

## JOHN SNOW

### The Broad Street Pump and After

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ON 19th June, 1858, the following notice appeared among the announcements of deaths in *The Times*: "On the 16th inst., at his residence 18 Sackville Street, Piccadilly, John Snow, M.D., of apoplexy, aged 45." For some weeks prior to his last illness Snow had been working on his book "On Chloroform and Other Anæsthetics." According to his friend Benjamin Ward Richardson, he was drafting the concluding paragraph and was actually writing the word "exit" when he was seized with a stroke from which he died ten days later.

It was nine years before his untimely death that Snow had first put forward his theory concerning the spread of cholera by polluted water. This he did in a small pamphlet of about 30 pages which was published at his own expense. But this first essay in the field of infectious diseases received only scant attention at the time. Five years later, in 1854, when cholera was sweeping across the country for the third time, he carried out his classic researches in South London. This investigation, which remains to this day a model of scientific inquiry, established beyond all reasonable doubt that cholera is a water-borne disease. Snow incorporated the substantial body of new evidence which he had gathered in the course of this inquiry into his "much enlarged" volume of 162 pages:—the so-called "second edition" of his book "On the Mode of Transmission of Cholera" which was published early in 1855. In the next three years only 56 copies of the book were sold, and in return for an outlay of £200 incurred in its preparation, the author was reimbursed with the princely sum of £3 12s. 0d.

Snow's theory ran counter to the prevailing view of his time, which attributed infectious diseases like cholera to the effluvia arising from filth and putrefaction. It is hardly to be wondered, therefore, that at first there were few who were disposed to accept this new explanation. In 1849, a reviewer commenting in the *Lancet* on Snow's first pamphlet on cholera wrote, "The arguments adduced by the author against emanations causing the disease are not by any means conclusive." Following the cholera epidemic of 1853-4, the Royal College of Physicians set up an investigation into its causes under Drs. William Baly and William Gull. They considered Snow's thesis and rejected it outright. "The theory as a whole is untenable," they reported and added, "The matter which is the cause of cholera increases and finds the conditions for its action under the influence of foul or damp air." So, too, the medical inspectors appointed by the General Board of Health in 1854 to inquire into the Soho outbreak, having examined Snow's views upon it, commented, "we see no reason to adopt this belief." The principal objections raised against Snow's theory were that it did not account either for the sudden onset or for the decline of the epidemics as satisfactorily as the current explanation in terms of miasmata.

In 1856, John Snow visited Paris with his uncle, Mr. Empson, of Bath. Empson, a dealer in curios, was known personally to the Emperor and Ward Richardson records that "on this occasion special imperial favours were shown to him in which the nephew participated." While in Paris, Snow entered his book at the "Institut de France" for a prize which was offered for the most outstanding contribution towards the prevention or treatment of cholera. Ward Richardson reports that no notice was taken of Snow's researches by the Institute. On the other hand Sir D'Arcy Power, the medical historian, writing of Snow in the *Dictionary of National Biography*, states that "his essay upon the mode of communication of cholera which was first published in 1849 was awarded by the Institute of France a prize of

£1,200." In reply to a recent inquiry made by the writer, M. Pierre Gauja, the present Archivist of the Institute, confirmed that Snow did not in fact receive this award. It would appear that his theory was no more acceptable abroad than at home, for about the same time Max Pettenkofer in Germany also rejected it.

In England two men of note, William Budd and William Farr, were almost alone in voicing their approval of Snow's thesis during his lifetime. In 1849, shortly after Snow had published his first paper on cholera, Budd brought out a pamphlet of his own on the same subject. He put forward a theory of causation and transmission of the disease similar to that of Snow, but in doing so he made a full acknowledgment of the priority of Snow's published work. In all his subsequent writings on cholera Budd stressed the water-borne nature of the disease and was at pains to give full credit to Snow for having first made this discovery.

William Farr at the General Register Office gave a more qualified support to Snow's theory. He himself had noted the high mortality from cholera which occurred in those districts of London whose water supplies were drawn directly from the sewage-laden reaches of the Thames. In the Report of the Registrar General for 1852 he discussed Snow's findings and reached the conclusion that the facts "lend some countenance to Dr. Snow's theory." Four years later, in his letter to the Registrar General, Farr presented a long and detailed statistical account of the cholera epidemic of 1853-4. He concluded as follows: "It is right to state that Dr. Snow by his hypothesis and researches and by his personal inquiries; that the Registrar General by procuring information and by promoting inquiry; as well as the Board of Health by the Report, have all contributed in various ways to establish the fact that the cholera-matter, or cholérine, when it is most fatal, is largely diffused through water as well as through other channels."

The report to which Farr referred was that made to the President of the General Board of Health by John Simon, in which he expressed the cautious view that "fecalised drinking water and fecalised air equally may breed and convey the poison." Simon remained for long an adherent of the old theory of the miasmata, and his acceptance of Snow's thesis came only gradually and after many years. In the month of Snow's death in 1858 he referred to his "peculiar doctrine as to the contagiousness of cholera" and commented somewhat patronisingly that "whatever may be the worth of the theory, it has been of use in contributing to draw attention to the vast hygienic importance of a pure water supply." Sixteen years later he had moved his position, and in a report to the Local Government Board he remarked, "Indeed, with regard to the manner of spread of the enteric diseases generally, it deserves notice that the whole pathological argument which I am explaining grew amongst us in this country out of the very cogent facts which our cholera epidemics supplied, and to which the late Dr. Snow 25 years ago had the merit of forcing medical attention, an attention at first quite incredulous, but which at least for the last 15 years as facts have accumulated has gradually been changing into conviction." Later still in 1890, in his "English Sanitary Institutions," Simon, looking back over the years to Snow's discovery, could write that it "may probably still be counted the most important truth yet acquired by medical science for the prevention of epidemics of cholera." This appreciation of Snow's work was handsome if somewhat belated.

The 30 years which followed the publication of Snow's book witnessed a plethora of new books on the subject of cholera. A perusal of 12 of these volumes disclosed no mention at all of Snow in six of them (Johnson, 1855; Jameson, 1855; Shrimpton, 1866; Jencken, 1867;

Parkes, 1873; Macpherson, 1884). Chapman (1866) rejected Snow's "far-fetched doctrine," Bellew (1855) found it "untenable," as did Boyd Mushet (1885). Only three of these writers expressed their agreement with Snow's conclusions: Macnamara (1872), Blanc (1873) and Wendt (1885). These examples indicate how tardy and gradual was the general acceptance of Snow's theory.

In 1884 Koch announced his discovery of the cholera vibrio to the Berlin Conference and ten years later an English translation of his papers on cholera was published in this country. Koch made no mention of Snow although he fully accepted the water-borne nature of the disease. William Gairdner, Professor of Medicine at Glasgow, contributed an Introduction to the English edition in which he paid a fitting tribute to John Snow:—

"Since Dr. Snow's researches were published and adopted by the Registrar General in England there has never been much doubt among us as to the water-communication of the choleraic infection, the evidence of which seemed to go on accumulating as the incidence of the disease, in respect of particular places, was more and more studied, and the severity of local epidemics was found to be strictly in accordance with the presence of dangerous impurities in the water supply."

The discoveries of the bacteriologists finally dethroned the doctrine of emanations, and served both to underline the soundness of John Snow's observations and to confirm the truth of his deductions.

#### THE BROAD STREET PUMP

The name of John Snow is invariably associated with the Broad Street pump and with the outbreak of cholera which centred upon it. The story of this old pump forms an interesting chapter in the history of public health. Just when it was set up in Broad Street is not known. The houses in this part of Soho were built between 1700 and 1740 and it is likely that the well was sunk about the same time. The district was a suitable one for shallow wells, for water could be obtained at a depth of about 20 feet almost everywhere. As a result wells were plentiful. There were at least 12 pumps within a radius of a quarter of a mile of Broad Street.

By 1850 two private companies—the New River and the Grand Junction—were supplying piped water to all the houses in the area. At that time these supplies were intermittent, the water being turned on for about two hours daily except on Sundays. Each household had to install a butt or cistern which was filled whenever the main supply became available. These storage butts were notoriously bad. They were usually uncovered, rarely if ever cleaned, and as a result the water drawn from them was generally dirty and often unsavoury.

By contrast the water from the well in Broad Street was clear, bright, and sparkling, albeit through the presence of carbonic acid and nitrates, the end-products of organic contamination. Throughout the district around Golden Square its waters, always available and invariably cool and palatable, were most highly regarded. Not only did householders close at hand make extensive use of it, but many people living at a distance preferred to draw their water from Broad Street in preference to their local wells. It was commonly the duty of the children to fetch the water from the pump, and old people living alone bemoaned the fact that they had no one to fetch water for them. The pump-handle had a ladle attached to it from which the children were accustomed to drink, although we know that some parents disapproved of this practice. Many of the small workshops in the locality kept butts filled with the well water to be used for drinking purposes, especially in summer. The water was also used for mixing with spirits in all the taverns round about and it was supplied to customers in the coffee-shops and dining-rooms in the area. Some of the little shops used to bottle the water, add a little effervescent powder and sell it as "sherbet" drink.

Perhaps the most striking testimony to the attractions

of this water comes from Snow's account of the widow of Hampstead. This lady, whose husband had formerly owned the percussion-cap factory in Broad Street, had a bottle of the well water brought to her by a cart which travelled each day to St. James. This was to prove her undoing, for in the cholera epidemic she alone of the inhabitants of Hampstead contracted the disease and died.

The month of August, 1854, was hot and dry and when cholera broke out in Broad Street it spread through the little neighbourhood like fire in a rickyard. Within ten days the population was literally decimated. It was without doubt, as John Snow himself described it, "the most terrible outbreak of cholera which ever occurred in this kingdom." At the time Snow was living in Sackville Street, about half a mile from the affected area, and although he was already fully engaged in his investigation in South London he hastened to the scene of this new outbreak. His suspicions quickly fell on the well in Broad Street and these were strengthened when he discovered that "nearly all the deaths had taken place within a short distance of the pump." He was able to establish that almost all the people who had died had consumed water from the pump. After pursuing his inquiries further, Snow recorded, "I had an interview with the Board of Guardians of St. James's parish on the evening of Thursday, 7th September, and represented the above circumstances to them. In consequence of what I said the handle of the pump was removed on the following day."

It is interesting to note that the Minutes of the Board of Guardians and of the Vestry contain no reference to Snow's intervention. It is probable that he made his representation to the sanitary committee which had been set up by the Guardians to act during the epidemic, and that it was this body which ordered the pump to be taken out of use. By the morning of 8th September the epidemic had already declined sharply and the closure of the well did little to affect its course, although it may well have prevented a fresh outbreak. The removal of the handle was not by any means the end of the Broad Street pump, for within a short time it was brought back into service again.

Two further associates of John Snow enter the story at this stage—one a doctor and the other a clergyman. The doctor was Edwin Lankester, who in the following year became the first medical officer of health of St. James; the clergyman was Henry Whitehead, the young curate at St. Luke's church in Berwick Street. Lankester was a member of the Vestry and at his instigation a local inquiry into the epidemic was ordered to be carried out at the expense of the parish. Both John Snow and Henry Whitehead were co-opted on to the committee which was set up for this purpose. It was in the course of this investigation that Whitehead made the discovery which had till then eluded Snow and which brought a triumphant confirmation of his hypothesis. This was the elucidation of the way in which the well had become polluted.

Whitehead discovered that a baby living at 40 Broad Street, the nearest house to the pump, had died from what was described as "exhaustion following diarrhoea" and that the child's illness immediately preceded the onset of the cholera epidemic. From his inquiries at the house he learnt that the baby's discharges had been disposed of into a cesspool which was less than three feet from the well. An immediate inspection revealed conspicuous evidence of the percolation of faecal matter from the ill constructed cesspool through the decaying brickwork which lined the well. The chain of evidence incriminating the pump was now complete. Yet even this disclosure did not secure its final removal. Instead, the well was closed for six weeks while the brickwork was renewed, it was then pumped out completely three

times, after which it was opened for use by the public once more.

In the following year, 1856, Edwin Lankester was appointed Medical Officer of Health of St. James's parish under the Metropolis Management Act. One of the first matters to which he gave his attention was the water supply of the district. It was his aim to get rid of the numerous shallow wells in the area, and in his first annual report to the Vestry he complained that "the most impure water in the parish is that of the Broad Street pump, and it is altogether the most popular." This comment is all the more striking when it is recalled that it was made within two years of the great epidemic. Lankester went on to report that a chemical analysis had revealed that this water contained more inorganic salts (chlorides and nitrates) derived from organic pollution than the common sewer.

The Vestry appear to have been unmoved by these revelations, so in the following year Lankester wrote to every one of his fellow medical officers of health in the Metropolitan area asking their opinions about surface wells. Their replies, which he published in full, showed that the general consensus of opinion was in favour of closure. This seems to have led to a minor victory, for at the beginning of 1858 all the shallow wells in the parish were closed by order of the Vestry. Lankester's success was short-lived, however, for in his report for that year he grumbled "You did not think it advisable to continue the closing of the pumps." And so, after an interval of four months all the wells were in use again.

Four years later Lankester took up the cudgels once more. In his customary forthright manner he informed the Vestry that all the wells in the parish were unsafe, with the single exception of the artesian near the church in Piccadilly. He reminded them that St. James was now lagging behind most other districts for "with the exception of our own parish these surface well-pumps have nearly all been closed throughout London." He spoke of "offering the public the filtered sewage of these pumps." This seems to have prompted the Vestry to take some action, for in 1864 Lankester was able to report that "the wells in the parish are gradually being abandoned—seven only remain." But the Broad Street pump was among them. He remarked that drinking fountains had largely replaced wells in popular esteem but that St. James had fewer of them than any other London parish.

It was in the next year that the threat of cholera returned to this country once again. Lankester thereupon urged the Vestry to lock the remaining pumps as a safety precaution, reminding them of the part that impure water, especially from surface wells, had played in the spread of cholera in the past. His warning went unheeded. The threatened outbreak materialised in the summer of 1866 when cholera broke out in the teeming slums of East London. Lankester promptly submitted to the Vestry a special report on the state of the wells which still remained in service in the area. This revealed abundant chemical evidence of organic contamination and once again he drew special attention to the Broad Street pump. Further support now came from another and perhaps unexpected source, for on 31st July a letter headed "The Broad Street Pump" appeared in *The Times*. Signed by Dr. W. Allen Miller, of King's College Hospital, and Prof. E. Frankland, of the Royal College of Chemistry, it deplored the fact that the old pump was still in use and commented on the unfitness of its waters. The writers concluded with a solemn warning that the whole area could be infected "by a single case of cholera occurring within the drainage area of the pump."

Three days later a case of cholera was reported in No. 30 Broad Street. Lankester now sounded a note of alarm. He warned the Vestry yet again of the dangers

of spreading the disease through the pollution of water, "this can occur in no other way than by our pumps." He pronounced the wells to be dangerous. "I dare not take the responsibility of remaining quiet while these pumps are open, and, at the risk of offending you by my pertinacity, I implore you to order the pumps to be shut."

This appeal seems to have been successful in bringing about, at long last, the final closure of the Broad Street pump. There are no further references to its use from that time.

Edwin Lankester died in 1874 and was succeeded as medical officer of health by James Edmunds. In his annual report for 1884, eight wells were mentioned by name, including the one in Broad Street which was said "to have been covered but not filled in." The rest is silence. Broad Street remained but its pump had passed into history.

Today, 100 years after the death of John Snow, the student of public health can still visit many of the places associated with his career. Bateman's Buildings, the little back street in Soho, where in 1836 Snow rented a room following his long walk to London to study medicine; Great Windmill Street, where a plaque on the wall of the Lyric Theatre marks the site of the Hunterian School of Medicine in which Snow was a student from 1836-38; Frith Street, Soho, where in 1838 he "nailed up his colours" and started his first practice; 18 Sackville Street which was his home from 1852 until his death, and Brompton Cemetery, where stands a replica of the original monument erected to his memory by his friends. But perhaps it is fitting that the pilgrimage should end in Broad Street—now Broadwick Street, W.1—and at the old tavern which three years ago was renamed in honour of John Snow. For, below the inn-sign which bears his portrait, a tablet on the wall draws the attention of the passer-by to a red granite stone at the kerbside. This stone marks the site of the Broad Street pump.

#### BIBLIOGRAPHY

- The following are the principal sources which were used in the preparation of this article:
- Richardson, B. W. "John Snow, M.D." *The Asclepiad*, 4, London, 1887.
- Snow, John. "On the Mode of Communication of Cholera." Second edition. London, 1855.
- Budd, W. "Malignant Cholera." London, 1849.
- Reports on Epidemic Cholera, Royal College of Physicians, London, 1854.
- Report of the Medical Council in relation to Epidemic-Cholera of 1854, General Board of Health, London, 1855.
- Annual Reports, Registrar General. London, 1848 to 1856.
- Report on the London Cholera Epidemics of 1848-9 and 1853-4, by the Medical Officer to the Board. General Board of Health. London, 1856.
- Report on the Cholera Outbreak in St. James, Westminster, 1854, by the Cholera Inquiry Committee, St. James's Vestry. London, 1855.
- Annual Reports of the Medical Officer of Health. St. James, Westminster, 1856 to 1884.
- Koch, R. "On the Bacteriological Diagnosis of Cholera and other papers." Translated G. Duncan. Edinburgh, 1894.
- Chave, S. P. W. "John Snow and Cholera in London." London School of Hygiene Library, 1955.
- Chave, S. P. W. "Henry Whitehead and Cholera in Broad Street." *Medical History* (1958), 2, No. 2, pp. 92-110.

THE Council of the Royal Institute of Public Health and Hygiene has appointed Mr. A. R. Horsham, F.C.I.S., F.C.C.S., F.R.Econ.S., as secretary of the Institute.

DR. CHARLES HILL, MP, Chancellor of the Duchy of Lancaster, opened the Royal Society of Health's "Milk and the Nation" exhibition at Charing Cross Underground Station, Victoria Embankment, London, on 2nd June. The opening day was graced by the presence of two Jersey calves from the Queen's herd at Windsor. The exhibition will remain open until 24th June.