Sewage Treatment

In 1848 Croydon had been described as "the worst district in the county from a sanitary point of view, with no sewers at all." [1] Cesspools generally prevailed, and the house sullage was thrown into the streets. Foul ditches, open drains and stagnant ponds abounded, including Scarbrook and Lauds' ponds, which received much of the town's drainage. These ponds were especially offensive and injurious to health and their exhalations, it was said, gave rise to epidemics.[2]

In 1848 a Health of Towns report had examined the water supply, town drainage, burials and roads. It was noted that the water supply was abundant but "the springs are nearly all contaminated, the water tainted, privies erected close to the wells in which the 'soil' percolates and with the water rendered impure, the sufferer has no remedy." [3] Despite all the filth and risk of disease, the effort to bring some elementary measure of sanitary reform in nineteenth-century Britain was resisted both in the House of Commons and by the Local Authorities. This was an issue that touched private property in every city in the country, and the vast body of affected interests stood firm against the handful of reformers. [4] However, when news came that a fresh wave of cholera [5] was sweeping into Europe from the East, this provided Edwin Chadwick [6] with a cruel and uncompromising ally.

In 1848 the Public Health Act was finally passed and a Central Commission established, called the General Board of Health, which consisted of a Chairman and two

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[1] *Report of the Sub-Committee of Towns (Health of Towns Association)*, 1848, p.6. (Thereafter called Health of Towns, 1848)
[2] *Statement of the Preliminary Inquiry by T Southwood Smith and John Sutherland on the Epidemic at Croydon; together with Reports by RD Grainger and Henry Austin*, London, G. Eyre and W. Spottiswoode, 1853, p.36. (Thereafter called *Statement*).
[3] *Health of Towns* 1848, p.6.
[4] A. Wood, *Nineteenth Century Britain 1815-1914*, Harlow, Longman, 2nd Edition, 1982, p.119.
[5] Cholera had first appeared in Britain in 1832-3.
[6] Edwin Chadwick, (1800-1890). In 1847 Chadwick was appointed to the Royal Commission on London Sanitation and a Metropolitan Commissioner of Sewers.

Commissioners. [7] The Chairman, Lord Ashley, was already Chairman of the Health of Towns Association and the two Commissioners were Southwood Smith [8] and Chadwick. The Board had the power to require the formation of Local Boards of Health (which reported to the GBH) if petitioned by 10% of the local ratepayers or if the locality's death rate exceeded 23 per 1,000 [9] (the national average was 21 per thousand). Lawrence has noted that:

> The significance of this Act scarcely lies in its content. It was for the most part permissive, empowering local authorities if they wished, to initiate local reforms by removing nuisances, laying down sewers and so forth. But as a government intervention into the conditions perceived to be connected with the production of disease, it was monumental. [10]

Fee and Porter point out that, "the power of the Act, however, was seriously undermined by being adoptive rather than compulsory, and it thus resulted in uneven standards of public health regulation throughout the kingdom." [11] Croydon's response to the Act is now discussed.

Edward Westall [12] and Cuthbert William Johnson [13] together sought to apply the Public Health Act to Croydon and petitioned the General Board of Health, having secured a petition signed by one-tenth or more of the Croydon ratepayers. Westall had been a Croydon resident since 1831 and Johnson since 1847/48. Johnson was a barrister and an active

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[7] R.A Lewis, *Edwin Chadwick and the Public Health Movement, 1832-1854*, Longmans, Green and Co, London, New York and Toronto, 1952, pp.182-3. (Thereafter called Lewis).
[8] Thomas Southwood Smith (1788-1861); sanitary reformer; MD Edinburgh 1816; founded the Health of Towns Association; wrote valuable works on epidemics and sanitary improvements; Jeremy Bentham left his body by Will to Smith for dissection in 1832; *Concise DNB 1948*, p.1217.
[9] Bynum, p.77.
[10] C. Lawrence, *Medicine in the Making of Modern Britain 1700-1920*, London and New York, Routledge, 1994, p.48.
[11] Cited in A..Wear (ed), *Medicine in Society*, Cambridge, Cambridge University Press, 1992 from E. Fee and D. Porter, 'Public Health, Preventive Medicine and Professionalization: England and America in the Nineteenth Century,' p.253.
[12] Edward Westall was a Croydon local GP who assisted in the formation of the Croydon Local Board of Health. He also prepared Croydon's quarterly returns for mortality from 1848-72.
[13] Cuthbert William Johnson (1799-1878); agricultural writer; barrister, Grays Inn 1836; FRS 1842; published *The Farmer's Encyclopaedia*, 1842; *Farmers Medical Dictionary*, 1845; *The Life of Sir Edward Coke*, 1837; translated *Thaer's Principles of Agriculture*, 1844; collaborated with W. Shaw and his brother, George William Johnson. *Concise DNB*, p.695.

member of the Metropolitan Commission of Sewers, and together with Chadwick, materially advanced the cause of sanitary reform in London.[14] *The Croydon Advertiser* pictured him virtually as Croydon's Mayor, "seated in his canopied chair, with his velvet cap, faultless necktie and expanse of shirt, a character not unlike Chadwick's, formidable and intolerant of fools." [15]

Croydon's Local Board of Health was formed in August 1849 [16] and on 27 November 1849 Thomas Cox, Croydon's Surveyor, prepared a fourteen page report entitled *Report to the Local Board of Health of Croydon Relative to Drainage and Water Supply*. It contained details of land and surface drainage, sewerage and water supply; suggestions as to the abolition of cesspools, privies, ponds, and ditches containing foul matter; a description of the principal main drains for conveying the sewage from houses; and estimates of the probable cost of the execution and maintenance for five years, of the principal works recommended. The new works were approved and work commenced in November 1850. By December 1851 Croydon had completed 'the combined works' of a constant fresh water supply, tubular drainage and sewage recycling.[17] The Croydon Local Board, under its vigorous chairman, Johnson, was now regarded as one of the most progressive and successful of the General Board's satellite authorities. Edwin Chadwick and Thomas Southwood Smith had attended a pleasant and heartening ceremony at the opening of the 'combined works.' They had looked on benevolently as the Archbishop of Canterbury, John Bird Sumner, lifted the valve of the great steam engine that pumped water to the high level reservoir. This vast tank was capable of holding 900,000 gallons, which, as Johnson explained, would supply all the houses in Croydon 'on the constant service principle.' Chadwick observed that Croydon was

[14] 'The History of Sanitary Progress in Croydon,' p.4.
[15] *Croydon Advertiser*, 2 May 1873.
[16] Croydon was the fifth Local Board to be set up in August 1849 after Uxbridge (April), Coventry (June), Chatham and Durham (July). By 1856 there were 185 Local Boards. CF Brockington, *Public Health in the Nineteenth Century*, Edinburgh and London, E & S Livingstone Ltd, 1965, p.185.
[17] *Illustrated London News*, 20 December 1851, pp.725-6.

"honourably in advance of the 130 towns now placed under the Public Health Act," and Southwood Smith predicted that, "the time was not long distant…when fever would never occur in such a town as Croydon, or that if a single case of fever did occur, it would then attract so much surprise and immediate investigation, as the breaking out of an epidemic in a prison." [18] As it turned out Southwood Smith's words were all too accurate.

THE CROYDON CASE

The 'Croydon Case' of 1852-53 was a typhoid epidemic, which affected one in ten of Croydon's inhabitants. This was despite Croydon being one of the first towns to adopt the 1848 Public Health Act and completing the 'combined works' of a constant fresh water supply, tubular drainage and sewage recycling by December 1851. Those attending the opening ceremony of the 'combined works' included Edwin Chadwick and Thomas Southwood Smith, the two Commissioners from the General Board of Health.

The 'Case' attracted widespread publicity and embarrassed Croydon's Local Board of Health, the General Board of Health and the Government.[19] Three separate investigations took place to find out the cause(s) of the epidemic, and these are discussed later. In the investigations William Ranger, an inspector to the General Board of Health, came in for particular criticism. He had been the engineer in charge of Croydon's 'combined works' and had reduced the size of Croydon's sewer pipes from six-inch to four-inch on the grounds that their design was too costly.

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[18] Ibid.

[19] C. Hamlin, *Public Health and Social Justice in the Age of Chadwick, Britain, 1800-1854*, Cambridge, Cambridge University Press, 1998, pp. 324-7; R.A. Lewis, *Edwin Chadwick and the Public Health Movement 1832-54*, London, Longmans, Green and Co, 1952, pp.315-8; SE. Finer, *The Life and Times of Sir Edwin Chadwick*, London, Methuen and Co, 1952, pp.447-8; B. Lancaster, 'The "Croydon Case": Dirty Old Town to Model Town - The making of the Croydon Board of Health and the Croydon Typhoid Epidemic 1852-53,' Croydon, Croydon Natural History and Scientific Society, Published by the Croydon Natural History and Scientific Society, 2001, vol.18 (7), pp.145-206; E. Landor, 'Public Health, Cholera and Mortality in Croydon in the Mid Nineteenth Century,' Unpublished final year dissertation for BA at Stirling University, 1974.

THE EPIDEMIC

Despite all the improvements in Croydon, isolated cases of fever began to appear by July and August 1852, reaching epidemic proportions by November 1852. On 11 January 1853 the following entry appeared in the Minute Book of the Croydon Local Board of Health:

> An epidemic of very serious and distressing character is prevailing in Croydon notwithstanding the extensive works of the Board for improving the sewage, drainage and water supply to the Town and neighbourhood and that it is advisable to solicit the immediate investigation by medical officers of the General Board of Health into the nature and cause of the disease. [20]

On 20 January 1853, George Bottomley, a Croydon surgeon, wrote to the *Surrey Standard* attributing the fever to local causes, saying he thought the illness was ordinary gastric fever. Carpenter wrote a reply to the *Surrey Standard,* saying that he and Westall had attended 370 cases and felt that the fever in Croydon was different to common fever. Only seven of these cases had proved fatal, giving a mortality rate of less than two per cent. Carpenter also listed the symptoms which were "the frequency of glandular complications, the frequent presence of an irregular rash, and in severe cases the universal presence of rose coloured or else livid spots on the abdomen." [21] Carpenter also claimed that the disease was not infectious or contagious. *The Times* reported on the 'Fatal Epidemic at Croydon' on 25 January 1853, and said that "the town and neighbourhood of Croydon are suffering from a fever of a very fatal character, which during the last fortnight, has been most fatal in its results, the victims being not, as is usually the case, among the poorer classes, but among the gentry and principal tradesmen in the town." The article referred to a mortality of 17 per 1000. Other critical

[20] Full Minutes of the Croydon Local Board of Health. (Thereafter called CLBH Minutes). The date given in the *Statement*, p.1 is given as 17 Jan 1853, which is incorrect.

[21] B. Lancaster, 'The "Croydon Case": Dirty Old Town to Model Town: The Making of the Croydon Local Board of Health and the Croydon Typhoid Epidemic 0f 1852-3,' Croydon, Croydon Natural History and Scientific Society, 18 (7) 2001, pp145-206, see p.183. (Thereafter called Lancaster). In typhoid fever "rose coloured spots" appear during the second week of the disease. Although Carpenter described these spots in his letter to the *Surrey Standard* he went on to say that the disease was not infectious or contagious.

letters followed, prompting the Local Board to gather all the doctors in Croydon to a meeting of the Board on 27 January 1853. [22] Thirteen out of Croydon's fifteen surgeons attended and four resolutions were agreed. On 29 January 1853 these resolutions were published in the *Times* as follows: [23]

1) That the disease exists extensively in other places besides Croydon.

2) That the rate of mortality in the cases of the epidemic in Croydon is unusually low.[24]

3) That the public reports relating to the fatality of the disease in Croydon, which have appeared in the newspapers, are very much exaggerated.

4) That the new cases within these few days have materially diminished in numbers.

The resolutions were also printed on handbills and distributed in Croydon.

However, by February 1853, eighteen hundred people had been affected, with sixty deaths [25] amongst Croydon's population of sixteen thousand.[26] At approximately the same time, about one hundred cases of breakages and blockages - from flannel, hay, shavings, paper, hair, sticks, kittens, a night cap, a cat, pig's entrails, a bullock's heart- began to be discovered in the pipe sewers. It was also reported that several inches of raw sewage covered some cellar floors and sewage saturated the ground outside the houses.[27] As a result of the deepening crisis, three investigations took place. First an independent report by Simon at the request of Croydon's Local Board of Health, [28] second a report from the General Board of

[22] CLBH minutes.
[23] *The Times*, 29 January 1853, p.7.
[24] Baldwin Latham states a death rate of 27 per 1000.
[25] The number of deaths varies: R.D. Grainger with 41; Neil Arnott with 60; Thomas Page with 70.
[26] *Reports, by Neil Arnott and Thomas Page on An Inquiry by the Secretary of State, Relative to the Prevalence of Disease in Croydon, and to the Plan of Sewerage, together with an Abstract of Evidence Accompanying the Reports,* London, G.E. Eyre and W. Spottiswoode, 1853, p.3. (Thereafter called Reports). Croydon's population is quoted as about 16,000, which is incorrect. According to Baldwin Latham, Croydon had a population over 16,000 as early as 1840, and in 1853 the population was 22,261.
[27] Croydon Local Board of Health to Home Office, 23 December 1853, PRO HO 45/5105.
[28] J. Simon, *Report to the Local Board of Health, Croydon, with Regard to the Causes of Illness Recently Prevailing in that Town*, Croydon, J.S. Wright, 1853, p.19. (Thereafter called Simon).

Health by Southwood Smith, John Sutherland, Richard Grainger and Henry Austin, [29] and third a Home Office Commission conducted by Neil Arnott and Thomas Page.[30]

Simon's Report

In 1853 there was no general agreement as to the causes of febrile disease and theories focused mainly on miasma, water propagation or a combination of both. Simon's report is now discussed.

Simon was asked by Johnson to ascertain if the new works, either by their failure or otherwise, had been instrumental in the production of disease. Simon's *Report to the Local Board of Health, Croydon, with Regard to the Causes of Illness recently Prevailing in that Town* acknowledged that during the previous fifteen months there had been progress with the Croydon water supply and house drainage, when it was hoped that it would improve the health of the population. However, as these sanitary works approached their completion, there arose in the town an unusual prevalence of fever and diarrhoea, which reached an unprecedented and epidemic severity. Simon's report listed a number of presumed relevant factors and causes of disease. These included fever prevailing elsewhere, unusual rainfall, impurity of water, great influx of day labourers, the absence of paving, defects in house drainage, remains of the former drainage system and failure of the new sewerage system.[31] Paradoxically, Simon felt that Croydon was far better off at that present time (1853) than it had been eighteen months previously.

Simon looked at the distribution of house filth and pointed out that the cesspools of eighteen hundred houses had been emptied. With reference to sewerage he noted that the greater portion of the daily sewage passed to an open building called the Filter House, where it entered a large tank measuring 3000 square feet. The sewage was partially strained of its solid ingredients and peat charcoal was spread on the surface. Intercepted solids were

[29] *Statement.*
[30] *Reports.*
[31] Simon, pp.5-7.

conveyed at night through the town for agricultural purposes, and the residual fluid passed from the filter house over a short distance to the river Wandle. Some of the sewage from four hundred houses at the North End of the town passed off by two pipes unconnected with the Filter House and was discharged without any interception or delay on to a field of about seventeen acres, where it collected in shallow pits and was then diffused in trenches. Large quantities of ordure were transported by carts from the cesspools and the Filter House and then taken to a farm. The field was saturated with animal manure beyond its power of digestion and had become a giant cesspool. Simon pointed out that "faecal evaporation and decomposition were a sufficient cause of disease and the main object of the Board was to remove cesspools from the immediate vicinity of houses." [32] Simon noted that the overflow of sewage began in December…and that the general disturbance of impure earth, necessary during your works, contributed continuously to the "fog of faecal evaporation" and led him to believe that miasma[33] was the cause of the recent illnesses. Simon made seven observations and suggestions at the end of his report, which are summarised as follows. All domestic drain-works should be inspected by a designated person; the utmost vigilance would be necessary to guard against renewed arrest of drainage either by obstruction of the sewers or their breakage; cesspools should all to be filled up; the old drainage in the High Street should be scrupulously examined in order to perfect its cleanliness; the general paving and street cleansing of the town required considerable improvement; the sewage outfall required re-consideration, and steps should be taken to reduce, within as narrow limits as possible, the present evils. The discharge of sewage into the river Wandle, he said, rendered the water unfit for human consumption. Simon admitted in his report, "this pollution cannot have affected the population of Croydon, I do not consider their discussion to lie within the scope of your

[32] Simon, p.11.
[33] The term miasmatic is one of the most ambiguous terms in the history of nineteenth-century medicine according to M.Worboys, *Spreading Germs, Disease Theories and Medical Practice in Britain, 1865-1900,* Cambridge, Cambridge University Press, 2000, p.38. (Thereafter called Worboys)

Chairman's reference." [34] In conclusion, Simon felt that the causes of the epidemic "all appear to be removable; that some of them have belonged almost of necessity to your period of transition; that none of them can be accounted essential to the improved system (of sanitary reform in Croydon)." In a post-script, Simon analysed the Surveyor's list of thirty-eight accidents (obstructions) that affected the sewers between 27 March and 10 November 1852. He also commented on the optimum size of the sewers and felt that this had not been generally agreed upon. Five hundred copies of Simon's report were printed by order of the Local Board, and he was paid a fee of 25 guineas, a fee he considered inadequate [35] compared to the £220 paid to Thomas Wicksteed, [36] the civil engineer.

Statement of the Preliminary Enquiry

The second report, *Statement of the Preliminary Enquiry*, by Southwood Smith, Sutherland, Grainger and Austin was completed on 21 April 1853. Carpenter[37] gave the first piece of evidence:

> Mr Carpenter, surgeon, who informed us, that the earliest recognised case of the disease had occurred in September last, in a person who came from Oxted, where a similar form of the disease was stated to have been prevalent. This case presented the same peculiar symptoms as the cases, which subsequently occurred in the town. It was also stated, that fever of the same character had existed in other places distant from Croydon.[38]

Southwood Smith and Sutherland blamed the fever on a mix of general constitution of the atmosphere (fever had been widespread that autumn), contagious transmission (the

[34] Simon, p.13.
[35] CLBH Minutes, 28 March 1853 and 5 April 1853.
[36] Ibid, 23 November 1853.
[37] Alfred Carpenter (1825-92) qualified at St Thomas' hospital and moved to Croydon in 1852 where he worked until his death in 1892. He became a leading light in the public health movement and was a lecturer in public health at St Thomas'. He looked after four successive Archbishops of Canterbury in Addington Palace and 'closed the eyes of three'. He was medical attendant to the cadets of the East India Company at Addiscombe College.
[38] *Statement*, p.1.

epidemic had been imported from a nearby village), and, as local causes, the excessive and long continued prevalence of rainy weather. Hamlin points out that Southwood Smith had been claiming for almost three decades that bad fever meant bad sewerage. The elements atmosphere, contagion, and dampness were all legitimate parts of an explanation of a disease outbreak. Hamlin argues that, as with the destitution years earlier, it was what was missing from the explanation that was significant. [39]

Hamlin also points out that Grainger's report took the same general strategy. He represented Croydon as intrinsically unhealthy. There were miasms, which arose in cleaning old sewers, emptying old cesspools, and spreading night soil, all in contravention of the General Board of Health instructions. And with overcrowding (seven people in two hundred square feet in some dwellings), it was no wonder that there was fever.

Austin's report focused on the breakages and the blockages in the sewage pipes. The chief problem was the bad connections between house drains and public sewers, and these were the responsibility of Croydon's surveyor, Cox. Also, things had been put into the pipe sewers that should not have been and, grudgingly, he admitted that Ranger's downsizing had been unwarranted. Worse, it had slipped past the Board's scrutiny, a fact that Austin's excuse - "It would not be supported that you [the GBH] would direct an examination of every minute portion of the many plans for which your sanction is demanded " - could not disguise. [40]

Southwood Smith and Sutherland's report contained the fullest description of the disease, which was noticeably absent from Simon's report. Grainger noted that "the type of the disease was what is professionally termed typhoid, not true typhus." [41] He later said that "in adults the fever was essentially of the continued form, whereas in children was remittent and of importance with reference to the cause of the outbreak." The report said that all the

[39] C. Hamlin, *Public Health and Social Justice in the Age of Chadwick, Britain 1800-1854*, Cambridge, Cambridge University Press, 1998, p.325. (Thereafter called Hamlin).
[40] Hamlin, pp.325-6.
[41] *Statement*, p.18.

practitioners who were questioned on the fever agreed that the present epidemic was different to that which had occurred in Croydon in former years. Later he went on to say that in "the great majority of cases the excretions contained bile; but in several instances the attack exhibited the leading marks of true cholera." For example, a Mr Hubbert observed, "it has attracted my attention that this diarrhoea was in many cases decidedly choleric, there being rice-water dejection's, the sunken eye, cold breath, great prostration, intolerance of heat, a sense of burning, heat on swallowing cold water, and in two cases complete suppression of urine." [42] Grainger wrote, "it is not, therefore, surprising that with such a large number of diarrhoeal attacks at Croydon, some of them should have presented the choleric type." Grainger recorded 1526 cases of fever and 41 deaths in the period from July 1852 to January 1853. He also highlighted the fact that Croydon did not have a Medical Officer of Health at this time and commented:

> In the Circular addressed to Local Boards of Health 'On Cleansing of Towns,' among other instructions the following appears: 'The clearance of cesspools, particularly during epidemic periods, is an operation of much danger in the manner in which it is ordinarily done. It should be done with copious dilution of the contents in water, with a pump and hose, and with the use of deodorisers.' So great is the importance attached by the General Board to the proper performance of this class of works, that they deem it essential they should be supervised by a medical officer of health. [43]

Grainger arrived at eleven conclusions, which are summarised below:

1. In former times Croydon suffered with epidemic disease, which in some years exceeded London and therefore indicated serious local causes of unhealthiness.

[42] *Statement*, pp.18-9.
[43] *Statement*, p.26.

2. The unprecedented character of the season from July 1852 - January 1853 inclusive in Croydon, as elsewhere, operated unfavourably on the public health in Croydon and predisposed the inhabitants to epidemic fever.

3. The accidental occurrence of the Bourne rivulet had operated very unfavourably.

4. Some cases had the characteristics of cholera.

5. The large number of fever cases and the enormous amount of diarrhoea had depended on a general epidemic influence and local conditions.

6. Local causes were effluvia arising in the interior of the houses or in their immediate proximity, owing to the defects and obstructions in their new drains, and the existence of old house-drains, and the overcrowded and unventilated condition of many dwellings of the poor.

7. The Filter House should be moved further from the town due the accumulation of a large amount of cesspool matter and precautions should be to prevent the escape of effluvia.

8. The practice of irrigating the meadows at Brimston Farm…generates effluvia in certain states of the weather, and should be discontinued.

9. That the spreading of night soil in large quantities in solid form and without proper precautions, in the immediate vicinity of the town, is objectionable and should not be carried on in future.

10. That in houses unconnected with the new works, and often distant from the town, fever and other zymotic diseases had prevailed to a large amount.

11. In connection of the new works with the epidemic, it is evident that they have not, under the circumstances recited in Mr Austin's Report, accomplished the great ends

> of sanitary improvements, though to some extent they may have mitigated the predisposing causes of epidemic disease. [44]

Grainger concluded by saying:

> There are in Croydon a large number of miserable dwellings, entirely unventilated and often densely crowded. Many of these I examined; and as overcrowding is, according to my experience, the most deleterious of all sources of preventable disease, I beg to state my conviction, that until these unwholesome dwellings, some totally unfit for human habitation, are placed in a more satisfactory condition, they will, notwithstanding the provision of efficient external works, continue to be in future, as they have been in former years, a constant source of zymotic disease, and of expense to the ratepayers of Croydon. [45]

> Austin's report highlighted the entire absence of ventilation in every part of the system.[46] He also pointed out the Local Board's lack of supervision:

> Regulations were issued by the Local Board, 'to be observed by persons proposing to connect their premises with the sewers or water pipes of the Board,' to secure the fulfilment of which it was very properly stipulated that 'no drains or water pipe is to be covered up until it shall have been inspected by an officer appointed by the Board for that purpose…Beyond the small number of houses first drained under the immediate direction of the officers of the Local Board, no such inspection has taken place, and builders and owners have apparently been allowed to proceed with this important branch of the work in any mode they pleased.' [47]

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[44] *Statement*, pp.33-5.
[45] *Statement*, p.34.
[46] *Statement*, p.43.
[47] *Statement*, p.41.

Home Office Commission

The appointment of a Home Office Commission reflected the government's general suspicion of the competency of the General Board of Health, and Chadwick realised at once that the Board and its works were in the dock.[48] Neil Arnott and Thomas Page conducted the independent Commission and their report, *The Prevalence of Disease in Croydon,* did not confirm the findings of the previous two reports. The report is dated 14 February 1853 although their *General Report* was not completed until 21 April 1853 (the date it was submitted to Lord Palmerston). The Commission had held open court in Croydon on 25 February, and 5 and 10 March 1853. Of the two reports, Page's thirty-four-page engineering report was more comprehensive and critical than Arnott's seventeen page medical report. As well as the above reports, two house-to-house surveys were conducted with questions concerning stoppages in the sewers, and illness. The first survey was by a Mr Baker for Grainger and Austin and the second by a Colonel Thompson for Arnott and Page. Finer writes, "their joint report came as a terrible shock. It confirmed all that the population of Croydon had been saying: the plan for sewerage had caused the epidemic, and the chief reason was the use of pipe drains and pipe sewers! " [49]

Page's report contained a chapter headed 'Of the absence of Ventilation in the Pipe Sewers' and remarked that "this important element of health and comfort, which has been generally neglected in dwellings, and almost totally neglected in sewers, which *must* soon be introduced into every plan of sewerage present or to come, has been entirely overlooked at Croydon." [50] Arnott, on the other hand, felt that because the promised downward ventilation was not occurring, the new sewers became a network for distributing deadly poison throughout the town, with gas rising through the network and out through drains.

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[48] Lewis, p.316.
[49] S.E. Finer, *The Life and Times of Sir Edwin Chadwick*, London, Methuen, 1952, p.447. (Thereafter called Finer.)
[50] *Reports*, pp.33-4.

The pollution of the river Wandle came in for criticism. Page's report pointed out that it was most unjustifiable to throw the filth from 10,000 people in Croydon into a stream from which at least as many hundreds had to drink, and recommended a better disposal of sewage. [51] Because there was no effective surface drainage, groundwater had seeped into the pipe sewers (intended only for household drainage), overtaxing the filtering plant and also contributing to the contamination of the nearby river Wandle.

Page found a correlation between fever and the new sewers, a matter on which the Board's doctors had been silent. He felt that Ranger had been arbitrary in his downsizing of the sewer pipes, and that Cox had not supervised the house connections carefully and had accepted poor quality pipe. [52] Inspection of the sewers had proved difficult, because there were only five manholes in seventeen miles of sewer.[53] Page took up broader issues of the Board's philosophy of technology. He recognised that one could only judge success or responsibility within a framework of assessment. Ranger's design was acceptable in terms of GBH doctrine, although the actual work was not; nor was the Board's oversight. However, from the perspective of the state of the art in pipe sewerage, Ranger's sewers were too small, long and thin. But judged in terms of health and cleanliness, the entire project was wanting. The main blame fell on neither Cox nor Ranger, but on the author or promoter of the mischievous system [Chadwick] who was sitting in self-gratification far away from the scene of strife.

Finer writes, "Chadwick was beside himself with vexation when the Report [by Arnott and Page] reached him. He ascribed the failures at Croydon to the bad workmanship of the jobbing builders and lack of superintendence." [54] With regard to the downsizing of the sewer pipes and the blockages, Chadwick felt a smaller pipe would increase velocity [of the

[51] *Reports*, p.52. One of the processes put forward was by Thomas Wicksteed, engineer to the patent solid sewage manure company.
[52] Hamlin, p.326.
[53] Reports, p.49.
[54] Finer, p.447.

water] and prevent deposition and he therefore supported Ranger.[55] Chadwick conceded that the pipes were thinner than the Board had specified. However, despite these problems only 150 yards of sewer had been broken, in a very deep cutting, whereas no less than sixteen miles of sewers were working successfully. Chadwick also questioned why the epidemic could be ascribed to the new works when its first visitation was at Oxted, [56] three quarters of a mile away? He also pointed out that the epidemic [number of cases] was three times worse at Oxted and six times worse at Sheriff Hutton.[57] Chadwick sat down to write a reply and exonerate himself and the GBH, and it was all that Shaftsbury [58] could do to persuade him that his letter was too controversial for publication. Instead Shaftsbury recommended that Chadwick should hand the matter over to Henry Austin.[59] In his letter to Chadwick, Shaftsbury wrote, "if sent forth as I have before me in MS, it would be absolutely the ruin of the Board [GBH]. You, I, and the Doctor, [Southwood Smith] we three, should *by our own act and deed*, be cast down, bound hand and foot, into the burning fiery furnace." [60]

A battle of reports and counter reports began and continued into the summer of 1854. The civil engineers publicly attacked the GBH while giving evidence before the Select Committee on the Great London Drainage Bill, thus damaging their reputation. Other reports followed. As a result, the confidence in the Croydon Local Board of Health was badly shaken and Johnson, the Chairman, lost his seat in the 1853 Local Board elections. Chadwick's reputation was also severely damaged, and in 1854 he was pensioned off after a bout of illness. Despite this setback Chadwick continued to be active in the Society of Arts, Social Sciences Association and the Sanitary Institute of Great Britain, and became a friend of Carpenter. I will now discuss how sewage is treated and disposed of.

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[55] Hamlin, p.324.
[56] Oxted is approximately ten miles from Croydon and not three quarters, as quoted in Finer, p.448.
[57] Finer, p.448.
[58] Previously known as Lord Ashley. He succeeded to the Earldom in 1851.
[59] Finer, p.448.
[60] Cited in Lewis, p.318. Letter from Shaftsbury to Chadwick, 15 October 1853.

SEWAGE TREATMENT AND DISPOSAL

On 7 March 1855 a meeting took place at the Society of Arts, London and a paper was given by John Bennet Lawes on 'On the Sewage of London.' [61] Lawes highlighted the economic factors of sewage disposal and reported that, " Of late years much money has been uselessly expended in patents and inventions for converting the sewage into portable manure, which might have been saved by a better knowledge of the true principles of manuring, and the wants of agriculture." [62] One of these patents was 'Wicksteed's Process' named after its originator, Thomas Wicksteed, who was not convinced that sewage irrigation would work and included calculations to show the impossibility of employing such a large amount of liquid by irrigation.[63] His process consisted of adding lime to the sewage, and the liquid mud was then put into a centrifugal machine to throw off the water. The resulting manure was dried off in sheds with a current of air and the manure sold off from £2 to £2.13s per ton. Lawes argued that Wicksteed's plans were too expensive costing a capital of one million to apply to the metropolitan sewage. Lawes argued that:

> … those who advocate the employment of sewage by irrigation, must therefore seek for an extensive tract of land at no great distance from London on which to deposit this fluid; whilst those who propose to separate from it a solid manure, must produce a substance of sufficient productive value to bear the cost of carriage to all parts of Great Britain.

Lawes believed that grass was the most suitable crop for the application of liquid sewage (solid faecal matter which was partially dispersed in water and strained of any residual solid matter by a filter), and that experience alone could decide what was the minimum area of land that would yield the maximum produce and rental from the sewage of London. "And

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[61] John Bennet Lawes, 'On the Sewage of London,' *JSA*, vol. 3, 1855, p.263-77. Also published into a 34-page pamphlet. (Thereafter called Lawes)
[62] Lawes, p.263
[63] Lawes, p.275.

grass being the produce grown, so milk and cream should be the chief products obtained in return." In conclusion Lawes said, " Whilst, therefore, they must be justly charged for the removal of the sewage on sanitary grounds, they might surely demand, that the cost should be lessened by a proper application of sewage; and it appears to me, that a liberal distribution of it on grass, is the most promising means of attaining this result." [64] Chadwick joined in the discussion afterwards, and the *JSA* reported the following:

> The only instance in which there had been any observations of which he [Chadwick] was aware of value in respect to sewerage in the new conditions as to drainage, were those of Mr Cuthbert Johnson [65], who for several years had observed the application of the sewerage on his own house to a plot of land, and had analysed the soil water, and noted the products on grass carefully. On his scale 33 acres of land would be required to apply the sewerage of 1000 persons on grassland. [66]

Another method of sewage disposal was the Pneumatic System, which was popular on the continent and invented by a Dutch engineer called Captain Liernur. The process consisted of a locomobile steam engine working an air pump, which extracted all the air out of the interconnected sewage pipes and in turn created a vacuum. The hermetically-closed house valves, were then, one after the other, opened and shut, thus discharging the privy contents, including all gases, into a street reservoir. These reservoirs were emptied at regular intervals by horse drawn pneumatic tenders and transported the sewage to decanting stations situated near a railway station, steamboat landing or canal.

Electricity was also used to treat sewage. For example at the Annual Meeting of the BMA in Birmingham held in July 1890, James MacLintock, MOH for Bradford, gave a paper to the Section of Public Medicine on 'A Discussion on the Electrical Treatment of Sewage.'

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[64] Ibid, p.277.
[65] Chairman of the Croydon Local Board of Health. In 1853 Johnson lost his seat on the Board after the 'Croydon Case' and was not re-elected until the 1862 elections.
[66] *JSA*, vol.3, 1855, p.281.

He highlighted the difficulties with the Bradford sewage, which included a large proportion of manufacturing refuse. The *BMJ* reported MacLintock as saying that "A large quantity of grease and other organic matter from wool washing gets into the sewage and materially enhances the difficulty of treatment, as well as in itself being of an offensive and dangerous character." The second difficulty with Bradford was the absence of available land for irrigation or filtration works in the immediate neighbourhood. The *BMJ* reported the following:

> Bradford is situated in the midst of a large number of manufacturing districts. It is entirely surrounded by busy and populous communities, which are ever on the watch to resist the establishment of any sewage or other works, which might prove detrimental to their interests. From the conformation of the land no site is available for irrigation or filtration works within the boundaries of the borough. The corporation has therefore been forced to adopt the system of precipitation, lime being the material employed.

The electrical treatment required an 'electrical plant' consisting of the following equipment: an electrolytic shoot [67] or channel; electric generator; motive power for the generator; necessary conductors for conveying the current to the shoot from the generator. The cost of the equipment was not mentioned and the *BMJ* quoted MacLintock as saying: "As to the question of cost, I am sorry that I have no definite information to lay before you. There can be no doubt, however, that a large initial expenditure is necessary on account of the immense quantity of iron employed, and the large amount of tank room necessary." The sewage passed between the vertical plates of the shoot, which were connected to the electrical supply. Some of sewage was also treated in a second shoot. The effluent then flowed into a

[67] The 'shoot' was constructed of brickwork and was 25 ft in length, 24ins wide, 4ft in depth. It was divided into eighteen cells each containing twenty iron plates, measuring 3ft x1ft 2ins x ½ ins and each plate weighed 70lbs.

channel, were it was further aerated and flowed into the Bradford Beck, a tributary of the river Aire.

During the discussions which followed, the *BMJ* reported the following: "The President [Alfred Hill, MOH from Birmingham] said he did not think the effluent from the electrical treatment was sufficiently pure to go into the stream to be used lower down for drinking purposes." The *BMJ* also quoted Carpenter and reported the following: "Dr Carpenter advocated sewage farming as the only useful method of utilising sewage. He referred to the Birmingham Sewage Farm [sewage irrigation] as a satisfactory solution of the difficulty as regards Birmingham. The electrical treatment could not remove much of the dissolved organic matter of sewage." [68]

SEWAGE IRRIGATION

Before we look at Carpenter's involvement with Croydon's sewage at the Beddington Farm and the use of sewage irrigation (the application of liquid sewage to fields of rye grass) it is necessary to look at the broader picture of sewage irrigation. I now discuss the sewage arrangements of Cuthbert Johnson and Alfred Crowley, both members of the Croydon Local Board of Health, who provoked adverse comments from the local residents and the press.

Criticism of Croydon Board members

Cuthbert Johnson (Chairman) and Alfred Crowley came in for criticism from local Croydon residents for irrigating their gardens with their own sewage. In his defence, the *Croydon Chronicle* reported Johnson as saying, " He knew that his sewage could not be a source of annoyance to anyone, because it was not allowed to decompose, and he was certain that no one could smell it, because no smell existed." Crowley was reported in the same article as

[68] *BMJ*, 1890, ii: 498-9

saying, " the gentlemen who had signed the letter in question appeared to be fighting upon an idea and not upon a fact." [69] In the discussions that followed at the Local Board of Health, reports from Philpott (the MOH) and Thomas Walker (the engineer) were read. Latham informed the Board that under the Public Health Act it was for the surveyor to report if a house was not properly drained, and in that case it must be connected with the sewer. The following appeared in the *Croydon Chronicle*:

> My [Johnson] operation has gone on for 27yrs, and I have never had any complaint. I believe that Mr Powell, who has agitated my waters, has admitted to a member of the Board that there is no smell. If we have created an offensive smell, we should have had the first enjoyment of it - (laughter) - but my neighbours, on both sides of me declare they have never smelt anything. [70]

The Board decided that following favourable reports from the officers, they were not prepared to take any action on the matter. The *Croydon Chronicle* editorial was highly critical of the Board and wrote, " The complaint lodged with them against two of their members, who had chosen to do what no other inhabitant dare accomplish without incurring heavy penalties, has been shelved in a very unsatisfactory manner." [71]

The following year the sewage arrangements of Johnson and Crowley caused a further stink and the *Croydon Chronicle* remarked:

> Mr Johnson's unique argument that no nuisance can possibly arise, as the sewage is turned on to his garden every morning at seven o'clock, is a shady compliment to his neighbours. It happens to be the hour when many open their bed-room window to "sniff the pure air from the Atlantic," as Sir Francis

[69] *Croydon Chronicle*, 19 June 1875.
[70] *Croydon Chronicle*, 3 July 1875. Johnson must have started with sewage irrigation in his garden in 1848.
[71] *Croydon Chronicle*, 17 July 1875.

> Head [72] designated it, and it is simply abominable that it should be tainted by operations, which the Board would be the first to stop were they carried out by anyone other than the Chairman.[73]

Beddington Sewage Farm

Carpenter thought the utilisation of sewage by irrigation was the most economical way of sewage disposal. The sewage farms produced grass, which could be fed to cattle, which produced both milk and meat. Produce could also be grown in the meadows and sold. Carpenter was proud of the Beddington sewage farm [see below] and, as will be seen later, he often entertained scientists, Thomas's students and other guests at the farm. There are also many issues regarding the management of sewage farms that need to be addressed. These include the economic factors, health risks, the quality of the produce grown and the health of the animals that grazed on the land.

First I discuss a letter written by Carpenter, in December 1883, to every member of the Croydon Council on the experiences he had gained at Beddington Sewage Farm. The letter was addressed "To The Mayor and Corporation Of Croydon." Carpenter wrote, " Gentlemen, The utilization of sewage has had my most careful study for nearly thirty years. It is one of the most important questions of the day, and one of the most difficult to determine." In the final paragraph Carpenter said:

> The duty of the Corporation is to purify the sewage at all cost. This can only be done by rye grass. The grass must be consumed. It ought to be consumed on the spot, because by that means there is the least waste of power. It should be turned into milk

[72] Sir Francis Bond Head (1793-1875) wrote an essay about the Poor Law when he was briefly Assistant Poor Law Commissioner in East Kent, when Edwin Chadwick was Secretary to the Poor Law Commissioners. Probably it was because of this connection that he was persuaded to write 'The Air We Breathe,' a review of Chadwick's *Report on the Sanitary Condition of the Labouring Population of Great Britain*. He was fond of pure air and chose to live at Duppas Hill, Croydon because of the Atlantic breezes. Also near the site of the Duppas Hill Workhouse Infirmary.

[73] *Croydon Chronicle*, 17 June 1876.

> and meat as rapidly as possible, and until there is capital sufficient on the land to effect this object, the Council are not likely to find a responsible tenant to take the farm, but when it is well stocked, when it is in good working order, and the produce consumed as fast as it is grown, there will, in my opinion, will be no difficulty in finding a tenant ready to take it off the hands of the committee, who would put such a stake into that for his own sake he must and would succeed. [74]

Croydon's sewage farm had been described many years earlier at a meeting of the Society of Arts on 3 February 1865, when John. C. Morton Esq. spoke on 'London Sewage from the Agricultural Point of View' [75] and Chadwick was also present.[76] Morton's description of Croydon's sewage farm was as follows:

> … near Croydon (Beddington) Mr Marriage deals with the sewage of 20,000 people, in a stream of 1,000,000 gallons per day, over an extent of about 250 acres [77]. He uses the water a second and a third time. His fields vary from 300 - 500 yards long ... Italian rye grass is sown in the autumn, and keeps down two or three years, and is then broken up for mangel-wurzel and followed by potatoes, and is then sown down again. [78]

Morton pointed out that the land that Mr Marriage rented cost £5 per acre, whereas the land in the neighbourhood was only worth £2 per acre. However, because the yield from the produce was £15 per acre, it was therefore a profitable concern.

The produce from the Farm was sold following advertisements in the newspapers such as the *Croydon Advertiser*. For example in 1870, Mr RW Fuller, auctioneer, announced that he had sold the growing potatoes on Beddington irrigation farm for £19 per acre.[79] In

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[74] *Croydon Chronicle*, 29 December 1883, p.5.
[75] *JSA*, vol. 13, 1865, pp.184-8.
[76] *JSA*, vol. 13, 1865, pp.202 and 207.
[77] This equates to 12.5 acres per 1000 population. Cuthbert Johnson thought 33 acres were needed.
[78] Ibid, p.188.
[79] *Croydon Advertiser*, 2 September 1870.

1871 the following appeared in the *Croydon Advertiser*, "The Croydon Irrigation and Farming Company are prepared to receive Tenders for the purchase of a quantity of Mangel Wurzel, to be removed from the Farm by the Buyers - Application to be made to the Manager, Beddington Lane, Beddington." [80] Later in 1874 Carpenter took some of the farm produce to a meeting of the Local Board of Health, in response to letters that had appeared in the daily press stating that the farm produce was spreading all kinds of diseases.[81] He announced that the three gigantic mangel-wurzels (weighing 18, 17 and 16 lbs) on the table before them were specimens of the produce of the Beddington farm, which showed what could be done by sewage. He also displayed a specimen of wheat. Later that year it was reported that the *Croydon Advertiser* " had an opportunity of inspecting an unusually fine crop of celery grown on the Local Board's sewage farm. Each root is a marvel in point of size and weight, while the taste is fully equal, if not better than that of the plants grown in the ordinary market gardens." [82]

Croydon the Pioneer of Sanitary Science

Carpenter's commitment to the farm paid off, and in 1866 the *Croydon Chronicle* reported on a meeting of the Local Board of Health with a heading 'Croydon the Pioneer of Sanitary Science.' The Chairman, Mr Drummond, reported that an important meeting had been held at Leamington [Sewage Congress, 26 October 1866] and thanked Carpenter and Baldwin Latham for " their kindness in attending that meeting, and for the very satisfactory, skilful, and successful manner in which they dealt with details respecting the sewage operations of the Parish of Croydon." Later it was reported that Drummond said, "there were no papers that would bear comparison with those read by Dr Carpenter and Mr Latham." Carpenter's paper was entitled 'The success and failures of the Croydon Local Board' and included a chapter on

[80] *Croydon Advertiser*, 4 March 1871.
[81] *Croydon Advertiser*, 24 October 1874.
[82] *Croydon Advertiser*, 21 November 1874.

how to deal with sewage. Carpenter described Croydon's attempts to deal with the sewage in the earlier years and the *Croydon Chronicle* quoted Carpenter who said, " The most serious errors, commercially speaking, were the attempts to deodorize the sewage." Sewage irrigation had been considered, but as the law stood then the Local Board was unable to provide land for irrigation purposes. However, when the law was altered, in 1860 the Local Board was able to take land out of the district [Beddington] for irrigation purposes. Carpenter later wrote, " In the hands of our engineer, Mr Baldwin Latham, it has been made a triumphant success, and presently will tell you what results have attended his efforts."[83]

Criticism

Conversely, there were many critics of sewage farming, although Carpenter was always ready to defend the Beddington Farm with his wealth of experience and knowledge. In Carpenter's presentation in 1869 to the Bristol Congress of the National Association for the Promotion of Social Science he pointed out that, " the objections which had been made of sewage farms were mainly three." These were:

> First, that sewage irrigation destroys vegetation, and turns the ground into a pestilential swamp, from which unhealthy miasms must arise, causing fever, ague, dysentery, and general unhealthiness to those living near to the land so used, even affecting population miles away from it. Second was that the wells in the neighbourhood would be contaminated with sewage elements by percolation, and thus also disease be engendered; and third, that the cattle fed upon such farms will be unhealthy, their flesh unwholesome, and their milk and butter unsafe for people to consume, and that the farms will be foci, from which disease will be spread to any of the cattle in the neighbourhood.

[83] *Croydon Chronicle*, 3 November 1865.

Carpenter reassured his audience and it was reported in the *Transactions of the National Association for the Promotion of Social Science* that he said, " nothing, however, could be further from the intentions of those who worked sewage farms than to have a swamp. Their great object was, by means of vegetation, to carry off the whole of the decomposing matter. This had been done very successfully at Beddington farm." Carpenter showed that the young vegetation not only absorbed many of the elements of the sewage, but the growing plants gave off a great quantity of ozone which could be recognised in many ways. The consequence was that there was really no evidence to show that sewage farms had been productive of evil results to health. In the case of Norwood, Carpenter pointed out that the death rate had fallen very considerably since the establishment of the sewage farm. He agreed that it was possible that some wells could become contaminated and said that earthy materials would usually act upon sewage as filters. Twenty feet of earth of any kind will purify sewage. Experiments, however, had shown that very little percolation takes place, even upon gravel. Finally, with reference to unhealthy cows, Carpenter felt the best answer was derived from experience: " The personal appearance and health of the cows at Beddington was admirable." More significantly, Carpenter showed that, "the mortality among the cows fed upon sewage grass in Croydon was much less during the cattle plague than in other parts in and near the metropolis. On the farm itself there had not been a single case of foot and mouth disease." [84] Carpenter produced a pamphlet from his Bristol talk and appended a paper on 'The Influence of Sewer Gas on the Public Health.' The first edition was advertised in the *Croydon Advertiser* and sold for one shilling.[85] A second edition, was also advertised on the front page of the *Croydon Advertiser,* and had a section entitled 'With Notes upon Recent Evidence Adduced Against Irrigation in the Houses of Parliament.' [86] Following the success of the

[84] *Transactions of the National Association for the Promotion of Social Science* (later called TNAPSS), 1869, vol.xiii, p.488. Conferences were held annually and Carpenter and Chadwick often took part.
[85] *Croydon Advertiser*, 12 February 1870.
[86] *Croydon Advertiser*, 29 October 1870.

second booklet, the *Croydon Advertiser* contained a long article entitled 'Dr Carpenter On Sewage Irrigation.' It concluded with the following paragraph:

> We do not feel ourselves very competent to decide upon the truly medical aspect of the paper, but our contemporary, *The Lancet,* says, after a more than copious review, "We recommend Dr Carpenter's pamphlet to the earnest attention of those who are practically interested in this important public question; " and we cannot do better than follow the lead of our distinguished medical contemporary.[87]

Criticism of sewage irrigation continued and on 4 January 1868 an article entitled 'The Health Officers and the Sewage Question' appeared in *The Lancet,* prompting Carpenter to write a swift response:

> I am not about to contrast the merits of irrigation as against the earth-closet system, but having some practical acquaintance with the subject, I wish to make a few corrections of errors advanced at that meeting. It was fully proved, at the Leamington Sewage Congress, that neither method was fitted for every case, and it will be experience alone, not by theory, that we shall eventually be able to weigh the merits of one against those of the other.

In his letter Carpenter corrected no less than five of the speakers, including the President of the Health Officers Association. He rounded on the first speaker by trusting his own practical experience rather than unworkable theory and said: " If Dr Hawksley [given name not known] had had any practical acquaintance with the working of parish matters, he would have known that his theory is impracticable, and his calculations erroneous." [88] The second speaker criticised the waste of water with irrigation, and Carpenter wrote, " I am not prepared to agree with Dr Letheby [89] that the excessive dilution of sewage is both wasteful and

[87] *Croydon Advertiser,* 17 November 1870.
[88] *Lancet*, 1868, i: 65-6.
[89] Henry Letheby (1816-1876), analytical chemist; M.B. London, 1842; lecturer on chemistry at the London Hospital; for some years he was MOH and analyst of foods for the City of London.

mischievous. The true key to the safe and profitable disposal of sewage is its immediate removal and rapid application to the land in a fresh state. This can only be done by much dilution, or by the general adoption of the earth-closet system." [90] The third speaker questioned whether the rye grass was wholesome or not, which prompted Carpenter to write:

> I now come to Dr Tripe's idea, that it is questionable whether sewage grass is perfectly wholesome. We have had extensive experience in this neighbourhood for some years, and I can safely say that there is not a particle of evidence in support of Dr Tripe's view. The consumption of the grass is so general, that if it were unsafe we must have discovered it long since.

The fourth speaker questioned the successful application of faeces on soils other than sandy ones, and Carpenter wrote:

> Dr Thudichum[91] is in error when he states that faeces are of no value whatever, except on sandy soil. We have most pointed evidence to the contrary. Our farm at South Norwood is a clay soil, and is even more successful than the gravel soil at Beddington; the length of the grass grown is greater, and the water passes off as perfectly freed from sewage ingredients.

The fifth speaker questioned whether the rye grass could be made into hay or not, and Carpenter replied, " Mr Girdlestone [given name not known] is also in error in stating that rye grass cannot be made into hay: it is so made, and there is a plan of making it by artificial means which, even in wet seasons, may render the farmer independent of sunshine; and where the supply is so abundant and constant, the drying process may be constantly at work."

The President criticised the principle of irrigation in winter, and Carpenter wrote:

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[90] *Lancet*, 1868, i: 65-6.

[91] Johann Ludwig Wilhem Thudichum (1829-1901), MRCS 1854, MRCP 1860, FRCP 1878. Simon was influential in getting Thudichum appointed in 1865 as Lecturer in Pathological Chemistry at Thomas's. Thudichum was one of a number of medical men who worked for Simon, some part time, during the period 1858-71. Simon said that Thudichum was 'the greatest chemist between Justus von Liebig and Emil Fischer and one of the truly original minds in biochemistry.' R. Lambert, *Sir John Simon, 1816-1904, and English Social Administration*, London, Macgibbon and Kee, 1963, p.402. (Thereafter called Lambert)

> The President's observations also require a correction. If he will visit the meadows during the prevalence of frost and snow, he will see that there is no check to the action of irrigation. It is a curious and instructive fact that the meadows do not freeze; the sewage is delivered upon them comparatively warm, and a moderate amount of vegetation is always found. Hence frost and snow, unless excessive and long continued, do not interfere with the principle of irrigation.

Carpenter concluded his letter with the following statement to the Medical Officers of Health: " I have to apologise for presuming to offer opinions to medical officers of health; but as we are all anxious for truth, I hope you will allow me, as a member of the Croydon Local Board of Health, to say what our experience has been." [92]

Spread of disease

The fear of the spread of disease associated with sewage irrigation was a constant source of worry, particularly to families living near the sewage farm. For example on 20 November 1871 Carpenter wrote a letter to the Editor of the *BMJ*, entitled 'Sewage and Entozoa,' correcting comments made by Thomas Spencer Cobbold [93] at a meeting of the Royal Microscopical Society. Cobbold had used terms somewhat to the effect that "while on swampy ground, as about Croydon and other low lying districts, where the mode of irrigation was practised." Carpenter rounded on Cobbold by saying,

" Surely Dr Cobbold has never visited Croydon, or he would be aware that it is neither 'low-lying' nor 'swampy.' There is nothing like a swamp in any part of the parish." The reason for the error becomes apparent when Carpenter says:

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[92] *Lancet*, 1868, i: 65-6

[93] Thomas Spencer Cobbold (1828-86), helminthologist; surgeon's apprentice in Norwich; studied medicine at Edinburgh, 1847; M.D., 1851; curator of Edinburgh anatomical museum, 1851-6; lectured on botany and zoology in London, 1857-84; studied parasitic worms; wrote treatises on parasites from 1864.

> Dr Cobbold has probably been misled by the biased evidence of Mr Hope [given name not known], who, curiously enough (though Croydon had won its successes in sewage-irrigation before Mr Hope was heard of, except as the type of a courageous Englishman), never reads a paper without asserting something to the detriment of Croydon. We are quite aware that our plans are not perfect, for perfection does not belong to human works; but I wish again to give publicity to two facts. First, I have carefully watched for evidence to bear out Dr Cobbold's theory. If I had found it I would have published it at once. There is no more evidence now than there was two years ago, when I contradicted Dr Letheby's deductions at a meeting of the Association of Medical Officers of Health.

Carpenter tried to reassure the readers of the *BMJ* and wrote:

> The five hundred acres of irrigated land under our direct supervision (not in the parish of Croydon) continue to be entirely free from the least particle of evidence that they promote either the distribution of entozoa or the production of enthetic disease. We have frequent returns of the state of health in that district; and during the past year the deaths have been at the rate of ten to twenty seven births; and, with the exception of a case of scarlatina which occurred on a hill more than a mile away from the fields, there is not a single death which can be referred to ordinary removable causes. [94]

Cobbold wrote a response to Carpenter's letter and Carpenter replied. Carpenter wrote, " In answer to Dr Cobbold, I wish to state that I have nothing to do with angry feelings, and that abuse is not argument." Carpenter reiterated the three main points that he put in his earlier letter and then went on to say that:

> Dr Cobbold could not dispute any of these three points, but adduces the theoretical and fanciful evidence, which was given before committees of the House of Commons.

[94] *BMJ*, 1871, ii: 627.

> The evidence was totally disproved at the time, and shown to be either unnecessary or improbable. The evidence then adduced had no weight with the judges, and their verdict proves the opinion of six distinct committees in the Lords and Commons to be against Dr Cobbold's witnesses. Dr Cobbold puts forward their evidence as if it had not been completely disproved. Dr Letheby's idea that "irrigated land is always a fetid, swampy morass" is an offspring of his imagination.

Carpenter then offered to invite Dr Cobbold to the fields "(unsatisfactory though they be), I shall be glad to show him that there are two sides to a question - a fanciful one and a real one - and that those most engaged in the work will be the best judges, unless they are determined to be deceived, which I am not." [95]

In 1873 a short article by Carpenter on 'The Supposed Dangers of Sewage Farms' appeared in the *BMJ*. In the article Carpenter wrote about the possible effects upon human beings of the ova of entozoa on sewage farms, which had been raised by the Croydon Microscopical Club (of which Carpenter was a member). He felt, however, that the possible dangers did not arise and noted that cases of taenia soleum [pig tapeworm] were unknown in Croydon inhabitants. However, if cases did occur, they usually occurred in someone from central Europe or Africa. Carpenter admitted, however, that contamination could occur, and recommended that meat be cooked properly and that sewage farms were properly managed. In the article Carpenter noted that some critics enquired about what happened to the millions of entozoan, which found their way down to the sewage farm. His reply was that he had often searched for them, at the outfall, but had never found them. [96]

In 1873 the possible links between typhoid and sewage farming, and the occurrence of typhoid fever and the use of milk were raised when Alfred Smee [97] wrote to the Editor of *The*

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[95] *BMJ*, 1871, ii: 711.
[96] *BMJ*, 1873, i: 382.
[97] Alfred Smee, (1818-77), surgeon and metallurgist; FRCS, appointed surgeon to the Bank of England in 1841; to Aldersgate Street Dispensary, London 1842; and to Central London Ophthalmic Institution; awarded Iris

Times. Smee pointed out that the cows liked the sewage grass and that the quality of the milk was increased slightly. However, the milk had a slightly rancid odour and the butter became offensive after a few days. In his reply Carpenter began by saying that Smee's letter was unlikely to influence the distinguished sanitary authority to whom it is addressed, but it may influence others who may be led to believe that the outbreak of typhoid fever in Marylebone was due to milk from a sewage farm. Carpenter commented that he had repeatedly exposed the hollowness of Smee's arguments, and pointed out that both his household and those of his patients consumed milk from the sewage farm and had not been able to associate evil with its use. [98]

On 23 September 1874 Sir Philip Rose wrote letter to the Editor of *The Times* under the title 'Water Storage and Water Waste.' His long letter contained the following paragraph:

> In almost every town the subject of drainage and water supply is now the prominent question of the day. It is occupying the attention of the thinking man beyond all other questions. The gravest doubts exist whether the plan of carrying off the excreta by water carriage through the sewers is not as radically unsound in theory as it is proved to be wasteful in practice and dangerous in its effects on health, and the distrust in this system is increasing day by day. Each of us can appreciate the danger of having within a few feet beneath us a subtle deadly poison, which at any moment may find a vent into our houses, and to inhale which, if not fatal, as it too often proves, is destructive of health.

However, most of the letter contained facts and figures relating to 'the Pneumatic System" of sewage disposal (discussed earlier). Carpenter wrote a reply, confining his comments to the utilisation of sewage by irrigation and said, "Sir Philip writes that water carriage of human excreta is wasteful in practice, dangerous in its effects on health, and that the distrust of the

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medal of Society of Arts for his battery; FRS 1841; initiated educational lectures of the London Institution, *Concise DNB*, p.1210

[98] *Times*, 16 August 1873.

system is increasing day by day." Carpenter contended that Rose had no evidence to prove the truth of his statements and, far from being wasteful; the cultivation of the land with sewage was profitable. [99]

Farm management

There was frequent criticism about the way Beddington farm was managed. For example in 1876 a letter from Carpenter, highly critical of Latham, appeared in the *Journal of the Society of Arts*. This contrasted sharply with the successful meeting held at the Leamington Sewage Congress in October 1866 in which Carpenter and Latham took part. In 1866 Carpenter had made reference to sewage irrigation and said, "In the hands of our engineer, Mr Baldwin Latham, it [sewage irrigation] has been made a triumphant success." [100] One of the reasons of their dislike for each other is likely to be due to the events surrounding the Croydon typhoid epidemic, in 1875, which are described later.

In Carpenter's letter to the *JSA* he was upset at Latham's highly offensive remarks made about him at the Society of Arts, claiming that he [Carpenter] had adopted a ruinous policy since becoming Chairman of the Sewage Farm Committee, Beddington. Carpenter concluded his letter and said, "we have unfortunately discovered in Croydon that Mr Latham is not a safe guide to follow in sanitary work. Whilst he followed the road which was pointed out to him by the Local Board he kept right, but as soon as he attempted to lead, and we trusted him, we fell into evils as bad as those from which we were trying to escape." [101]

In December 1877 the *Croydon Chronicle* reported that a highly critical article, on the Beddington Sewage Farm had appeared in the *Globe*. The article prompted three replies to the *Croydon Chronicle*, from Latham, Price and Carpenter. Latham said, "… you draw conclusions as to the management of the above farm which might lead your readers to

[99] *Times*, 26 September 1874.
[100] *Croydon Chronicle*, 3 November 1866.
[101] *JSA*, vol.24, 1876, p.760.

suppose that it is not only unprofitable by reason of its bad management, but that it is prejudicial to the health of the district in which it is located." Latham pointed out the large increase in the rent from £996 in 1867 to £4,612 in 1877 was the main cause of the deficit. Price argued that the poor balance sheet was down to bad management and highlighted the high rental of £112 per acre. He also pointed out that the committee of management of the farm were continually quarrelling and changing the farm manager every three years. Even when the last manager had asked for an increase in his salary, from £100 to £200 per annum, the committee refused and the manager left. However, the committee must have had a change of heart, as an advertisement in the papers later appeared for a new manager at £200 per annum. With reference to the farm being the cause of the outbreak of fever Price wrote, "I think you may dismiss this from your mind at once. The folks in the neighbourhood of the farm are 'extremely' healthy." In his letter Carpenter pointed out that although the sewage farm utilised the secretions of more than a thousand fever patients, not a single case of fever had occurred in the surrounding district of the farm. The *Globe* reported that the cost of utilisation of sewage in Croydon was one and three quarter pence per head of population, which Carpenter regarded as cheaper than in any other place of the same size in the kingdom. *102*

On 7 January 1887 Carpenter wrote to Chadwick and said, "I have a complaint against the Society of Arts. I wanted an opportunity to answer Dr Tidy[103] in detail. [regarding the treatment of sewage] They would not give it and it is impossible in a single short speech to deal with the fallacies contained in his paper." [104] Either because of Carpenter's request to the Society of Arts and/or Chadwick's help, Carpenter was granted his wish. In February

[102] *Croydon Chronicle*, 15 December 1877, p.3.
[103] Charles Meymott Tidy (1843-92), sanitary chemist; MB Aberdeen, 1866; professor of chemistry at the London Hospital, 1876; reader of medical jurisprudence to the Inns of Court; public analyst and deputy medical officer of health for London; invented new method of analysing water, 1879, and published numerous works on sanitary and chemical science and legal medicine. *Concise DNB*, p.1300.
[104] Chadwick papers, box 444, 7 January 1887.

1887 Carpenter gave a paper at the Society of Arts on the 'Utilisation of Town Sewage by Irrigation.' In his opening remarks Carpenter said:

> Allow me to thank the Council for having given me this opportunity of stating the case of sewage irrigation, in accordance with my request. I made that request immediately after I read Dr Tidy's paper upon the treatment of sewage. Having read the abstract, I considered it a veiled attack upon the principle of sewage irrigation, which required a specific reply.

The following was reported in the *JSA* "I [Carpenter] will now return to Dr Tidy's paper, and taking his framework as my skeleton, I will deal with the fallacies contained in it in my remarks upon the general subject." The four headings that Tidy used were as follows: 1) The method of applying sewage to the land; 2) The soil best suited for irrigation; 3) The crops most suitable for a sewage farm; 4) The value of crops so grown. Robert Rawlinson was called upon by the President to give a vote of thanks and it was reported in the *JSA* that Rawlinson[105] said, "he had listened to the paper with the greatest interest and pleasure." [106]

The financial viability of the sewage farm was a constant worry, particularly to the ratepayers. Earlier on 9 and 10 May 1876, the Society of Arts held a conference on the 'Health and Sewage of Towns.' The General Committee included Chadwick, who was Vice President, and Latham and Carpenter who were on the committee. Carpenter's paper dealt with the 'Financial Account of the Beddington Sewage Farm.' He demonstrated that the over ten years period from 1867-76 the total receipts and payments showed a loss to the Parish of Croydon of £5441 16s 6d. Carpenter was asked questions from the audience including

[105] Rawlinson, Sir Robert (1810-1898), civil engineer; entered employ of Jesse Hartley [q.v.], 1836; chief engineer under the Bridgewater trust, 1843-7; inspector under the Public Health Act, 1848; chief engineering inspector to local government board, 1848-88; head of sanitary commission, and sent by the government to seat of war in Crimea, 1855; knighted, 1894; published technical works and reports. *Concise DNB*, p.1089. Rawlinson was a supporter of Chadwick's views.
[106] *JSA*, vol.35, 1887, pp.221- 42.

Chadwick[107] who asked if the sewage delivered on the farm was in a state of putridity, or whether it was distributed fresh. Carpenter replied that in theory it was delivered fresh, but unfortunately they had many badly constructed sewers. The result was that the sewage was not always as fresh as it should be. Chadwick suggested that it could be corrected by the re-adoption of a new system of self-cleansing sewers. Chadwick also enquired if there had lately been any cases of typhoid in Croydon and what had been the condition of the drainage at those points especially. Carpenter replied that an epidemic of typhoid, which arose the previous year, was most likely caused by the interference with the water supply. The water had been delivered containing typhoid matter, and a number of cases of fever had occurred. The excreta of the patients found its way into some of the badly constructed sewers, and the gases arising unfortunately found their way into some of the houses, which were built by speculative builders and not constructed as they ought to be. Wherever typhoid cases were found there was some defect in the sewer arrangement, by which gases found their way into houses or into the water supply or both. [108]

Later, on 14 November 1876, Carpenter wrote a letter to the Society of Arts about the previous year's financial statement of the Beddington sewage farm. The statement highlighted a deficit of £1,505 between receipts and payments. By deducting the valuation of the farm, this deficit could be reduced to £1,039. Carpenter pointed that an enormous rental was paid for more than 400 acres out of the 466 acres, and that £500 was charged against the farm on account of the freehold land, which belonged to the parish.[109]

[107] Up to this time Carpenter had only written one letter to Chadwick, on 27 Sept 1869, concerning the Beddington Sewage Farm.
[108] *JSA*, vol.24, 1876, pp.614-7.
[109] *JSA*, vol.25, 1876, p.48.

EDWIN CHADWICK

Carpenter and Chadwick both attended the Annual Congresses of the National Association for the Promotion of Social Science, the Society of Arts and, later, the Sanitary Institute of Great Britain. In his letter to Chadwick, dated 27 September 1869, Carpenter thanked Chadwick for his kind and encouraging note and said, "I wish you could have taken part in the proceedings, as something will be wanting if you are not there." [110] We are not told where these proceedings were or any details about the paper. However, we do know that Carpenter gave his first paper on 2 October 1869 to the National Association of Social Science Congress at Bristol, which was entitled: 'On the Physiological and Medical aspect of Sewage Irrigation.'[111] It is highly likely that Carpenter was referring to this Congress, as Chadwick and Carpenter were both members of Council of the Health Section of the National Association for the Promotion of Social Science and were both interested in sewage irrigation. Carpenter's letter discussed three issues, namely water supplies, the Beddington Sewage Works and Westall's quarterly mortality tables. With reference to the Beddington sewage works Carpenter wrote:

> The Beddington Farm is not carried on at all to our satisfaction and next March it will be decided upon by the Board by lapse of time the lease expiring and I believe it will not be renewed to Mr Marriage but retained in the hands of a manager whose object will be to work it with entire reference to its sanitary state on the principles enunciated in my paper as necessary for the proper sanitary state of a sewage farm without reference to the pecuniary return. I believe the latter will be secured by it

[110] Chadwick papers, box 444, 27 September 1869.
[111] *TNAPSS*, 1869, vol. xiii, p.488.

more effectively than is at present. Our great point is to avoid the formation of marshy spots upon the ground otherwise as you pertinently surmise we should get disease. [112]

At the 1871 annual conference of the National Association for the Promotion of Social Science, the subject of removal and utilisation of sewage was on the agenda. Chadwick joined in the discussion afterwards, and said the cheapest mode of removal was by water, which arrested decomposition and carried the sewage away most completely. [113] With reference to health Chadwick went on to say:

> In England we had a good test of the water closet system, as water closets were brought into prison cells. As a rule, no class of persons, have so high a degree of health as prisoners. The death rate was reduced to about three to four per 1000. It was lamentable at this time that the distinction should not be understood between a self-cleansing sewer, and one, which allows the deposit to accumulate. And there was a further distinction between sewage fresh and sewage putrid. Nothing could be more important than this distinction. If anybody going to a water closet perceives a foul smell he may be satisfied that the sewage is bad.[114]

Sewage Farm competition

In 1880 a Sewage Farm Competition took place and the Mansion House Committee, in connection with the London International Exhibition of the Royal Agricultural Society, offered two prizes, each to the value of £100, to the best-managed farms in England and Wales. There were three judges, and unfortunately for Croydon, one was Latham. Class I was for the best managed sewage farm utilizing the sewage of less than 20,000 people, and Class II for sewage farms for over 20,000 people. Croydon was entered in the Class II category

[112] Chadwick papers, box 444, 27 September 1869.
[113] *TNAPSS*, 1871, vol. xv, p.414, Annual Conference, Leeds.
[114] Ibid.

together with Birmingham, Doncaster, Reading and Leamington. [115] Bearing in mind the management problems at Beddington and Latham's highly critical comments in 1876 to the Society of Arts about the farm, it is not surprising that Croydon failed miserably. Leamington won in Class II and the judges recommended a second prize to Doncaster, with Birmingham highly commended. The *Croydon Chronicle* summed up the mood and wrote, "If there had been a prize for the farm in the worst condition it would have had a much better chance." [116] Carpenter must have been dismayed by these events, and yet despite all these setbacks he would later put the Farm on to the International stage.

Visits to the Farm

By November 1871 it had been announced at the Local Board of Health that the Rivers' Pollution Commissioners were to visit Beddington Farm. The *Croydon Advertiser* reported, "The Chairman observed that the Royal Commissioners had made many elaborate reports on the subject, and were almost unanimous in their commendation of the system for the disposition of sewage by means of irrigation. (Hear, hear) " [117]

Other visits to Beddington Farm took place, and on 12 June 1875 Carpenter entertained 200 scientists when it was recorded that the weather was exceedingly stormy and the luncheon tent was wrecked. The *Croydon Chronicle* remarked:

> Dr Carpenter who, we might say, has to an extent inherited the kingdom of Beddington, or rather its farm, gave a sumptuously prepared feast to a number of guests, invited for the express purpose of proving to the best of his ability that irrigation was the cheapest system and best for the disposal of town sewage; that sewage-grown crops are not injurious to cattle; that adjacent property is not

[115] *Croydon Chronicle*, 7 February 1880.
[116] *Croydon Chronicle*, 19 June 1880. The delay was due to full reports being compiled on all the farms.
[117] *Croydon Advertiser*, 4 November 1871.

> deteriorated in value by the presence of the irrigation farm, and that the health of the neighbouring district bears favourable comparison with others far removed.

The guests included many influential members of the Houses of Parliament, and representatives of Local Boards who were learning the secret of sewage farming. The *Croydon Chronicle* then went on to say, "We in Croydon have paid very dearly for the materials out of which the experiments have been made and which Dr Carpenter's guests are to profit from. But having paid the bill we are permitted to gaze with admiration on the purchase and bid others admire our enterprise." [118] Carpenter later wrote to the *BMJ* about the Croydon Sewage Farm, and said "I have to thank you for your impartial review of the inspection of Beddington Sewage Farm and may refer to the visit by the scientists already mentioned." Carpenter pointed out that the annual accounts only showed receipts and expenditure, and did not show any of the items termed 'un-exhausted improvements' such as making fences, roads and building cow houses. He said that until a seven-years account could be published together it was not possible to show a balance on the right side. [119] Later, on 20 June 1877, Carpenter showed a class of students from Thomas's around Beddington Farm, as he was Lecturer in Public Health at Thomas's at this time.

In 1877 Carpenter wrote to Chadwick, inviting him and a friend to lunch, with a chance to visit the Beddington sewage farm. In a P.S. Carpenter pointed out to Chadwick the farm balance sheet he had delivered at the Society of Arts Sewage Conference the previous week.[120] He wrote another letter to Chadwick on 4 September 1877 and included a reply to a question about the sewage farm:

> In answer to your question regarding the sludge it is simply strained out by a strainer and the crude sewage allowed to go on the land at once. The faecal balls and coprolotics and other rubbish, which is collected at the filter house is mixed with the

[118] *Croydon Chronicle*, 19 June 1875.
[119] *BMJ*, 1875, i: 873.
[120] Chadwick papers, box 444, 10 May 1877.

> dustbin refuse and left to putrefy at the filter works. It is a nuisance with its removal. It is sold at 2s 6d a load, which is quite as much as it is worth. The load being a cartload, as much as one can take away.[121]

1881 International Medical Congress

1881 was the year of the International Medical Congress, held in London which Sakula has said, "was arguably the greatest and most historic medical congress ever held." [122] Carpenter appears in a large group portrait.[123] He predictably read a paper to the Congress on 'The Utilisation of Town Sewage by Surface Irrigation: being the experiences gained at Beddington Sewage Farm.'[124] He also invited 200 members of the International Medical Congress to visit the Beddington Farm. The *Croydon Chronicle* reported: "They consisted of representatives of every nation and language."[125] The *Croydon Guardian* wrote, "It was important because it afforded the only opportunity of furnishing for discussion a subject with practical illustration." The article continued, "A special train had conveyed the members from Victoria Station to Beddington, where carriages awaited them, and in these the company rode over the farm, alighting at the various points of interest, and journeying on, watching the process of irrigation to the outfall into the Wandle, where the water, in effluent state, is discharged, and flows to regions unknown." In the discussions that followed, one gentleman from Buenos Aires had come to gain what information he could about the disposal of sewage in a city of 300,000 persons. Others came from the United States, South Australia and

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[121] Chadwick papers, box 444, 4 Sept 1877. In this letter Carpenter told Chadwick that he had given a short course of lectures on public health to the students at Thomas's and that they were to be published in a book by Simpkin and Marshall. Carpenter promised Chadwick a copy when the book was printed.
[122] A. Sakula, 'Baroness Burdett-Coutts' Garden Party: The International Medical Congress, London 1881,' *Medical History*, 1982, 26: 183-90. Forty-three medically qualified ladies from different countries were excluded from the meetings of the Congress because they were women.
[123] Ibid, fig 4 facing page 185.
[124] A.J. Carpenter, 'The Utilisation of Town Sewage by Surface Irrigation: being experiences gained at Beddington Sewage Farm' London, Office of BMA, 161a Strand, 1881, pamphlet 19 pages.
[125] *Croydon Chronicle*, 13 August 1881, p.4

European towns. [126] Carpenter provided lunch for the guests in the large hall of the Beddington Asylum nearby. The *Croydon Chronicle* noted, "The *piece de resistance* was a noble baron of beef weighing 110 lbs, the animal who had been butchered to make a medical holiday having passed its uneventful life in eating rye grass on the farm." At the end of the proceedings Carpenter proposed the health of the Visitors, associating with the toast the names of Bishop Tufnell and Chadwick. The following then appeared in *Croydon Chronicle*:

> Mr Chadwick, in replying said he wished to have the opportunity of exhibiting the progress that had been made in this place in Croydon. It was nearly the first place the Local Government Board, of which he was chief medical officer, had to deal with, and at that time the death rate of the parish was something like twenty-eight in the thousand. But what had sanitary science done in Croydon? It had reduced the death rate from twenty-eight to as low as fourteen in the thousand. This was an example of what sanitary science had achieved by rudimentary means, which were further improvable.

The article continued and reported Chadwick as saying:

> The elements of sanitary science were so very certain that sanitary scientists could undertake to achieve grand results. At present the death rate in London was twenty-two in the thousand, but he (Mr Chadwick) believed it was possible to reduce it to seventeen in the thousand or less. Those present had seen an example of what could be done and they might, by applying the same simple principles, in time achieve results. They might reduce the mortality by one half. (Cheers) [127]

The *Croydon Chronicle* summed the day up when it wrote in its Editorial, " The fame of the Croydon sewage farm, and of Dr Carpenter, will be spread in almost every corner of the civilized world. Before the visitors left nearly all of them shook hands with the Doctor,

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[126] *Croydon Guardian*, 13 August 1881.
[127] *Croydon Chronicle*, 13 August 1881, p.3.

whose liberality in defraying the cost of a special train, and providing carriages and lunch, was thoroughly appreciated." [128]

On 27 August 1881 Carpenter wrote to Chadwick and enclosed a paper with a list of those present at the luncheon. Carpenter noted, " that several Frenchmen were present." Carpenter continued, "we are much as when you visited us, our mortality could easily be reduced to 10. We ought to have a MOH who could continually inspect our lower class of house." [129]

The feasibility of Carpenter buying the farm was raised in June 1887, when the following heading appeared in the *Croydon Chronicle*: 'Dr Carpenter Proposes to take over the Beddington Sewage Farm.' [130] This came about following a letter Carpenter had written to the Town Clerk, which had been read publicly at a meeting of the Croydon Town Council and without Carpenter's consent. The following week Carpenter wrote a letter to the *Croydon Chronicle* and asked if they could publish a reply that he had written to the Town Clerk. The letter said, "I am much obliged to your courtesy in sending me a copy of a part of the report of the Farm Committee. I protest against the publication by the committee without my consent of a private letter written to a member of the Corporation." [131] Carpenter continued, "However, I shall not complain of its publication, as it will show the Corporation that I am not afraid to put £20,000 of my own capital into the farm, as I feel certain that I should gain a good £5,000 a year by the investment." However, Carpenter's offer was never taken up.

Visits to the farm continued, and in July 1888 Carpenter invited two hundred members of the Association of Sanitary Inspectors of Great Britain, a body whose duties were described as "onerous and very unpleasant." The party included William Corfield and Louis Parkes. As well as the Beddington Farm they also visited the large dairy farm and

[128] Ibid, p.4.
[129] Chadwick papers, box 444, 27 August 1881. Carpenter was unhappy with Philpott.
[130] *Croydon Chronicle*, 18 June 1887, p.2.
[131] Ibid, p.3.

public baths. A luncheon provided by Carpenter was held in the Small Public Hall.[132] Later, in 1889, an important visitor to Croydon and the Beddington Sewage Farm was Dr de Pietra Santa, President of the Societe Francaise de Hygiene. Carpenter introduced Dr de Pietra Santa to the Borough Council at a meeting, saying that he was one of the most eminent sanitary engineers on the continent and thought it a great privilege for the Corporation to have his presence on this occasion. In reply the *Croydon Chronicle* wrote, "Dr de Pietra Santa said he had great admiration towards Croydon, and he hoped the town would go on to prosper. The Council were the Croydon police in a sanitary sense, and he and others on the continent fully appreciated the work being done here in Croydon. (Applause) " [133]

In 1891 the Seventh International Congress on Hygiene took place in London, which was opened by the Prince of Wales. Carpenter gave a paper on Sewage Farming. [134] The *Croydon Chronicle* concluded its report by saying "We congratulate Dr Carpenter upon his views being so largely reflected at such an important gathering as that now being held in London." [135] This was Carpenter's last talk on sewage farming before he died in 1892.

[132] *Croydon Chronicle*, 14 July 1888, p.3.
[133] *Croydon Chronicle*, 11 May 1889, p.2.
[134] *BMJ*, 1891, ii: 382-3.
[135] *Croydon Chronicle*, 15 August 1891, p.4.