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# THE FINAL CATASTROPHE– CHOLERA IN LONDON, 1866[1]

*by*

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IN 1866 PANDEMIC CHOLERA attacked Britain for the fourth and final time in an epidemic which struck with extreme ferocity in the East End of London, killing very nearly four thousand people there between the end of July and the beginning of November.[2] The epidemic has not yet received detailed attention either from social historians or in the literature of the history of medicine. It is, however, generally agreed in each of the existing accounts that it was the action (or, more accurately, the negligent inaction) of the East London Water Company which decisively determined the dissemination and scale of the outbreak.[3] An analysis of the time structure and localized pattern of mortality associated with the epidemic does indeed reinforce such an interpretation.[4] The intention of this article is not, therefore, in any sense "revisionist", for posthumous exoneration cannot be proffered where it is so evidently undeserved. It seeks rather to illuminate the extraordinarily diverse spectrum of attitudes towards water-transmitted disease which were in competition for intellectual and social hegemony in Britain in the mid-1860s.

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[1] A version of this paper was originally read to a meeting of the British Society for the History of Science at Chelsea College, London, in January 1976. I would like to thank Peter Searby for his very helpful comments on a subsequent draft.

[2] On no day between 21 July and 6 August did fewer than a hundred inhabitants of the East End perish from the disease: and only at the beginning of November did weekly mortality decline to less than twenty. Mortality during the water-borne climax of the outbreak is summarized below:

| Week ending: | | | | |
|---|---|---|---|---|
| | 14 July | 20 | 11 August | 673 |
| | 21 July | 308 | 18 August | 369 |
| | 28 July | 818 | 25 August | 198 |
| | 4 August | 916 | 1 September | 122 |
| | | | 8 September | 74 |

See 'Mr. J. Netten Radcliffe on cholera in London, and especially in the eastern districts' in *Ninth report of the medical officer of the privy council*, Parliamentary Papers 1867, XXXVII, Appendix 7, Tables VI, VII and VIII.

[3] A basic chronology of the epidemic and its alleged determinants may be derived from Norman Longmate, *King cholera*, London, Hamish Hamilton, 1966, pp. 212–222; Francis Sheppard, *London 1808–1870: the infernal wen*, London, Secker & Warburg, 1971, pp. 294–296; Henry Jephson, *The sanitary evolution of London*, London, T. Fisher Unwin, 1907, pp. 189–192; and William A. Robson, *The government and misgovernment of London*, 2nd ed., London, Allen & Unwin, 1948, pp. 105–106.

[4] On historical methodologies for assessing the extent and duration of water-borne epidemics see M. Durey, *The first spasmodic cholera epidemic in York*, York, St. Anthony's Press, 1974, pp. 9–12. The highly localized nature of the epidemic of 1866 is shown in the following table of district death-rates:

Such an examination shows that it was only a minority within what may be loosely characterized as the *avant garde* in the nascent profession of epidemiology which gave unqualified support to the view that the outbreak of 1866 was decisively carried by water. It is, therefore, unhistorical in a far from trivial sense to assume that the East London Company stood unequivocally condemned at the bar of specialist opinion. Any total account must move beyond simplifications of this kind and separate out a multiplicity of epidemiological and socio-medical theories as a complement to the undeniably concrete conclusion, which may be—and, indeed, was—deduced from the statistics of district mortality collected by William Farr at the Registrar-General's office, that the epidemic was primarily spread by unsafe water. But to the great majority of those who specialized in medicine and the protection of public health in the 1860s such a supposition smacked of scientific error and social irresponsibility.

The article falls into four parts. The first is a brief chronological outline of the epidemic described principally and deliberately from the perspective of two "progressives"—William Farr and Edward Frankland—who were directly involved in monitoring mortality and possible modes of transmission. In the second, the company's defensive strategy is situated within the mainstream of consensus medical ideology, exemplified here by the writings and public statements of the metropolitan medical officers of health. There is then an analysis of the findings of the various Parliamentary and departmental investigations which, either directly or indirectly, set themselves the task of evaluating the precise degree of culpability of the East London Company. Finally, attention is given to the orientation and testimony of those influential statesmen of the "new" medical science—notably John Simon and Netten Radcliffe—who were strategically placed to modify future systems of administrative control and public health legislation.

## I

By the end of July 1866, mortality in the East End had reached traumatic levels and William Farr at the Registrar-General's office was already well aware of the probable

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LONDON: district death-rates from cholera per 10,000 population: 1866

| | | | | | |
|---|---|---|---|---|---|
| London | 18 | St. Giles | 10 | Poplar | 89 |
| Kensington | 4 | Strand | 6 | St. Saviour, | |
| Chelsea | 4 | Holborn | 7 | Southwark | 7 |
| St. George, | | Clerkenwell | 12 | St. Olave, | |
| Hanover Square | 2 | St. Luke | 15 | Southwark | 6 |
| Westminster | 6 | East London | 18 | Bermondsey | 6 |
| St. Martins in the | | West London | 8 | St. George, | |
| Field | 5 | London City | 7 | Southwark | 1 |
| St. James, | | Shoreditch | 11 | Newington | 3 |
| Westminster | 5 | Bethnal Green | 63 | Lambeth | 7 |
| Marylebone | 3 | Whitechapel | 76 | Wandsworth | 5 |
| Hampstead | 1 | St. George-in-the East | 97 | Camberwell | 6 |
| Pancras | 6 | Stepney | 116 | Rotherhithe | 9 |
| Islington | 4 | Mile End | | Greenwich | 20 |
| Hackney | 11 | Old Town | 64 | Lewisham | 6 |

See: *Report of epidemic cholera in England 1866*, Parliamentary Papers 1867–68, XXXVII, Table 26.

role of unsafe water in the transmission of the epidemic. He was also pessimistic about the possibilities of preventive action. "The Company will no doubt take exemplary pains to filter its water", he told his confidant and informal scientific adviser, Edward Frankland, "but it is not easy to guarantee the purity of water drawn from such a river as the Lea, in dangerous proximity to sewers, cuts and canals".[5] On 30 July in another letter to Frankland, he reiterated his contention that there must be a connexion between the abnormal contamination of the Lea and the spiralling death rate in the East End, and on the following day, he was telling Frankland that the epidemic "quite reminds me of the Southwark slaughter" of a dozen years earlier.[6] Some kind of rapid action was imperative but, when approached informally, the East London Company bridled at the suggestion that it might be even minimally responsible for the dissemination of the disease: and on 2 August, in an attempt to stifle damaging rumours, Charles Greaves, the company engineer, who was to play a dramatic role in the subsequent unravelling of the tragedy, wrote to *The Times* giving an assurance that the water which was being drawn from the Lea was absolutely safe.[7] This was in partial response to Farr's statement that use was still being made of a canal which connected the company's filter beds at one of their works directly with the river. Unknown to Greaves, Farr had already examined detailed maps and, to his intense indignation, had discovered that there were in fact two pumping establishments—at Old Ford and at Lea Bridge. At the former, besides a covered reservoir, there were also two others which were not covered. Whatever the exact means of transmission of cholera in the East End, therefore, the company had clearly contravened a clause of the Metropolitan Water Act of 1852 which outlawed uncovered reservoirs within five miles of St. Paul's.[8]

Greaves' response was forthright. He accused the Registrar's office of consulting out-of-date maps and went on to insist that, although the canal had yet to be filled in, ". . . not a drop of unfiltered water has for several years past been supplied by the company for any purpose".[9] But the existence of the uncovered reservoir had already temporarily undermined the company's position and Farr now moved swiftly. On 3 August he wrote to Frankland's assistant: "The engineer, Mr. Greaves, states that there is still a connexion between the *wells* of the engines at *Old Ford* and the uncovered reservoirs, but denies that these waters are ever used". To test the reliability of this assertion, Farr asked the assistant to undertake rigorous analyses of water from the single covered and from the two uncovered reservoirs at Old Ford, as well as at the Lea Bridge works both before and after filtration.[10] Predictably, the chemical analysis revealed nothing and the repercussions which flowed from this unsuccessful effort to identify the presence of the cholera "poison"—the terminology legitimized by John Snow and now freely deployed by the "progressives"—were to prove of exceptional methodological significance in the controversy which ensued.

[5] This, and subsequent letters are reprinted in ibid., p. 191.
[6] Farr to Frankland 31 July 1866.
[7] *The Times*, 2 August 1866.
[8] Jephson, op. cit., note 3 above, p. 191.
[9] *The Times*, 2 August 1866.
[10] Farr to Valentin, 3 August 1866.

## II

Both during and in the immediate aftermath of the virulent epidemic, the company retaliated against the accusations of the "progressives" by citing authoritative miasmatic and "sociological" theories of disease which purported to explain the peculiar vulnerability of the poorest and least hygienic districts of the East End. N. Beardmore, the engineer to the River Lea Trust, wrote to the Registrar's office on 6 August to insist that: ". . . overcrowding, deficiency of drainage, and inferior articles of food are more likely to have promoted cholera than impurity or deficiency of water". The East End, he went on, was populated by ". . . dock labourers, sailors, mechanics in the new factores [*sic*], and great numbers of laundresses", all social groups whose poverty, irregular lives and underdeveloped sense of personal hygiene made them especially susceptible to the disease.[11]

The company was also able to rely on the open or tacit support of a majority of the metropolitan medical officers of health. The acting officer for Mile End Old Town claimed that he had "never seen or read a single reliable fact" to support the water theory.[12] His colleagues were less extreme but they nevertheless endorsed a wide range of alternative hypotheses which implicitly minimized the direct influence of unsafe water. Sociological schema of the kind that Beardmore had championed, based on allegedly empirical observations which emphasized poverty *per se*, the influence of social class and a dissolute way of life, were held to be more persuasive than the "exclusive" water theory. There was also a continuing commitment to the atmospheric "Thames-borne" theory of infection, first propounded by William Farr in his then pioneering work on elevation, meteorology and the "epidemic atmosphere" in 1849 and 1854.[13] "The present epidemic", explained the medical officer for Greenwich, who was clearly attracted to this kind of theoretical framework, "has mainly existed in all parts of my district as are contiguous to the River Thames. The nearer the river, the more cases of cholera, and the greater the severity of attacks generally, the disease gradually decreasing in virulence and numbers as the distance increases from the river."[14]

But by far the most popular total explanation to which the medical officers subscribed was the well-tried generalized Chadwickian hierarchy of ". . . bad water, bad air, defective drainage, overcrowding, dirty and irregular habits", with the important proviso that it was invariably traditional non-specific miasmatic conditions, and not unsafe water *per se* which occupied a determining position.[15] By this period, the seemingly indefinitely flexible miasmatic doctrine had also incorporated elements

[11] Cholera report 1866, op. cit., note 4 above, p. 229.

[12] *Report of Captain Tyler to the Board of Trade in regard to the East London Waterworks Company*, Parliamentary Papers 1867, LVIII, 444. Evidence of Dr. Corner.

[13] The principal tenets of the doctrine are set out in: *Report of the Medical Council in relation to the cholera epidemic of 1854*, Parliamentary Papers 1854–55, XLV, 6; and *Report of the committee for scientific inquiries in relation to the cholera epidemic of 1854*, Parliamentary Papers. 1854–55, XXI, 51. See also, William Farr, 'The cholera epidemic of 1853–4' in *Seventeenth annual report of the registrar-general*, pp. 74–108.

[14] Cholera report 1866, op. cit., note 4 above, p. 278. Evidence of Henry N. Pink.

[15] *Report of the Medical Officer of Health: Bethnal Green*, 1866, p. 20.

of Pettenkofer's more rigorous soil theory of disease.[16] "There certainly is a difference between the mortality of the parts supplied by the three water companies", the medical officer for Kensington recorded, "but I do not attribute this at all to the water, but rather to the drainage, overcrowding, and more especially the clay soil of the northern part".[17]

It was Thomas Orton, medical officer to the Limehouse district, and a combative though fair and thorough opponent of the "exclusive" water theory, who provided the most acute summary of the various explanations which were championed by activists in the public health movement in London in the mid-1860s.[18] The validity of his assertion that ". . . pretty generally amongst all classes the theory of the water poison is repudiated . . . especially among the poor" is open to the objection that many ordinary people do seem to have been aware of at least some of the dangers of drinking unsafe water.[19] But his catalogue of favoured hypotheses on the causation of cholera—an even more richly variegated crop than had been canvassed and found wanting in 1849 and 1854—was comprehensive and authoritative.

Orton identified as many as a dozen epidemiological "schools" and splinter groups. A powerful section of the medical establishment continued to insist on the primacy of meteorological phenomena, but there was also influential advocacy of a more accurate observation both of telluric variables and subtle changes in the level of atmospheric ozone and "electricity". Among the growing numbers of "modern" and "scientific" medical thinkers, who were conversant with the work of Liebig and Pasteur, Orton recorded support for the concept of "zymotic fermentation", although there were serious divergencies as to precisely which agent—fungus, "animalicular body" or "poison"—was alleged to underlay the disease process. The most significant aspect of the survey, however, was the relegation of the distinctive corpus of ideas explicitly associated with the names of Budd and Snow to the most comprehensively criticized and rejected of the "poison"-based categories.[20] Even when proper allowance has been made for Orton's own prejudices, here was potent confirmation of a profound animosity among public health workers both to the "exclusive" water theory and the emerging notion of the specificity of disease.[21]

[16] For a concise delineation of Pettenkofer's work see Major Greenwood, *Epidemics and crowd diseases*, London, Williams & Norgate, 1935, pp. 150–159.

[17] Cholera report 1866, op. cit., note 4 above, p. 263. Evidence of F. Godrich.

[18] Orton's views on the epidemic are contained in two pungent reports. 'Special Report by Thomas Orton, Medical Officer of Health, Limehouse, on the cholera epidemic of 1866', London, 1866; and *Report of the Medical Officer of Health Limehouse (1867) with supplementary and conclusive remarks on the cholera epidemic in east London.* He was particularly scathing towards Captain Tyler, the Board of Trade inspector, whose training, like so many public health functionaries of the time, had been military rather than medical. See Orton, op. cit. (1866), p. 13.

[19] Orton, op. cit., (1866), note 18 above, p. 4. The limitations of his strictures on popular attitudes to unfiltered water are more fully discussed on page 41 below.

[20] Orton, op. cit. (1867), note 18 above, p. 10.

[21] Snow's classic formulation had been: "I consider that the cause of cholera is always cholera; that each case always depends upon a previous one." *Select committee on public health and nuisances removal bill*, Parliamentary Papers 1854–55, XIII, Q 150.

There are interesting parallels with attitudes towards cholera transmission discerned among American doctors and sanitarians by Charles Rosenberg, *The cholera years: the United States in 1832, 1849 and 1866*, Chicago, University of Chicago Press, 1962, p. 199.

On this broader issue of the acceptance or rejection of the germ theory see E. H. Ackerknecht,

It might be concluded from this analysis that the metropolitan medical officers of the mid-1860s had no interest in water quality: but such an assertion would be over-dogmatic. Given the existing, although, as we have seen, confused, consensus on the mechanism of spread of infectious disease, it was inevitable that it would be the issue of quantity rather than quality which would claim the greater attention. If houses and bodies could be kept clean, it was argued, the general death rate would decline dramatically. But the companies' refusal to extend constant supply and their draconian policy towards poor tenants who fell behind with their payments, or who misunderstood or failed to comply with a by now complex body of regulations, retarded progress.[22]

In a political and environmental context of this kind questions of quantity and quality became intertwined and inseparable. For where dwellings or even whole courts were dependent on either a common butt, or on an inadequately serviced cistern, what became known as "domestic pollution" was inevitable.[23] The attraction to medical officers of this particular explanation of the process of infection was that it could be accommodated both within the generalized miasmatic doctrine as well as within a looser version of the "exclusive" water theory. According to the former, emanations from an unsafe cistern interacted with atmospheric impurities to produce disease: according to the latter, cholera or typhoid, in a sense which was never clearly defined, was quite simply swallowed. Thus it was that before, during and after the epidemic of 1866, medical officers sustained a powerful campaign for constant supply and regular cleansing of domestic storage systems.[24] This was a programme which could be advocated without violation of a total belief system still resistant to incorporation of the "exclusive" water theory.[25]

## III

It was within the context of this diverse but not wholly hostile set of theories and counter-theories that the East London Company set about its defence. It was especially fortunate in being able to call upon the services of Henry Letheby, Simon's successor as medical officer to the City of London, who had regularly tested its water in his capacity as analyst to the Association of Medical Officers of Health.[26]

'Anticontagionism between 1821 and 1867', *Bull. Hist. Med.*, 1948, **22**: 562–593; and J. K. Crellin, 'The dawn of the germ theory: particles, infection and biology' in F. N. L. Poynter (editor), *Science and medicine in the 1860s*, London, Wellcome Institute of the History of Medicine, 1968, pp. 57–76.

[22] The policy of the water companies at this time is summarized in Robson, op. cit., note 3 above, pp. 100–120. See also, A. K. Mukhopadhyay, 'Politics of London water supply 1871–1971', Ph.D. thesis, London, 1972.

[23] For contemporary examples of "domestic pollution" see, *Report of the Medical Officer of Health: Shoreditch*, 1859, pp. 12–13: and *Report of the Medical Officer of Health: Hackney*, 1862, pp. 13–14.

[24] See, for example, the comments on this topic in *Eleventh report of the Medical Officer of Health: Mile End Old Town*, p. 17: and *Rivers pollution commissioners: second report: river Lea*, PP 1867: XXXIII: Q 3, 220. Evidence of James Knight, surveyor to the vestry of Mile End Old Town.

[25] This compromise position is well demonstrated by the remarks of J. J. Rygate in *Eleventh report of the Medical Officer of Health: St. George-in-the-East*, pp. 26–27.

[26] Letheby tended to take up a sanguine attitude towards the quality of the capital's water supply, and he thus frequently crossed swords with the more sceptical Edward Frankland. See, for example, Letheby's remarks to the Metropolitan Association of Medical Officers of Health: *Minutes: ordinary meetings*, 17 April and 1 May 1869.

Letheby, one of the most able critics of the water-borne theory, pointed to the technical and methodological difficulties of actually locating the inferred cholera poison.[27] He made telling use of the by now familiar argument that ". . . teetotallers and others who drank largely of the East London Water in its unboiled condition, . . . had been signally exempt from the disease",[28] and that it would have been equally convincing (or unconvincing) to canvass the proposition that the epidemic had been transmitted by a common gas supply.[29] He dwelt at length on the implications of "closed" institutions where there had been heavy consumption of East London water but relatively low mortality, defying supporters of the "exclusive" theory to explain such an apparent anomaly.[30]

Letheby's eloquently destructive skills were badly needed, for by Christmas 1866 the company's case had been apparently fatally weakened by Charles Greaves' sudden and unabashed admission that there had indeed been what he described as an "implied sanction" to draw upon unfiltered water during periods of exceptionally high demand.[31] It is an indication of the continuing novelty of the water theory that the only justification that Greaves felt impelled to submit was that Letheby had assured him that the unfiltered water which had been stored for emergency delivery was of the highest standard. And Frankland's assistant, in the emergency analysis which has already been noted, had not been able to dispute this judgement on chemical grounds.[32]

In the light of Greaves' confession, the formal report by the Board of Trade could not be anything but harsh, yet, from the company's point of view, it was not wholly condemnatory. "A distinct infringement of the provisions of the 1852 Act" had indeed occurred, but the inspector was not prepared to grant the East End complainants their case in full.[33] The crucial rider was phrased in the following terms: ". . . any poison so distributed would have been in a condition, if it were soluble in water, of considerable dilution; and I am not prepared on that account, as well as in consideration of other respects of their district, to go as far as the Memorialists, in asserting that this water was the principal if not the sole cause of the fearful mortality from cholera".[34] In other reports concerned with the allocation of blame for the outbreak, this "deplorable state" of the East End was made to carry a heavier burden: and what has been designated in this article as the "sociological" explanation tended to be given priority over any theory which isolated a specific infective medium.

Although the Rivers Pollution Commissioners deplored the company's laxness in distributing filtered supplies which had then been immediately subjected to admixture with untreated water, they also drew pointed attention to insanitary "local conditions".[35] Similarly, the framers of the report of the Select Committee on East London

[27] Tyler's report, op. cit., note 12 above, p. 460.
[28] *Select committee on the east London water bills*, Parliamentary Papers, 1867: IX: 363.
[29] *Royal commission on water supply*, Parliamentary Papers, 1868–9: XXXIII: Q3, 906.
[30] Tyler's report, op. cit., note 12 above, pp. 458–459.
[31] *Rivers pollution Commissioners*, op. cit. note 24 above, 1867 Q 203.
[32] See above p. 34.
[33] Tyler's report, op. cit., note 12 above, p. 448.
[34] Ibid., p. 460.
[35] Rivers pollution commissioners, op. cit., note 24 above, p. xxi.

Water Bills, which had originally been drafted in the immediate aftermath of the epidemic, noting an "entire concurrence"[36] with the Board of Trade's castigation of the company under the Act of 1852, subsequently revised their conclusions as follows: "We think it right to observe that the evidence leads to the opinion that the spread of cholera might equally be ascribed to defective sanitary arrangements and to other causes".[37]

In such a climate, the East London Company could counter-attack with a degree of confidence and in July 1867, the directors wrote to the Board of Trade disputing the implications which had inevitably been drawn from the inspector's report by the public at large, and seeking what amounted to an official pardon.[38] Carefully pre-selected phrases which the inspector, for reasons of scientific accuracy, had allowed to stand in a deliberately tentative form, were taken from their context and skilfully presented to give the impression that the company had been misrepresented and unjustly maligned. The directors minimized the misdemeanours of 1866, while simultaneously congratulating themselves on undertaking improvements which were, so they claimed, neither required of them by law, nor by prevailing views on the prevention of infectious disease.[39] The Board of Trade, however, declined to reconsider its verdict.[40]

By late 1867 public and specialist opinion had hardened against the company's unrepentant arrogance. In the summer of 1866, William Farr had spoken with deliberate and measured ambiguity of this "disastrous accident in East London".[41] Now the invariably moderate *British Medical Journal,* which continued to support a broadly miasmatic theory of cholera transmission, presented evidence which revealed that on several occasions in 1864 and 1865 as well as in 1866, the company had delivered unfiltered water.[42] According to the more militant *Lancet*, the company had knowingly taken advantage of the scientific and technical difficulties surrounding the chemical identification of the postulated cholera "poison".[43] Such critics had not suddenly been converted to the "exclusive" water theory: what they considered intolerable was that a company which had been given great power over the welfare of the capital, had not hesitated to break the law, while simultaneously arguing that the law itself was redundant.

## IV

The most influential of the public health specialists, John Simon, now urged that the companies be finally subjected to more intensive and better informed public surveillance. "The power of life and death", he declaimed, "in commercial hands is

[36] *Lancet,* 2 November 1867.
[37] *Select committee on east London water bills,* op. cit., note 28 above, p. xiii.
[38] 'Copy of Correspondence between the Board of Trade and the East London Waterworks Company with Reference to Captain Tyler's Report on the Water Supplied by the Company', Parliamentary Papers, 1867, LVIII, 481–493.
[39] Ibid., p. 486.
[40] Ibid., pp. 490–493.
[41] Cholera report 1866, op cit., note 4 above, p. xliv.
[42] *Br. med. J.,* 16 November 1867.
[43] *Lancet,* 2 November 1867.

something for which, till recently, there has been no precedent in the world, and even yet the public seems but slightly awake to its importance." But significantly, and like so many others, he went on to lament the failure of existing techniques of chemical analysis to provide evidence of the existence of the cholera "poison".[44]

When he directly addressed the scientific community, Simon was even more cautious in his assessment of the causation of the epidemic. Netten Radcliffe had prepared an outspoken critique of the behaviour of the East London Company for the medical department at the Privy Council. In a characteristically incisive addendum to Radcliffe's report, Simon asked rhetorically: ". . . for the substance of Mr. Radcliffe's conclusion is it necessary to assume that the water was drunk?" and then proceeded to put the weight of his authority behind an account cast in Pettenkofer's terminology.[45]

Scrupulous scientist and symbolic protector of public health that he was, Simon could not accept hypotheses which had yet to be fully verified under laboratory conditions or through irrefutable statistical and epidemiological research: his strength, as Royston Lambert has noted, lay precisely in his ability to reconcile the progressive and consensus views which have been the subject of this article.[46]

Radcliffe, on the other hand, seems to have been more aware of the urgent need to refute miasmatically-based doctrine in order to dramatize the potential dangers of water and river pollution, to rebuke the water companies, and to weaken the appeal of what appeared to him to be an over-exclusively "sociological" and hence non-scientific account of the mode of transmission of infectious disease.

The two most convincing counter-arguments to the "exclusive" theory, which we have seen stated by the articulate Henry Letheby, were, first, that there was no known practical means of demonstrating the existence of the cholera "poison"; and, second, that large numbers of consumers of allegedly unsafe supplies had nevertheless escaped infection.[47] To neutralize the first objection Radcliffe drew upon the voluminous data gathered during the country-wide statistical surveys undertaken by Simon's department. If this body of evidence were analysed objectively, he contended, then it was clear enough that cholera and typhoid would not ". . . attain general prevalence in a town except where the faulty water supply develops them".[48] To the second criticism, which postulated an alleged logical inconsistency as much as any empirical flaw, he urged that ". . . the positive and generally more applicable facts may justly, and for practical purposes, warrant a conclusion apparently in contradiction with certain negative facts of much more restricted application".[49] Logic, in other words, must be tempered by the dictates of commonsense: the reality of epidemiological fieldwork, warts and all, must replace the caricature so readily derided by armchair sanitarians.

But Radcliffe was expressing a minority view even within the untypical set of

[44] *Royal commission on water supply*, op. cit., note 29 above, Q. 7, 127.

[45] Radcliffe, op. cit., note 2 above, p. 368.

[46] R. S. Lambert, *Sir John Simon and English social administration 1816–1904*, London, MacGibbon & Kee, 1963, part IV, *passim*.

[47] See above p. 38.

[48] *Twelfth report of the medical officer of the Privy Council*, Parliamentary Papers, 1870, XXXVIII, 611.

[49] Radcliffe, op. cit., note 2 above, p. 331.

beliefs shared by the vanguard of the public health movement: of the major figures involved, only Farr and Frankland could be counted as unequivocal allies. In the absence of tests for specificity, of a generally agreed *modus operandi* for the inferred cholera "poison", as well as an only primitive knowledge of the precise bacteriological effects of filtration on raw river water, what might seem to have been the deliberately deceitful obduracy of the East London Company and its apologists, may be more meaningfully located within its proper historical context. Nor need this be interpreted as exoneration for, as we have already noted, the directors and the engineer had indeed flouted the law, and later, tortuously attempted to justify actions which the law condemned.

It is, however, necessary to be clear about both the nature and the aims of the Metropolitan Water Act of 1852, as well as of popular attitudes to water-transmitted disease in the mid-1860s. It is tempting to assume that the clauses which outlawed the use of water from uncovered reservoirs and which insisted on "adequate" filtration were devised rigorously and specifically to prevent large-scale epidemics of the most dangerous water-transmitted diseases, cholera and typhoid. But such an assumption cannot be sustained. The mid-century debate over water supply in London centred more on matters of political and economic control than the effects of unsafe water on public health;[50] and the conservative stance of the medical officers of health a dozen years later demonstrated a continuing scepticism to the radical ideas which had first been proposed by John Snow and William Budd.[51] Despite Thomas Orton's confident generalizations to the contrary, broad associations between unsafe and unfiltered water and "bad health" were widely accepted among the population at large.[52] But causal connexions were only rarely made explicit and were more likely to be intuited by ordinary people than embraced by specialists in social medicine. In this sense, the East Londoner who found a dead and decomposing eel in his supply pipe in 1866 and moved immediately to the conclusion that the East London Company had been responsible for the dissemination of cholera, was closer to a correct analysis than the miasmatist who tended to propound the more generalized "sociological" schema which has been discussed in this article.[53]

During the next twenty-five years, the miasmatic paradigm was finally supplanted by the emerging concept of a still largely inferred germ theory of disease, but the effects of this change on epidemiological and public health practice were by no means pre-ordained. William Farr's long-standing ideal had been a predictive theory which would rest, rock-like on an accumulated body of statistical observation;[54] but

[50] See the definitive analysis in R. A. Lewis, *Edwin Chadwick and the public health movement 1832–1854*, London, Longmans, Green, 1952, pp. 258–279.

[51] For a penetrating interpretation of the wider impact of the ideas of the two innovators see: Margaret H. Pelling, 'Some approaches to nineteenth century epidemiology with particular reference to John Snow and William Budd', B.Litt. thesis, Oxford, 1971.

[52] On Orton's position see p. 36 above.

[53] Material on popular attitudes to polluted water may be found in *Report of the General Board of Health on epidemic cholera*, Parliamentary Papers, 1851, XXI, 21. Evidence of Dr. Gavin, *Report of the General Board of Health on the supply of water to the metropolis*, Parliamentary Papers, 1850, XXII, Q 724–731. Evidence of Robert Bowie and Dr. Gavin; and *Select Committee on the metropolis water bill*, Parliamentary Papers, 1851, XV, Q 6, 139.

[54] On the theoretical content of Farr's approach see: John M. Eyler: 'William Farr on the cholera: the sanitarian's disease theory and the statistician's method', *J. Hist. Med.*, 1973, **28**: 79–100.

for obvious practical and theoretical reasons, this was no more likely to be attained in 1866 than it was a hundred years later. Another school of practitioners, directly descended from the miasmatists, remained loyal to Pettenkofer's postulates which implicitly minimized the possibility of laying bare exact correlations between mortality and any single, given environmental variable.

In the long run, however, it was Netten Radcliffe's persuasively commonsensical, although almost excessively non-doctrinaire advocacy of the detailed analysis of each epidemic within the parameters of a tested corpus of mutually reinforcing medical, scientific and epidemiological knowledge, which eventually superseded its rivals. According to this approach, it was imperative to act *as though* unsafe water was likely to have been the primary medium during any wide-ranging outbreak of cholera or typhoid, and in the thirty years following the epidemic of 1866 it provided the ground-rules for an increasingly efficient surveillance of the metropolitan water supply.[55]

SUMMARY

This article examines a single event—the traumatic cholera epidemic which afflicted the East End of London in 1866—in an attempt to cast light on a more general historical topic: the extent to which laymen and specialists in public health during the 1860s accepted or rejected the theory that infectious disease might be decisively transmitted by unsafe water. Following an account of the chronology and regional impact of the outbreak, the attitudes of two distinct groups, the medico-scientific "*avant-garde*" and the metropolitan medical officers of health, are analysed and compared. It is suggested that it was only an "*élite* within an *élite*"—notably William Farr, Edward Frankland and Netten Radcliffe—that was willing to subscribe wholeheartedly to the view that the cholera had been spread *via* unsafe water, distributed by the East London Water Company. Other progressive thinkers, and, most significantly, John Simon, chose to assess the epidemic in terms that were still heavily influenced by classical miasmatic doctrine; and a majority of the medical officers of health lent their authority to interpretations which reinforced the water company's contention that no single version of the emerging germ theory of disease could adequately explain the course of the outbreak.

In the longer term, the water company's ill-fated admission that it had knowingly flouted the provisions of the Metropolitan Water Act of 1852 provoked widespread public hostility; and, in the aftermath of the epidemic, it was this miscalculation, rather than any transformation in popular attitudes towards the role of water in the spread of disease, which triggered demands for more rigorous public control of the water companies. The "final catastrophe" of 1866—and, especially, Edward Frankland and Netten Radcliffe's consistently outspoken and unambiguous indictment of the "water poison"—had a decisive impact on water treatment policies during the final thirty years of the nineteenth century.

[55] Edward Frankland's role during this period was of central importance. Despite his continuingly "informal" and advisory status in the twenty years following the epidemic, he successfully extended and elaborated his analytic methodology. An impression of his dynamic conception of the "water problem" may be gained by comparing his early comments in Parliamentary Papers 1872, XLIX, 804–808, with his mature *Report* for 1891 in *Registrar-general: summary* 1890–91, pp. xliii–lii.