

## JOHN SNOW

John Snow, epidemiologist, pharmacologist, anesthetist, and physician, celibate and crusader against alcohol, seems as pure as his name. As the perceptive epidemiologist of the cholera epidemics in London and Newcastle in the mid-19th century, he was the first to provide experimental data in support of the water-borne theory of the spread of the pathogenic agent. The demonstration of the anesthetic properties of ether and chloroform enabled him to display his talents in quite another field of medical science. He pursued a systematic pharmacological study of volatile anesthetic drugs and, with the information gained, used this to become the foremost anesthetist in London.

John was born in York in 1813, the son of a farmer. In private school, it is reported that he was eager to learn and was especially fond of mathematics. At the age of 14, he became a pupil of William Hardcastle, surgeon at Newcastle-on-Tyne, and studied at the Newcastle Infirmary. Before he had completed his training as a surgeon's apprentice, he became a vegetarian and a prohibitionist. Having accepted this way of life, he remained a vigilant crusader in the following years. His first experience with cholera was in the 1831 epidemic in Newcastle. It began or was first recognized during the Polish-Russian War, and moved westward across Europe, over to Britain, and eventually spread to a number of countries throughout the world. More than 20,000 persons died in Britain during the epidemic.

Snow was not a particularly social fellow; rather, he preferred books, laboratory experiments, and bodily exercise. Reserved, clever, and considered by some to be a little peculiar, he was not too proud to ask for a translation in the library when the original treatise was unclear.<sup>1</sup> Furthermore, he was a faithful member of the Westminster Medical Society, a body which gave particular encouragement to young members of the profession who were eager to present a scientific essay or engage in a debate. In 1838, at the age of 25, Snow qualified for membership in the Royal College of Surgeons of England. His formal education was completed in 1844, at the age of 31, and he passed the M.D. examination at the University of London.

Epidemiology and anesthesia shared Snow's attention while he was building a practice in London. His contributions to epidemiology were not as extensive possibly as those in anesthesia, but were judged by several to be more significant. Cholera epidemics provided the source data for his observations in field epidemiology, which are fundamental and were made some time before the investigations of Pasteur and Koch in microbiology. The concept of the spread of cholera remains valid, although micropathogenic agents were not identified until decades later. Snow reasoned that, since

the initial symptoms of cholera usually indicated primary affliction of the alimentary tract, the pathogenic agent gained entrance into the body via the stomach.<sup>2</sup>

There is sufficient evidence also, I believe, in the following pages, to prove the mode of communication of cholera here explained.

The instances in which minute quantities of the ejections and dejections of cholera patients must be swallowed are sufficiently numerous to account for the spread of the disease; and on examination it is found to spread most where the facilities for this mode of communication are greatest.

Firsthand experience was obtained in an outbreak of cholera which occurred near the intersection of Cambridge and Broad streets, Golden Square, London, in 1854. In a period of 10 days, more than 500 fatal cases were reported. The number would have been considerably greater had not a large percentage of the population fled the city. Snow's epidemiologic studies concentrated on the contamination of the water from the street pump.

I suspected some contamination of the water of the much-frequented street-pump in Broad Street. . . . I requested permission, therefore, to take a list, at the General Register Office, of the deaths from cholera, registered during the week ending . . . which was kindly granted. Eighty-nine deaths from cholera were registered, during the week.

On proceeding to the spot, I found that nearly all the deaths had taken place within a short distance of the pump. . . . The result of the inquiry then was, that there had been no particular outbreak or increase of cholera, in this part of London, except among the persons who were in the habit of drinking the water of the above-mentioned pump-well. 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.

Before pursuing the epochal investigations in the spread of cholera, Snow did not ignore the opportunities in the newly discovered anesthetic agents in the 1840's. One of his first communications before the medical society described a device for treatment of asphyxia and the resuscitation of the newborn.<sup>3</sup> The instrument was based on the principle of a pulmotor, which had been invented by a Mr. Read of Regent Circus. Snow assumed that the stimulus for the first respiration in the newborn was similar to that for others; that is to say, it arose from inadequate oxygen pressure. Also, he speculated that the pulsive action of the blood was partially related to the capillaries, since the action of the heart was not sufficient to propel the blood throughout the circuit.

While Snow was waiting for his practice to expand, the discovery of ether for anesthesia was announced to the world. With a background and interest in respiration and asphyxia, it seems natural for this manifest curiosity to have led him into experimental studies on the pharmacology of anes-

thetic agents and the use of ether in the practice of anesthesia. A few of the experimental studies dealt with ether. Chloroform, on the other hand, benefited most from his investigations. The design of an improved inhaler, supplemented by experimental studies on anesthesia, placed Snow in the advanced anesthesia coterie in London.

The uncertain reputation of ether, plus the desire of the English to be somewhat different from the Americans, has been held responsible for the preference of Syme and Simpson, especially, for chloroform. However, neither physician was endowed with the capacity or displayed any consuming desire to investigate chloroform in the laboratory. Snow filled the void. The physical and pharmacological properties of a number of volatile agents were studied. The boiling point, the percentage of mixture of the experimental substance with air, and the quantity required by inhalation for insensibility were included in the physical studies. The pharmacological aspects included the minimal lethal dose in animals and mode of death, whether by cardiac or respiratory failure. However, extensive precautions were taken to prevent unnecessary suffering in animals; they were not used thoughtlessly in experiments. The effect of the agents on man concluded the investigation. Snow was invariably the experimental subject in this phase.

Snow administered chloroform to the young and the old. By 1857, this agent had been given to 186 infants under one year of age; two were only 8 and 10 days old. At the other extreme, chloroform was administered to several patients over 75 years of age and to one as old as 90 years. The precipitation of a fit of epilepsy with chloroform was observed in the susceptible. Neither menstruation nor pregnancy was judged to be a contraindication if there was need for anesthesia. No ill-effects were observed in patients with pulmonary tuberculosis. Skillful administration of anesthesia permitted the surgeon to operate on patients with heart disease. Even with anesthesia, however, surgery was for the swift. Readministration of chloroform was recommended, "if the operation lasts more than a minute or two."<sup>4</sup> Also,

When the surgeon is cutting in the neighbourhood of important parts, it is desirable to prevent any sign of sensibility, and to keep repeating the chloroform so as to keep up the coma, without, however, causing embarrassment of the breathing, or wide dilatation of the pupil. In the greater number of operations, however, it is better to wait till there is some sign of sensibility, such as a slight cry or tendency to flinch, before the inhalation is resumed; and then a few inspirations of well diluted vapour make the patient quiet again.

The records of 50 fatal cases of inhalation therapy, including postmortem examinations when performed, were reviewed critically. The deaths in several of the cases upon review were judged to be

unrelated to the anesthetic agent, in others to an overdose of the agent, with cardiac arrest. In Case 44, mouth-to-mouth respiration was practiced.

Mr. Bowman commenced practising artificial breathing, by the application of his own mouth to that of the patient. By this means, the chest was made to fill very completely, and the process was kept up almost without intermission for from five to eight minutes. During the first three or four minutes after the alarm began, the patient continued at times to make slight sighing efforts at voluntary inspiration, and the case was not thought, by those looking on, to be by any means hopeless. At length, however, these finally ceased, and from that time it was apparent that the man was dead.

The extent of Snow's anesthetic practice was remarkable. Although the incidence data for each of the surgical procedures were not recorded, he reported that:<sup>4</sup>

I have notes of 49 cases of amputation of the thigh in which I have administered chloroform. . . . I have notes of 31 cases in which I have administered chloroform during this amputation (of the leg). . . . I have memoranda of 197 cases of necrosis in which I have given chloroform. . . . I have notes of 147 operations for hare-lip, for which I have given chloroform. . . . I have, however, administered chloroform fifty-three times during the extraction of cataract. . . .

Snow's policy in reviewing medical books is similar to the current policy of the book review section of this periodical. Snow was reluctant to compose a harsh review. In his judgment, if the book was good, it was deserving of praise; if the book was bad, why be troubled to review it. With so many books received in this editorial office and with the opportunities to review only a small percentage of the total, the precedent established by Snow has been followed in recent years. If space is not available in this journal to comment on good books, then such space is not available to discuss the sad features of bad books.

Whether studying an epidemic of cholera or extending the information on anesthesia, Snow remained an excellent practitioner of medicine. Completely devoted to his patients, he was willing to forego a fee when the patient was unable to pay. His life was rather selfish in that he never married and his hours were not troubled by the responsibilities of a home or family. One obvious conclusion is that his abstemious life did not lead to undue longevity. He died in 1859 at the age of 45, having suffered from hematemesis several times in the years preceding his death. The terminal event was preceded by left hemiparesis.

1. Richardson, B. W.: *Disciples of Aesculapius*, vol. 1, New York: E. P. Dutton & Co., 1901.

2. Snow, J.: *On the Mode of Communication of Cholera*, 2d ed., London: John Churchill, 1855.

3. Snow, J.: On Asphyxia, and on the Still-born, *London Med Gaz* 1:222-227, 1842.

4. Snow, J.: *On Chloroform and Other Anesthetics*, B. W. Richardson, ed., London: John Churchill, 1858.