Oxford (1856)

certainty that these districts were attacked, not so much in consequence of their *low situation*, as from the *great amount of population they contain.*"

In 1848 Petermann had compiled and drawn a fine population map of the British Isles on the basis of the census of 1841.[1] He was later called on to design a population map of England and Wales (Fig. 5) and another of Scotland to illustrate the 'Census of Great Britain, 1851' (1852). These two engraved maps, drawn on a scale of $31\frac{1}{4}$ miles to 1 inch, show, by very delicate shading, the differences in density of population, the darkest shading being used for a density of 600 persons and upwards per square mile. Petermann said in his "Statistical Notes" that a comparison of his population maps with his cholera map showed "that the more densely peopled districts were proportionately the most severely attacked." He said that while the "great level of the Fens" did not suffer much from cholera, "the elevated land of Birmingham, forming a pretty extensive plateau of 500 feet mean elevation" was one of the most severely afflicted parts of the whole kingdom. This proved, according to Petermann, that altitude was of little significance in the spread of cholera and that density of population was of far greater importance. He also included some interesting remarks on the influence of the seasons on the progress of the disease, illustrated on his map by an inset diagram of "the number of places of Great Britain attacked by the disease in different months." As a result of his investigations he concluded that "the warmer season favours the progress of the disease," and that "cholera forms a tolerably regular course, ascending rapidly from May to August, attaining in that month its summit, and then descending again with equal rapidity till November, from which month till May it keeps a pretty low ebb."

Petermann's cholera map of the British Isles also contains an inset plan of London divided into 43 registration districts; and detailed tables of the number of cases of cholera, the deaths, the total population and the proportion of deaths to population in each district. On this plan (Fig. 6) six different tints of red or pink were used to indicate the varying proportions of deaths from cholera to total population in the outbreak of 1832. Petermann adopted a scale ranging from one death in 35 persons for the worst district of Botolph (without Aldgate) to one in 900 persons or more for areas least affected and applied the appropriate tint to each registration district. The plan gives some idea of the distribution of the districts most seriously affected in 1832; they included Southwark, Bermondsey and the City.

About 5000 persons died in London in the outbreak of 1832, another 1000 in 1848–9, and over 10,700 in the severe epidemic of 1854.[2] In 1866 there were over 5500 deaths in London, mainly distributed in the East End and not so largely in Southwark and other parishes south of the Thames as in previous outbreaks.

In 1856, one year after the publication of John Snow's map of cholera in the Broad Street area of London, Dr. Henry Wentworth Acland (1815–1900) produced his 'Memoir on the cholera at Oxford in the year 1854.' Oxford experienced three outbreaks of cholera, with 95 deaths in 1832, 75 in 1849 and 129 in 1854. Like

[1] 'Map of the British Isles elucidating the distribution of the population based on the census of 1841' (London, 1849). This map, compiled and drawn by Augustus Petermann on a scale of 1 : 1,600,000 was exhibited to the statistical section of the British Association for the Advancement of Science at Swansea in 1848; and Petermann read a paper on the subject to the section. See *Geogr. J.*, **121** (1955), pp. 448–50.

[2] The official Report of the General Board of Health on the cholera epidemic of 1849 includes a rough "Cholera Map of the Metropolis, 1849," which indicates by very crude shading the districts of London most affected; as well as a similar map of Glasgow. See *British Parliamentary Papers*, **21** (1850). Dots showing deaths from cholera in London in 1866 were drawn superimposed on "maps of the geological formations" in the *Report of Medical Officer for the Privy Council for 1866* (London, 1867).

Petermann, Dr. Acland was a Fellow of the Royal Geographical Society, having been elected in 1855, and his geographical interests are clearly revealed by the remarkable maps in his book. His detailed plan of the city of Oxford is on a scale of approximately 10 inches to 1 mile. In addition to marking rivers and streams the plan has contours drawn at intervals of 5 feet below the summit of Carfax, the highest point in the old city (Fig. 7). Carfax is marked as 49·64 feet above an assumed datum which is a point 12 feet below the base of the monument at Sandford

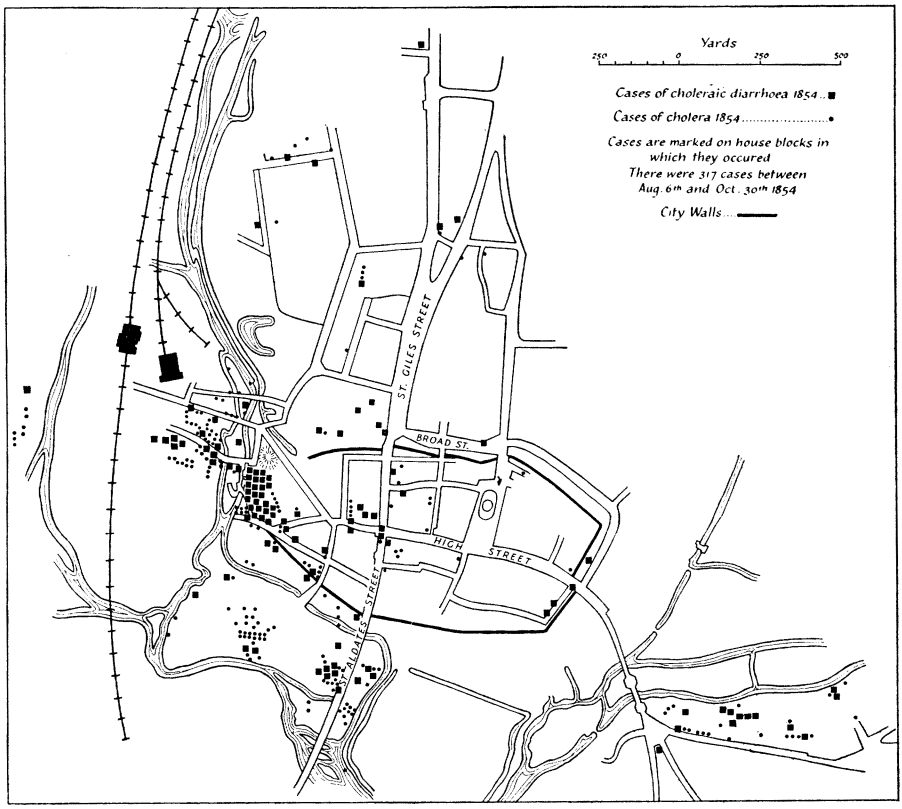

Fig. 8. H. W. Acland's map of cases of choleraic diarrhoea and cholera in Oxford in 1854 (1856)

Weir. By this curious arrangement the first 5-foot contour below Carfax is marked 44·64 feet, the next 39·64 feet and so on. Contours had been introduced into the maps of the Ordnance Survey by Colonel T. F. Colby, R.E. (1784–1852) in about 1830, but it was still unusual in 1856 to make a plan of a city with contours at such a close interval. Certainly these 5-foot contours give a clearer and more detailed picture of the relief of the old walled city of Oxford, standing on a gravel terrace about 25–30 feet above the normal level of the river, than do most modern maps. Dr. Acland obtained these contours from the unpublished drawings of Robert Syer Hoggar, an engineer.[1] The plan (Fig. 11) shows by colour and symbols the

[1] Hoggar calculated that the summit of Carfax was 37 feet above the average level of the water under Folly Bridge. The difference between Carfax (209 feet above sea level) and the

parts of the city still undrained in 1855, and the rivers and streams that were then contaminated by sewers as well as the points of contamination. By blue symbols of different shapes the cases of cholera in the 1832 epidemic can be differentiated from those of 1849 (Figs. 9 and 10); both sets of cases are marked in the streets in which they occurred. For the epidemic of 1854, by using two different black symbols, Dr. Acland distinguished the cases of choleraic diarrhoea from those of cholera, and for that year he was able to plot each case in the actual house block concerned (Fig. 8). Acland's map also marks by special symbols those parts of the city which

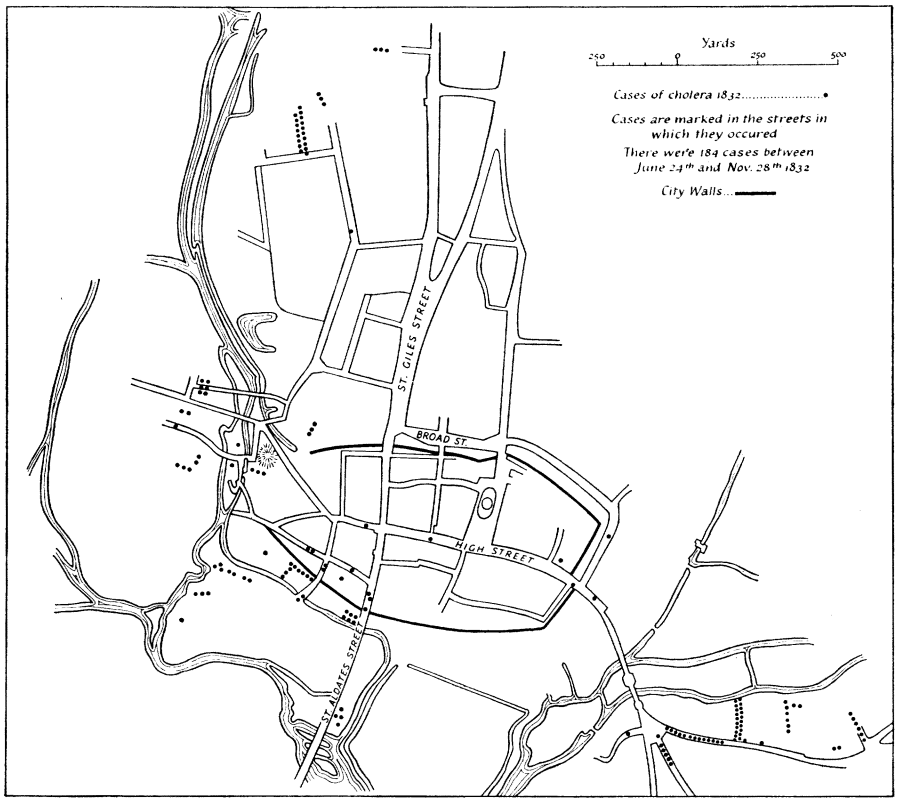

Fig. 9. H. W. Acland's map of cases of cholera in Oxford in 1832 (1856)

had been described by W. P. Ormerod and others some years earlier as unhealthy; those which had been wholly remedied; and those which had been partly remedied since they wrote.

Acland's plan of Oxford is the most elaborate in the whole series of cholera maps. It is not possible to discuss Acland's text fully, but it should be noted that, like Petermann, he carefully considered the relation of cholera mortality to altitude. Acland did not reach the same conclusions as Petermann, but followed the opinions

average level of water under Folly Bridge (179 feet above sea level) is now 30 feet. The difference of 7 feet between the measurement of 1856 and that of 1958 is mainly due to changes in the level of the river which occurred after the construction of weirs and partly to alterations at Carfax itself. Hoggar's published plan of Oxford is dated 1850, but the copy in the Bodleian shows contours in manuscript only.

expressed in the Registrar General's Report on cholera in 1849, that altitude in London had "a more constant relation with mortality from cholera than any other human element." Acland took his contour line marked 29·64 feet (Fig. 7) as a division between an upper and a lower level in Oxford. This contour was 16·47 feet above the average water level at Folly Bridge and 20 feet below Carfax. He calculated that in the three Oxford epidemics 141 cases occurred in the upper level and 362 in the lower, and estimated the population in the upper level at 14,200, and that in the lower at 12,300. He concluded "that mortality on our lower

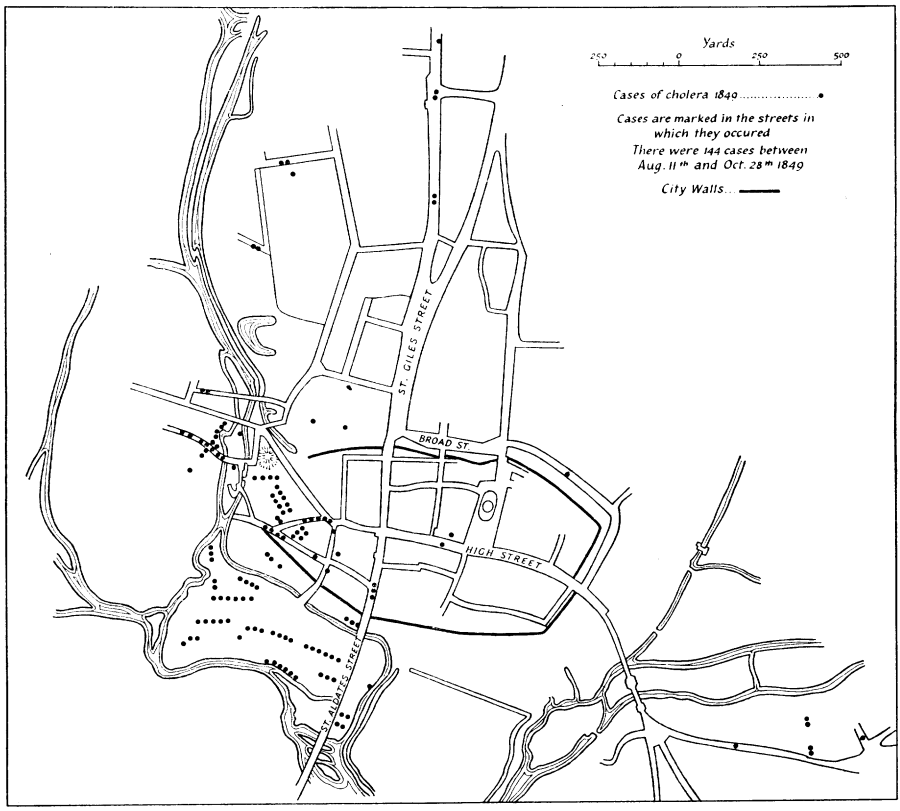

Fig. 10. H. W. Acland's map of cases of cholera in Oxford in 1849 (1856)

level was proportionately three times as great as that of our upper level."[1] Acland's contour correlations are explained by drainage, as at lower levels the opportunities for contamination were much greater. Acland also gave a full description of the meteorological conditions during the outbreaks, with elaborate diagrams, as part of his attempt to correlate weather with disease. "The publication of the cholera memoir," said J. B. Atlay, "raised Acland from the position of a country physician in good practice to that of an authority on sanitary and hygienic questions of acknowledged repute, not only at home, but on the continent, and in Canada and the United States."[2]

[1] Acland, H. W., 'Memoir on the cholera at Oxford' (1856), pp. 49–50.
[2] Atlay, J. B., 'Sir Henry Wentworth Acland' (1903), p. 197.

A brief reference should be made to two pioneer health maps. In 1882 Dr. Alfred Haviland produced a *Health-Guide map for Brighton* and in the following year a similar map for Scarborough.[1] The Brighton map, drawn on a scale of 9 inches to 1 mile, showed geology in colour and relief by contours at 25-foot intervals. The most unusual feature of the map was the indication of "aspect" which was shown by arrows and letters. Arrows point in the direction of the slope and letters show the wind point to which the slope was exposed. Wind charts and climatic statistics

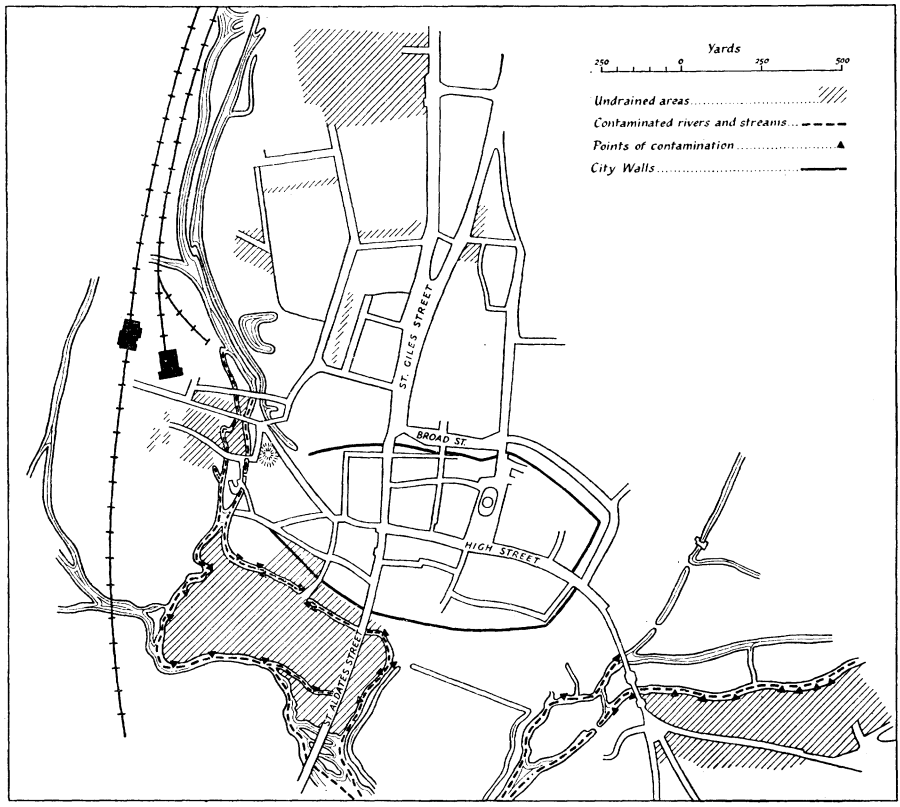

Fig. 11. H. W. Acland's map of undrained districts in Oxford 1854 (1856)

fill the borders of the map. The object of these two maps was to indicate the varying merits of different parts of the towns concerned in the matter of health.

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[1] Haviland, A., 'Scarborough as a health resort: its physical geography, geology, climate and vital statistics with a health-guide map' (1883).