

JOHN SNOW — VICTORIAN PHYSICIAN

Anthony Ashcroft

The School of Medicine in Newcastle upon Tyne dates its origin to 1832, when the first courses of lectures were given to a small group of students in rooms above a doctor's surgery in Bell's Court, Pilgrim Street. The building remains, in a dilapidated state, but the handsome original doorway was removed and is now in the new Medical School in Framlington Place.

John Snow was one of that first group and was destined to become the most celebrated. He is remembered both for his dramatic intervention in removing the handle of the Broad Street pump in Soho during the cholera epidemic of 1854, which brought the local outbreak to a speedy conclusion, and for his pioneer work on chloroform anæsthesia. The anæsthetists have an annual lecture in his name.

Original material relating to the life of John Snow is scanty and, like most accounts, this one is based largely on the Memoir published by Richardson in the year of Snow's death.¹ It is clear that he was both talented and industrious to a degree, and rose from humble beginnings to reach distinction in his relatively short life, only achieving due recognition some time after his death. Medical journals of the time tended to be verbose but the death notice in *The Lancet* of 26 June 1858 contained only the brief statement:

Dr. John Snow — this well-known Physician died at noon on 16th inst. at his house in Sackville Street from an attack of apoplexy. His researches on Chloroform and other anæsthetics were appreciated by the Profession.

Such a brief notice may have been due to a difference of opinion with Thomas Wakley, the irascible and outspoken editor of *The Lancet* at that time. However, when his treatise on chloroform² was published later in the same year, it received very favourable reviews both in *The Lancet* and *British Medical Journal*, where it was noted as 'exhibiting the struggles of a poor man of sterling integrity and much merit, but destitute of those popular talents by which early success is sometimes attained'. 'Had the author survived a few years he would have reaped the desired fruits of his labour in seeing established a rational, safe and extended employment of anæsthetic agents.'

John Snow was born in North Street, York on 15 March 1813. The family had lived in North Street for many years and both his grandparents and father are buried in the tiny churchyard there. He was the eldest of eight children and the others followed diverse occupations; for example, his brother Charles became an hotel keeper in York but later emigrated to Australia; another brother became a colliery manager in Yorkshire; and yet another took Holy Orders, whilst two of his sisters opened a private college for young ladies at The Mount, York.³ At the time of John's birth, his father's occupation was recorded as "labourer" and he later became the driver of a

horse drawn bus; it was only some time after John had left home in 1827 that his father acquired a small farm near York and became rather more prosperous, but at the time of John's birth and early childhood the family was not at all affluent and it is a source of some mystery where the means were derived for his education. We know that he was privately educated in York, possibly at St Peter's, although no records remain to confirm or deny this possibility. Little is known about his schooldays except that he was very proficient in arithmetic and interested in natural history, a fondness for which continued all his life.⁴

A possible source of means for his education, both at York and later at Newcastle, lies with his close life-long relationship to the Empson family. We know that his mother Frances Askham had adopted the name of Empson and it is probable that she was the illegitimate daughter of Mary Askham, who subsequently married John Empson. John Empson went to live in Bath and was probably well-to-do and well-connected because we find that in 1856 he took John Snow on a visit to Paris, meeting the Emperor Napoleon. The young John Snow was particularly industrious at school, being fond of mathematics, but we know little of his life there and at the age of fourteen he was apprenticed to William Hardcastle, a General Practitioner Surgeon in Newcastle.⁴ At that time William Hardcastle was living and practising in Westgate Street opposite St John's Church, although after John Snow left Newcastle he removed to one of the elegant houses in Greenfield Place.

Apprenticeship to a General Practitioner Surgeon in those days was usually for a period of five years and would have cost about 100 guineas, quite a substantial sum in 1827. The apprentice would have spent the first years living with his master and assisting in the day to day duties of the practice, including the preparation of drugs and dressings, writing up the day book and acting as general dog's body, observing over his master's shoulder, as it were, the practical application of the healing art. It was a well tried method of medical education, although poles apart from the highly structured vocational schemes of today. In the last two years of the apprenticeship it was customary to obtain hospital practice by walking the wards at the infirmary.

William Hardcastle was well established and highly thought of in the Parish of St John's. We find that he was surgeon and secretary to the lying-in hospital in Rosemary Lane and, after he died in 1860, a stained glass window was placed to his memory in St John's Church. In the autumn of 1831 cholera appeared in Sunderland and quickly spread over the north east of England and other parts of the country. William Hardcastle was appointed by St John's parochial council to minister to the sick in that parish and, because there were violent outbreaks in neighbouring villages, he sent his apprentice to cope with the epidemic at Killingworth Colliery. So in 1832 at the tender age of nineteen John Snow achieved the responsibility of independent and as yet unqualified medical practice.⁵

Little of the old Killingworth remains. Dial Cottage, half a mile away in Forest Hall, was for many years the home of Robert Stephenson, the

railway pioneer and inventor. Killingworth High Pit, where he was the engineer, has long since been worked out and filled in. It is now such a picturesque village that it is difficult to visualise the squalid, overcrowded and unhygienic pit rows of the mid 19th century, and of course the pattern of a collier's life contributed greatly to the rapid spread of infection. John Snow wrote subsequently of the colliers, who descended the pit with food and drink for a shift of eight or nine hours:

The pit is one huge privy, and of course the men always take their victuals with unwashed hands..... That the men are occasionally attacked while at work I know, from having seen them brought up from some of the coal-pits in Northumberland in 1831-32, after having had profuse discharges from the stomach and bowels, and while fast approaching to a state of collapse.⁶

With the benefit of hindsight and our knowledge today, it is hardly surprising that cholera spread like wildfire in such conditions. In 1832 doctors were only just beginning to understand the infectious nature of cholera and the remedies available were limited, being confined to the prevention of dehydration, together with the use of opium derivatives and other simple drugs; nevertheless John Snow's efforts appear to have been much appreciated. Persons who died in the parish were buried at Longbenton churchyard, the average number of deaths per annum being seldom more than 100 but in the year 1832 there were no fewer than 235. Unfortunately for our researches the cause of death was not recorded prior to 1837. The attractive church at Longbenton is surrounded by serried rows of tombstones, apart from the large area where cholera victims were hastily buried in unmarked graves. Within a short space of time, the usual funeral observances were abandoned. Coffins were smeared on the inside with coal tar and the dead were buried within nine hours of death, the pall being dispensed with and frequently the hearse abandoned in favour of a cart, a single attendant leading the horse at arm's length. The coffin was tipped into the grave and speedily covered with quicklime.⁷

The epidemic lasted several months and his first impression of medicine in the raw must have made a profound impression on the young John Snow, but the practice of medicine alone was not enough and in October 1832 he returned to Newcastle to pursue his studies. Whilst still an apprentice in Newcastle, John Snow became interested in his own health, becoming a vegetarian and teetotaller, a regime which he preached and practised for almost the whole of his life, and may have carried to absurd extremes, because we learn that he developed phthisis, renal disease and a duodenal ulcer — evidence of which was ultimately found at post-mortem.⁵

The population of Newcastle at that time was about 40 000 and there were only 10 physicians and 28 surgeons, most of whom would be in General Practice. A small group of them decided to commence instruction in medicine and surgery and a course of lectures was advertised in 1832, the modest premises over the entrance to Bell's Court being acquired for the purpose.

There were only eight students in the first session, who paid two guineas for the course of lectures and five guineas for hospital practice in the Newcastle Infirmary. After two sessions the premises proved inadequate and in 1834 the embryonic school was transferred to the Hall of the Barber Surgeons at Manors. Following this brief course of lectures and hospital practice, coming at the end of five years' apprenticeship, most students would take the LSA or MRCS, but it was not until the Medical Act of 1858 that registration became compulsory.⁸

When John Snow reached the end of his apprenticeship he must have wondered, like so many young doctors, what should be the next step in his professional life. He did not come from a wealthy or medical background and had his own way to make in the world, so perhaps his intention was to earn a little money as well as to broaden his experience, because in 1833 at the age of twenty we find him as an assistant to Mr Watson of Burnopfield, where he stayed for about twelve months, following which he returned to his native York for a brief visit. He then moved on to Pateley Bridge in Nidderdale, becoming assistant to Mr Warburton, where he stayed for about eighteen months. He seems to have found his work there very rewarding, but it must have been a hard life and he speaks of many rough rides and a fair share of night work; those who know the dale with its scattered farms will appreciate that the life of a country doctor in those times must indeed have been hard. We do not know the house where he stayed at that time but perhaps it was the apothecary's shop in the High Street, now a delightful tea room. In later years he spoke with great affection of Mr Warburton 'his old master', who must have been well thought of in the neighbourhood. Perhaps he was getting itchy feet again, because he then returned to the family home at York, engaging himself in the formation of Temperance Societies and taking long walks into the country, pursuing his study of natural history.⁹

It was in 1836 at the age of twenty-three that the great change in direction was made, when he decided to become a student in London. This involved quite an adventure and he made a long pilgrimage on foot from York, via Liverpool, and through North and South Wales, staying at Bath with his uncle, John Empson, and thence to London, where he attended the Hunterian School of Medicine in Windmill Street. In 1837 he enrolled at Westminster Hospital and in the following year became MRCS and LSA. He was then in a position to engage in independent practice and, to use his own phrase, he 'nailed up his colours' at 54 Frith Street, Soho, and, although he subsequently moved to Sackville Street, he spent the remainder of his professional life living and working in Soho.¹⁰

By the year 1837, when he was only twenty-four years of age, John Snow had already laid a very firm foundation for his distinguished life. He had spent five years in apprenticeship to an established General Practitioner, with hospital practice in a well respected provincial hospital; he had spent two years assisting in very different practices; he had coped with the desperate extremes of a cholera outbreak whilst still a student and had then made his

way to London, where he had taken the two most necessary basic medical qualifications, which would enable him to set up in practice. I wonder if he paused at this point and came to a conscious decision as to the ways in which his energy should be directed — we will probably never know but several strands of his life seem to begin simultaneously at this point. Firstly, he seems to have sought experience and clinical practice wherever the opportunity presented itself and we find him visiting the out-patients of Charing Cross Hospital on a purely honorary basis, hoping no doubt that his name would become known and that a procession of patients would soon begin to roll up to his rooms in Frith Street, Soho Square. I expect that, as for so many of his generation who were lacking in influence or private means, this was a long slow business and it was some years before he was properly established in practice but he lived a simple quiet life until his practice increased. Perhaps he worked off excess energy in violent exercise; for example, on Easter Monday 1837 he walked to St Albans and back, a distance of fifty miles, with his friend Joshua Parsons but he needed to take the horse bus the last mile or so down the Edgeware Road.¹⁰



Figure 1. Snow — early in his career.

The second strand in his medical progress was the pursuit of further academic honours. Now, whilst it was not entirely necessary to possess a University degree, it was certainly a pre-requisite for one who aimed at consultant practice and so we find him taking the MB of the University of London in 1843 and proceeding MD with Honours in 1844 at the age of thirty-three.¹¹

The third strand in his medical life was his involvement with the Westminster Medical Society.¹² I suspect that, being of a shy and retiring nature, both a vegetarian and teetotaler, of slender means, living very plainly and keeping no company, he must have found this a somewhat painful experience. Most medical societies in those days were no less convivial than they are today. Nevertheless he persevered and his efforts achieved recognition. It is recorded that, when he first attended the meetings, he was very timid and, although he spoke to the point, his contributions seemed largely ignored,¹² but he continued to attend the meetings¹³ and reported in *The Medical Gazette* the results of his researches into a wide variety of medical topics.¹⁴ Research, then, was the fourth strand in his medical life. The research and the publication of his findings must have occupied a considerable proportion of his time, because the experimental work was carried out with tremendous application and in great detail, the two most famous examples being, of course, his work on anæsthetic agents and the epidemiological study of cholera, to which we shall turn shortly.¹⁵

John Snow's experimental work in anæsthesia probably began about 1846 but ether anæsthesia dates back to 1842, when it was used by Long on a small scale; it was later used by Morton for dental extractions in 1846 and its popularity really began at that time. With his by now accustomed thoroughness, he investigated all the physical properties and physiological effects of ether¹⁶ and various other similar chemical compounds and experimented on a considerable scale first with animals, before applying for permission to use it in the out-patients' dental department at St George's Hospital. There he acquired a reputation as an anæsthetist of great skill. He soon progressed to general surgery and made a great impression on Robert Liston of University College Hospital, who was responsible for his introduction to that hospital. Unfortunately Robert Liston died in 1847 but by this time John Snow's reputation was advancing. Like so many anæsthetists, then and now, he designed and made his own apparatus, but with his ether apparatus the main difficulty lay in producing quantities of anæsthetic vapour at the right temperature, a problem which he soon overcame by the use of a copper spiral placed in a water bath.¹⁷

The use of ether was, however, soon superseded by chloroform, which James Young Simpson had used for midwifery in November 1847; Snow turned his attention to this and characteristically designed a special inhaler with face piece, which, with only minor modifications, became used in many London hospitals and elsewhere. In Newcastle the Infirmary report for 1850 records that the use of chloroform was most general, being administered in

all severe operations and being universally successful and perfectly safe — the patients indeed insisting on its use — ‘they should first of all have the chloroform and be set fast asleep’. Snow was, of course, quick to publish the results of his work¹⁸ but unfortunately it was not until after his death that his major work on chloroform and other anæsthetics was published. Not only was Snow most careful in all his experimental work, but he meticulously recorded, in the three volumes of his diary, the clinical details of all his patients.¹⁹ These diaries are now in the possession of the Royal College of Physicians and make fascinating reading, being as legible today as they were at the time when they were written. Two representative pages, not entirely chosen at random, include the accounts of the administration of chloroform to his most famous patient, Queen Victoria.²⁰ John Snow had been consulted at the birth of Prince Arthur in 1850 but did not actually administer the anæsthetic then; however, he was called in attendance on 7 April 1853, when Prince Leopold was born. The extract from his diary reads as follows:

Thursday 7th April:

Administered chloroform to the Queen in her confinement. Slight pains had been experienced since Sunday. Dr. Locock was sent for about nine o'clock this morning, stronger pains having commenced, and he found the os uterus had commenced to dilate a very little. I received a note from Sir James Clark a little after ten asking me to go to the Palace. I remained in an apartment near that of the Queen along with Sir J. Clark, Dr. Fergusson and (for most part of the time) Dr. Locock till a little after twelve. At twenty minutes past twelve by a clock in the Queen's apartment [*sic*] I commenced to give a little chloroform with each pain, by pouring about 15 minims by measure on a folded handkerchief. The first stage of the labour was nearly over when the chloroform was commenced. Her Majesty expressed great relief from the application, the pain being very trifling during the uterine contractions, whilst between the periods of contraction there was complete ease. The effect of the chloroform was not at any time carried to the extent of quite removing consciousness. Dr Locock thought the chloroform prolonged the interval between the pains and retarded the labour somewhat. The infant was born at thirteen minutes past one by the clock in the room (which was three minutes before the right time) consequently the chloroform was inhaled for 53 minutes. The placenta was expelled in a very few minutes and the Queen appeared very cheerful and well, expressing herself much gratified with the effect of the chloroform.⁽²¹⁾

This of course was his own account but Queen Victoria herself recorded in her diary:

Dr. Snow gave that blessed chloroform and the effect was soothing, quieting and delightful beyond measure.

One could hardly be more appreciative than that!

Thursday 7 April

Administered chloroform to the Queen in her confinement. Slight pains had been experienced since midnight. Dr. Locock was sent for about nine o'clock this morning, the uterine pains having commenced, and he found the os uteri had commenced to dilate a very little. I remained ^{at home} from Sir James Clark a little after ten o'clock on my way to the Palace. I remained in some pain until noon, that of the Queen being sent for Dr. Clark for 2 or 3 minutes. ~~For the most part of the time of Dr. Locock till a little before~~ ^{11.35 minutes} the chloroform was given by a clock in the Queen's apartment. I commenced to give a little chloroform with each pain, by pouring about 15 minims to 20 minims on a folded handkerchief. The first stage of labour was nearly over when the chloroform was commenced. Dr. Locock was much relieved from the application, the pain being very trifling during the uterine contractions, and which between the periods of contraction was completely eased. The effect of the chloroform was such at every time carried to the extent of gentle vomiting consciousness. Dr. Locock thought that the chloroform perhaps the interval between the pains, and that the labour advanced. The pains were less at 15 minutes past three by the clock in the room (which was 3 minutes before the 2nd stage) consequently the chloroform was injected in 5 or 6 minims. The placenta was expelled in a very few minutes, and the Queen appeared very cheerful and tranquil, expressing herself much gratified with the effect of the chloroform.

Figure 2. Snow's diary entry for 7 April 1853.

Some four years later on 14 April 1857, he was again called to administer chloroform to the Queen in her ninth confinement; clearly this was not quite so straight forward as last time. His account of the confinement reads as follows:

Tuesday 14th April

Administered chloroform to her Majesty the Queen in her ninth confinement. The labour commenced about a fortnight later than was expected. It commenced about 2.00 a.m. of this day when the medical men were sent for. The labour was lingering and a little after 10 Dr. Locock administered half a drachm of powdered ergot, which produced

some effect in increasing the pains. At 11 o'clock I began to administer chloroform. Prince Albert had previously administered a very little chloroform on a handkerchief about 9 or 10 o'clock. I poured about 10 minims of chloroform on a handkerchief folded in a conical shape for each pain. Her Majesty expressed great relief from the vapour. Another dose of ergot was given about 12 o'clock and the pains increased somewhat afterwards. The Queen at this time kept asking for more chloroform and complaining that it did not remove the pain. She slept, however, sometimes between the pains. Before one o'clock the head was resting on the perineum and Dr. Locock wished the patient to make a bearing down effort, as he said this would effect the birth. The Queen, however, when not unconscious of what was said, complained that she could not make an effort. The chloroform was left off for 3 or 4 pains as the royal patient made an effort which expelled the head, a little chloroform being given just as the head was passed. There was an interval of several minutes before the child was entirely born; it however cried in the meantime. The placenta was expelled about ten minutes afterwards. The Queen's recovery was very favourable.²¹

It is noteworthy that he did not use his vaporiser in obstetric cases where analgesia, or at any rate a lighter plane of anaesthesia, was desirable in the majority of cases.

Royal approval of chloroform did much to counteract the strongly expressed views of those who thought that childbirth was meant to be painful.²² As it says in the Scriptures, 'In sorrow shalt thou bring forth children'. The fiery Thomas Wakley, editor of *The Lancet*, was amongst those who expressed a reactionary opinion, when he wrote:

Intense astonishment, therefore, has been excited throughout the profession by the rumour that Her Majesty during her last labour was placed under the influence of chloroform, an agent which has unquestionably caused instantaneous death in a considerable number of cases..... We could not imagine that anyone had incurred the awful responsibility of advising the administration of chloroform to Her Majesty during a perfectly natural labour with a seventh child.^{23,24}

As we have seen, the antagonism between Snow and Wakley continued until Snow's death.

It is perhaps somewhat surprising that John Snow does not appear to have received any honour following his attendance on the Queen but then anaesthesia hardly achieved the respectability that it enjoys today. The administration of anaesthesia seems to have been a major activity of his, although it cannot exactly have been a moneyspinner, because his income from all sources never exceeded £1000 per annum, even at the height of his career.²⁵

We now turn from John Snow's contribution to anaesthetic science to his work on cholera. The cholera epidemic of 1832, of which he had experience at Killingworth, was part of a widespread outbreak but was nothing like so severe as the succeeding epidemics of 1848 and 1853. The problem of the

transmission of cholera, and indeed its very nature, was quite unknown in 1832 although a Newcastle practitioner, TM Greenhow, and Dr WR Clanny of Sunderland, both published small volumes on its treatment at that time.²⁶ It is of interest that William Hardcastle, John Snow's principal, and Greenhow had applied for the same surgical post at Newcastle Infirmary, but Hardcastle withdrew his application and Greenhow was appointed, and by the year 1848 Greenhow was the senior surgeon to the Infirmary. I wonder whether getting into print was as important then as it appears to be today in securing advancement. Be that as it may, the treatment for cholera advocated by Greenhow seems to have depended on the use of mustard emetics, tobacco enemas and the liberal use of opium tincture, calomel and brandy. England was virtually free of cholera between 1832 and 1848 but Snow's experiences in the earlier epidemic were not forgotten and, when he spoke to the Westminster Medical Society in 1849²⁷ and also at greater length in his book On the mode of communication of cholera,²⁸ he emphasized the importance of personal cleanliness and also incriminated contaminated drinking water as the medium for communicating the infection. There were others who felt that the disease was airborne or spread by fomites but Snow's observations, that in areas of outbreaks the water itself was offensive, proved to be the clue from which all else followed. It became clear that the water supply was frequently contaminated from adjacent sewers, house drains or cess pools. He presented these observations and advanced his theory as to the likely mode of infection, recommending a few simple measures by which the disease could be avoided:

- 1) the washing of hands after touching patients:
- 2) the washing of hands before touching food:
- 3) that one should drink only pure water or water which had been filtered or boiled.

He hastened into print in 1849^{15,27} because, as we have seen, he was simultaneously deeply involved with his work on chloroform. There was a great deal of argument and discussion about cholera in both the lay and medical press of the time but it was not until the next outbreak in 1854 that his views were accepted. Having implicated an impure water supply as the likely cause of cholera, he devised a simple test with silver nitrate, which readily confirmed the presence of impurities, visiting each house for the purpose. He noted that in Southwark and Lambeth the population derived their water supply from two companies; the Lambeth Water Company supplied pure water drawn from Thames Ditton and the Southwark and Vauxhall Company supplied water from the river at Battersea, which was contaminated. In the Southwark and Vauxhall area twelve times as many cases of cholera occurred as in the Lambeth area. He published his findings and supported them with evidence in incredible detail so that there remained no doubt of the truth of his assertions.²⁹

It was, however, the catastrophic outbreak in his own practice area which supplied the final proof and by which he is remembered. This is the

episode of the Broad Street pump; Broad Street lies in Soho between Frith Street, where he originally set up in practice, and Sackville Street where he then lived. At the end of August 1854 an explosive outbreak of cholera occurred in the area of Broad Street and Golden Square and there were more than five hundred fatal cases of cholera in ten days. He would have attended many of these patients himself and numbers were admitted to hospital, but of course the majority would die at home. Snow had noted where the deaths occurred and subsequently published, in the second edition of his book, a map showing the situation of each death. Although there were several other pumps in the district, the majority of deaths were in the immediate vicinity of the Broad Street pump. It is difficult for us in these healthy times to visualise the horror of such an epidemic — five hundred deaths in an area of a quarter square mile over a period of ten days; Snow recorded every one.³⁰

Not since the Great Plague had there been such an outbreak and the population of the area was on the verge of panic, ready to leave homes and possessions to escape to healthier areas. The parochial church council or Board of Guardians was responsible for the health of the community and, on the evening of Thursday 7th September, the vestrymen of St James Church met to discuss the cause of the outbreak and what might be done to contain it.³¹

Dr Snow requested a hearing and, with brief but cogent argument, persuaded the vestrymen that the Broad Street pump was the source and centre of the outbreak.³² The vestry was incredulous but, fortunately for history, heeded his advice and followed his prescription — to remove forthwith the handle of the pump.³¹ Within days the epidemic waned. There are those who have suggested that the epidemic was already past its peak at this point but there can be little doubt that this simple but striking prescription rapidly brought the epidemic in that area to an end.³³ The site of the pump is still marked and the public house, which used to be named the City of Newcastle, has been renamed the John Snow in his memory. Professor Bradford Hill was invited by Watneys to dedicate it to his memory in 1955, although JF Fulton commenting on the address by Professor Mackintosh, Professor of Public Health at the London School of Hygiene and Tropical Medicine, felt that it was somewhat inappropriate that John Snow, who remained a bachelor, a teetotaler and a vegetarian³⁴ all his life, should have a Soho public house as his chief memorial.³⁵ Snow himself, however, noted that the brewery workers themselves appeared immune to cholera — their fluid requirements were met exclusively from the barrel. Snow published the whole of this research in 1855 in the second edition of his work *On the mode of communication of cholera* and in 1856 he visited Paris with his uncle, Mr Empson, who had known the Emperor Napoleon for many years. During this visit he entered a copy of his treatise in competition for a prize of £1200, offered for the discovery of a means of preventing or curing the disease but he was not successful.³¹ With the advance in public health and the provision of a pure water supply, cholera soon became a thing of the past so far as this

country is concerned and John Snow returned to devoting his energies to the development of anaesthesia. His treatise on chloroform was an immense labour of love running to over 400 pages, representing the culmination of his life's work, but unfortunately his health was beginning to deteriorate. Whilst still in his thirties he suffered from pulmonary tuberculosis and probably nephritis also. His friends managed to induce him to relax his strict vegetarian ways and to take a more varied diet.³⁵

More recently he had suffered a hæmatemesis and in December 1857 he had a slight stroke but continued with his writing and all his other professional activities until the last.³⁶

He had just completed the last sentence of his treatise when he sustained a cerebral infarction from which he eventually succumbed on 16 June. The following Monday he was buried in Brompton Cemetery,³⁷ where his grave is marked by a distinctive memorial. His was a short life of considerable activity in a wide range of general and special interests and we can be proud that the Newcastle School of Medicine influenced him in this to some considerable extent.

Acknowledgements

I am grateful to Elizabeth Lazenby for providing the notes and references, and to the Royal College of Physicians for permission to reproduce Figure 2.

Selected bibliography

- Armstrong Davison M H. John Snow and the Enlightenment. *Proc Roy Soc Med* 1958; 51: 834-5.
- Barrett N R. Tribute to John Snow. *Bull Hist Med* 1946; 19: 517-535.
- Bradford Hill A. Snow — An appreciation. *Proc Roy Soc Med* 1955; 48: 1008-12.
- Cohen, Lord. John Snow — 'The Autumn Loiterer'. *Proc Roy Soc Med* 1969; 62: 99-106.
- De S N. *Cholera*. Oliver and Boyd, 1961.
- Duncum B. *Development of Inhalation Anaesthesia*. Wellcome Historical Medical Museum, Oxford 1947.
- Fraser I. John Snow and his surgical friends. *Anaesthesia* 1968; 23: 501-14.
- Fulton J F. Editorial. A Snow Centenary. *Lancet* 1955; 1: 1113-4.
- Hume G H. *History of the Newcastle Infirmary*. Andrew Reid: Newcastle, 1906.
- Keys T E. John Snow, M.D., Anesthetist. *J Hist Med* 1946; 1: 551- 566.
- Longmate N. *King Cholera*. Hamish Hamilton: London, 1966.
- Mackintosh J M. Snow — the man and his times. *Proc Roy Soc Med* 1955; 48: 1004-07.
- Snow J. *On the mode of communication of cholera*. First edition, London 1849; second edition enlarged, London 1855; reprinted with introduction by Wade Hampton Frost, New York, 1936.

Snow J. *On narcotism by the inhalation of vapours.* (1849-52). Facsimile edition with an introductory essay by R H Ellis. London: Roy Soc Med, 1991.

Snow J. *On Chloroform and other Anæsthetics.* London 1858. (Ed. Richardson B W).

Turner G G, Arnison W D. *The Newcastle School of Medicine.* Andrew Reid: Newcastle, 1934.

Notes and references.

1. Richardson B W. Memoir of John Snow: appended as an introduction to Snow J., *On Chloroform and other Anæsthetics*, London: John Churchill, 1858: pp i-xliv. In the following notes, where the memoir is indicated, as opposed to Snow's actual text, the references given are to Richardson, but with arabic numerals substituted for the original roman.
2. Snow *op cit* note 1.
3. NB. This is not the present-day Mount School run by the Society of Friends.
4. Richardson *op cit*: 2.
5. Richardson *op cit*: 3-4.
6. Snow J. On the prevention of cholera. *Med Times Gaz* 1853; *ns*7: 367-9.
7. See for example: [Sykes J] *An account of the disease termed cholera morbus, from its first appearance at Sunderland, to its final departure from Northumberland and Durham....* Newcastle: John Sykes, 1832.
8. Newman C. *The Evolution of Medical Education in the Nineteenth Century.* London: Oxford University Press, 1957: 186-193.
O'Malley C D. *The History of Medical Education.* Los Angeles: University of California Press, 1970: 243-244.

See also the chapter and references concerning Education and the General Medical Council in F N L Poynter: *The Evolution of Medical Education in Britain*, London, 1966.

9. Richardson *op cit*: 4.
10. Richardson *op cit*: 6-9.
11. Richardson *op cit*: 12.
12. Richardson *op cit*: 8-9.
13. John Snow's contributions to the Westminster Medical Society were recognised when, after its amalgamation with the Medical Society of London in 1849-1850, he became Orator and in 1855 President of this re-formed Society.
14. Snow published more than thirty papers on cholera and public health and a similar number on ether, chloroform, other anæsthetics and respiratory physiology. Many were read to the Westminster Medical Society and later published in the *London Medical Gazette*. Among the most important of these papers in chronological order are:

Asphyxia and the Resuscitation of New-born Children. 1842; *ns*1: 222-227.

On the Use of Ether as an Anæsthetic. 1847; *ns*4: 156-157.

On the Pathology and Mode of Communication of Cholera. 1849; *ns*4: 730, 745, 923.

On the Communication of Cholera by Impure Thames Water. 1854; *ns*9: 365-366.

On the Chief Cause of the Recent Sickness and Mortality in the Crimea. 1855; *ns*10: 457-458.

Drainage and Water Supply in Connection With the Public Health. 1858; *ns*16: 161, 189.

See also *Dictionary of Scientific Biography*, volume 12, 502-503, and Youngson A J. *The Scientific Revolution in Victorian Medicine*. New York: Holmes and Meier, 1979: 76.

Snow J. *On narcotism by the inhalation of vapours*. London: Wilson and Ogilvy, 3 volumes, 1848, 1851, 1852. Facsimile edition, edit Ellis R H; London: Roy Soc Med, 1991.

15. Snow J. *On the mode of communication of cholera*. First edition, London 1849; Second edition enlarged, London 1855; Reprinted with introduction by Wade Hampton Frost, New York, 1936.
Snow J. *On Chloroform and other Anæsthetics*. London: John Churchill, 1858. (Edited by B W Richardson).
16. Snow J. *On the Inhalation of the Vapour of Ether in Surgical Operations*. London: Churchill, 1847;
Snow J. *On narcotism by the inhalation of vapours*. *op cit* note 14.
17. Richardson *op cit* note 1: 14-15.
18. Some of Snow's papers on chloroform are:
On the Inhalation of Chloroform and Ether, with description of an apparatus. *Lancet*, 1848; 1: 177-180.
On the Administration of Chloroform During Parturition. *Assoc Med J* 1853; 1: 500-502.
19. Richardson *op cit*: 32.
20. Richardson *op cit*: 31.
21. Snow's diary is in the library of the Royal College of Physicians, London.
22. Snow, in 1853, showed that chloroform could hardly be refused to mothers on the grounds of safety, when he stated in *The Lancet*, 1853; 2: 609-10, 'It should be remembered that no death from chloroform had occurred in midwifery, and he only knew of one case where the patient was in danger, and that arose from gross mismanagement, for the husband was giving the chloroform, and looking another way.' Prince Albert was obviously more adept!
23. Editorial in *The Lancet*, 1853; 1:452.
24. Twenty five deaths from chloroform anæsthesia were reviewed in the *Assoc Med J* 1853; 1:134-6. The very first was recorded in 1848 in the practice of Dr TN Meggison of Winlaton (near Gateshead) and the post-mortem examination of the case was made by Sir John Fife.
Fatal application of chloroform. *Lancet* 1848; 1:161-2.
Simpson JY. Remarks on the alleged case of death from the action of chloroform. *Lancet* 1848; 1:175-6.
Snow J. The fatal chloroform case at Newcastle. *Lancet* 1848; 1:239.
25. Richardson *op cit*: 40.
26. Greenhow T M. *Cholera: its non-contagious nature, and the best means of arresting its progress shortly examined. In a letter addressed to the Right Worshipful Mayor of Newcastle*. Newcastle: E. Charnley, 1831.
Clanny W R. *Hyperanthrax or the cholera at Sunderland*. London: Whittaker, Treacher and Arnott, 1832.
27. Snow J. On the mode of communication of cholera. *Lond Med Gaz* 1849; ns9: 466-470.
28. First published in London in 1849; see note 15 above.
29. Richardson *op cit*: 20.
Also: On the Communication of Cholera by Impure Thames Water. *Medical Times and Gazette*, 1854; ns9: 365-366.

Snow, on page 88 of the second edition of *On the mode of communication of cholera* (see note 15 above), gives the following table as proof of these findings:

	Population 1851	Cholera deaths in 14 weeks ending 14 Oct.	Deaths per 10,000 living
Houses supplied by Southwark and Vauxhall Water Company	266,516	4,093	153
Houses supplied by Lambeth Water Company	173,748	461	26

30. Richardson *op cit*: note 1:20-22.

Snow J. Communication of cholera. *Med Times Gaz* 23 September 1854, 39-54.

Report on the Cholera outbreak in the parish of St James, Westminster, during the autumn of 1854, presented to the vestry by the Cholera Inquiry Committee. London: July 1855.

31. Richardson *op cit*: 20-22.

32. Rawnsley states that Snow found the source of the outbreak with the help of the local curate, Rev Henry Whitehead, who had discovered that, just before the outbreak, a child had died at 40 Broad Street from exhaustion following diarrhoea, but that the symptoms were those of cholera. The child's napkins had been soaked in water, which was then thrown down a sink and thence into a cesspool which seeped into the pump well. Rawnsley H D. *Henry Whitehead, 1825-1896*. Glasgow: 1898: 29-42 and 206.

33. Chave S P W. Henry Whitehead and Cholera in Broad Street. *Med Hist* 1958; 2: 92-108.

Chave S P W. The Broad Street pump and after. *Medical Officer* 1958; 99.

Bailey W and Gull W. *Reports on the epidemic cholera drawn up at the desire of the Royal College of Physicians*. London: 1854.

34. Richardson *op cit* 2-3; Richardson states here that, 'During the third year of his apprenticeship, viz., when he was seventeen years old, he formed an idea that the vegetarian body-feeding faith was the true and the old; and with that consistency, which throughout life attended him, tried the system rigidly for more than eight years.'

See also Richardson *op cit* 13.

35. Richardson *op cit*: 2-3.

Richardson, *op cit*: 13, says that he relaxed his strict vegetarian diet in 1845.

Fulton J F. John Snow — Epidemiologist. *J Hist Med* 1955; 10: 428-9.

Mackintosh J M. Snow, the man and his times. *Proc Roy Soc Med* 1955; 48: 1004-07.

36. Richardson *op cit*: 41.

37. Richardson *op cit*: 42-44.