HISTORY OF MEDICINE

Construction of London's Victorian sewers: the vital role of Joseph Bazalgette

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Until the early 19th century, London's River Thames, contained relatively clean water. Some 200 years before this, Sir Christopher Wren (1632–1723) realised that drainage and sewage disposal would sooner or later prove a major problem in an expanding city.[1] He designed a relevant system; however, this was not constructed and his subsequent work related to prestigious buildings (including St Paul's Cathedral) rather than underground feats of architecture or engineering. In the early 19th century there was little or no consistency regarding sewage disposal in different districts of the metropolis; cesspools were regarded as the proper receptacles for house drainage.[2 3] However, things were to change suddenly, and in the 1840s it became compulsory to drain houses into sewers (all of which ultimately ran into the Thames)[4 5]; within six years, >30 000 cesspits were systematically abolished, and "all house and street refuse [was] turned into the river".[1 3] This inevitably meant that Thames water (from which domestic water supplies were derived) was heavily contaminated by sewerage; popular media of the day (that is, newspapers and journals) launched a campaign for cleansing Thames water (fig 1).[6–9]

Disease—before the enunciation of the germ theory—was considered by most authorities to arise from miasmas. The mid-19th century was a time when "sanitary reform" was at its height. Thomas Southwood Smith (1788–1861) became known as the "father of sanitary reform".[10] Cholera epidemics raged in London in 1831–32, 1848–49, and 1853–54; during the last of these John Snow (1813–58) was able, on epidemiological grounds, to demonstrate that this disease was most likely contracted from faecally contaminated drinking water.[11 12] This was several decades before the "germ theory" of disease was generally accepted. Also, Florence Nightingale (1820–1910) (herself a miasmatist) popularised the "sanitary concept" during her widely acclaimed activities at Scutari in the Crimean War (1854–56).[13]

By the late 1850s, Parliament was becoming increasingly unhappy that nothing was being done to alleviate a worsening situation. By July 1858, the smell from the Thames at Westminster proved too much for the Parliamentarians, who concluded that the premises were, at that time, unusable.[1 14] This "great stink" gave Benjamin Disraeli (1804–81), the future Prime

*Figure 1 Cartoon depicting the atrocious state of River Thames water in the mid-19th century (*Punch *1858;***35***:5).*

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Minister, a valuable lever to persuade Parliament to allocate £3.5 million to improve London's sewerage disposal.

London's sewerage system

The Chief (Municipal) Engineer to the Metropolitan Board of Works (MBW) was at this time Joseph William Bazalgette (1819–91) (fig 2).[1] Still in his 40s, he designed (in conjunction with Colonel William Haywood [1821–94]) and supervised, the building of an elaborate system for London's sewage disposal. Three objects were kept in view: (i) waste disposal, (ii) land drainage, and (iii) introduction of a (safe) water supply system. An important *a priori* consideration surrounded the fact that the Thames is *tidal*, that is, if a dead horse was thrown into the river at Westminster or the city of London, it would be taken a few miles down river only to return on the next (incoming) tide, that is, it would *not* be transported to the estuary, and hence to the (open) North Sea. In order to circumvent this, Bazalgette designed a system of sewers from which, by means of four huge pumps, it was possible to discharge London's sewerage into the Thames at Barking Creek (northern) and Crossness (southern), via outfall sewers (that is, well to the east of London—past the tidal segment of the Thames. This system was outlined, by Bazalgette, in a communication to the Institution of Civil Engineers at a meeting held on 14 March 1865, an occasion when (Sir) Edwin Chadwick (1800–90) took part in the ensuing discussion.[3] This lecture was to mark the completion of this huge operation, and the system was officially launched at the Crossness pumping station by HRH The Prince of Wales (later King Edward VII) (1841–1910) on 4 April 1865.

Northern Thames Embankment

In the early 19th century, the marshy banks of the Thames were inhabited by mosquitoes which transmitted *Plasmodium vivax* malaria. Concurrently with provision of the "Main Drainage" system of London, Bazalgette designed (and engineered) the north Thames embankment; the southern component involved the construction of the new St Thomas' Hospital[15]; this was not completed until 1875.[1] The project was granted £2.15 million by Parliament. Three objects were of paramount importance: (i) housing of the northern level sewer, (ii) accommodation of the Metropolitan District Railways' Inner Circle (underground) Line, and (iii) improvement of the quality of the foreshore of the Thames—which at this time apparently consisted of extensive mudbanks covered with putrid excrement. A road was built over the northern embankment. This initiative was subsequently described by Edward, the only son (out of the 10 children of Bazalgette's marriage to Maria Keogh) to follow his father's profession—on 9 April 1878.[16]

Other activities carried out by Bazalgette

Apart from these two vast engineering projects, Bazalgette designed several of London's bridges including those at Putney, Hammersmith, and Battersea[1]; he also submitted a plan for Tower Bridge, but that was not accepted. In 1883–84, Bazalgette served as President of the Institution of Civil Engineers.[1] In his masterly presidential address, his major theme was: the way(s) in which engineering can improve the wellbeing (and longevity) of *Homo sapiens*.[17]

Figure 2 Joseph William Bazalgette (1819–91): detail of the memorial which was unveiled in 1901 on the north Thames Embankment[1]—near the "Embankment" underground station.

Epilogue

Bazalgette was an engineer—with no medical background—"of small stature and . . . somewhat delicate health"; he hailed from French Huguenot ancestry. This man arguably did more for the health of Londoners in the mid-19th century, than anyone before or since.[1 18] His name should (in my opinion) be bracketed with those of the other great "sanitary reformers" of the 19th century—John Simon (1816–1904) (also a Huguenot),[19] Thomas Southwood Smith,[10] the seventh Earl of Shaftesbury (1801–85),[20] James Kay (later Sir James Kay-Shuttleworth) (1804–77),[21] Neil Arnott (1788–1874) and many others, including Edwin Chadwick[22] and Florence Nightingale.[13] There are surely many lessons to be learned from Bazalgette's endeavours in London which would benefit immeasurably the health of the populations of "third world" (developing) countries today![1]

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7 Anonymous. "Faraday giving his card to father Thames; and we hope the Dirty Fellow will consult the learned Professor". *Punch* 1855;**29**:27.
8 Anonymous. "Father Thames introducing his offspring to the fair city of London". *Punch* 1858;**35**:5.
9 Anonymous. "The London bathing season. 'Come, my dear!—come to its Old Thames, and have a nice bath!'" *Punch* 1859;**36**:249.
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