# The man whose skills saved millions

## David Honeywell

Published by Nocton Publishing,
25 Fawcus Court, Redcar,
Cleveland, TS10 5QX, England
http://nocton-publishing.com

ISBN 978-0-9572599-3-5



British Library Cataloguing in Publication Data.
A catalogue record for this book is available from the British Library

Cover design by Stephen G. Nicholls
www.coastalviewandmoornews.co.uk
Dr Snow photo and inhaler illustration: Courtesy of
The National Portrait Gallery
Photography: Serena Jade-White

## Acknowledgements

The research for this book was started in the 1970s by my late Uncle - Donald Mulcock. Donald worked as journalist most of his life and was still freelancing until the age of eighty-two when he died in 2002. He never completed this book, so I later took it over, completing and editing it myself. Apart from his journalist career, Donald's other achievements included gaining the Fellowship of the Royal Anthropological Institute for his research on the 'Veda tribe' of Ceylon (now Sri Lanka).

He also worked for Barnado's as a child psychologist for gifted and disturbed children; was an officer in St John's Ambulance; and served in the RAF and army in World War II when he worked as a medic in the Royal Army Medical Corps during which time he treated both British and Japanese soldiers. He was awarded the Burma Star and later worked for the Salisbury Journal, the Western Gazette as well as submitting regular articles for the Salisbury Medical Journal. He achieved degrees in law, anatomy and physiology, and diplomas in psychology and medical history - the latter at London University when he was sixty-six-years-old.

When he started his research for this book, there was no Internet, which means all his hard work was done the old-fashioned way, conducting face-to-face interviews and physically going around museums and places linked to Snows' life; much in the same way his hero Dr Snow worked.

During this work, he became widowed and eventually left his home in Salisbury to move to Teesside to be with myself and my mother (his sister) Nancy. As he got older, he struggled to carry on this work, therefore, as a tribute to my late uncle; to Dr Snow and my family, I felt compelled to complete the work he had started.

## Preface

The book details death and disease in Britain during the Nineteenth Century and the struggle surgeons had in keeping up with the growing epidemics. It has many anecdotes and quotes by eminent surgeons of tragic results during operations. It discusses their experimentation using ether and chloroform as anaesthetic and what took place in the operating theatres.

It describes Snow's upbringing in his birthplace of York amongst squalor and disease and how he embarked on a remarkable career as a doctor from the young age of fourteen years when he left his hometown to train at Newcastle Infirmary.

It talks about how the Industrial Revolution brought in its wake the rapid growth of certain towns and with it overcrowding, unsanitary dwellings, squalor and pestilence. Sunderland was badly affected by cholera in November 1831, when Snow had learned of this serious epidemic, which had just entered Britain through the port of Sunderland from Europe. And here's how the story begins.

## Introduction

One evening in September 1854, during London's worst cholera epidemic, a slight, middle aged man, dressed in black, rapped on the door of the house in which St James' Parish Board of Guardians were meeting. He was admitted, giving his name as Dr John Snow, physician and surgeon. He said he wanted to see the Guardians as a matter of urgency and was ushered into their presence. He told them he had a matter of life and death to discuss with them.

At first, the Guardians were taken aback at the intrusion on their private discussions, but quickly gained the impression that Dr Snow was in deadly earnest. They bade him to sit down and say his piece. He told them that he had a practice in Soho and that he had discovered that cholera was spreading through contaminated water supplies, particularly from the popular Broad Street pump from which people living in the locality drew drinking water.

He explained that there had been many deaths in that area and demanded that the Guardians should remove the pump handle immediately to prevent any further use of the pump and its well. The meeting listened aghast at the outrageous suggestion that a public water supply should be cut off, but they soon saw urgency and wisdom of Snow's request and agreed, albeit grudgingly.

The next day, the Broad Street pump handle was removed, and so was born the now famous story of John Snow and the Broad Street pump handle affair.

The story's claim that the cholera epidemic thereafter died down dramatically and that his actions saved a large number of lives is colourful, but not entirely accurate, for the epidemic was already waning when he made the request for the removal of the handle. It is a nice little story however, and despite Snow's impressive achievement in another field, anaesthesia, he is remembered today principally for his work on cholera and the Broad Street incident. A public house today stands near the site of the pump and is aptly named the 'John Snow'. What remains today of Snow? Simply his memorial stone over his grave in Brompton cemetery, placed there by anaesthetists. His homes in Frith Street and Sackville Street have long gone, including a London County Council commemorative plaque, which once was attached to the outer wall of his Sackville street house and was disposed of when the house was demolished. And, there is no trace of his birthplace in the ancient city of York, but a plaque has been placed close to where it had once stood. Perhaps the most fitting memorial to Snow is the operating theatre in every hospital in the country, where anaesthetists with their complex modern apparatus are carrying on a tradition founded by Snow as the first professional anaesthetist.

John Snow was born in a cottage in the historic North Street, a riverside thoroughfare in the ancient city of York, on 15 March 1813. He was the first born of labourer William Snow and his wife Frances, who would eventually have a total of eight children, four sons and four daughters.

The Snow family was long established in the city, and William and Frances married in the village church at Huntington, near York. William's parents, William Snow - Senior and Hannah Snow, both lived in the parish of North Street and are buried in the tiny churchyard of All Saints Church.

Little is known about the family background of John Snow's mother, apart from the fact that she was the illegitimate daughter of a domestic servant, Mary Askham. Snow did not refer to this aspect of his family history. When Mary Askham gave birth to Frances, she was working at a large house at Ledsham, near Pontefract. The child was baptised on 15 February 1789, but we do not know the identity of her father. The Askham's were an old York family and after bringing up the baby on her own for four years, Mary returned to her native city.

There she subsequently met and married weaver John Empson who lived in Stockton Lane. Frances took the name of her stepfather and was known as Frances Empson.After their marriage, Mary and John Empson and little Frances made their home in Acomb, a suburb of York today, but then a village. The couple had three sons, Charles born in 1795, who was destined to play an important part in the life and career of John Snow: John born 1798 and William 1801. Their father appears to have spent a somewhat unsettled existence during the early years of the marriage. He worked firstly as a weaver, then a gentleman's servant and finally as a labourer.

John Empson was therefore unlikely to have amassed much money from any of these occupations and it remains a mystery as to the manner in which his eldest son, Charles, made a fortune by the time he was forty. All three Empson sons were devoted to their stepsister, Frances, who grew up with them.

They were at Huntington Parish Church the day she was married to William Snow on 24 May 1812, and no doubt at the christening of their first child, John, on 15 March the following year.

John Snow spent his early years in comparative poverty with his parents and younger brothers and sisters in the tiny house in North Street, which was the Snow's first family home. The house does not exist today, as far as we are aware. The street would hardly be recognisable to Snow today apart from the historic Thirteenth Century church of All Saints, the quaint little lane alongside it with a few ancient cottages and a few houses further along North Street. It is remotely possible that one of the little cottages was Snow's birthplace, but of this, there is no evidence. The existing few buildings, which were there in Snow's time do, however, give an inkling of the sort of atmosphere in which Snow grew up.

In Snow's boyhood, North Street was a narrow, dingy thoroughfare, running alongside the River Ouse. This part of the city had been a trading area since the Tenth Century when the Viking settlers established a thriving trade with Dublin. In fact, the little quay near Snow's home was known as "Dublin Stones".

At the turn of the Nineteenth Century, the area was noisome with its rows of cramped, poorly lit, insanitary homes, squalid courtyards and alleyways, some of which ran down to the river edge, amidst ramshackle warehouses and wharves. It was an exciting spot for an adventurous young boy to grow up in and young John Snow and his brothers must have had many boyhood adventures on the wharves and watching the sailing barges arriving with their cargoes.

The Snow family regularly attended All Saints Church, which today is famous for some of the finest medieval stained glass in the country. John spent the first eight years of his life in this street and then in 1821, William Snow, who had moved up a little in the social scale, having become a carman (the driver of a horse drawn omnibus), probably one he had hired – moved with his growing family to more roomy premises in Queen Street, just around the corner. There were now four children to house and feed, John, Charles and William born 1816, Robert, 1818 and Thomas 1821.

During their times in Queen Street, the Snows had three daughters, Margaret (Mary) born 1822, Hannah, 1823, Sarah, 1825 and George who lived for less than one year and is buried near his grandparents in All Saints churchyard.

The family was in Queen Street for some sixteen years, during which time the children grew up and William Snow managed to save sufficient money from his horse bus project to lease, or buy, a small farm at Rawcliffe, near York. Many references to Snow's origins published, describe him as the son of a farmer, but he was, according to parish and other records, the son of a labourer and it was not until he was well established as a physician at the age of twenty-four that his father became a farmer.

Snow's certificate, issued when he qualified at the Society of Apothecaries, clearly shows that his father had advanced somewhat in social standing, for on that document he is described as a "merchant". Of his success in this calling, we know nothing, but as he is shown in the York Census of 1841 as a farmer, it is likely he was a cereals farmer and acted as a merchant for seeds. William Snow's career was shrouded in mystery until he became settled as a farmer when his son John, was in his mid twenties, qualified.

John Snow on his occasional visits home, helped his father on the farm, and later in life told friends that he "dreaded early winter mornings, which were too intimately to be pleasantly acquainted with the benumbing effects of the cold". This quaint, obscure style of speech was typical of Snow in his maturity.

As a child, Snow was sensitive and reserved. He was sent to a small private school, which was, at that time, able to offer a better education than the local grammar schools, which used the "new learning", based on classics and theology with a view to schooling its pupils for Oxford and Cambridge universities.

Snow was a bright pupil and he rapidly absorbed the elements of the English, French, writing, bookkeeping and arithmetic. When he was fourteen years of age, he appears to have outgrown his school, as we are told he had learned "all that his schoolmaster was able to teach him". Apart from his schoolwork, Snow showed a keen interest in the natural history of the countryside around York.

He was also interested in historical places and soon acquired a sound knowledge of the history of his hometown, one of the country's most historic cities.

He knew and loved the famous Minster, often walked along the medieval walls around the city and over the newly built Ouse Bridge, which replaced an ancient bridge on which there had been little shops, like the Rial in Venice. His youthful interests in nature resembled those of the famous surgeon and anatomist, John Hunter.

During Snow's boyhood, York was famous for several light industries, such as printing, glass blowing, linen making, scientific instrument manufacture, drug making and confectionary. The

population then was 20,000, about one sixth of the present day population and life expectancy was poor. The average life span was about thirty-five years, and one third of all children born were likely to die before reaching the age of five. Sanitation was primitive and hygiene unknown. It is remarkable, therefore, that William Snow and his wife were able to bring to adulthood, seven of their eight children under the appalling conditions of the time, and what is more, two of the daughters lived well into their eighties.

When the time arrived for John Snow to leave school and find a job, his father was doing well with his horse drawn bus, but it is clear that William Snow did not have sufficient financial resources to give his son much backing for a professional training, and it is equally clear that at this point, uncle Charles Empson, a wealthy man, offered to help finance his favourite sister's son for a medical career.

Empson was a man of the world, a well-known personality in Bath, where he lived in retirement and had an impressive record behind him of South American exploration and as a naturalist and zoologist. He was therefore au fait with the requirements of the various professions. It is almost certain that it was Empson who thought that young Snow should apply his considerable talents to medicine, and suggested it to the family. He knew just the man to take John under his wing and train him as an apothecary.

Empson knew a highly respected and competent Newcastle upon Tyne surgeon, William Hardcastle, and it was arranged that John Snow should be apprenticed to him for five years, the usual period being from five to seven years. We do not know what premium was paid for young Snow's apprenticeship, but it was probably in the region of £150 and undoubtedly paid wholly or largely by Charles Empson.

Empson undoubtedly launched John Snow on his career as a physician, and may well have helped with the careers of the other children in the Snow family. The other three boys did well for themselves, the second son Charles becoming an innkeeper and proprietor of a temperance hotel in York before emigrating to Australia. The next son Robert, qualified as a mining engineer and eventually was a senior official, probably manager, at Garforth Colliery, near Leeds. Thomas, the youngest son trained as a teacher and clergyman, serving his title as curate at Salford and then becoming chaplain to Halifax prison and later vicar of Underbarrow, where he died in 1893.

Two of the girls, Mary and Hannah, received a good education, which was then unusual for girls from a family like the Snows, both becoming schoolmistresses. They ran a dame's school in Dale Street, Nunnery Lane, York, for many years after which they founded a College for Young Ladies at the Mount, a very fashionable part of the city. There they remained for fifty years and retired as spinsters to Harrogate at the end of the century.

Sarah Snow was the only daughter to marry and she does not appear to have had any real education at all. She married a local farmer named Collier and they made their home at Layerthorpe, then a village near York, and today a suburb. John Snow remained a bachelor all his life, but his brothers each married and the Rev Thomas Snow had two highly gifted sons, Thomas born in York in 1852, who became a classics scholar and Fellow of Corpus Christi College, Oxford, and William born in Halifax in 1867, also a classics scholar.

The close interest shown by Charles Empson in the Snow family, was something John Snow never forgot, and he was in touch with his uncle until his death. Having obtained Mr Hardcastle's willingness to take John as an apprentice, Empson arranged for the boy to start his studies as soon as possible and his prospects were detailed to him. The system for training apothecaries and surgeons prior to 1815 was haphazard to say the least. Thanks to the Apothecaries Act, 1815, however, the Worshipful Society of Apothecaries initiated a formal programme of medical tuition with a period set aside for "walking the wards", the time honoured methods of gaining clinical experience.

In 1824, only three years before Snow embarked on his apprenticeship, it was only possible to gain recognised qualifications through hospitals in London, Edinburgh, Aberdeen and Dublin. The position became intolerable, as hordes of apprentices passing through provincial hospitals were at a disadvantage. This resulted in a sudden upsurge of provincial medical schools after the passing of the long overdue Anatomy Act of 1832, which brought recognition for such schools attached to voluntary hospitals.

In 1843, the London College of Surgeons became the Royal College of Surgeons of England and after reorganisation, started awarding its Fellowship as evidence of competence and standing in surgical practice. The surgeon therefore changed from an ill trained, ill-educated craftsman in 1815, to a highly qualified member of the medical profession, and after 1845, allowing for famous exceptions of course.

**North Street, York as it is today**


**John Snow plaque situated on the side wall of the Park Inn Hotel York in North Street**

## 1

## Apprentice Days

Towards the end of 1827, John Snow packed his bags and took the stagecoach from York to Newcastle to embark upon his medical career. He was, after all, only fourteen years of age and leaving home proved a daunting experience for the boy from a closely knit, warm family. It is surprising that Charles Epson could not have found young Snow an apprenticeship with a York surgeon. There were several good ones, particularly Caleb Williams of Micklegate, who was later to take in, as an apprentice, Jonathan Hutchinson, who became a pioneer in neurology and one of the country's most distinguished physicians. Perhaps Empson preferred to place his nephew with a surgeon with whom he was personally acquainted.

Snow had been well drilled in the rights and obligations of an apprentice. He would live with the family of his master and obey him implicitly. His clothing and pocket money would be provided by his father, in exchange for the premium paid by Empson and probably a small part by his father, Hardcastle would teach him "the art, profession and mystery of a surgeon and apothecary". In his last year, he would "attend practice at a hospital", in his case it would be Newcastle Infirmary.

On his arrival in Newcastle, a fast growing city at the centre of a great coalfield, and an important port, Snow made his way to 52 Westgate, opposite St John's Church, where Mr Hardcastle lived and practised. Snow's first biographer, his friend Sir Benjamin Ward Richardson, tells us very little of Snow's apprenticeship, but we may gain an idea of Snow's experiences from a contemporary account by Sir James Paget of his own apprenticeship at about the same time as John Snow. Paget, a brilliant surgeon, who was later to use Snow's services as an anaesthetist, tells us of his apprentice days thus: "The necessary daily work was dull and at times tedious and apparently useless. One had to be in the surgery from about nine to one, again two or three to five or six every day. And there,

one's time was chiefly occupied in dispensing, seeing a few of the patients, as they might have called of poorer classes; in receiving messages, making appointments, keeping accounts, making out bills and receiving payment. When the master came in from his rounds of visits, one had to write out his dictation for each day, the name of the patient seen, the reasons for the visit, and the prescription for the medicines received. These were then made up and sent; the bottles to be neatly corked and covered; the pills to be duly rolled and smoothly rounded; the leeches to be put in their boxes".

Paget says, during his apprenticeship he learned dispensing, gaining a practical knowledge of medicines and how to make them up, to account properly, "learning business like habits needed for practice" and showing neatness, care, and cleanliness in minor surgery. He learned the elements of anatomy slowly and remarkably, one might think, he left time for reading and studying natural history or any branch of science and "ample opportunity for observation in practice".

Some observations by Paget, gave an inkling into the sort of conditions with which Snow had experience, during his own experience. Paget says he often met cases of ulcerated leg, which were useful for learning bandaging; coughs, colds, occasional slight injuries and "not a few, especially women, who came to be bled, for there was a common belief that bleeding once or twice a year was a help to health". Paget said these patients were usually bled until they fainted or became very faint. "A pad was applied to the sliced vein, and a bandage round the elbow and off they went home".

Of course, in his first couple of years, Snow as a boy would have been largely a "dogsbody", cleaning and labelling medicine bottles, utensils, instruments, learning to roll pills on the pill board, filling bottles with mixtures, but later learned to make poultices and plasters, bandage and administer cylsters (enemas). No doubt when he was competent enough to bleed a patient, he carried out this operation with a lancet or that formidable instrument the scarificator, a many bladed machine in a small brass box, which incised the skin when the blades were spring released. He would also have learned to cauterise parts of the body for the removal of growths, and to stop haemorrhage.

Among the drugs with which Snow became familiar, were calomel, a widely used purgative and cure-all, mercury a popular remedy in venereal disease conditions, opium used as a sedative and an analgesic in pre-anaesthetic days. Strychnine was used for palsies and debility. At this period there were three categories of medical practitioner, the apothecary who was roughly equivalent to today's general practitioner, an over worked and dedicated member of the profession, usually possessing the MRCS and the licence of the Society of Apothecaries, although many got by quite successfully with just the MRCS. The surgeon, like the apothecary, was apprenticed to his craft and obtained the MRCS.

At the top of the professional pyramid however, were the physicians who had attended either Oxford or Cambridge and whose badge of office had, for a very long time, been the golden-headed cane, the carriage, and the elegant frock coat and top hat, which in the early Nineteenth Century, doctors carried with their little wooden stethoscope.

Snow was fortunate in having a master who was not only a skilled surgeon, but held a senior appointment at Newcastle's Hospital for Poor Married Women in Rosemary Lane. Here, Snow was able to receive a good training in midwifery. There is no doubt that Hardcastle treated Snow as if he had been his own son and taught him thoroughly. In later life, Snow referred with respect and affection to his old mentor, who incidentally was a forebear of the late and better known William Hardcastle of BBC's World at One programme, and a distinguished former newspaper editor. It was during his apprenticeship that Snow decided to become a vegetarian and tee-totaller. He remained a vegetarian all his life, and indeed a tee-totaller, until an illness in his thirties when, on medical advice, he was encouraged to "take a glass of wine" from time to time. He also became a strong swimmer. His brother, the Rev. Thomas Snow, was also a tee-totaller and he remained a steadfast abstainer to the end of his life in 1895.

Snow seems to have been a reticent, sombre, introspective young man. He affected the dark clothing of the Quakers, although not of that persuasion. He had a curious, gruff voice, with an intonation that made it difficult at times for people to understand him, until they got to know him better. He was a difficult person to get to know intimately, but once he took to a person he was loyal to the end.

He enjoyed his own company best in his early years and spent all his spare time walking in the countryside, armed with notebook and pencil. He was an inveterate note taker, a practice that stood him in good stead in his later researches. He also regularly attended local meetings of vegetarian societies and temperance groups, taking part in discussions and lecturing. He was convinced that vegetarianism was the sure way to good health, and the Hardcastle household understanding their apprentice's "quaint ways" was amiably tolerant.

Towards the end of 1830, when only seventeen years of age, Snow on his master's recommendation, was appointed "surgeon" at Killingworth Colliery; famous today for its link with railway pioneer, George Stephenson, who had been an engineer at the colliery. It was not unusual for unqualified trainee doctors to occupy such responsible positions; the candidate welcomed the wide experience gained and the mine owners welcomed the cheap labour they offered.

Killingworth colliery was one of the largest and wealthiest coalmine combines in the country. It was part of the Grand Allies Group run by a board of directors, which included Lords Ravensworth and Wharncliffe. The conditions, under which their hapless employees worked, were nothing short of scandalous. Today there is little of Snow's Killingworth left, apart from Dial Cottage at Forest Hall nearby, which has been preserved as the home of Stephenson.

Snow's experience among the miners and their families considerably widened his knowledge, which had so far been confined to a prosperous urban practice. He was, for the first time, introduced to industrial medicine at its most basic and rawest. It must have come as a considerable shock to him to find little boys of seven and eight working below ground, hunched up as they opened and closed the trap doors hour after hour to allow through the tubs of coal.

The fathers and older brothers of these boys toiled away for fifteen hours a day under the most appalling conditions imaginable, amid dampness, coal dust and imminent danger of gassing or roof falls. There was a total lack of hygiene above and below ground. There were none of the modern facilities for "washing up" in, well appointed shower or any other sort of baths. The miners took their "snap" or snack down into the pit with them, and ate without any thought of cleaning the coal dust and grime off their hands. These men, stripped to the waist, hacked away hour after hour at the coal face, bent double, piling coal on a sledge, which was dragged by an older boy through two to three foot high tunnels, to the cage for transport to the surface.

Snow met with many of the results of this working lifestyle. He encountered injuries from rock falls, lung disease, gassing, fractures, sprains, cuts and bruises, burns from minor explosions. Fatalities were frequent, but the largest medical problem was the long term one of general debility, caused through terrible working conditions, slum homes and a poor diet. It is not surprising that a large number of pit boys and young pitmen never lived to see their twenty-fifth birthday.

During the winter months these human moles did not see the light of day, except on Saturdays, when they trooped to the surface to collect their pittance called pay, and again on Sundays when they were expected to attend chapel.

One man who had a deep insight into the working conditions of the time was Charles Turner Thackrah, founding father of Leeds Medical School, an apothecary-surgeon in that city, who in 1831 published the first work, in English, on industrial medicine entitled: The effects of Arts, Trades and Professions… on Health and longevity. He told of dressmakers working some fifteen hours a day for twelve shillings a week; weavers ten shillings to twelve shillings; silk weavers nine to eleven shillings.

Mines were not the only industrial establishments to employ young children, for Thackrah found 329 children, 198 young women and seventy men working in a power loom weaving factory, most of them doing thirteen hour days. He found boys entering coalmines at the age of six or seven for door opening, driving pit ponies and propelling the trucks.

## 2

## CHOLERA
## The first outbreak 1832

Like Thackrah, Snow found these working children mainly ill looking, small, sickly, barefoot and ill clad. Many suffered from stones in the bladder due to their poor diet. The young men were almost all pallid and as thin as the children. Early in November 1831, Hardcastle and Snow learned of the serious epidemic of cholera, which had just entered Britain through the port of Sunderland from Europe. The disease hit the town on 19 October and spread alarmingly, reaching Gateshead by December. The medical fraternity was appalled at the prospects of this mass infection.

Within ten weeks of cholera entering this country, 402 people had been taken ill, a third of them dying. At Gateshead, one carpenter made fifty coffins in one week for cholera victims in his locality. Special burial grounds were set aside in towns and villages for victims of the epidemic. By the end of 1831 more than 82,000 had contracted cholera and 31,000 died from it in a total of 430 towns and villages up and down the country. The mining communities in particular suffered grievously from the outbreak because of their working and living conditions. Snow was aware of the conditions only too well and his brother, Robert, later to become a mining official in Yorkshire, commented many times that the pits were "nothing more than cesspools".

With the epidemic about to reach Killingworth Street, John's Parochial Church Council in Newcastle appointed Mr Hardcastle, Snow's mentor and principal, to minister to the neighbouring villages, and so it was that John Snow came to find himself despatched to Killingworth Colliery to tackle the outbreak there on behalf of his master, in Spring 1832. Snow had just celebrated his nineteenth birthday; was only partially trained, but had the authority of his official status as

surgeon to the colliery. This was to be the first experience of public health emergency, and it was certainly a baptism of fire for the young medical trainee.

By his tireless work for the sick, his constant visits to the little hovels, which passed as miners' homes nearby, his primitive, but in many cases effective preventive measures, he became the hero of the

Killingworth cholera outbreak. Day in and day out he had to go down into the pit to tend colliers who had collapsed during the early stage of the disease.

He showed a total disregard for his own well-being, and he was by no means a robust young man. After the epidemic had subsided, the miners and their families paid glowing tributes to the work of their young doctor. Long Benton churchyard contains rows of tombstones marking the graves of cholera victims in the locality. During the latter part of the epidemic, Snow was alarmed to learn that out of 450 cases of cholera in his home town of York, 185 died, and that one of the worst affected areas was the area in which his parents, brothers and sisters were residing. The interiors of coffins of cholera victims were coated with tar, and the bodies had to be limed within hours of death. Hearses could be hastily summoned, farm carts or the formal hearse. Quicklime was poured onto the interment.

York's public water supply had become contaminated, and there was a widespread belief among the citizens that a plot had been hatched by the local doctors and gentry to "do away" with the poor by infecting the water supplies deliberately. A quite ridiculous notion in fact, but one, which became the source of a local panic. There was almost a riot in Snow's old street, North Street, when the inhabitants who had become alarmed over the frequency with which hearses were passing their homes, lay in wait for the next driver of a hearse, and threatened to throw him and his vehicle in the nearby river.

Some people believed that the mere sight of a hearse, bearing a cholera victim's body, was sufficient to give them the disease! By the time the epidemic had died down in 1832, Snow had completed his five years apprenticeship with William Hardcastle, who now arranged for his apprentice to undertake his one year "walking the wards" at Newcastle's Royal Victoria Infirmary, at the same time attending lectures at the recently formed embryonic medical school in Newcastle. In that very year, five well-known local doctors, alive to the need for a medical school, advertised a course of lectures beginning in October 1832. They were G Fife, J Fife, S Knott, A Fraser and HG Potter; none of them were, at that time, on the staff of the infirmary. Hardcastle saw to it that Snow registered for the very first course of lectures.

Newcastle's first medical school held its first course in premises over the entrance to Bell Court, Pilgrim Street, next to the surgery used by some of the founders. Eight students enrolled for the first session, including Snow, William Miller, Thomas Humble, Henry W Fife, son John Fife one of the founding fathers, John Ismay Atkinson, Thomas L Watkin, George Risdale and Edward Downing. The fee for the course of lectures was two guineas, and an additional five guineas for the essential hospital practice at the Infirmary. By a strange coincidence, Snow would once again encounter John fife, one of the five founders of the medical school, sixteen years later when they clashed over the cause of death of Britain's first victim of chloroform anaesthesia.

The Newcastle medical course proved very popular, and less than two years after the first course, bigger premises had to be sought, and in 1834 the school had moved to the hall of the Barber Surgeons at Manors. The school was the sixth provincial medical school, to be founded between 1824 and 1832, having been preceded by Manchester, Birmingham, Sheffield, Leeds and Hull. It was customary for well-established local physicians, surgeons and apothecaries to give the lectures at these pioneer medical schools, and these included anatomy and physiology, material medical and therapeutics, chemistry and botany, midwifery and clinical studies linked with the local hospital.

Snow and his companions "attended the hospital practice" at Newcastle Infirmary by arrangement with the school. These first medical students had no corporate accommodation and lived with their masters as apprentices or at home.

They studied privately between lectures and fitted their studies in with their obligations to their masters in the practices. Snow spent his little leisure time swimming and walking, always his favourite leisure pursuits. He also roamed the countryside around Newcastle, studying the local flora, fauna and architecture.

Some of the lectures began at 8.00 am and Snow knew that when he returned home, he would have some duties to perform in Mr Hardcastle's practice. It is interesting to reflect that when Snow began as an apprentice in 1827, it was only twelve years after the passing of the Apothecaries Act, 1815, which tried to regularise medical practice. It is an astounding fact that prior to the Act, anyone could practice and dispense medicine without any formal education or having passed any examinations.

Once the Act came into force however, and it had met with fierce opposition from the College of Physicians and the College of Surgeons, no one could "attend, prescribe or dispense medicine for gain in a medical case", unless they were a Member of Licentiate of the Society of Apothecaries.

Those who intended to become surgeons had to take the examinations of the College of Surgeons and become Members, likewise the prospective physician had to become a licentiate of the college of Physicians, and had to take the M.D. afterwards if they wanted to become a Fellow of that College.

The Apothecaries Act gave the poser to its governing body to prosecute anyone breaching the Act, and several members of the College of Surgeons were fined. The medical student of those days had to attend the private medical schools, which were beginning to mushroom in London. The first notable

private establishment was the Hunter brothers, Great Windmill Street School and others followed, such as Tuson's in Little Windmill Street, and Dermott's in Gerrard Street, and Brooks School in Blenheim Street.

Unfortunately, York medical school was founded too late, 1834, for Snow to take advantage of; otherwise he might have been apprenticed in his home city firstly in his career. To gain the qualifications of the Society of Apothecaries, the student had to complete usually a five years apprenticeship, plus a year's attendance at an approved hospital, where he did his clinical training. He then sat for the Society's qualifying examination to gain Membership of Licentiateship. Many medical men then followed this up with Membership of the Royal College of Surgeons, through examination.

Medical students of Snow's era had to face the unpleasant fact that surgical operations had to be performed without anaesthesia, the only relief being alcohol or opium. The first experiences of operations could be traumatic to the more sensitive student like Snow. Both John Keats, the poet, and Charles Darwin, the biologist who had been medical students, have described the harrowing time they had during their attendance at surgical operations.

For example, Darwin who studied medicine at Edinburgh only five years before Snow, describes two visits he made to the operating theatre of Edinburgh Infirmary. He saw two very bad operations, one of which was on a child:

"I rushed away before they were completed. Nor did I ever attend again: hardly any inducement could have been strong enough to make me do so… the two cases fairly haunted me for many a long year."

The hospitals had totally inadequate water supplies, were squalid, overcrowded, dirty and inadequately lit and ventilated. There were hotbeds of cross-infection and more than half of a surgical ward could be decimated by the "hospital diseases", the most feared being gangrene.

James Young Simpson once said that women who delivered their babies outside a hospital, had a seven times greater chance of coming through their ordeal safely. And, of course, one has to remember, that there was no trained nursing staff. Snow's days were pre-Florence Nightingale days. Many of the nurses were well meaning but slovenly, Sairey-Gamp types at best, and at worst, drunken harridans. They were largely uneducated, unreliable and incompetent. One contemporary hospital doctor described them as "All drunkards without exception, sisters and all, and there are but two nurses whom the surgeon can trust to the patients with their medicine".

Snow and his fellow students, when walking the wards in Newcastle Royal Infirmary, encountered many cases of ulcers, tubercular affections, heart and lung complaints, fevers, gout, hernia which of course was palliative only, as abdominal operations were very rare because of their high mortality rate. One of the commonest operations, however, which was attended with a good deal of success, was cutting for stone in the bladder, lithotomy, or the more difficult process known as lithotrity in which a formidable instrument with crushing jaws, was introduced into the bladder trans-urethra. There were also many cases of diseased bones, fractures, cleft palate and cataract.

In Snow's London, the surgeons and physicians were not above nepotism, and favouring, in particular, relatives and their expensively fed personal students. Well-established physicians and surgeons, in addition to private practice, held honorary posts in local hospitals, and often taught at the private and hospital attached medical schools, which increased their fame. To gain a university medical school, or hospital appointment, needed wealth, influence or paternalism. Snow had recourse no one of these paths to fame.

In 1833 Snow's apprenticeship and year's hospital training was completed, and he started to look around for an assistantship in a country practice, although not yet formally qualified. This was the usual procedure, prior to application for membership of the Society of Apothecaries or the two Royal Colleges.

He was sorry to leave the Hardcastle family, but he was fortunate to find another equally good master. He was a Mr Watson, surgeon and apothecary at Burnopfield, near Newcastle. There, Snow worked long hours undertaking all manner of duties including dispensing, visiting patients, aiding in the surgery and making up accounts. But he admitted later in life that he learned his craft with Mr Watson.

This was the start of a restless period in Snow's life, for after less than a year at Burnopfield, he decided to return to his home in York. During his few months break in the city, he came to know some of the leading medical men, including James Allen who was an expert in midwifery, and later that year, became the first lecturer in that subject at the newly founded York Medical School. Allen was one of several medical men of note who backed him for a subsequent London appointment.

Snow took advantage of his break to go on natural history rambles in the countryside, attend and address Temperance Society meetings, and spend some time with his brothers and sisters, most of whom were now in their teens.

He had been home only a few months when he hankered after medical work. During the summer, he applied for and obtained another post as an assistant in general practice, this time with a Mr Joseph Warburton at the remote Yorkshire village of Patelely Bridge, near Harrogate.

Dr Warburton, the leading physician of the area, was forty-eight, married with a teenaged son and daughter, and lived in a solid stone built house next to the parish church. This house, incidentally, served as a doctor's residence from that time until quite recently. As it turned out, the eighteen months that Snow spent in Pateley Bridge were to be among the happiest days of his life. Although, he once described the place as 'a certain half-inaccessible village' he enjoyed his time there and commented, "he had never worked so hard in his life". Snow became very friendly with Warburton's son Joseph, who was aged eighteen and helped his father in the practice, probably as his apprentice. The daughter, Anna, was a charming sixteen-year-old, of whom Snow became very fond.

Snow was still a keen vegetarian and abstainer, and caused some amusement and confusion at times in the kitchen with his food and drink fads. He did not delude himself. He knew he was different from most of his male acquaintances, and commented wryly in later years that he "puzzled the housewives, shocked the cooks and astonished the children" in whichever household he happened to be living.

He admitted however, that the families with whom he lodged treated him with kindness and understanding, and had fond memories of them later in life. Mrs Warburton and her servants occasionally made sly digs at Snow over this "monkish" ways, which he took all in good part.

He had a gruelling baptism in rural practice, riding horseback to remote moorland cottages and farmhouses in all weathers, delivering babies, tending fevers and other illnesses and performing minor surgery. It was a tough life involving interminable hours of hard work, on many days of the week. Furthermore, a good deal of responsibility fell on his shoulders, but, who was as yet, not fully qualified. He told a friend some years later: "I had many rough rides, a fair share of night work and a good gleaning of experience".

After about eighteen months, Warburton advised his young assistant to gain further and wider experience before taking his qualifying examinations. Although he was sorry to lose Snow, he was anxious to further his career. In spring 1836, Snow, acting on his master's advice, left the practice and returned to his hometown of York to ponder his next step. He continued his studies, as he would ultimately have to face the examinations of the Society of Apothecaries and Royal College of Surgeons, in order to gain qualifications for general practice.

Whilst in York, Snow would undoubtedly have consulted his friend Dr James Allen to gain his views and advice on qualifying. Again, during his months in York, he pursued with vigour, his activities with the Temperance Movement, giving lectures in the city and in surrounding places, including Leeds. He collected natural history and geological specimens from the countryside around, and also studied what he described as "social, sanitary and architectural features". This could have been the first stirring of Snow's eventual deep interest in public health matters.

He may have pursued Charles Turner Thackrah's The Effects of Arts, Trades and Professions on Health and Longevity which he published in 1831. It aroused considerable interest as the first English medical book on industrial medicine. Thackrah, one of the luminaries of Leeds Infirmary and the medical school, was himself a surgeon apothecary in the city.

Snow had gradually built up a little library of medical books for his studies, and borrowed a few more from his local doctor friends. He read widely and deeply throughout the months he was at home. He discussed his future with his parents and possibly wrote to Uncle Charles Empson telling him of his plans to further his career.

He finally decided he would go to London. This step appears to have met with all round approval and Snow embarked upon a truly heroic journey. Instead of taking the coach, he made up his mind to walk the whole distance between York and London, but not in a direct line! He chose to walk across the Pennines to Liverpool, through North Wales to Gloucester, along the Great West Road to Bath, and then on to London - an enormous journey for someone who was not very robust.

Snow took his time and made a careful study of scenery, natural history and fine buildings on his interesting marathon trek. When he arrived in Bath, he visited his uncle, who lived in an impressive Georgian house in Terrace Walks facing the River Avon, and not far from the famous Pulteney Bridge.

Empson was forty-one, and had recently settled in Bath after an adventurous career exploring some of the most remote parts of South America, studying ornithology, an interest he shared with his nephew. Although he had not been formally trained as a scientist, he became distinguished as a natural historian and biologist. He collected a wide variety of rare and interesting plants and minerals on this expedition. Unfortunately, the ship on which they were being transported to England foundered, and these items and valuable notebooks and papers were lost.

However, some of the earlier treasures, which Empson had collected in South America, reached home safely and made a fascinating display in his museum, which was a great attraction to scholars. Empson, at one stage, appears to have held a government appointment, but nothing is known of this.

Whilst in America, Empson was involved with the Mexican revolutionaries. He was an admirer and personal friend of the famous General Simon Bolivar, who liberated a large part of South America from Spain, and during the 1820s, had met Empson in Mexico. Before leaving that country for England, Empson received from him a gift of a solid gold ornament, of which he was very proud.

## 3

## Hunters' school

After a few days rest in Bath, Snow set off for London. He had carefully calculated how long it would take him to get to the capital, for he had made up his mind to enrol at the famous Great Windmill Street School of Anatomy, which had been founded by William Hunter over sixty years previously. The new term began in October 1836 and Snow was eager to make a start. He arrived in London like Thomas Wakley, the fiery editor and founder of the Lancet, without friends or powerful patrons and having little money. After enrolling at the School he took his place on the hard wooden benches with the other students, many of whom were younger than himself by several years. He was always proud to have received some of his training at this famous school, which had turned out some of the greatest names in British surgery.

In October, Snow started to attend lectures, two courses of chemistry given by Hunter Lane, and a similar number for Materia Medica and Forensic Medicine by Dr Epps; anatomy and physiology given by Mr Lucas, Mr Jones and Mr Savage; botany by Mr Epps, principles and practice of medicine by Dr Ryan and Dr Venables and midwifery.

When Snow undertook his studentship at the School, it was fast approaching the end of its life. It had fallen into the hands of men keener on making money than instructing would-be doctors. It was a sad decline considering the great men who had taught or been educated there, including William and John Hunter, Matthew Baillie, Benjamin Brodie, Charles Bell, Herbert Mayo and Caeser Hawkins, to mention only a few.

At the time of Snow's entry, Mayo and Caeser Hawkins had relinquished control of the School, six years earlier. Snow must have managed to save enough money from his meagre earnings as a colliery doctor, and an assistant in the practices there served to pay the fees for the one years' course. For some time students had tended to go to the lively and flourishing private medical

school at Hyde Park Corner, which was linked, however tenuously, with St George's Hospital nearby, and others went to a similar establishment at the new Middlesex Hospital.

The work Snow did at the School was acceptable to both the Royal College of Surgeons, and the Society of Apothecaries, which did not recognise some of the private medical schools that had mushroomed in the capital.

The standard of medical qualifications at this period was not very high. Once a man had obtained the licence of the Society of Apothecaries, he seldom went on to sit the examinations of the Royal Colleges. But the better type of general practitioner usually gained the MRCS and LSA diplomas and Snow was to become one of these.

Snow, who was unusually shy at first, made firm friends with a young man from Beckington, near Bath. He was Joshua Parsons, whose father was a doctor. Snow and young Parsons found themselves lodging in Bateman's Building, just off Soho Square, and this was to be their home for the next eighteen-months. Both were conscientious, hardworking students who never failed to attend lectures, and did not join those students who were absent from lectures, usually drinking, carousing, playing cards or attending low music hall matinees.

Parsons and Snow spent more time than any other students working away in the dissecting room, and often stayed back in the evenings, long after the others had gone home. One can only admire their fortitude, considering that the dissecting room was a frightful place, unventilated, freezing cold in winter and diabolical in summer through the heat and stench.

It was during the stifling hot summer that year that Snow and Parsons were experimenting with Arsenite of Potash solution, as a preservative for cadavers (corpses). This new concoction had been discovered by Hunter Lane and the two students, later joined by three more, decided to dissect a body pickled in the chemical to see if it worked. The conditions under which they worked were beyond imagination. After the experiments had been completed, Snow was satisfied that the chemical was potentially dangerous to those using it, and he recommended that it should be abandoned. Lane accepted Snow's advice without comment.

About this time Snow was acting as a demonstrator, and taking a keen interest in toxicology, having been inspired by his lecturer Dr Epps. He avidly read the writings on the subject by the leading

toxicologist of the day, Sir Robert Christison, who was on the staff of the University of Edinburgh's medical school.

Early in 1837, Parsons became perturbed over Snow's health. Snow had never been of a robust constitution, he was slightly built and may have had predisposition to tuberculosis. This may have accounted for the fact that Snow, a very experienced walker and swimmer, came off worst in a walking marathon against Parsons, who challenged him to the walk on Easter Monday. They planned to walk from Soho to St Albans via Harrow, about fifty miles. Poor Snow, he barely made it to Edgware before he had to give in. In fact, he had to take transport to complete his journey home whilst Parsons triumphantly completed the course on foot.

During their time together, Parsons was impressed with Snow's "solid talents, industry and personification of order". He later said that Snow never allowed any personal considerations to stand in the way of his scientific pursuits. Both young men were widely read and closely studied the various scientific and medical journals of the day. Snow himself confessed that he had neither the time nor the inclination for reading fiction, saying he found it "unrewarding".

Snow was a deeply religious man at heart, though we have no record of his affiliation to any particular church. He was something of a wit, we are told, and used to regale his small circle of intimates with amusing anecdotes, in that droll manner of his. He was keen on the arts and often attended the theatre and concerts, and particularly enjoyed public readings of Dickens, Thackeray and various contemporary writers.

Towards the end of his year's stint at the Great Windmill Street School, he began to show signs of ill health, probably the first stirrings of pulmonary tuberculosis. He suffered several bouts of fever and had considerable trouble over accidental cuts to his fingers during dissections. Parsons was so concerned over his friends' deteriorating health that he was on the verge of calling Charles Empson, but had second thoughts and spoke to a physician friend about Snow's health, describing his increasing tiredness in the evenings. He said Snow would often become drowsy, which was most unusual for him, and close the book he was reading and go off to bed hours earlier than usual. The physician however, did not seem particularly perturbed over what he had heard and advised Parsons that it was not necessary to call Empson.

Snow soon tired of his enforced idleness and resumed his studies and dissecting as the basis for his experiments. His determination and indomitable willpower seem to have lifted him out of his health set-backs and he was soon back to his usual self.

At the end of summer 1837, it was the parting of the ways for the two friends. They had completed their mandatory year at a medical school prior to sitting their examinations for qualification, and whereas Snow stayed on at his lodgings for the time being, Parsons decided to return to his home in Beckington, Somerset, to become eventually a general practitioner.

Both men left the school not a moment too soon, for shortly afterwards it disappeared from the London medical school scene, a sad end to one of the best known and admired training establishments in the country. Snow and Parsons had recently left when it was noticed that the Lancet no longer mentioned the School in the list it published annually for the guidance of medical students. A plaque at the rear of the Lyric Theatre today, marks the site of the school and the present stage door was formerly the entrance for "subjects" for dissection, taken there for sale by the nefarious "resurrectionists", the body snatchers on whom medical schools, prior to the Anatomy Act of 1831, were utterly dependent for supplies of cadavers for teaching students dissection.

## 4

## The Westminster

During the autumn of 1837, Snow began his one-year "hospital practice" at Westminster Hospital, prior to sitting his qualifying examinations. This was a new hospital, only opened three years earlier and was in fact the third Westminster Infirmary. The new one had been built in Broad Sanctuary, opposite Westminster Abbey, and was in the pseudo-gothic style of architecture.

Westminster Hospital was the first voluntary hospital in London, and had been founded in 1716 through the good offices of the philanthropist "Good" Henry Hoare, founder of the banking family of that name. The hospital was founded to care for the poor people of the district, and existed for over 100 years before it was finally demolished in 1950.

Snow was aged twenty-four and had a good deal of practical experience behind him when he entered the hospital as a clinical student. On the staff, at that time, were medical personalities who were to become famous in medical history. For example, the surgeons included Sir Anthony Carlisle and Anthony White, each of whom had served as President of the Royal College of Surgeons; and an

amazing character who had become a figurehead of military medicine when he was in the army, George James Guthrie. There were also William B Lynn and the irascible and quarrelsome F Hale Thomson.

At the same time as joining the hospital as a student, Snow enrolled at the private medical school in Dean Street, which was not officially attached to Westminster Hospital, but allowed its students to walk its wards. This privilege was no doubt due to the fact that the school had been opened by, non other than, four of the most senior, distinguished, honorary medical and surgical staff of the hospital.

The school had come into being in 1834, after an abortive attempt by two of Snow's former tutors, Dr Epps and Dr Ryan, of the Great Windmill Street School, to form a Westminster Medical

School. The need for such a school was obvious and so surgeons, JG Guthrie and Hale Thomson and physicians Robert Bentley Todd and John Burne of the Westminster Hospital, decided to set up a school themselves. After all, it was right and proper that Westminster men should run a school in Westminster!

Snow always regarded his Westminster Hospital days as the most important stage in his early career, and used to tell friends later in life; "My time at the Westminster was one of the most rewarding episodes of my life".

In May 1838, Snow sat and passed the examination for membership of the Royal College of Surgeons, London. It is doubtful if any member in recent times could boast such a bevy of great names on his diploma, as that gained by John Snow. The President Sir Anthony Carlisle, whose signature takes precedence was very interested in Snow's career, and helped him a great deal at the outset of his London studies. One of the Vice Presidents, Robert Keate, would later use Snow as an anaesthetist and the remaining signatories include Astley Cooper, GJ Guthrie, Benjamin Brodie and Samuel Cooper.

During the autumn of 1837, Snow decided to join the old established Westminster Medical Society with which he was to have close connection over the ensuing twenty years.

It was one of the oldest medical societies in the country, having been founded in 1809 for the benefit of medical students, to encourage them to give addresses on medical topics, enter into debates and learn from others. Later, medically qualified men joined, and when Snow became a member virtually all its membership comprised of medical practitioners. They used to meet in the gloomy, cheerless Westminster premises.

One of Snow's contemporaries once remarked that it was "sufficiently dreary to prevent any but the staunchest friend from attending". Snow was one of those staunch friends. He never missed a meeting, and after his initial shyness, entered into the debates. He became devoted to the organisation, which in effect provided the only hope for those members without money or influence to make their way into London's cut-throat medical world. It was possible by dint of lectures published in the Lancet and similar medical journals, to become known in the profession. Snow, a young man with no connections, little money and a diffident personality, needed such a medium to exercise his considerable talents and intelligence. He later said "upon this early connection with the Westminster Medical my continuance in London depended and all my succeeding scientific success".

His first efforts were not, however, attended with much success. His strange way of speaking and diffidence made it difficult, at first, for other members of the Society to understand his drift when he began giving his papers. At first his remarks tended to go over the audience's heads. Ward Richardson said 'He was rarely noticed as a speaker', he also said he was often referred to as "the last speaker", his name having slipped memories. Undaunted, Snow regularly put his name down as next speaker and took an active part from the start in discussion.

Within twelve months of joining the Society, his big opportunity came. Until then, he had been merely a debater and commentator on the offerings of others. In the winter session of 1837, he gave his first lecture, which was entitled 'The Effects of Combustion of Candles Containing Arsenious and Animal Life'. The talk was based on his scientific experiments and apparently went down well with his audience, who by now had become used to his delivery. It also attracted the attention of Wakley who reproduced it in the Lancet.

As time went on, he and Snow became one of the most regular lecturers at the Westminster Society meetings, and later paid a warm tribute to the interest and attention paid to his talks. "Upon this early connection with the Westminster Medical, my continuance in London depended, and all my succeeding scientific success" he told his intimates. During the ensuing five years, he spoke on a wide variety of subjects, but two themes were consistent, toxicology and the physiology of respiration.

On this occasion, he told members that earlier that very day, he had, albeit recklessly, inhaled a mixture of ten, twenty and forty-percent of carbon dioxide along with ordinary air. He said it had not "even produced irritation of the fauces" (anatomy). His ideas on Carbonic Acid Gas Poisoning were published in the Lancet and the London Medical Gazette.

The matter did not rest there. Three months later, Golding Bird and Snow were again locked in argument over the same topic. Snow showed that the gas was toxic when inhaled, that a decrease of oxygen in the atmosphere was dangerous to life and that if both these effects were combined, they

proved more rapidly fatal. His quantitative experiments showed that five to six percent concentration of the gas could give rise to alarming symptoms. He succeeded in controlling the concentration of carbon dioxide in closed spaces, firstly with limewater and then with caustic potash solution.

Although Snow disagreed vehemently with Bird on this and on some other occasions, they were good friends; both men were leading lights in the society. Snow respected Golding Bird's brilliance of medicine. Only at the age of twenty-one he had been described as a precociously eminent physician. In fact, his formal examinations were waived because of his genius and the reputation he had obtained.

During his twenty-two years membership of the Society, most of his lectures were published in various medical journals, and kept his name in the forefront of research into medical topics.

Snow's prowess was after all in general practice and medical science, and research was a sideline. Snow today is best remembered as a pioneer in anaesthesia and epidemiology, but too little has been said of his work in general practice. He was one of the early family doctors who saw the wisdom of a scientific background. He was also one of that dedicated band of practitioners who combated the fast flowing tide of quackery and patent medicines.

Although, many of his friends disagreed with some of his more startling theories, Snow was unperturbed. It may well be that they failed to follow his reasoning because of lack of scientific training and research. Some three months after his inaugural lecture he was again addressing the Society. This time it was on his favourite hobbyhorse, abstinence. He presented a report on Abstinence Societies, illustrating the medical dangers of excess alcohol consumption. This address arose out of lengthy and widespread correspondence Snow had engaged in with secretaries of various abstinence societies up and down the country including the two with which he had personal connections, York and Leeds.

Some see, in these first two talks, the beginnings of Snow's lifelong interest in toxicology, in which subject he was subsequently a medical school lecturer.

Having gained his MRCS, Snow realised he needed the Licentiateship of the Society of Apothecaries to give him the right to prescribe, and set about preparing for their examination. About this time he was appointed a voluntary visiting apothecary (physician) to the outpatient department of the Westminster Hospital. He was to hold this appointment for about seven years, and found it invaluable for keeping in touch with hospital practice and the senior staff.

At the same time he was still residing at Batemans Buildings, Soho, an area in which incidentally he spent the whole of his life in one address or another. We may gauge the worth of the Royal College examinations by some of the comments by those who sat it, about the same period as Snow, who has nothing to say on the matter, or if he had it was never put into writing! One contemporary described the examination for membership as "grotesquely inadequate" and another candidate said both the college and the Society of Apothecaries "launched upon the unsuspecting public successful candidates following an hour interview with four ancient surgeons whom put forward their pet theories to candidates who took little part in the general discussions, which then ensued among the examiners themselves".

Some candidates, apparently, were confused and indeed astounded, when told to answer conundrums supposed to be for their "edification and entertainment". There were no searching tests of candidates' knowledge of anatomy, physiology, pathology or clinical ability.

The examination board, it seems, was particularly impressed with students who had undergone a classical education, and one such student emerging from the examinations room with flying colours told a waiting friend: "To pass the finals a student needs neither, accurate knowledge of facts nor the possession of sound principles".

Happily, many candidates were sound in principles like Snow and other men, who became eminent medical personalities. Those practitioners, who were ambitious, particularly in the realms of all round general practice or hospital appointments, need to qualify as a Licentitate of the Society of Apothecaries as well as MRCS, and Snow was intending to do this. Oddly enough he seems to have suffered a blind spot over the detailed requirements of appointments at the very hospital where he had trained, and was now a visiting apothecary.

His lapse came when the Westminster hospital invited applications from suitably qualified practitioners for a staff appointment as Apothecary to the Hospital, a sort of residential physicians in succession to the late Mr Thurnham. Snow applied for the post fully expecting to get it because he was well known already at the Westminster.

He spent no little time and money on assembling an impressive line up of backers for the appointment, the usual practice in those days to obtain an important staff appointment. He produced the customary canvassing pamphlet bearing an impressive list of sponsors, including Sir Anthony Carlisle, President of the Royal College of Surgeons London and his old apprenticeship master Hardcastle and Warburton of Pateley Bridge, for whom he had worked as an assistant four years previously.

They all gave Snow a glowing testimonial. He put in his formal application with the testimonials. Back came the stunning reply that he was not eligible because he did not hold the licence of the Society of Apothecaries, which as Snow should have realised was an essential requirement of such a post.

In despair Snow immediately set about "cramming" for the examination, which he was undoubtedly capable of passing at that point, and sought entry papers from the Society for the impending examination in July. He had less than three months to prepare for the examination, but Snow received a further blow when the Society huffily told him he was too late for that examination.

Snow pleaded with the Society to let him sit even if his application was out of time. He cited his recent success with the MRCS examination, his out patient appointment at Westminster Hospital and his impressive list of backers for the hospital apothecary appointment. It was to no avail. The Society hierarchy would not budge. And so, with a heavy heart, Snow had to withdraw his application for the Apothecary's post at his own hospital, and he believed what Ward Richardson said of this misfortune years later: "Clearly their leniency extended to those who had friends at court". Richardson knew that the Society had, on previous occasions, bent their rules and granted special dispensation to much less worthy candidates than John Snow. But this factor had already been pointed out to the Society at the time of their refusal of his application, and they remained unmoved.

This episode had a much greater effect on Snow than has hitherto been appreciated. He never again applied for a hospital appointment, even after he obtained his LSA later that same year. He never found himself offered one even when he was well established as a professional anaesthetist. In October, he duly sat the Society's examination and passed with flying colours. A month earlier he had moved from Batemans Buildings to 54 Frith Street, not far from the house in which the composer Wolfgang Amadeus Mozart had stayed with his father and sister on his visit to London as a small boy over seventy years before. He rented the house from a Mrs Williams, widow of an Army officer who was noted for his books on India.

Snow set about the thankless task of founding a new medical practice from scratch. Unknown, with little financial means, no patronage and an unimpressive personality, he hopefully put up his first brassplate outside the house. In his own words he says, "I nailed up my colours". Whilst waiting for patients, he set up a small laboratory in a back room and managed to scrape together enough money to buy basic equipment for experiments in respiration in particular. He had collected a small library of useful books on poisons, a subject which fascinated him from his student days. One of them was "Treatise on Poisons" by Robert Christison, Professor of Medical Jurisprudence at Edinburgh University, and a noted pioneer of forensic medicine.

These early days in practice were frustrating, lamely and penurious. But there was his beloved Westminster Medical Society, which he attended regularly and at which he often spoke. He was an expert on poisons and often gave expert evidence at criminal trials. Snow experimented with opium, arsenic and mercury amongst other substances. Snow's early days in Frith Street were lonely, penurious times. His only solace was his books and research with an occasional trip to theatre and plenty of walking.

The months passed and Snow had only managed to attract half a dozen patients or so and was painfully reminded of the need for influence and patronage. Richardson summed up his hero's position thus: "Snow having no personal introduction to the bedsides of dowagers of the pill mania dynasty had no entrée to the fashionable London homes and salons". It is doubtful whether Snow would have attracted much attention from those who could have launched him on a successful general practice. He was not much of a social success, with his crabby ways and inordinate shyness in the presence of strangers. His personality undoubtedly stood in his way when it came to making a mark in social circles, even if he had received backing from influential contacts. His outlook on medicine was unlikely to commend him to the very people who could have helped him for he was vehemently against any form of quackery and pill mongering. As most fashionable doctors gave patients what they wanted, patent medicine or nostrum, Snow would have not succeeded on this account in any event. Something of the unique character of the man can be gauged from these attitudes alone. Integrity was his outstanding characteristic.

His first notable contribution was during the autumn session in 1838 when he gave an address on Carbonic Acid poisoning. He had been experimenting with respiration in animals and man, following the sad tale he had read of a man who had died in a coffee house from carbon acid (carbon dioxide), from a stove poisoning. Not long afterwards, he read in The Times of the death of a night watchman who had remained throughout one night in St Michael's Church, Cornhill, to observe the effects of a new type of stove which had just been installed.

This case had aroused the interest of many medical men, but Snow in particular, because one of his fellow members of the Westminster was Dr Golding Bird who had given evidence on the watchman at the inquest. Snow had done a considerable amount of research into carbon dioxide gas before these two cases came to light. At that time it was not recognised by most medical men that the vapour, emanating from the incomplete combustion of carbonaceous material, contained carbon monoxide in addition to carbon dioxide and other gases.

When Golding Bird gave his lecture on the case at the Society's meeting, Snow challenged his views on the cause of death of the watchman. Bird contended that different quantities of carbonic acid gas produced different effects. He said four- percent of the gas produced a coma, and eight to ten-percent, suffocation. Snow would not accept this theory and claimed that the watchman died from the effects of the gas resulting from the diminished quantity of oxygen in a given volume of air.

Furthermore, Snow seldom, if ever, gave a talk without having ample scientific evidence to back up his theories. On this occasion he told members that earlier that very day he had, albeit recklessly, inhaled a mixture of ten, twenty and forty-percent of carbon dioxide along with ordinary air. It had not, he said, "even produced irritation of the fauces". His ideas on this topic and his address were published in the Lancet and the London Medical Gazette in December, under the heading 'Carbonic Acid Gas Poisoning'.

The matter did not rest there. Three months later, Golding Bird and Snow were again locked in argument over the same topic. Snow showed that the gas was toxic when inhaled, that a decrease of oxygen in the atmosphere was dangerous to life and that if both of these effects were combined they proved more rapidly fatal. His quantitative experiments showed that five to six percent concentration of the gas could give rise to alarming symptoms. He succeeded in controlling the concentration of carbon dioxide in closed spaces, firstly with limewater and then with caustic potash solution.

Snow seems to have got no further with Golding Bird, even if his ideas might have fallen on fertile ground with other members of the Society. Although he disagreed vehemently with Bird on this and a few other occasions, they remained good friends and both men were leading lights in the Westminster. Although Golding Bird was about the same age as Snow, he was a much more experienced and sophisticated man. When only twenty-one, he had been described as "a precociously eminent physician" and his formal examinations were waived because of his genius and "the reputation he had already obtained," whatever that implies. He had for example, been licensed by the Society of Apothecaries without being required to take their examinations, and at the age of twenty-four gained the degree of Doctor of Medicine. He was appointed a lecturer at Guy's Medical School and worked with such great men as Astley Cooper, William Bright and William Addison.

A Norfolk man, Golding Bird was the first to describe Oxaluria and from 1841-3 was chairman of the Westminster Medical Society. He was a distinguished physician and a leading authority on urinary diseases before he was forty. During the 1840s he and Snow vied with each other at regular intervals for the speaking honours at the Society's meetings. It is not beyond the bounds of probability that many members grew a little tired of the speaking monopoly exerted by these two.

Snow remained a visiting assistant physician to the Westminster Hospital for six years. During this period, he learned the bitter lesson experienced by many men from the provinces; good contacts were necessary in the capital in order to found a profitable practice. Nepotism was rife; the best-known example of this was Astley Cooper's influence in obtaining prestigious hospital appointments for his nephew, Bransby Cooper, and former pupils Joseph Green and Aston Keys. But there is nothing to suggest that any of his family or proteges were other than dedicated and highly competent surgeons.

## 5

## General practice

General practice in the early Nineteenth Century was a hazardous undertaking, and in the main poorly paid. To help make ends meet the general practitioner took on sick club contracts, which themselves, were poorly paid, but did tend to get the doctor's name known over a wider sphere than it might otherwise have done. The average workman could not afford doctor's bills, so he joined a Friendly Society Sick Club, paying a penny or two pence a week for himself and his family. The society or club invited tenders from local GPs, and prepared to take on their books, several hundred patients for treatment and medicines.

The capitation fee was three shillings a year, per patient; so 500 patients would bring in about £75 per year. Many GPs, desperate for work, would often bid with ridiculously low capitation fees to obtain these sick club contracts to augment a meagre private practice. It was disgracefully derisive payment for a medical man when one considers, that at that period of time, a footman in a grand house could earn between £40 and £50 per year.

John Snow applied for the appointment as Club Doctor to four of these sick clubs, and was accepted. He probably had as many as 1500 patients on his books and earned around £300 per year from them. Considering his tiny private practice he needed the clubs as his staple income at this time. As if he

did not have enough to do, this dedicated, hardworking young doctor, despite his not very robust health, became a voluntary assistant to visiting physicians at the new Charing Cross Hospital.

Snow was only twenty-six years of age and had very little spare time, with his two hospital visiting commitments, his four sick clubs, his private practice and his burgeoning experimental work in physiology, not to mention his active

attendance and lecturing at Westminster Medical Society. Ward Richardson described Snow at this period in his life as: "An earnest man, without any notice of quackery" who was endeavouring to establish himself on the basis of sound and rational medicine. Impressed with the external origin of disease, he aimed at removing external causes and studied nature in preference to the Pharmacopoeia, which contained many remedies of doubtful efficacy, some little altered since Galen's days, and some positively revolting in character.

Snow did a great deal of work among the poor at the five-year-old Charing Cross Hospital, and at Westminster Hospital, which combined with his private practice, resulted as he said himself in, "my doorbell ringing all day and frequently at night too".

Among new friends he made at Charing Cross Hospital was Richard Partridge, assistant surgeon, for whom he would later work with as an anaesthetist. He also got on well with the chief surgeon, John Howship and physician WD Chowne. The Hospital has an interesting history. It was founded by Dr Benjamin Golding, and Lord Inman, in Trafalgar Square, for the poor, and many years later, Snow is reported as having given "great service to the poor" at the hospital.

He was now earning sufficient to buy more scientific equipment for his researches. A portrait of Snow at this time depicts him as an earnest looking young man, keen eyed, sporting mutton chop whiskers and sombre clothing. His hair is thinning above the high forehead. He has a prominent nose and sensitive mouth. A contemporary describes him as "a quiet man, reserved and peculiar, a clever man at bottom but not easy to understand." And so he remained for the rest of his life.

Incidentally, while working at Charing Cross Hospital, Snow must undoubtedly have encountered one of it most famous sons, David Livingstone, who was a mature student and later made his name as an explorer. London, at this period, was a city of contrasts with great wealth in a few hands and abject poverty for the masses. Serious social problems had arisen through rapid industrialisation, which brought a rapid increase of population, thus placing an intolerable burden on the rudimentary water and sewage systems, most of which served the better off residents.

Appalling overcrowding in noisome, pest-ridden hovels in the courtyards, the alleys, the mean little streets, presented serious health problems and "fevers" were legion. It was to take outbreaks of cholera to get something done about these conditions, and Snow was to play an important part in two of these epidemics.

Various commissions discussed at length the plight of the poor, and discovered to their apparent amazement, that a great number of folk could not afford the essentials of life such as bread and meat. The built-up area of London spanned about six miles, including the "villages" of Clapham, which was then described as a "superior area", Chelsea, Fulham and Kensington.

When Snow lived and worked in Soho shortly after leaving the Windmill Street School of Anatomy, Trafalgar Square was only ten-years-old; the National Portrait Gallery had only recently been completed, and the new British Museum was still being built. Those who could afford transport had the use of broughams, hackney carriages or the like; those of lowlier means might use the public horse-drawn omnibuses, which were popular. Snow, always a frugal man, usually walked where practicable.

When he was not tending to his patents or working at his laboratory bench, Snow, managed to snatch an hour or two to study in the library of the Royal College of Surgeons. He was a familiar figure in that establishment, and we are told by a contemporary that he was 'not too proud to ask the librarian for a translation when an original bothered him.' Snow was always conscious of the limitations of medicine and surgery in his lifetime, and could take a broad view through his knowledge of medical history.

It is interesting to divert at this point to see what medical literature was open to Snow, at this period in his life. One of the doctor's best friends during the first half of the Nineteenth Century was the publisher John Churchill. This gentlemen rescued many a physician and surgeon from obscurity by publishing his ideas or lectures. To peruse a list from John Churchill's publishing house is like looking at a list of Britain's most eminent physicians and surgeons.

Among Snow's books there would undoubtedly have been copies of George Gregory's 'Elements of the Theory and Practice of Medicine', also 'Practical Observations on the Preservation of Health' by Sir Anthony Carlisle, and probably Samuel Cooper's 'First Lines of the Practice of Surgery', although, surgery was not one of Snow's particular interests.

Apart from his personal interests, Snow would have been interested to read the surgical works of the leading figures in that field, J G Guthrie, Robert Liston, Sir Benjamin Brodie, Sir William Lawrence and the famous male-midwife Samuel Merriman. One of the most curious books to be published at this time,

although not strange to the practitioners of the day, was Thomas Mapleson's Practical Manual on Cupping. Mapleson was, incidentally, her Majesty's Cupper, which lends some importance to the practice of bleeding or cupping at that time.

During his early work in general practice, Snow gathered some interesting material, which he used for his autumn lecture to the Westminster Medical Society in 1839 entitled 'Ansarca (general dropsy) following on Scarlatina'. His physiological studies into respiration were progressing very favourably, and Snow had been in communication with various eminent scientists, including Christison and Justus von Leibig, whom Snow particularly admired. Leibig was not only one of the founders of physiological and agricultural chemistry, but the pioneer of laboratory teaching in chemical science. He attracted a large number of students to his laboratories at Giessen, which had been established in 1826, the first institution of its kind to be connected with university teaching.

In 1831, Leibig, one of three scientists, in different parts of the world, was pursuing research into chloroform, the others being the Frenchman Soubeiran and American Samuel Guthrie. None of them seems to have explored the drug's application to surgical procedures. That was left to James Young Simpson, sixteen years later.

Early in 1841, Snow by now an experienced and respected speaker at the Westminster Medical Society, spoke on "Distortion of chest and spine in children from enlargement of the abdomen". The days had passed when he was referred to merely as "the last speaker" or received no comment at all to his address.

He always spoke to the point, but was not always understood, as he often preferred advanced theories or highly technical treatises, which assumed a knowledge as advanced in physiology as his own. He had a small circle of personal friends but had little time for social events, although he occasionally took time off his incessant medical duties and studies to visit the theatre or concert hall. There is no record of him ever having sought out the company of women, and he seemed to have become the archetypal bachelor at an early age.

He derived great satisfaction from his own little library, his experiments, walking and swimming. He spent a good deal of time in the library of the Royal College of Surgeons, and the librarian of the time had described him as "a quiet, scholarly man who was never too proud to ask for a translation when the original bothered him."

Snow's most outstanding lecture so far was given at the Society's meeting on 16 October, 1841 and was entitled On Asphyxia and on the resuscitation of still-born children. It was published on 5 November, in the London Medical Gazette and aroused considerable interest among medical men. In his address, Snow gave a brief review of work already done on respiration and put forward his own observations and experiments, he told members:

"The number of children that die of asphyxia at the time of birth is very considerable. Writers on midwifery have stated that one-twentieth of the children brought forth are still-born, and of these a large proportion are asphyxiated from various causes, often at the very moment of birth".

Snow went on to say that the apparatus in ordinary use for respiration was the bellows but this, although, much better than breathing into the lungs of the child, was liable to many objections, including likely danger to the texture of the lungs by over distension. Then Snow made it clear that the main objective of his talk was to introduce to his colleagues that he had invented, what he deemed to be the solution to the problem, a small apparatus of two syringes, one of which, by a tube adapted to the mouth and closing it, withdrew air from the lungs and the other syringe returned the same quantity of fresh air through a tube fitted to the nostrils.

Snow said the apparatus provided for a constant current of air, to and from the lungs, as in natural respiration. He then demonstrated the "double air pump" which had been made for him, to his own design, by a Mr Read, instrument maker of Regent Circus. The pump was basically a smaller version of the double air pump for adults, which Read had demonstrated to the Society three years earlier, as a new method of performing artificial respiration in place of the bellows. In the children's version, Snow showed that the fresh air from the atmosphere was warmed on the way through a tube and a metal coil, in warm water before entering the asphyxiated baby's lungs.

Snow was to use a similar heating system to improve the efficiency of the administration of ether in his own apparatus six years later.

When demonstrating the double air pump to his audience, Snow warned:

"This artificial respiration should be preserved for some time, say an hour at least, before we give up in despair, and if our efforts be successful, we should still persevere until the child is completely revived, and capable of carrying on a full and effective respiration of its own…"

This early experimental work is notable for Snow's sound reasoning and logical approach. In many of his experiments he had resource to small animals, but was always careful to minimise any pain or discomfort to his animals.

Respiration was dominating his thinking at this stage and only a matter of weeks after his lecture, on infant asphyxia, Snow was again on his feet at a meeting of the Westminster Medical Society on 18 December. This time he spoke on, Paracentesis of the Thorax, which was published in the London Medical Gazette a month later. Again Snow turned up with a piece of apparatus he had invented. This time it was a trocar and cannula, with a stop clock designed to withdraw fluid from the chest "without making a direct communication between the cavity and the external air."

Snow was nothing, if not resourceful, and he continued this questing after better methods of investigation of conditions throughout his life.

He told the members: "The chief object of this paper is to lay before the Society the drawing of an instrument, which any member can get made by his own instrument maker." He concluded his talk with the words: "This instrument must possess great advantages in the cases in which paracentesis, is at present, performed and it will extend the occasions on which the operation may be resorted to, with safety and advantage."

Snow never imposed any financial strings to his inventions, and was only too delighted if anyone took them up in practice. Not long after placing his drawings of the trocar and cannula apparatus before the members, Snow had his own instrument made up from the plans by Read. This was his seventh lecture since he joined the Society, but in addition he never lost an opportunity to comment on others' lectures and could, at times, become a little tedious to those not so academically orientated. But he was one of the most regular attendees, a loyal supporter and as a reward was elected to the committee. This was his first step on his way up to the top in the hierarchy of his beloved "Westminster" which was the pivot of his whole existence in his all too short life.

It is interesting to see what medical books were on offer at this time, namely George Gregory's "Elements of the Theory and Practice of Medicine"; Carlisle's "Practical Observations on the Preservation of Health" of particular interest to Snow; Liston's "Practical and Operative Surgery" and Thomas Mapleson's "A treatise on the art of cupping".

During February 1843, Snow opened his copy of the Lancet to read a blistering attack, by its editor, on the medical establishment. Wakley criticised the medical profession for abysmal lack of scientific knowledge. In his ledger he declared: "The information of the medical science is very little greater than that of people at large. This is an extremely humiliating fact".

Wakley maintained that it argued "a want of mental energy on the part of those practitioners which is much lamented". He then goes on to identify the reasons for this lack of knowledge among doctors including he says, "a vile system of medical legislation which has demoralised the profession and deprived its members of that self respect, and elevation of mind without which no exalted end can be attained."

He then castigates the fashionable practitioner in these words: "He has to keep up a certain establishment and expenditure, which are not all essential to his real position as a medical practitioner, but are a sacrifice to the prejudices of society… he retains thus neither time nor means for acquiring the scientific improvement which would render him additionally respectable in the eyes of sensible men…" He roundly deplores "the deficiency of medical practitioner in scientific knowledge". Wakley reserved his next attack for that pompous body 'The Worshipful Society of Apothecaries'. Snow, a member of that august body, naturally sat up and took notice. Wakley said that fashionable doctors might imagine their best friends were the dowager countesses and 'listless ladies of fashion' and added: "They should be infinitely more indebted to the Old Ladies of Rhubarb Hall (his scathing reference to the Society)… who have converted the medical practitioners of this realm into pill-mongers".

Later that year, Snow was again on his feet before the Westminster Medical Society, this time speaking on the pathology and therapeutics of circulation of the capillaries. It was not one of his more inspiring efforts, and there was some criticism of it. Snow seems to have had inexhaustible reserves of energy, for apart from his hospital, sick club and private practice, albeit small, his lectures and experiments, he still managed to find time to study for the Bachelor of Medicine degree of London University. He passed at the first attempt, and as if that was not sufficient, he followed that up the following year by passing with first class honours, an examination for the Doctor of Medicine degree of the same university. The university records describe him as "a student of Westminster Hospital".

Early in 1844, the first signs of a serious breakdown in Snow's health manifested themselves, though he characteristically tried to brush them aside as interfering with his work. There is no doubt he had overdone things and the imperceptible decline in his health probably explains why, this year, he only gave one lecture to the Westminster Medical Society, which was most unusual for him, this time on a toxicological theme and entitled "A case of acute poisoning by carbonate of lead". He was finding difficulty in carrying out his ordinary work and experimenting was sparse and spasmodic this year.

The final blow came early in 1845. He had barely completed his latest paper, which was entitled 'Case of malignant or haemorrhagic smallpox' when his condition deteriorated rapidly, and he became so ill that his colleagues compelled him to give up work, for the time being, in light of a similar attack he

had suffered a few years before. His medical advisor told him to take more exercise and have plenty of fresh air. Snow made a token gesture to the concern of his friends, and dropped inessential work, but he was soon back at his laboratory bench preparing papers. Within twelve months he suffered a serious relapse involving the kidneys, and he finally had to admit defeat and give up all his work. But not before he had been convinced of the seriousness of his condition by no less a person than the famous Dr Richard Bright, of Guy's Hospital, who had been called in by Snow's neighbour and good friend, Dr Peter Marshall. Marshall, who lived in Greek Street, was four years older than Snow, and like him, had been a student at the Great Windmill Street School of Anatomy.

Marshall was a leading physician, a quiet, courteous man who had become alarmed over his friend's deteriorating health, and had experienced his stubborn attitude to such matters. Bright, of course, is still remembered today through the disease, which bears his name. He and Dr Prout were the country's leading kidney specialists. Bright, Prout and Marshall all told Snow to stop all work, leave London and take a long holiday with plenty of rest, nourishing food and fresh air. He was also warned about his strict vegetarian habits and advised to relax them and "take a little wine" from time to time. Snow, although a dedicated teetotaller, evidently enjoyed his modest tipple for he continued to have his little wine after his recovery!

Snow went to stay with his old friend of his student days, Joshua Parsons, now in practice as a country doctor in the village of Beckington, near Bath. When Parsons saw Snow, he was appalled at his friend's state of health. He looked dreadfully ill and Parsons immediately took him in hand and saw to it that he rested and spent a good deal of time out of doors. Parsons probably neglected his own practice to look after Snow for they often went out walking, riding and swimming. After several weeks recuperating, and with warnings from Parsons to avoid overstrain when he returned to his work in London, Snow took leave of his friend and travelled to the Isle of Wight where he remained for several months, but we do not know where or with whom he convalesced. Later that year Snow felt refreshed and seems to have recovered sufficiently well to pick up the threads of his work in London, although it is not clear whether all his commitments, such as, the sick clubs and hospital external appointments, had been kept open for him, except perhaps Westminster Hospital.

Once he was back in harness, Snow appears to have given little thought to his recent serious breakdown illness and set about his experiments with zest, and accepted an appointment as Lecturer in Forensic Medicine at the Aldersgate Medical School. This school achieved considerable fame and was one of the largest in London rivalling that at St Bartholomew's Hospital, several of whose top surgeons worked part time at Aldersgate School.

The Lectureship suited Snow very well for it gave him increased opportunities to pursue his great interest in toxicology, with the resources of the School behind him. He used to regale his close friends, in his usual droll manner, with the amusing incidents, which occurred at the School of which he was very fond.

Fortunately, he seems to have so recovered his health that he was able to engage in the vast volume of work, which had previously been his lot. Thanks to his improved health and his appointment at Aldersgate School, the stage, unknown to him, was being set for his most spectacular achievements.

On his return to the medical society meetings following his illness, Snow gave an address in the autumn of 1846 on "Alkalescent urine and Phosphatic Calculi" and shortly after described a "Case of strangulation of the ileum in an aperture of the mesentery," both being published in the London Medical Gazette, the former in November and the latter a month later. During the early 1840s, Snow cannot have been unaware of some of the spectacular Board Room rows at the Westminster Hospital, during his tenure as a visiting physician. They mainly involved Hale Thomson and G J Guthrie, the prickly ex-Army surgeon who was a hero at Waterloo. Thomson was not really at home in the medical profession and J F Clarke, a contemporary of Snow, and at one time on the staff of the Lancet, tells us in graphic form a little of these undignified squabbles. On the medical staff were two antagonistic parties - Mr Hale Thomson versus Mr Guthrie. Thomson was generous, impetuous, imperious, a staunch friend and good hater. He was not equal to his post, having never worked as a student or practitioner. Guthrie had a serious quarrel with Sir Charles Forbes who, like Guthrie, was a retired Military Surgeon. Frobes challenged Guthrie to a duel but he declined. Thomson, who was very attached to Guthrie, offered to go as proxy. Shots were exchanged but no harm was done and Sir Charles declared that honour had been satisfied. For many years Thomson was called 'bullet proof' Thomson.

Thomson was a tragic figure in Westminster's history. He was badly at odds with his medical colleagues, students and staff. On one occasion he performed lithotomy on a man and his colleagues declined to assist him, so he called in Liston, yet Thomson, on that occasion, operated successfully and with considerable skill.

During the years 1845-7, he was alleged to be incompetent by most of the medical staff and asked Clarke for his help, but was broken down in cross-examination in a terrible case in which he had performed lithotomy on a child and had fallen foul of the ever present risk, injury to the rectum.

After inquiries revealed three similar misfortunes in a Norwich hospital, Thomson won his case, but it ruined him. He, nevertheless, stuck to his post at the hospital and was consulting surgeon to the end. Guthrie and his son Charles took no active part in the proceedings against Thomson, but it was well known that they had been opposed to him. It was a sad fact that Thomson had been instrumental in keeping young Guthrie out of the post of Assistant Surgeon at the hospital, yet neither Guthrie senior nor his son held this against Thomson whose strange ways were well known to them. Perhaps it had something to do with the fact that there were efforts being made behind the scenes to oust Thomson and replace him with Charles Guthrie.

This was only the latest row at the hospital, eight years earlier, Sir Anthony Carlisle, then senior surgeon, was deemed incompetent through age, and complaints about his ability were received not only at the hospital but also at the office of the Lancet. The Governors refused to remove such an eminent staff member and he remained there until he offered his retirement.

## 6

## The Ether revolution

The year 1846 was a momentous one in the life of Dr John Snow. It was fortuitous that his health had improved, for this year was to find him facing the greatest challenge of his life. He published little during the year, giving only two lectures to the Westminster Medical Society, one on "Alkalescent Urine and Phosphatic Calculi" and the other on "Strangulated Ileum in an Aperture of the Mesentery".

His physiological researches continued but were interrupted, sadly, in June when he learned of the death of his father in York, on 2 June. He attended the funeral at the city's All Saints Church with other members of the family after which he returned to his work. Little did Snow know that whilst he was preparing the strangulated ileum lecture, a dramatic medical breakthrough was being enacted in Boston, USA, 3,000 miles away, which would have an incalculable influence on his own life and work for the next decade. It was the discovery of ether anaesthesia in surgery.

On 16 October, Boston dentist Thomas Morton, armed with an inhaler he had devised based on Nooth apparatus, walked into Massachusetts's General Hospital, Boston, and before an incredulous audience of medical men in the operating theatre, now known as the "ether dome" gave ether for the first time in a major surgical operation.

His apparatus comprised a spherical glass flask with two necks, one admitting air from the exterior, the other for the patient to breathe in air, which had passed through the ether soaked sponge in a glass jar. A mouthpiece was attached to the side neck with two leather valves to allow a one-way flow of anaesthetic, which could not, however, be controlled.

Morton successfully anaesthetised the patient, a young man called Gilbert Abbott, after which the distinguished surgeon, John Collins Warren, operated for Abbott's haemangioma of the neck. The operation was successful and more importantly, quite painless. At the conclusion, Warren told his amazed audience: "Gentlemen, this is no humbug." He later wrote: "A new era has opened on the operating surgeon. His visitations on the most delicate parts are performed not only without the agonising screams he has been accustomed to hear, but sometimes in a state of perfect insensibility and occasionally, even with an expression of pleasure on the part of the patient".

Sadly Morton seems to have become paranoid over his discovery, which he patented under the name of "Letheon" and threatened any plagiarists with legal action. But in fact, he was not in reality, the first to use ether for general surgery. Had the hapless Crawford Long, a twenty-seven-year-old surgeon of Jefferson, Georgia, been quicker off the mark and published his successful painless excision of a cyst from the neck of his friend James Venable, under ether in March 1842 he could have been the first, not Morton.

Perhaps the most extraordinary blind spot of early use of anaesthetic was the case of the distinguished British Scientist, Humphrey Davy. In 1800, nearly half a century before Long and Morton, he was the superintendent of the Pneumatic Institution run by Dr Thomas Beddoes in Bristol. They were engaged on research into various gases to see which were useful as remedies for Beddoe's new and fashionable methods of treating ills.

In 1779, Davy succeeded in producing pure Nitrous Oxide Gas and used it in experiments on his friends and himself. He wrote:

"I made many experiments to ascertain the lengths of time for which it might be breathed with safety, its effects on the pulse and its general effects on the health when often respired." Davy used the gas on himself to relive the agony of an erupting wisdom tooth. "One day when the inflammation was most troublesome, "I breathed three large doses of Nitrous Oxide. The pain almost diminished after the first four or five inspirations…"

After a series of experiments he wrote: "As Nitrous Oxide in its extensive operation appears capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion takes place…"

Curiously, Davy did not think to pursue this important observation and save hundreds of thousands of people from unnecessary pain forty-six-years before Morton's demonstration in Boston. In fact, he came to regret ever publishing details of his work on the analgesic properties of Nitrous Oxide, which he described as "the dreams of a misemployed genius which the light of experiment and observation has never conducted to truth…" Dr F F Cartwright in his book, The English Pioneers of Anaesthesia states that Davy's work on Nitrous Oxide constituted the first recorded suggestion of a practical means of anaesthesia.

In 1824, a twenty-four-year-old Ludlow general practitioner, Henry Hill Hickman, claimed to have performed experiments on animals showing that surgical operations could be carried out successfully and painlessly under Carbon Dioxide gas. Unfortunately, he never got around to making clinical trials before he died at the young age of thirty. His pamphlet describing the experiments was, however, undoubtedly the first ever publication devoted exclusively to anaesthesia. His work was made public twenty-four-years after Davy's experiments with Nitrous Oxide and twenty-two-years before Morton's discovery of ether anaesthesia.

But in considering Davy and Hickman in the context of the early history of anaesthesia, more attention should be given to the experiments at Guy's Hospital than has previously been accorded to that hospital's staff. For example, Dr William Allen entered in his diary on a day in March 1800, the following:

"Present Astely Cooper, Bradley, Fox and others. We all breathed the gaseous oxide of azote. It took a surprising effect on me, abolishing completely at first all sensations; then I had the idea of being carried violently upward in a dark cavern with only a few glimmering lights… I had suffered no pain and in a short time I came to myself".

Allen, was one of the first to describe the analgesic properties of Nitrous Oxide, an anaesthetic still used. Allen was a lecturer in chemistry to Guy's Hospital and would, one have thought, impressed a man like Astley Cooper with his discovery. But nothing was done about the potential pain killing aspects of Nitrous Oxide and for many years afterwards Guy's operations were performed without the benefit of anaesthesia.

In fact, Snow himself later wrote that the "medical officers at Guy's and St Thomas' Hospitals had a strong objection to narcotism by inhalation for the first two or three years after the practice was introduced…" He refers to chloroform after 1847.

With hindsight, it is curious that no one seemed to have picked up the first hint at the use of ether in surgery when on 11 November, some five weeks before Liston's demonstration, an American physician visiting this country spoke at a meeting of the meico-Chirurgical Society in London about the use of ether in Boston the previous month.

It is the more surprising because Snow, at least, was a member of the Society and was likely to have been present on that occasion. The American doctor either must have sounded a crank to his audience or they could not bring themselves to believe that American medicine was so far advanced! Yet, we are told he invited a member of the audience to participate in an experiment using ether to put him out for a brief spell. We even know the name of the lucky volunteer. He was a Dr Montague Duncan. Whilst under the ether, the lecturer plunged a needle into the volunteers arm. When Duncan recovered he declared he had felt no pain. Another broad hint to the medical fraternity was also ignored, for five weeks after this demonstration an article entitled "Animal Magnetism Superseded – discovery of a new hypnopoietic" referring to the ether lecture was published. Mesmerism was very popular at this period and several physicians, notably John Elliotson, practised it with considerable success on patients for minor surgical procedures and as a therapeutic measure. Others however, were strongly opposed to the practice of hypnotism in medicine.

Elliotson, physician at University College Hospital, had studied Mesmerism under Baron Du Potet - one of Dr Mesmer's pupils. Du Potet helped a large number of patients through hypnotism and practised at the Salpetriere Clinic in Paris, made famous by Charcot. Elliotson attracted a large number of patients to his mererism clinic at the UCH, but as far as his colleagues were concerned including Liston, it was mere quackery and they would have none of it. Tragically, Elliotson, who was hoodwinked into carrying out absurd procedures, resulted in him having to resign four years after introducing mesmerism.

It was an ignominious end for a man who had been one of the hospital's first physicians and Fellow of the Royal Society to boot. A popular teacher, he had been one of the first doctors in this country to use the stethoscope invented by the French physician Rene Laennec. He also introduced quinine as a treatment for malaria, a common disease in Britain in those days and was a friend of novelist Charles Dickens, who had witnessed some of his mesmerism sessions.

It is ironic that a man like Elliotson, who was out of his time, should have received such vilification and disgrace when one sees medical hypnotism as accepted and respectable handmaiden to the psychiatrists today. The news of the Boston ether demonstration was first introduced into Britain by ship's surgeon Dr William Fraser. On the morning of 16 December 1846, he disembarked from his ship the HMS Arcadia, Cunard's wooden paddle steamer at Liverpool. Fraser carried out with him a package of information concerning Morton's demonstration of ether in the operation performed at the Massachusetts's Hospital in Boston two months earlier. It was fortuitous that Fraser happened to be in that city at the time Morton gave the ether and actually met him and discussed the use of the drug with him.

Dr Fraser was anxious to impart this precious knowledge to his medical colleagues in his hometown of Dumfries. Within three days of his arrival home, he had imparted his knowledge to two friends, surgeons at the Dumfries and Galloway Hospital, William Scott and James M'Laughlan. The two surgeons were so impressed with the potentialities of ether that they hastily assembled an apparatus to administer the drug on the lines of the Morton inhaler, and then had to find a patient.

On 19 December, the two surgeons amputated a leg of a male patient, the ether being given by Mr Scott. The operation was successful and the patient felt no pain. Unlike the Morton demonstration, Scott and M'Laughlan performed the operation without an audience and they never laid claim to being the first to perform an operation under ether in Britain. Despite arguments for and against this claim, it seems certain now they were now the first, despite Robert Liston's claim to be the "first". Strangely, Scott only claimed the honour in October 1872 in a letter to the Lancet, twenty-six years after the event! He had obviously published no report in any medical magazine at the time of his historic operation in 1846. Nevertheless, although Liston's operation under ether was two days after Scott and McLaughlin, he is today firmly acknowledged as the first to perform general surgery under ether.

The first published accounts of ether anaesthesia appeared in the Boston Medical and Surgical Journal of 21 October, 1846, but the first account in Britain was in the lay Press; a small paragraph appeared in the Liverpool Mercury on Friday 18 December, as follows:

"A method of mitigating pain in surgical operations by the inhalation of certain ethers has been discovered in America and it is said that successful experiments have been made".

The first British medical profession heard of ether through their medical journals was when, eight days later, the Lancet referred to Dr Bigelow's paper on ether used for the extraction of teeth and an amputation. It was one week after the dental operation of Mr Robinson with Dr Boott in London.

Surprisingly, Wakley, the intrepid editor of the Lancet, had missed a "Scoop" and dismissed the claim with faint praise in these words: "Such a discovery, if it stands the test of examination, will be an invaluable boon. The means used is believed to be an inhalation of the vapour of sulphuric ether for two or three minutes, which it is stated produced insensibility for about an equal length of time".

As Dr Fraser arrived in Dumfries, a letter was delivered to a Dr Francis Boott, of Gower Street, London. Boott an Englishman, had formerly worked in the USA where he had met Professor Jacob Bigelow, the surgeon at Harvard Medical School. Begelow had been present at the Morton demonstration and had lost no time in gathering together all the information he could on ether and surgery to send to his old friend. Included with the letter was an interesting paper on the subject by Bigelo's talented son, Henry Jacob Bigelow, who was a surgeon at the Massachusetts Hospital: In the paper Bigelow junior described the use of ether for dental operations, one of which had been performed using the drug on his own daughter.

In a second letter, dated 28 November 1846, Professor Bigelow enclosed a cutting from the Boston Daily Advertiser describing the Boston operation on young Abbott.

Bigelow wrote as follows:

My Dear Boott,

*I send you an account of a new anodyne process lately introduced here, which promises to be one of the most important discoveries of the present age. It has rendered many patients insensible to pain during surgical operations, and other causes of suffering. Limbs and breasts have been amputated, arteries tied, tumours extirpated and many hundreds of teeth extracted, without any consciousness of the least pain on the part of the patient. The inventor is Dr Morton, a dentist of this city, and the process consists of the inhalation of the vapour of ether to the point of intoxication.*

On receipt of this letter, Boott took the good news to his friend and neighbour James Robinson, a well-known London surgeon-dentist. A former student of Guy's hospital, Robinson was surgeon-dentist to the Metropolitan Hospital. Robinson arranged with Boott to undertake a dental operation on Saturday 19

December on Bootts niece, a Miss Lonsdale. He managed to obtain a supply of ether from a chemist who specially made it up for him, as it was not at that stage available "over the counter".

In the meantime, Robinson, following the details of Morton's inhaler in Bigelow's letter to him, set about devising an ether inhaler for the operation. The apparatus was made by well-known local instrument maker, Mr W Hooper, and incorporated a ball and socket valve. Miss Lonsdale duly attended upon Mr Robinson at his Gower Street home, where Boott was waiting in the study ready to perform the first dental operation under ether in Britain.

Miss Lonsdale was persuaded to inhale from the crude inhaler and she was very soon under the influence of the ether, which was administered to her by her uncle. Mr Robinson removed her troublesome impacted wisdom tooth "without the least sense of pain or the movement of a muscle". She said afterwards that she had felt no pain and recalled a "heavenly dream". The operation was watched in amazement by Mrs Boott and two of her daughters.

Although this operation went off easily under ether, the next one was not a happy experience, for the ether inhaler was too small and the flow of vapour was uncontrolled and erratic. Boott can be forgiven for using it, for it was after all, the first of its kind. Neither Boott nor Robinson, were of course, aware of the major operation under ether, which was being performed that same day hundreds of miles away in Dumfries and Galloway Hospital and vice versa.

Later that day, Boott delivered a note to London's leading surgeon, Robert Liston, whom he had known from his Edinburgh days. No sooner had he read the news of the operation on Miss Lonsdale he hurried around to the flourishing dispensary business of his old friend, Peter Squire, in Oxford Street and told him that he required some pure ether to carry out a surgical operation two days later.

Liston rushed off leaving Squire to discuss the matter with his gifted nephew William Squire. The following morning, Sunday, the two of them assembled a Nooth's apparatus in which they inserted a sponge soaked in sulphuric ether. William, with commendable courage one might think, volunteered to try out the anaesthetic. His uncle administered the drug and William became unconscious. When he awoke he "felt fine" and was told by his uncle that he would give the ether to Lison's patient the very next day.

William Squire was not a stranger to this sort of experiment for a couple of months before, as a medical student, he had offered himself as guinea pig for experiments with Nitrous Oxide and other gases during laboratory experiments at University College. About one of the experiments, he commented: "I struck my knuckles hard against a desk without feeling any pain". He had attended operations performed by surgeons of University College Hospital and admired none more than his uncle's friend Robert Liston. He looked forward to giving the first ether anaesthetic for the great man.

On Sunday, Liston lost no time in seeking out a suitable case for his historic operation. He made his ward rounds at University College Hospital and decided that the most suitable patient was Frederick Churchill, a thirty-six-year-old Harley Street butler. Churchill had a chronic disease of a knee joint following a bad fall. Liston told him that he would have that leg off the next day. Churchill, having seen something of the agony suffered by fellow patients who had undergone operations, was not at all enthusiastic and declined the offer. But, Liston, assured him that he "would not feel a thing" as he would be using a sleeping gas.

Liston then returned to his home, sat down and wrote several letters to colleagues describing the historic operation he was to perform the next day. On Monday 21 December 1846, a bitterly cold day, crowds lined the hard wooden benches of the operating theatre at University College Hospital to watch Liston at work in an exciting new venture. The theatre was typical of the period. The seats around the central arena went up in tiers, the front row being reserved for distinguished visitors.

The small arena contained a plain wooden table, resembling a kitchen table of the time, under which there was a trough containing sawdust to soak up the blood. Nearby was a small handbowl on a stand for the surgeon to use in hand washing, not of course, with any thought of sterilisation. An ordinary Windsor chair stood near the table for the surgeon's special guest and close by was a plain wooden cupboard, which contained the instruments and other apparatus. An excellent restored example of this type of early Nineteenth Century operating theatre is to be found in the attic of what used to be the parish church of St Thomas', and is now the Chapter House of Southward Cathedral. The theatre, which is entered from Borough High Street not far from Guy's hospital on the opposite side of the road, is well worth the visit. The theatre, which was for women patients at St Thomas' was built in 1821 and functioned for forty years until in 1862, the hospital premises were to be sold to the railway company running into nearby London Bridge terminus, the final closure of the hospital was in 1865 when it moved to its present site. Among students present in Liston's theatre that day, was one who was one day to become more famous that Liston himself. His name was Joseph Lister, founder of antiseptic surgery twenty years later.

Shortly after 2.00pm that Monday, 21 December, Peter and William Squire entered the UCH theatre and set up their apparatus based on Nooth's apparatus, following the description given to them by Liston of Morton's apparatus.

The upper glass bulb of the apparatus contained a sponge and attached to the lower, bell shaped, part of the inhaler, was a flexible tube with a mouthpiece, which was inserted into the patient's mouth whilst the nose was clipped.

William Squire poured the ether on the sponge and asked for a volunteer to try it out. He looked around the room. No one stirred - there was deadly silence. Then he spotted a huge muscular attendant waiting at the door for the arrival of Liston. He ordered the man, porter Sheldrake, to lay on the table and suck in the gas from the inhaler whilst Squire held his nose. After a couple of minutes inhaling, Sheldrake suddenly became violent, leapt from the table, shoved Squire aside, climbed over the railings at the bottom of the tiers of seats and barged into the mass of onlookers. He was finally calmed down, at the top of the steps, by some of the students.

At 2.15pm in strode Liston, a giant of a man with a commanding presence, an idol of patients and students alike. With him was his assistant William Cadge. Liston wore the customary blood and pus crusted frock coat, his operating coat, with a few threads of wax hemp ligature stuck to his buttonhole ready for use when ligature time came.

There was no pre-operation hand washing ritual, hand washing was for that stage in the operation when the surgeon found his progress hampered by blood encrusted hands, gloveless of course. Rubber gloves were not a part of surgical procedures until 1871 and afterwards. First to use them in this country was Mr J Williams, of Manchester and it was John Ward Cousins of Portsmouth who began to use a special clean operating coat in 1884. Both welcome innovations followed, of course, Lister's great work on antiseptic surgery in the 1860s.

The surgeon laid out Liston's instruments and Liston removed from his instrument box a long, narrow amputation knife specially made to his own design. With a theatrical gesture, Liston turned to his expectant audience and declared: "We are going to try a Yankee dodge today, gentlemen, for making men insensible…" At this point the patient, Churchill, was brought into the theatre and placed on the wooden table. William Squire put a handkerchief over the man's face, placing the mouthpiece of the Nooth type apparatus under it and into Churchill's mouth. The patient, at first, resisted the pungent fumes of the ether but the firm grip of the burly theatre attendants kept him steady and he continued breathing in the fumes and gradually succumbed.

Told the patient was ready, Liston picked up his amputation knife and set about the speedy removal of the diseased leg in his typical silent, grim faced manner. He was famous for his speed and dexterity as an operator and was taking no chances of a sudden revival of the patient in this, the most important operation of his life. He removed the leg in twenty-eight seconds flat, according to a group of his students who made a habit of timing his operations.

Whilst Liston swilled his knife in the nearby bowl, Cadge was working opposite him and had been responsible for legating arteries with strands of hemp from his buttonhole, watched the recovery of Churchill with interest. The man had just come round from the ether and was protesting loudly: "I don't want my leg off. I want to die," demanding to be returned to the ward. He was completely unaware that he had come out of the operation painlessly and successfully.

Everyone was both astounded and moved as the attendants took Churchill back to the ward he had only left five minutes before. His voice trembling with emotion and excitement, Liston turned to his audience declaring: "This Yankee dodge, gentlemen, beats mesmerism hollow." But there was more to come. Having witnessed the first major operation under ether in England, the majority of the students shuffled out of the theatre having accorded their hero a round of applause as if they had just witnessed a theatrical performance.

Those that remained behind had the opportunity of seeing the master at work on a second patient using ether. This was an operation for the removal of an ingrowing toenail. Although, a minor operation it nevertheless was a painful one, but again the patient felt no pain during the operation. Again Liston was applauded and he left the theatre elated.

He got into his carriage and went directly to his home at 5 Clifford Street, where he sat down and wrote a letter to the man who had started it all, Francis Boott. His note said:

"My Dear Sir,

I tried the ether inhalation today in a case of amputation of the thigh, and in another requiring the evulsion of both sides of the great toenail, one of the most painful operations in surgery, and with the most perfect and satisfactory results.

It is a very great matter to be able, thus, to destroy sensibility to such an extent and without, apparently, any bad results. It is a fine thing for operating surgeons, and I thank you most sincerely for the early information you were so kind to give me of it."

With fine sense of the occasion, Liston had made hurried arrangements for as many of his colleagues and friends as he could muster, in the short time at his disposal, to join him in a dinner party at his home to mark this great landmark in medicine. There, he once more, demonstrated the effects of ether on his hapless assistant, Cadge, who gave way to the euphoria of the evening. His forecast that within six months no operation would be performed without using ether, proved to be correct, as news of the technique spread across Europe. There was, however, an immediate response to the experiment in London for the People's London Journal on 9 January 1847, announced:

"Hail, happy hour: that brings the glad tidings of another glorious victory. Oh, what a delight for every feeling heart to find the New Year ushered in with the announcement of this noble discovery of the power to still the sense of pain and veil the eye and memory from all the horrors of an operation… WE HAVE CONQUERED PAIN."

London, and provincial surgeons alike, shared misgivings over new the anaesthetic. On the other hand, there were those, both in London and other parts of Britain, who were prepared to use chloroform with enlightened care and success.

Salisbury folk, not least the local medicoes, must have been intrigued to read in the issue of the Salisbury and Winchester Journal of 9 January, 1847, the following snippet of news emanating from Bristol: -

"We notice, of a few days since, a method of rendering a patient insensible to pain during the performance of surgical operations by the inhalation of vapour of ether combined with atmospheric air…"

This historic, if brief, item of news referred to the use of ether in a surgical operation at Bristol General Hospital, not to be confused with the Infirmary, a much older institution. The patient was a young man who had a leg amputated above the knee by surgeon, Mr J G Lansdown, one of the hospital's first medical officers. The ether was given by the senior physician, Dr Alexander Fairbrother, who had been at the hospital since 1838 and was eventually to join the staff of the rival Infirmary, where he served with distinction for twenty-three years.

It was reported that after the patient had inhaled the ether vapour for about one and a half minutes, he became unconscious. The new item continued:

"When the surgeon commenced his incision, and after a lapse of two or three minutes, Dr Fairbrother again administered the vapour keeping his fingers on the patient's pulse and watching his breathing. Wine was administered in small quantities alternately with the vapour, which kept the patient in a state of unconsciousness for a period of fifteen minutes. The limb was separated from the body in one minute. During the operation the features had not exhibited the least pain and the patient remained motionless. After the operation he awoke perfectly quiet and calm and said he had felt no pain either in the cutting through the skin, nor the bone sawing…"

Surgery practised in most London and provincial hospitals in Snow's day was by today's standards brutal, crude and very limited in scope. Abdominal surgery was taboo as the results would have been almost wholly fatal, although, there was some limited success with ovariotomy operations. Operations during this period and for a further forty years, almost, were bloody and dangerous, even if after the discovery of ether they were painless.

The high rate of mortality from operations (about eighty-five- percent) was mainly due to post-operative infection, which resulted in the majority of patients being treated conservatively. Those operations that were performed were of a limited scope and variety and formed only a small part of the surgeon's work. Most of the time he treated inflammations, minor injuries, skin disorders, venereal disease and prescribed medicines and appliances.

Large hospitals each had one regular operating session a week, for that was all that was necessary. Large hospitals in England and Scotland might, for example, average 120 to 150 operations annually. Contrast this with two decades after the discovery of ether and chloroform when St Bartholomew's Hospital, for example, had 320 operations and Guy's 541, due to anaesthesia and antiseptic methods of Lister.

It was not long afterwards the Liston demonstration of ether that other hospitals were trying out the gas including Bristol, Liverpool and Edinburgh. The Lancet reported that the operating theatre at Guy's Hospital was "densely crowded" on the first few occasions that ether was given to patients and that the theatre at St Bartholomew's was "much crowded by practitioners as well as students".

The day after his demonstration at University College Hospital, Liston wrote to his old friend and former pupil, Dr James Miller, Professor of Surgery at Edinburgh, describing his first operation using ether as "a boon for mankind". On the day that Miller received the letter he read it out to his University class, obviously completely unaware that in Dumfries two surgeons had used ether before Liston. About the same time, Miller told his next-door neighbour, James Young Simpson, about Liston's achievement. Both men lived in Queen Street, an elegant residential part of the city much favoured by physicians and surgeons. Although, Simpson was aware that certain substances had analgesic properties, like opium, he

was very interested in the reports on ether and immediately made plans to go to London to see Liston and discuss with him the implications of the new anaesthetic.

We know little of that historic meeting but Simpson, after he had seen Liston, returned to Edinburgh full of enthusiasm for the new gas and armed with the necessary apparatus for its administration. Simpson subsequently commented:

"He (Liston) expressed to me the opinion that the new anaesthetic would be of special use to him, who was so swift an operator, as he thought, like Bigelow, it could only be used for a brief time. I went back, however, from this London visit to Edinburgh bent on testing its applicability to midwifery."

Despite the Dumfries claim, it was afterwards acknowledged by the bulk of the medical profession in Scotland that Miller was the first Scottish surgeon to use ether anaesthesia in a surgical operation. Miller, a son of the manse, had succeeded Charles Bell as Professor of Surgery in 1842 and as Acting Surgeon at the Infirmary. A handsome man, he was a good lecturer and a bold and dexterous operator. He first used ether at the Royal Infirmary, the day after receiving the letter from Liston, and other surgeons at the hospital began to use it within a fortnight.

Only days after Miller's inaugural operation under ether, Simpson gave ether for the first time in a midwifery case at the Edinburgh Lying-in Hospital for a woman who was likely to undergo a long arduous labour because of her deformed pelvis. Although, sadly her baby died, the mother recovered satisfactorily having felt no pain during her labour.

After this first experience of labour under anaesthetic, Simpson could think of nothing else. He was determined to see that this great boon to mankind was readily available in the labour wards of ally lying-in hospitals.

Difficult as it may be to be believe, this experience overshadowed the news he received that same day that the Queen had appointed him as her physician in Scotland. Simpson wrote to his brother, thus about his first delivery under ether on 19 January:

"Flattery from the Queen is perhaps not common flattery, but I am far less interested in it than in having delivered a woman this week, without any pain, whilst inhaling sulphuric ether. I can think of naught else".

Simpson was guilty of many things but false modesty was not one his faults. He was a kindly, caring physician devoted to his calling. Ether was the answer to his constant question "can nothing be done to make operations less painful?"

He was so delighted with the results of the first use he had made of ether in his midwifery practice that he henceforth used it whenever he felt the need. In the March issue of the Journal of Medical Science there were articles by Simpson on the use ether inhalation in midwifery practice. He wrote of the efficiency of ether, not only forceps deliveries, but also to relive pains in natural labour. He enthused about his first case saying that the results were "most gratifying" and that he had never had the pleasure of watching over a series of "more perfect or more rapid recoveries". He had not, he declared, witnessed any disagreeable results to either mother or child. He devised an improved inhaler, but soon abandoned it in favour of the simpler and more direct method of dropping ether on to a handkerchief and placing it over the patient's face.

He used the same method with the anaesthetic, which superseded ether, namely chloroform. Although, Snow roundly criticised this haphazard method, it was de rigeur in Scotland for many years. Simpson's humanity in his midwifery work comes through clearly when reading of the following incident:

One cold Sunday night, Simpson had been tending a woman who was gravely ill and this had taken him much longer than he had anticipated. His next patient, a woman in labour, had been delivered of her child by the time Simpson arrived at her home, despite the fact that he ran to her house, a considerable distance away. Finding that he was too late he apologised profusely telling her: "I'm sorry, but you will never have to suffer such pain again". He then drew from a pocket under the folds of his winter coat a bottle of ether saying: "This would have put you to sleep and made it painless. I'll be out in the morning. Sleep now."

In the meantime, a pamphlet issued by Simpson commending the use of ether to relieve labour pains, which was widely circulated, brought down on his head the wrath of many church dignitaries and not a few eminent lay folk of eminence. What had aroused their ire, apart from the obvious, assuaging of pain during childbirth? It was Simpson's suggestion that medical men were more qualified to determine whether the use of ether was moral or immoral, according to Biblican teaching. He said he had repeatedly asked himself:

"Shall we ever be justified in using the vapour of ether to assuage the pains of natural labour?"

And answering his own question, he said that it would become necessary to determine whether, on any grounds, moral or medical a professional, man could deep himself justified in withholding it.

He may have stirred up a hornet's nest in this country, but in Europe, he found some useful allies. His pamphlet was widely acclaimed in France and Germany and to mark their appreciation of his

writings on ether and midwifery, the Berlin Obstetrical Society made him an honorary member. There was slow, cautious acceptance of the use of ether in midwifery but during 1847, Simpson used the gas in all his cases in Edinburgh Lying-in Hospital. He also used it in his practice when he would administer it for anything, from a few minutes to several hours depending on the case involved.

Like other pioneers, he found it very inconvenient going back and forth to the patients' houses, sometimes to the top of tenement buildings, carrying a huge glass bottle, part of the anaesthesia apparatus of the day. Apart from the objections to ether on religious grounds, many medical men did not like it because it left behind an objectionable smell, irritated the eyes and could catch fire if it was too near a naked gaslight. Although, Simpson had been delighted with the effects of ether in his practice he soon set about looking for a better anaesthetic.

Edinburgh's leading surgeon James Syme, an old enemy of Simpson, did not allow his quarrel with the obstetrician to hinder his use of the new gas. He tried it out in February 1847 but abandoned it the following month. He re-started using it again a few months later and published reports of six operations in, which he successfully used ether although he added with commendable caution "I do not wish to sanction its indiscriminate employment".

Syme, like many surgeons of his day, was of the view that the sensation of pain was an important feature in operations, but neither Liston nor Simpson held this view after the arrival of ether and chloroform.

Whilst Syme, Miller and Simpson were forging their paths in the history of ether in Scotland, John Snow, in London, was experimenting on the gas with enthusiasm and dedication. In his biographical sketch of Snow, B W Richardson says of this period in Snow's career:

"In this year (1846) the news came over from America that operation could be performed without pain under the influence of sulphuric ether. The fact was just such a one as would at once attract the earnest attention of Dr Snow. It was a physiological, as well as a practical fact. It was rational in its meaning, and marvellously humane in its application. The question, once before him, was in a scientific sense his own. His previous experimental studies in respiration and asphyxia had prepared him for this new inquiry. He lost no time, therefore, in investigating the new fact; he took it up for its own sake, however, not from any thought, at that time, of a harvest of gold… the first inhalations of ether in this country were not so successful as to astonish all the surgeons, or to recommend etherisation as a common practice. The distrust arose from the manner in which the agent was administered. Dr Snow at once detected this circumstance and… remedied the mistake by making an improved inhaler. He next carried out many experiments on animals and on himself and brought the administration to great perfection…"

It was a fact that Snow was one of the first, if not the first, to detect the dangers lurking in the casual, non-scientific administration of ether. He was appalled at the way unskilled and irresponsible people were drummed up to give ether on a piece of rag or a sponge to a hapless patient only too eager for painless surgery. Snow tells us of the day that these reprehensible practices were dramatically brought home to him and spurred him on to the production of some inhaler to control the flow of ether and air.

One day, Snow was hurrying out of one of the hospitals at, which he had been giving ether, when he bumped into a druggist he knew. This man was carrying, under his arm, a great glass bulb, which was the usual type of apparatus at that early stage in the history of anaesthesia.

Snow raised his topper in the customary polite greeting and said, "good morning". The druggist replied breathlessly: "Good morning to you doctor, but, pray do not detain me. I am giving ether here and there and everywhere. I am getting quite into ether practice."

Snow was stunned. He knew the man had, neither scientific knowledge nor training of any kind, which could fit him to administer a potentially dangerous narcotic like ether. He would be ignorant of the various stages through which the patient passed when inhaling the vapour, thought Snow, after the druggist had rushed off: "Rather peculiar; here is this man without the remotest physiological idea… and an ether practice?" He concluded thinking to himself: "If he can get an ether practice, perchance some scraps of the same thing might fall to a scientific unfortunate." If, this was indeed, the first notion Snow had of making anaesthesia his life work, perhaps we owe more than we realise to that opportunist druggist who made Snow think upon anaesthesia as a speciality.

Snow was, of course, well prepared to study anaesthesia in some depth because of his many years' interest in the physiology of respiration. He had already published three well-researched and comprehensive articles on the subject by the time he took up his researches into inhalers.

Surgeons generally looked upon ether, and indeed its successor chloroform, as a means to an end, but Snow saw it as a subject worthy of study in its own right. Once he had learned of the introduction of ether into Britain, he took an immediate interest, which lasted for the rest of his life.

Considering the means at his disposal at that period of medical knowledge, his experiments were very accurate and complete. He carried out more than 40 experiments involving the anaesthetisation of

small animals and birds and these were probably the first true pharmacological experiments into the action of anaesthetics.

Snow was one of the first to emphasise the importance of an open airway during anaesthesia of a patient and he advocated rational methods of artificial respiration. As all operations were performed in a great hurry to save the patients anxiety great pain, shock and blood loss – and this situation obtained for many years after the discovery of ether and chloroform – the period of anaesthesia was rarely more than a few minutes. Patients were, therefore, never wholly anaesthetised, as we know it today.

A good deal of Snow's early experiments were involved in the manufacture of a satisfactory inhaler for ether, to replace the rough and ready glass bowl or flask, containing an ether soaked sponge. These early glass inhalers tended to freeze up and the tube leading from it was of such a narrow calibre, that breathing was restricted.

Whilst Snow was working on his inhaler, the public began clamouring for the "blessed relief" of ether in surgical operations and as might have been anticipated accounts began appearing regularly in the newspapers of eminent personalities having had an operation under ether. A popular publication "The People's London Journal" enthused as follows:

"Oh, what a delight for every feeling heart to find the New Year (1847) ushered in with the announcement of this noble discovery of the power to still the sense of pain, and veil the eye and memory from all horrors of an operation… we have conquered pain…"

Within a fortnight of the first public announcement in Britain of painless surgery, a horde of surgical instrument makers busied themselves inventing all manner of ether inhalers. Within a few weeks of Liston's historic operation, at least six firms were advertising their inhalers and medical men were regaled with illustrations in the Pharmaceutical Journal in the spring of 1847 of inhalers by Smee, Hoffman, Bell, Tracy and Heineken. One volume contained no less than twenty-nine inhalers of various shapes and sizes. But credit should go to William Hooper who subsequently invented an attachment for the inhaler used by Robinson, which facilitated the administration of oxygen, if needed, to resuscitate the patient taking ether.

Several of the advertised inhalers were serviceable, but others were of little real value. During the first six months of ether practice, the Lancet published no less than 111 references to the gas. Never before, nor probably since, has such deep interest been shown in medical topics as in ether. The year 1847 had barely been dawned before reports appeared in medical journals of operations under the new wonder vapour at Kings College, Guy's, St Thomas' and Westminster Hospitals in London and at Bristol Infirmary and Wolverhampton Hospital.

The first operation under ether at Bristol General Hospital was performed by Mr J G Lansdown, the ether being administered by Dr Alexander Fairbrother, a Physician at the hospital. The operation was reported in the Salisbury and Winchester Journal as having taken place on or about 2 January 1847. The item appeared in the issue of 9 January as follows:

"We noticed a few days since, a method of rendering a patient insensible to pain during the performance of surgical operations by the inhalation of the vapour of ether combined with atmospheric air. The successful amputation of a leg of a patient at Bristol General Hospital… a young man had his left leg removed above the knee… Mr Lansdown, operating surgeon, performed it and was induced to try the effect upon the patient, of the inhalation of the vapour by Dr Fairbrother, senior physician. One and a half minute's inhalation and the patient became unconscious.

"When the surgeon commenced his incision, and after a lapse of two or three minutes, Dr Fairbrother again administered the vapour, keeping his fingers on the patient's pulse and watching his breathing. Wine was administered in small quantities alternately with the vapour, which kept the patient in a state of unconsciousness for a period of fifteen minutes. The limb was separated from the body in one minute. During the operation, the features did not exhibit the least pain and the patient remained motionless. After the operation he awoke perfectly quiet and calm and said he had not felt any pain."

At this time John Snow was well into "an ether practice" and working in feverish bouts, often exhausting himself to the point of collapse. He seems to have taken little notice of his earlier bouts of illness and was still observing a strict dietary regime.

He took particular notice of the various pieces of apparatus coming on to the market, which claimed to be the answer to safe administration of ether, and later chloroform. Most were based on the type of inhaler used by Morton in America and Squire for the Liston pioneer operation in London. Snow found that because of the poor conduction of the ether-soaked sponge and the glass jar containing it, the patient inhaled only small amounts of the vapour through the freezing process, the reduction of temperature in the jar and the narrowness of the inhaling tube, making respiration difficult. On occasions, the patient failed to lose consciousness with this type of apparatus, because insufficient air was getting through to the patient thus causing asphyxia.

Snow commented: "On this account and through other defects in the inhalers, the patient was often very long in becoming insensible, and in a not a few cases, he did not become affected, beyond a degree

of excitement and inebriety, which would meet these defects. He wanted control over the ether-air flow to the patient, which would take into account the fact that at different temperatures air would take different amounts of ether vapour.

It is remarkable that out of all the inhalers advertised for use with ether, not one had an efficient, comfortable mouthpiece. Each apparatus required the patient to take, into the mouth, a tube and then his nose was firmly gripped by a clip. All the inventive genius put into the design and production of these inhalers, including Snow's own first inhaler, failed to see the wisdom of a face piece enclosing the patent's nose and mouth at the same time.

But to give Snow due credit, about three months after he first demonstrated his Mark I inhaler to the Westminster Medical Society, his Mark II model did have an attached proper face piece, which he acknowledged, he had based on an original idea of Dr Francis Sibson, who was surgeon at Nottingham General Hospital. Sibson's original model had also a strap to the mask to keep it firmly in place. Sibson's ingenuity over the mask and Snow's practical work on the apparatus itself was a happy combination, which was a boon to anaesthesia almost from the word go, and both men rejected any idea of patents for their pieces of apparatus.

A fortnight after the publication of the Lancet report, John Snow was addressing the Westminster Medical Society on his experiences of ether and demonstrated his first ether inhaler, a metal bottle, which he had designed and had built by a local instrument maker with whom he was friendly. The bottle was held in the hand, the heat of which was sufficient to aid the evaporation of the ether. It had a flexible tube and face piece and was a distant improvement on the glass bottle used by Morton. He undertook a considerable amount of research into the improvement of the inhaler.

Later he perfected his second inhaler, which was a black japanned metal box, which one writer has described as resembling a black cigar box. It was made of tin and half of it contained a spiral vaporiser, the other half containing warm water when in use. A tube, face piece and valve linked the box to the patient. This apparatus was illustrated in Snow's book On Chloroform and has been reproduced many times since in anaesthesia and other journals and books.

The inhaler proved and served very well for many years until Clover's apparatus superseded it. During its currency Snow's inhaler was used widely in London and provincial hospitals as well at the Army Medical Services, who had a number of these inhalers in use during the Crimean War. Salisbury Infirmary, for example, began to use the Snow Inhaler almost from its inception.

Snow's research into the production of this new and much improved inhaler had, at the same time, helped him to solve the problem of the minimum necessary diameter of the flexible tube leading from the vaporiser to the patient. It is interesting to note that over seventy years later, Sir Ivan Magill too worked on this question of the diameter of the breathing tube, and his researches led to the same conclusions as those of Snow. During the 1847 celebrations marking the centenary of the advent of anaesthesia in Britain, there was, on display at an exhibition a replica of Snow's "cigar box" inhaler, which apparently worked quite satisfactorily when put in practice! Snow's second inhaler not only worked well but it was portable, easily and cheaply made and at no time did Snow seek a patent for his inhalers; he was content that anyone who wished should copy them. His inhaler was designed to give a 30 percent chloroform vapour in the air to the patient. He found that he could put children under ether anaesthesia in about three or four minutes, but with adults it took longer.

Snow's fascination with ether was natural, according to Ward Richardson, who wrote: "…the news came over from America that operations could be performed without pain under the influence of sulphuric ether. The fact was just such a one as would at once attract the earnest attention of Dr Snow. It was a physiological as well as a practical fact. It was rational in its meaning and marvellously humane in its application. The question, once before him, was in a scientific sense of his own. His previous experimental studies on respiration and asphyxia had prepared him for this new inquiry. He lost no time, therefore, in investigating the new fact; he took it up for its own sake, however, not from any thought at the time of a harvest of gold".

Like Snow, Richardson had thought that such a boon would have been snapped up by most medical men, but in practice this was far from being so. Richardson later said: "The first inhalations of ether in this country were not so successful as to astonish all the surgeons, or to recommend etherisation as a common practice. The distrust arose from the manner in which the agent was administered. Dr Snow at once detected this circumstance and… remedied the mistake by making an improved inhaler. He next carried out many experiments on animals and on himself and brought the administration to great perfection…"

Without doubt, Snow was the first medical scientist in modern British medicine and was certainly the first to carry out scientific research into the physiological effects of anaesthetics, following them up with suitable inhalers controlling the quantity and flow of the gas in clinical use. Snow's experiments showed that despite what some surgeons believed, ether vapour did not produce a kind of asphyxia in patients by excluding oxygen from the lungs, but in fact altered the composition of the blood so as to

reduce to a minimum the oxidation of nervous and other tissues, a theory to which he returned in more detail in 1851.

Snow, in articles and addresses to medical societies, insisted that those who administered ether should have control over the concentration of the vapour and air reaching the patient's lungs and this, of course, what Snow had striven to achieve in his inhalers. He might be forgiven for telling one meeting: "My own apparatus accurately and easily regulates the delivery of the anaesthetic mixture",

He pointed out, however, that the best apparatus could be dangerous in the wrong hands. He told one meeting: "A person of sound skill and judgement with at least some scientific understanding of the more important physiological processes involved" should be the person who administers the vapour. Snow, however, was an idealist; he imagined that there were hordes of doctors with his unique medical and scientific training. He was, in fact, the first to appreciate the significance of oxygen starvation in anaesthesia.

**7**

## St George's Hospital

Few advances of note were made between Snow's title and the early Twentieth Century. Sir Ian Fraser, in a lecture in 1967 declared that as far as he could see when he was a medical student and house surgeon in the early 1920s, anaesthesia differed little from that in John Snow's lifetime.

Sir Ian described how he used the drop bottle and open mask with its layers of gauze carefully counted. "In some wards, it was the resident student who gave the anaesthetic while the house surgeon assisted and vice-versa in other cases", Sir Ian told his audience. He added: "Along the lines of communication from student via the house surgeon to the Chief, regular information was given regarding the size of the pupil and its ability to contract, and, if they were not fully satisfied, the eye was wide opened and inspected by all three".

He said that "trivial matters" like burns and loss of teeth from the anaesthesia administered were treated more or less as "a rub of the green".

Snow's imagination had been enlivened by the exciting news of ether and he saw for himself a career as a professional anaesthetist - Britain's first – in the wake of Liston's historic operation under the drug. It so happened that he was acquainted with a well-known London dentist called Fuller, who lived in Manchester Square and did some dental work in the outpatients' department of St George's Hospital.

He approached Fuller with the proposition that he, Snow, should give ether to the dental patients in outpatients. Fuller was enthusiastic over the proposition and arranged for Snow to give ether to his patients. It was late January 1847 and the day after Snow's impressive show among the outpatients during Fuller's dental session, the dentist spread

the news about the new anaesthetics man around the general surgeons "upstairs". One of the hospital's leading surgeons was Edward Cutler, who with

some of his colleagues had become somewhat disillusioned over ether following unfortunate incidents a little earlier in the month, which had attracted unwelcome press-publicity.

Cutler recalled 14 January as one of the most traumatic he had known during his St George's hospital operating sessions. Three patients were booked in for operations on that day. The first to experience the delights of the new fangled anaesthetic ether lost his nerve and declined to have his operation under the gas. The second patient, a strongly built individual, resisted the ether and was never put under the anaesthetic. The third patient took the ether satisfactorily but unfortunately came round just as the surgeon was beginning to saw through his diseased tibia!

With such experiences fresh in his mind, one can sympathise with Cutler, when he was less than enthusiastic on hearing Fuller's news about the new anaesthetist John Snow, whom he had engaged for dental anaesthesia.

Cutler was hardly impressed by Fuller's statement that Snow had a masterly control over the administration of ether through his own inhaler and that the dental session of the previous day had gone like clockwork, but he relented and said that Snow could give ether for him at his operating session of 29 January. Snow was told by Fuller that he was engaged by Cutler to give ether for him. Snow, who was delighted at the first opportunity to demonstrate his skill and his first apparatus, attended St George's on 29 January and happily the house surgeon to Cutler has left us an impression of that first day of Snow's visit to St George's. He was Mr Bumpstead and he wrote later: "I, myself, under the instruction of Dr Snow, gave the ether to some of the earliest cases. I well remember the first instrument, a large cumbersome flat glass bottle measuring at the bottom nine or ten inches across with a flexible tube and a mouthpiece at the end to cover both the nose and mouth. The next apparatus was a sort of metal bottle, invented by Dr Snow, which was held in the hand. This also had a flexible tube and face piece". This was, of course, the apparatus, which Snow, had demonstrated to the Westminster Medical Society.

At this point it is worth taking a closer look at Snow's first employer. Edward Cutler was a fascinating personality. He was fifty-one- years old, the son of a Wimborne, Dorset, clergyman and was one of that illustrious band, the "300 original fellows" of the Royal College of Surgeons. He had one thing in common with Snow; he too had studied at the Great Windmill Street school of anatomy, but in its heyday.

When Snow first met Cutler, he had been a surgeon at St George's Hospital after a nine-year spell as assistant surgeon. He had assisted the legendary Sir Benjamin Brodie, leading surgeon in London, and had also served as a military surgeon for a spell with the Life Guards.

It was not long after Cutler had engaged Snow that the intrepid Robert Liston came to hear of the "anaesthetic wizard," John Snow and wanted to know more about this young pioneer. Liston needed an anaesthetist to take over from young William Squire, who had given the first ether, anaesthetic for him and now intended to concentrate on passing his final medical exams. He had no intention of devoting his professional career to anaesthetics. In fact, about two years later, Squire qualified serving with the brilliant surgeon, John Arnott as house surgeon at University College Hospital. Squire eventually had a private practice in Orchard Street, Portman Street and later Harley Street and Ealing. He was a skilled epidemiologist and was elected FRCP in 1879.

Liston unobtrusively visited St George's and watched Snow at work. He liked what he saw and forthwith-engaged Snow as his anaesthetist at UCH. This auspicious appointment undoubtedly set Snow firmly on the path of fame as an anaesthetist. Liston had been at UCH for thirteen years after a successful career in Edinburgh. He was an impressive figure, over six-feet-tall, strong, haughty and egotistical, but described by a contemporary as a "prince of surgeons". He was the first to excise successfully the upper jaw and was a pioneer in laryngoscopy. He was, however, reputedly insolent and rude, but rarely to his patients.

Contemporaries claimed he was invariably kind and solicitous for the welfare of his patients, be they rich or poor. He was worshipped by his staff and pupils. He was a well-known figure in the University College Hospital, clad in his dark green coat, wearing wellington boots, striding through the wards. He was the fastest operator in the capital, a prime qualification for the surgeon in the pre-anaesthetic days. He was often critical of his colleagues and particularly so of his opposite number at the hospital. Physician, John Elliotson, was a supporter of the new fangled "animal magnetism" craze. Hypnotism was regarded by most doctors as mere quackery and not to be tolerated. One can hardly blame Liston for his attitude. Both Liston and Elliotson, nevertheless, attracted huge classes of students.

At this period in medical history, UCH a hitherto unknown opportunity for many young men without wealth or influence to get a foothold in medicine, it is not surprising that John Snow, who was himself without wealth, was honoured to be a part of UCH. The college hospital, which was in effect the comparatively newly founded London University's medical link institution took in all denominations of students, not just Anglicans as at Oxford and Cambridge and helped break down the barriers of privilege and class. No wonder the establishment figures referred to London University as "that low place in Gower Street" and "Stinkomalee".

Liston cared not a jot for the insults being hurled at the university and its medical school. He much enjoyed the cut and thrust of controversy.

He was an inveterate exhibitionist. Soft and gentle in the sick room, he was a formidable enemy. Many of his students remembered him as a surgeon who possessed such remarkable strength, that when amputating a thigh, he used one hand to hold the limb, compressing the artery with his left thumb and sawing and cutting away with the right hand, tended by only one assistant. He invented a long splint and some bone forceps. During operations, he used to challenge his audience of medical men and students to time him, particularly during amputations and cutting for the stone and he took the precaution of warning them that if they "blinked an eye they might miss the whole performance".

Liston, undoubtedly a showman, was at the peak of his profession at a time when lightning speed in surgical operations was paramount. He may not have been a scientific surgeon, but his exceptional knowledge of anatomy gave him confidence to tackle some operations, which other surgeons would never have attempted. For example, he perfected the method of amputation with flaps and his straight splint for fracture of the thigh has come down to us in recent times.

This then was the man for whom Snow worked with, until Liston's untimely death, before the end of their first year together. Liston was a keen sportsman and yachtsman and this latter pursuit seems to have something to do with his demise. Once Snow had started giving ether for Liston, other surgeons who worked at the UCH sought his services too, including Richard Quain and Thomas Morton.

An assistant physician at that hospital was Alfred Baring Garrod, later knighted, who was to play an important part in Snow's researches into the method of the spread of cholera.

During April 1847, the Lancet pointed out that although the number of operations had doubled, in some hospitals, since the introduction of ether, many surgeons remained "profoundly and obdurately" silent on the subject, as one contemporary put it!

Even Bransby Cooper, a leading surgeon at Guy's Hospital, had denounced the use of ether, saying it was not called for, as pain was a "premonitory condition, no doubt fitting parts, the subject of lesions, to repertory action" and therefore that the surgeon should feel averse to the prevention of it.

During the winter of 1846/7, some of the methods of anaesthesia with ether being used in provincial hospitals came to light. According to Mr C G Wheelhouse, surgeon at Leeds Infirmary, "In the dissecting room, so far as Leeds was concerned, the principles of anaesthesia were born and developed. We soon rigged up a large glass vase, like a tea urn, filled it with sponges, attached an India-rubber tube to the spout, saturated the sponge with ether and through the tube inhaled the vapour, as though a Turkish hookah pipe, and we fell over, one after another, quite insensible and unconscious of anything that was done to us… Before many days we saw patients operated on in this insensible condition and we found that they recovered quite well as those who had borne the agony of their operation."

One of the earliest of the Leeds anaesthesia enthusiasts was Thomas Nunneley, better remembered today for his implacable hostility to Lister and antiseptic methods.

Nunneley is worth looking at more closely. He deserves better than the usual few dismissive lines accorded him by medical historians, which as ever, dwell on the anti-Lister aspect. Thomas Nunneley, an original Fellow of the Royal College of Surgeons, was four years older than Snow. He had a special interest in toxicology, like Snow, and was lecturer in this subject at Leeds Medical School. He also had a general practice. Again, like Snow, his capacity for work was tremendous. He was very receptive to new ideas when a young man and in 1849 when he was aged forty, he began with great enthusiasm to investigate the new science of anaesthesia, hoping to improve it. Like Snow, he tried many substances to test their anaesthetic properties. Oddly enough, he rejected Ethylene, the gas on which Snow, at the end of his life, placed so much faith and hope, only to be disillusioned in its results.

Nunneley had better results with "Dutch oil" and coal gas. He was up to the Lister episode, thoroughly progressive, open minded and prepared to try anything new. By 1847, ether and chloroform were being used in the operating theatre at Leeds Infirmary, whilst Nunneley, in the background, sought improvements.

After about eight months of giving ether to patients in hospitals and private practice, John Snow felt the urge to publish his findings without further ado. He approached the indefatigable John Churchill, who was always prepared to publish worthwhile medical treatises. In September 1847, Snow's first book was published, entitled somewhat exhaustively: "On the inhalation of the vapour of ether in surgical operations: containing a description of the various stages of etherisation and a statement of the result of nearly eighty operations in which ether has been employed in St George's and University College Hospitals".

It is an excessively long title for a small work of only 88 pages, but it contained some of the most original work on medical science of the time and was, in effect, the first textbook on anaesthesia in this country. Although, it was based on a relatively small number of cases, always bearing in mind that very few major surgical operations were undertaken at this time, it gives a concise and interesting description of ether anaesthesia. Snow describes the various phenomena he noted during administration of the gas and perhaps the most notable feature of the monograph is his description of the four stages of anaesthesia, which remained guidelines until well into this century. This apart, the details contained in the book reveal the wide patronage Snow received for his skills as an anaesthetist, including great names like Brodie, Caesar Hawkins, Cutler, Tatum, Keate and Pollock. These were only a few of the three dozen top London surgeons who used Snow's services between 1847 and 1858, the year in which he died. In his book, Snow lists fifty-two operations carried out at St George's Hospital during the eight months he had attended there and of these twenty-one were amputations of the thigh, leg and arm. Eighteen of the patients recovered. There were several lithotomies, among the most frequently performed operations.

If one dips into the list for St George's one finds that on 11 February, 1847 Mr Cutler operated on four-year-old, William Doran, for stones in the bladder. Snow gave the ether and the child "recovered without any unfavourable symptoms" according to Snow's diary, and left hospital on 3 March. Operations for the repair of harelip were commonplace and on 1 April, Mr Charles Johnson operated on a twelve-year-old girl for the defect as an outpatient. Snow reports that she was discharged "cured". Snow's forty-fourth case at St George's involved ten-year-old Henry Hemson, who was operated upon for stones in the bladder by Caesar Hawkins and "recovered without untoward symptom".

As will have been noted, these cases chosen at random, all relate to children and serve to show what soon became apparent, that Snow was particularly devoted and caring towards his small patients. A lifelong bachelor he always regretted not having children of his own. As regards his review of cases at his other main hospital, the University College Hospital, Snow records details of twenty-three cases involving surgeons Richard Quain and Thomas Morton and of course Robert Liston who died three months after publication of the book.

These cases involved ten amputations of the thigh, leg and arm, plus six lithotomies. Here, as at St George's, there were six fatalities all told. Snow commented: "It is very evident that in none of the six cases that ended fatally (at UCH), can the event have been caused, or in any degree promoted, by the inhalation of ether since, there are very sufficient and well recognised causes to account for the results". There were no fatalities among the lithotomy patients at either hospital although, the operation, judged by present day standards, were crude and gruesome to say the least.

The book which bore, on its title page, the description of John Snow as M.B., a Fellow of the Royal and Medical and Chirsurgical Society and a lecturer in Forensic Medicine, was the culmination of many months of careful, precise and original work, some of which had been foreshadowed in three articles he had published earlier that year, the fist in the Lancet entitled "Observations on the vapour of ether and its application to prevent pain in surgical operations", and "Inhalation of the vapour of ether in surgical operations" and the third in London Medical Gazette entitled, On the inhalation of the vapour ether.

Although Snow described the classical four stages of anaesthesia in his book, Francis Plomley had a few months before, defined the three stages. Snow however, was the first to detail the four well known stages, namely induction; struggling or breath holding; delirium, dreams stage, surgical anaesthesia stage and fourthly overdose or bulbar paralysis stage.

Before leaving Snow's book "On the inhalation of the vapour of ether" it is worth noting that one of his most important cases, involving Liston as surgeon, was on 3 May, 1847, when a lithotomy was performed on a twenty-eight-year old Joseph Rice, who had come all the way from Australia for the operation, and undoubtedly did not know until after it had been completed that it would be painless. He was discharged as cured on 6 June. He tells, in his book on ether practice, of several children to whom he gave ether. One of his earliest cases was that of Master Williams Doran, aged four, a patient of Mr Cutler, who had lithotomy performed upon him for stones in the bladder – a common complaint among young and old, said to be due mainly to the poor and monotonous diet of these times – and recovered without any unfavourable symptoms from the ether. He left hospital in about three weeks following the operation. Hare lip repairs were very common and on 1 April, Mr Henry Charles Johnson, operated on a little girl of twelve to repair her hare lip, and Snow reports that she too recovered without any untoward symptoms from the anaesthetic and was described as "cured". On 22 July, Mr Caesar Hawkins, successfully removed stones from the bladder of ten-year-old Henry Hemson, by lithotomy and again an uneventful recovery.

Snow must have felt great satisfaction that he was able to use his knowledge and skill in anaesthesia to relieve the hitherto excruciating pain that these children would have experienced, had they come under the surgeon's knife six months earlier. Although, Snow's book on ether was obsolete almost before it reached the bookseller, the contents are of considerable interest for they represent, for us today, the very first experiences in Britain of the earliest form of anaesthesia.

In the book, Snow describes the various stages of etherisation, as he called it. Details of the seventy-eight operations he attended as anaesthetist and the two hospitals. He is described in the title page as, a Fellow of the Royal Medical and Chirurgical Society and Lecturer in Forensic Medicine. The eighty-eight-page book is dated September 1847.

By far, the largest category of operations at the two hospitals was amputation. Of the fifty-two operations, forty-two were for amputation of thigh; leg arm and four were for lithotomy. Three deaths occurred in the amputation cases. There were ten amputations among the twenty-six operations at University College Hospital and six lithotomies. There were two deaths, again following on amputations. None of the six fatalities, says Snow, were due to any adverse effects from the ether inhalations.

It was, in this book, that Snow gave details of his noted "five stages of etherisation" which largely stood the test into modern times. Snow, like many other doctors, was apprehensive of the casual manner in which ether, and later chloroform, was being given. Any Tom, Dick or Harry was press ganged into giving anaesthetics in many hospitals and in private practice. In hospitals a porter, or even a relative of the patient, would give the ether or chloroform; it was regarded by some, of the less enlightened surgeons, as a chore to be delegated to some minion. It was entirely down to Snow and his successor, Clover, that anaesthetics was elevated to a specialist branch of the medical profession, and even then it was not until the early Twentieth Century that the first professional anaesthetists were being employed in our hospitals. It is surprising how recent some of those appointments have been, for general practitioners were frequently used for the purpose into the 1930s.

It is interesting to note that in his discussion of the various stages of anaesthesia, Snow describes a fifth stage, which he said he had observed only in the lower animals. This was the first accurate description of the phenomenon of intercostal paralysis, which he detailed in his second and last major work On Chloroform published posthumously in 1858. His views in relation to human beings were confirmed sixty-seven years later by Albert h Miller of Providence, Rhode Island, USA when in 1925; he described clinical experiences of this form of paralysis.

Unfortunately, Snow's first book on ether anaesthesia was barely on the bookshelves of the booksellers when it was virtually eclipsed by the news of James Young Simpson's success with chloroform as an anaesthetic. The book cost 3s 6d a copy and sold only 126 copies. Snow, however, does not appear to have been unduly upset by the fate of his first book. He saw definite advantages in the use of chloroform over ether and was soon converted to the new anaesthetic.

A little known fact is that a short while before Snow's book "On Ether" Dr James Robinson, the dentist who first used ether in London for dentistry, had published a slim volume on the gas, but it seems to have fallen onto stony ground and Snow's work is accepted as the first textbook on any anaesthetic practice. As with Snow's book on ether, Robinson's opus was never taken up by the medical profession. It should also be remembered that Robinson was the first to use oxygen to counteract adverse effects of ether.

The remarkable thing about Snow is that although he was eagerly sought after as an anaesthetist by all the leading London surgeons, in their voluntary hospital appointments, as well as private practice, he was never appointed in a permanent capacity to any one hospital. It was well over half a century later that the first professional part time anaesthetists were appointed to hospital staffs. His long service to St George's, some eleven years, was however recognised for he was made an Honorary Governor.

About the time his book was published, Snow had become dissatisfied with the face piece of the apparatus he was using for inhalation of ether because of problems over the mouth tube. Fortunately, he had recently heard of a nose and mouth mask, which had been designed by Francis Sibson, resident surgeon at Nottingham General Hospital. The mask comprised a rubber funnel, which fitted snugly over the patent's nose and mouth, a much more satisfactory device than the customary tube which went into the mouth, the nose being compressed by a clip. The mask was secured to the face by a strap. A brass tube with valves and a flexible tube linked the mask to the container. Like Snow, Sibson did not seek to profit from his invention, which became a standard fixture. Snow incorporated the Sibson mask into his own inhaler apparatus and long afterwards inserted his own valve into the face piece itself to control the gas flow.

Snow, in his clinical experience with ether, found the patients experienced disagreeable side effects when taking ether, and usually vomited after the operation. A major objection to ether was that a large quantity was required and this tended to produce violent behaviour in the intermediate stage of anaesthesia.

During December 1847, the medical fraternity in London and University College Hospital in particular, suffered a grievous loss with the sudden death of Robert Liston. His death was a personal loss for John Snow, who had much admired him and never forgot that it was Liston who had helped make his fame as an anaesthetist.

Liston collapsed at his home and died on 7 December from aortic aneurysm, probably the result of a blow he had received sometime before, from the boom of his yacht. He was only fifty-three and at the peak of his career. Snow was among the large number of mourners at Liston's funeral in Highgate Cemetery. His operating table is among the cherished relics of the era in the University College Hospital museum.

Liston's untimely death was a grievous personal loss to Snow, for undoubtedly his patronage had brought him to the notice of many of London's leading medical men. He was not in the wilderness for long however, for Snow's skill had been sung by Liston to William Fergusson, at King's College Hospital, who quickly took on Snow as his anaesthetist and so began a long and fruitful friendship. Snow tended his patients at the Hospital and in his private practice for many years.

Snow admired Fergusson for his conservative approach to surgery and his name crops up many times in Snow's notebooks. Fergusson, like Liston, was a Scotsman and a product of the Edinburgh Medical School. He had been a pupil of the notorious Robert Knox, who fell from grace because of his link with the body snatchers, Burke and Hare. Fergusson was a surgeon at Edinburgh Royal Dispensary and Infirmary. When he saw his prospects dwindle in the shadow of the great James Syme, he moved to London in 1840, on appointment as Professor of Surgery at King's College Hospital.

A tall, handsome, unassuming man, Fergusson was kindly and generous and a much quieter character than Liston. He did not sport a good bedside manner, but he had an attractive personality and was very popular with his patients. Painstaking and very skilled, he had a strong, practical bent, and invented many surgical instruments. He was an expert wood and metalworker, a competent fly fisherman, a violinist and an enthusiastic dancer of Scottish Reels! He was so rapid when operating that visitors to his theatre were warned: "Look out sharp, for if you only wink you will miss the operation together." Fergusson, in his conservative fashion, would sooner excise a diseased joint that amputate the whole limb, as most other surgeons were doing at that time. He was not, however, the founder of conservative surgery; that honour goes to Henry Park, of Liverpool Royal Infirmary, who had fostered the idea seventy years earlier.

Snow witnessed some of the advances made in surgery by Fergusson, including those for harelip and cleft palate. Not even Liston, the master of skilful surgery, could match Fergusson's style and method in a trying and critical operation. From the moment he began an operation to the end, Fergusson operated swiftly and in total silence. He commanded the highest fees of any surgeon in London and, at the same time, gave unstintingly of his time to treating the poor. He was a social being and often invited his friends to his jolly get togethers and dinners at his favourite hostelry, The Albion Tavern. Among the guests were many literary and drama figures.

Snow always had a soft spot for his first hospital, St George's, where he worked as an anaesthetist. One of the most interesting and brilliant surgeons who worked there was Richard Partridge, one of the "original" 300 Fellows of the Royal College of Surgeons, and a former demonstrator at the Hunterian School of Anatomy. He was famous for the part he played in the body-snatching era in London. Whilst a Demonstrator at King's College Medical School, he became suspicious over a body brought to the school by a couple of well-known local "resurrectionists". Partridge, who was familiar with the Burke and Hare outrage in Scotland, was uneasy when the two body snatchers, Bishop and Williams, delivered to the school's back door the body of an Italian boy.

A quick examination of the corpse made Partridge realise he was dealing not with a subject from a genuine burial, but a freshly murdered youth. He told the two body snatchers he did not have sufficient cash to pay them there and then and asked them to return for their nine guineas. Off they went and Partridge informed the police, who were waiting for the two men on their return. They stood trial, were convicted and both hanged. An accomplice called May was transported for life. In 1840, Partridge resigned his post as surgeon at Charing Cross Hospital, to take up a similar appointment at the newly established King's College Hospital, in Clare Market. He was something of a wit and one day when a medical student asked him the name of his two rather decrepit carriage horses; he replied that one was called Longissimus Dorsi, and other Os Innominatum!

When Snow first met Partridge at St George's, he also made the acquaintance of a brilliant young assistant surgeon who was to make his name as an ophthalmic surgeon. He was William Bowman, three years Snow's junior, and he worked also at Moorfields Eye Hospital where he became a full surgeon in 1851. Snow gave anaesthetics for him at King's College Hospital. Bowman was one of the first to become expert in the use of the ophthalmoscope in this country, and was a close friend of Florence Nightingale. He was subsequently knighted.

Another fascinating character Snow worked for was William Coulson, an enormously wealthy Cornishman, with a large practice built up mainly on his unrivalled skill and knowledge of bladder complaints. For many years he had the largest surgical practice in London. A tall, robust man with an autocratic air, he dominated St Mary's Hospital, Paddington. He was a devout Liberal and a literary enthusiast, including among his wide circle of influential friends, Carlyle and John Stuart Mill. He gave Snow a good deal of work and had high regard for the anaesthetist's skill. His private fortune was estimated at over quarter of a million pounds. Coulson, a champion of the underdog and common man, was one of the best lithotomists in the capital and was a regular contributor to the early issues of the Lancet.

Whilst working at St George's, Snow encountered the remarkable young anatomist, Henry Gray, whose name lives on even today through his famous book Gray's Anatomy, known to generations of medical students, since its publication in 1858. Gray was only twenty-five years old when he was elected a Fellow of the Royal Society. Tragically, at the point when he was about to be appointed Assistant Surgeon at St George's in 1861, he died at the age of thirty-four from smallpox whilst attending his nephew who had the disease. One of the giants on St George's staff was the ubiquitous, Robert Keate, whom Snow came to know well. When Snow first met him, Keate was seventy and without a thought of retirement.

He had been a surgeon at the hospital for forty years and it took a considerable weight of opinion to compel him to stand down in 1853. An original Fellow of the Royal College of Surgeons, he was a well-known man about town. He has been described by a contemporary as "a square, compact little man with a rough complaining voice."

In the year Snow was born, Keate had succeeded his uncle as surgeon at St George's and subsequently held prestigious appointments, like those of Sergeant-Surgeon Extraordinary to King William IV, and later to the young Queen Victoria. He was by all accounts a brilliant diagnostician and operator, much feared by his house surgeons and dressers, because of his rather picturesque language and sharp temper. Keate was a man of high principles, hating privilege and preferment. Twice, he declined Baronetcy from two Prime Ministers because he considered such honours "derogatory to the profession". He was however, proud to be acclaimed by his own kind when he was twice elected to be President of the Royal College of Surgeons. He had the unusual distinction of serving as surgeon to four sovereigns. But he used to lament that he made no money out of these Royal appointments. He once told Sir James Clark, Queen Victoria's Physician, "I have attended four sovereigns and have been badly

paid for my services. One of them, now deceased, owed me 9000 guineas. The late King William IV always paid me on my journeys to Windsor… but he and the Queen, as a rule, were a grievous loss to me."

It riled Keate to think that on many occasions he had obeyed a summons to attend upon the Royal Family, leaving a room full of patients anxious for his advice. He did not receive a single gift from his Royal masters, "not even a toothpick," he once remarked bitterly.

One of Snow's most loyal supporters, in his early days as a professional anaesthetist, was aristocratic, George Pollock. A Field Marshal's son, Pollock was four years Snow's junior in age and his uncle was the famous Chief Baron of the Exchequer, Sir Frederick Pollock.

George Pollock had been house surgeon to, Sir Benjamin Brodie and personal physician to the governor-general of Canada when the latter was living in Britain. Pollock served St George's Hospital for thirty-four years, having first been appointed Assistant Surgeon in 1846, shortly before Snow began working there. He was a good anatomist and an expert on eye diseases and cleft palate operations, of which there was a considerable number performed at this period. He was appointed surgeon to Ormond Street Hospital for Sick Children when it first opened. He was also Surgeon in Ordinary to the Prince of Wales, later Edward VII.

## 8

## Chloroform

When James Young Simpson gave his historic talk to the Edinburgh Medico-Chirurgical Society on 10 November, 1847, describing his discovery of chloroform as an effective anaesthetic unknown to anyone but a handful of the staff at St Bartholomew's Hospital, London, he had been pipped to the post!

For six months earlier, using an impure form of chloroform called chloric ether, the distinguished surgeon, Sir William Lawrence, had been persuaded by a brilliant seventeen-year-old medical student at St Bartholomew's Medical School to use the drug for surgery.

The story is fascinating for many reasons, not the least because it illustrates the fact that no amount of originality, carried on in private practice or hospital, is of any earthly use unless it is published to the medical world as a whole.

The St Bartholomew's claim begins about Spring 1847, when young Michael Cudmore Furnell, who had not long been enrolled as a medical student at St Bartholomew's was working in a London pharmacy under the pioneering chemist and Quaker, Jacob Bell, who was to become the founding "father" of the Pharmaceutical Society. He knew that, Lawrence had used ether as an anaesthetic following Morton's discovery in USA but that is caused problems with some patients.

Furnell, thereupon demonstrating considerable perspicacity, hit upon the notion of seeking a better anaesthetic and tinkered about with a rarely used gas called chloric ether, which was an impure form of chloroform. He found it had a soporific effect similar to ether but without that drug's disadvantages, particularly its suffocating effect on some patients.

Furnell suggested to his friend and teacher, Holmes Coote, surgeon working with Lawrence that his "chief" might like to try it out in his next operation. Holmes Coote, was a demonstrator in anatomy at St Bartholomew's, and often assisted Lawrence in hospital and private practice. When Furnell told him he had tried the drug out on himself and that he was convinced it was safe, Holmes Coote approached Lawrence about it, the very same day, and Lawrence operated on a woman patient who was unable to take ether. It was a success.

Ten days after Simpon's announcement on chloroform, and the same day as the news of chloroform anaesthesia was published for the first time in the Lancet, Holmes Coote was operating on three patients using the Furnell discovery, on a thin, flat sponge. He obviously had not been reading John Snow's recommendation to use the Snow inhaler. Holmes Coote removed stones from the bladder of a twenty-year-old man by lithotomy. It took two minutes to put him under the new drug and the operation lasted just seventy-five seconds! The second case, also lithotomy, lasted ninety seconds and the third case was the removal of a breast tumour, which took three minutes only.

Taking account of the short time which operations at this period took to complete it is no wonder Snow was able to work for over two dozen surgeons without overworking himself.

So, why did Furnell or Holmes Coote declare their priority in the chloroform discovery stakes? We shall never know. It took Furnell twenty-four years to declare his priority, by which time, Simpson had died and Furnell had spent many years overseas as a military surgeon.

Modesty is one thing, but it is ridiculous to contemplate such an enormous lapse of time between the discovery and claim. It shows an extraordinary sensitivity in Fuller's personality that he waited until Simpson had died, before he published his own claim.

Only, Holmes Coote and Lawrence's own circle of colleagues and friends knew of Furnell's pioneering efforts in the chloroform saga. It is extraordinary that Snow, who gave chloroform for surgeons from St Bartholomew's at this period, heard nothing of this interesting story until seven years after the Simpson discovery. But he did then pay tribute, albeit somewhat belatedly, to Furnell in a letter to the Lancet. But Furnell was not worried, he qualified, became a Fellow of the Royal College of Surgeons and served with great distinction as a Surgeon-Major in the Queen's Indian Army (Madras) and subsequently was a lecturer in physiology at Madras Medical School, of which he became Principal, in the 1870s. Holmes Coote was surgeon at St Bartholomew's from 1864 to 1872, whilst Lawrence became one of London's leading surgeons, working at the same hospital for forty-one-years and making a name for himself in ophthalmology.

The neglect to acknowledge Fuller was anathema to Edinburgh University's distinguished toxicologist, Sir Robert Christison. Joseph Lister acknowledged the prior claim of Lawrence and Holmes Coote but unfortunately forgot poor Furnell.

Having made Furnell's claim for him, it nevertheless remains a fact of life that James Young Simpson was the first to announce to the world his great humanitarian "breakthrough".

He had the vision to develop the potentialities of chloroform, which had, in fact, been discovered in 1831, almost simultaneously by three scientists working in isolation in different parts of the world. There was Guthrie in New York, Souberian in France and Liebig in Germany. It was at that stage known as Chloric Ether, the gas with which Furnell experimented. The name chloroform was not given to it until four years later by Parisian chemist, J-B Dumas.

Simpson, like Lawrence at St Bartholomew's, had his attention first drawn to the possibilities of the drug by "an outsider". In Simpson's case it was Dr David Waldie, a Scottish medical graduate working as a chemist in Liverpool. As it happened, Waldie was visiting Scotland in the autumn of 1847 and he called on his old friend Simpson, and described to him the possible use of chloroform as an anaesthetic. They were both unaware, of course, that Holmes Coote, Furnell and William Lawrence had started using an impure form of the drug earlier that year.

Waldie agreed to provide Simpson with pure chloroform for experiments, but unfortunately his Liverpool laboratory was destroyed before he could deliver the drug. Simpson, undeterred, asked around for supplies of chloroform and the Edinburgh firm of Duncan, Flockhart agreed to supply him. From that point a rather sad acrimony grew up between Waldie and Simpson over chloroform.

There were some acrimonious exchanges between Waldie's friends and Simpson. They claimed that Simpson had not given Waldie proper recognition over the part he had played in the chloroform saga, but they were wrong when they said that Simpson had never acknowledged Waldie's work. In any event, it was most unfortunate that Waldie's laboratory was destroyed by fire at the very moment he was about to supply Simpson with his first bottle of chloroform. Simpson had to get his supply from the old established drug house of Duncan and Flockhart in Edinburgh. After his first experiments, he referred to Waldie's work in at least one public address.

During the winter of 1847 there were several sessions of "chloroform frolics" in Simpson's home, involving himself and his long suffering assistants, Matthew Duncan and George Keith. It is possible that some of these frolics were witnessed by Robert Christison and James Miller. The type of scene which was witnessed by visitors has become part of medical history, through the illustration of such a session published in various books on the history of medicine. One illustration, in particular, is famous, where Simpson and his assistants are lying under the dining room table in a stupor.

The incident is described by Simpson, who on November 4th had "discovered" a bottle of chloroform. Duncan and Keith were present. "I poured some of the fluid into tumblers before my assistants, Dr Keith and Dr Duncan and myself. Before sitting down to supper, we all inhaled the fluid and were all under the mahogany in a trice to my wife's consternation and alarm." Friends of the trio were not amused at their antics and were genuinely apprehensive over their foolhardy experiments, with what was, after all, an unknown drug in clinical practice. One of them, Professor Miller, admitted his anxiety and frequently called at the house at this period to see that everything was all right. It was coincidence that he happened to call at the house on that fateful night of November 4th and found Simpson just awakening from the effects of the chloroform, being under the table with Duncan who was snoring and Keith, whom he saw in "a high state of excitement" kicking out violently.

During this extraordinary scene, Simpson's wife and some of their relations happened to be in the house, and they too witnessed part of the grotesque performance of Simpson and his two colleagues. After he had recovered, Simpson was so excited over his discovery that he persuaded his niece, a Miss Petrie, to try out the chloroform for herself. The plucky girl complied and taking the drug very soon fell into a sound sleep, after crying, "I'm an angel, Oh I'm an angel".

By this time Simpson had used up his meagre supply of pure chloroform and asked Duncan and Flockhart for more. It should be remembered that it was a long and slow process to produce any useful quantity of the drug in the early days. Simpson made a public pronouncement on his historic discovery

at a meeting of the Edinburgh Medico-Chirurgical Society on 10 November 1847, under the title "An account of a new anaesthetic agent".

He told members that chloroform was simple to administer and that no complicated apparatus was necessary. It could, he said, be poured from a bottle onto a hollow sponge, a handkerchief or piece of cloth and held over the patient's nose and mouth. He invited members to try it out for themselves there and then. Some accepted and we are told that there was, as a result, "some unseemly behaviour". Two days before he attended that momentous meeting, Simpson used chloroform in his midwifery practice. The patient was the wife of a colleague who was anticipating a difficult labour. Simpson formed a handkerchief into a funnel shape and placed it over the woman's face. He dripped chloroform onto the handkerchief until the woman was anaesthetised. She was delivered of a baby girl without any problems occurring. The child was christened Wilhelmina, but Simpson for many years afterwards used to call her, "Saint Anaesthesia", to commemorate the time he delivered his first baby using chloroform. The following day he arranged to give chloroform at the Royal Infirmary, for three patients who were operated upon by James Miller, only hours before he went along to address the Medico-Chirurgical Society meeting.

Miller was one of the most enthusiastic of the Edinburgh surgeons over the use of chloroform, for like some other noted surgeons of the pre-anaesthesia days he "broke out in a sweat", just before carrying out a surgical operation.

It was a historic day for Scottish medicine when, on 10 November 1847, within hours of Simpson's lecture announcing his discovery of chloroform anaesthesia, James

Miller began operating on the first of three patients using chloroform as the anaesthetic.

The first patient was a six-year-old boy from the Highlands, who only spoke Gaelic. Through an interpreter, Simpson persuaded the terrified child to inhale the pungent vapour through the chloroform soaked handkerchief placed over his nose and mouth. At first, the little boy struggled under the stupefying fumes, held his breath and within a few more minutes was fast asleep.

Miller then skilfully removed the diseased part of the child's radius, which was badly affected by osteomyelitie. Miller later described the operation thus:

"After a few inspirations the boy ceased to cry or move. A deep incision was now made down to the diseased bone and by the use of forceps nearly the whole of the radius in the state of sequestrum was extracted. During this operation and the subsequent examination of the wound, not the slightest evidence of the suffering of pain was given… he slept soundly. Half an hour afterwards, he was found in bed, like a child newly awakened from a refreshing sleep…"

The child told Miller, through a medical student who knew Gaelic, that he felt no pain. Miller was equally heartened by the results of the ensuing two operations, again under chloroform. One involved delicate surgery on a soldier's badly injured face, and the other the amputation of a man's big toe. It is interesting to note, at this juncture, that five days earlier Robert Liston, at University College Hospital, London, amputated the big toe of a five-year-old girl, Isabella Grace Hunter, and the anaesthetist was almost certainly John Snow.

On 15 November, Simpson published his pamphlet describing the successful use of chloroform in surgery and midwifery. Some 4,000 copies were sold within a few days and many thousands after. At about the same time, the medical and lay press carried many accounts of the use of the new "wonder drug". Thereafter, Simpson received a large number of congratulatory letters from a wide cross section of the public wanting to know all about the "magical fumes". On November 20th, he published his first article on chloroform in the Lancet, and within weeks was able to report that he had successfully used the drug in more than fifty cases of labour. Most of the Edinburgh surgeons, who up to now had been using ether, abandoned it in favour of chloroform, including Syme.

Simpson had dropped ether on discovering the efficacy of chloroform for midwifery, and his career took a steep upward climb to bring him fame. At this point the famous rivalry over the use of ether in England and chloroform developed, although, in England and Wales many surgeons dropped ether in favour of chloroform. The Royal Society and the Physiological Society were but two of the learned bodies, which debated, in great earnestness, the merits and otherwise of both ether and chloroform. Whilst he gained the laurels, Simpson had continued attacks made upon him by the Church, as indeed had happened over ether. But he took little notice and was a good match for critics.

Within a fortnight of Simpson announcing his discovery of chloroform anaesthesia, Snow, with almost indecent haste, dropped ether and began administering chloroform, but not without having carried out his own tests on the drug first. He soon came to the conclusion that chloroform had certain distinct advantages over ether. He is said to have used ether on only twelve occasions after the discovery of chloroform anaesthesia.

Snow adapted his successful ether inhaler to administer chloroform with a maximum of five percent air. He quickly saw the potential of chloroform in surgery and on one occasion commented:

"Many operations take place on children which, could not be performed in the waking state; excision of joints and tedious operations for the removal of necroses bone, are often performed on persons who would be altogether unable to go through them, except in a state of anaesthesia; and the moving of stiff joints by force is an operation now frequently performed, although it would probably not have been thought of it narcotism by inhalation had not been discovered".

He also observed wryly that with ether and chloroform the surgeon was able to "obtain the consent of his patient to a number of other operations, where it would either not have been obtained or not at the most favourable time if the patient was to suffer the pain of them".

Snow was not enamoured of Simpson and the Scottish school of surgeons who used the casual method of giving chloroform by a cloth, handkerchief or on a sponge.

He was astonished to learn that on one occasion, when Simpson was attending a confinement, the chloroform bottle was accidentally knocked over spilling the contents over the carpet. Without hesitation Simpson took out his penknife, cut off a piece of chloroform soaked carpet and held it in front of the patient's nose. She inhaled the vapour quite happily, apparently, and then slept throughout the delivery.

Snow's sudden abandonment of ether in favour of chloroform has been seen by some as a weakness in his character; a tendency to bow to current fashion and expediency, but this is hardly fair. That he would sometimes give in to expediency if he thought it in the interest of his patient is undeniable. When asked why he had switched so suddenly to chloroform from ether he told his inquirer:

"For the same reason that I use a phosphorus match in place of the tinder box; an occasional risk never stands in the way of ready applicability."

Snow's Mark II inhalers, adapted from the ether apparatus comprised an outer jacket filled with water, the air inhaled by the patient first going round the outer surface of the cylinder, which contained blotting paper soaked in chloroform. Snow quaintly refers to this paper as "bibulous paper". This first chloroform inhaler is the one usually seen in illustrations, accompanying references to John Snow, and is depicted being used by a Victorian lady, sitting bolt upright in a chair, face piece firmly in place with a strap and a flexible tube leading to the cylinder.

Snow used an initial amount of chloroform, ranging from two to two and a half fluid drachms. One drachm of the chloroform was absorbed by the blotting paper, the remainder staying at the bottom of the cylinder. One drachm of chloroform was added from time to time, as necessary. As with other gases, Snow carried out intensive tests with chloroform on animals and himself to evaluate its potential and dangers. He discovered, from his experiments, that the second degree of anaesthesia would be reached in a human being of average weight, after the inhalation of twelve minims of chloroform. He calculated that eighteen minims would induce the third degree – surgical anaesthesia – and that deep narcosis would ensue after twenty-five minims. Inhalation of thirty-six minims, he found, would produce respiratory arrest. It was in the light of these discoveries that, Snow looked with apprehension on Simpson's haphazard methods of giving the drug. He stressed the inherent dangers of chloroform in an article entitled "The new Letheon agent", which was published in the Lancet and the London Medical Gazette.

Despite his enthusiasm for chloroform, Snow privately admitted that ether was the best anaesthetic in his opinion, and admitted that ether had fallen into disrepute because it had been given by unreliable administrators. He declared ether was safer because it would not cause sudden death by paralysis of the heart. Also, it had a better "flavour" than chloroform and was not too unpleasant to take. He found it took eight to nine times more ether to bring about insensibility than chloroform. Because of the longer duration of the effects of ether, Snow felt it was particularly useful for certain operations on the face, such as, the removal of jaw tumours, repair of harelip and making a new nose. He claimed that ether produced greater relaxation of the muscular system than chloroform, and that it was better suited for the reduction of old dislocation and strangulated hernia.

A modern commentator, Ralph Waters, although acknowledging Snow's considerable achievements, fuels that Snow allowed himself to become an opportunist through public demand because: "Chloroform accomplished a beautiful induction for the surgeon to see, and it was more pleasant for the patient to take". Waters claims that against his better judgement, Snow did what was easier to do than argue.

Waters thinks that Snow's acceptance of chloroform was his greatest weakness and there is no doubt that his casting off of ether, which he regarded highly, to replace it with chloroform at the drop of a hat before it had been thoroughly tested by himself, was uncharacteristic. Yet, one must consider his sudden conversion to chloroform against the background of his daily professional work with London's leading surgeons. These men were anxious for the quickest and best results and Snow only gave them what they wanted, but not with total disregard for the patients. He did spend a long time on trying to eliminate risks from chloroform anaesthesia. In any event, Snow preferred to give the new drug than leave ether or chloroform in the hands of the manifestly unskilled. In some hospitals he had found anaesthetics

being administered by a porter or attendant, or even a relative of the patient and many surgeons were slaphappy in their approach to anaesthesia, and had little knowledge of its effects.

On the credit side, however, Waters acknowledged that Snow, with his immense and unrivalled knowledge of chloroform at that time, and his improved inhaler did not have more than one fatality in over 4,000 administrations of the vapour and that one was doubtful. Snow and Simpson, between them, gave a total of 13,000 anaesthetics between 1847 and 1858 without a single death occurring, a truly remarkable achievement.

Each of them pursued, in his own stubborn way, of giving the anaesthetic, Snow with his meticulously designed inhaler, and Simpson happy with his casual giving of chloroform on a handkerchief, piece of cloth or sponge. They may have been poles apart in their ideas of giving the anaesthetic, but their individual success rate was virtually equal.

The advent of chloroform anaesthesia was not widely acclaimed as some writers have suggested. Pockets of surgeons here and there in the capital and provinces were, at first, enthusiastic about its use, but generally it was viewed with suspicion by the conservative practitioners, who formed the bulk of the medical profession. In fact, one of the older surgeons at Charing Cross Hospital, where Snow worked part time as a Visiting Physician, commented sometime after the introduction of chloroform into some hospitals, "I like to hear a good honest scream".

Some of the important provincial hospitals were rather quicker to take up the challenge. For example, Charles Parker, a very able surgeon at the Radcliffe Infirmary, Oxford, used ether for the first time at the hospital only three months after it had been introduced into England. On 4 March 1847, Parker amputated the thigh of a sixteen-year-old boy with tibial osteomyelitis. He wrote in his notes: "The operation was the double flap – and ether was used with complete success." The boy was discharged, cured three months later, and following this operation there was frequent mention of anaesthesia writes Mr A H T Robb-Smith in his "A short history of Radcliffe Infirmary".

In any event, the London hospitals were not uniformly enthusiastic over chloroform, and Snow commented some years later in the British Medical Journal: "The medical officers of Guys and St Thomas' Hospitals had a strong objection to narcotism by inhalation for the first two or three years after the practice was introduced…"

Despite the publicity given to the efficacy of chloroform as an anaesthetic, there were still many surgeons up and down the country, who either did not accept it or if they accepted it worked at the same breakneck speed in the pre-anaesthesia days.

Such a one was Sydney Jones, of St Thomas' Hospital, who never did quite realise that the patient, whom had been put to sleep by chloroform, was feeling nothing during the operation and that therefore he need not rush the job.

According to Munro Smith, in his fascinating history of British Royal Infirmary: "The surgeons were unwilling to "experiment" on their patients and for many years after use became general, long and painful operations were frequently gone through without anaesthetics, the patients being carefully strapped down and sometimes large doses of brandy and opium given".

> The first mention of the use of chloroform at this hospital appears in the records of 31 August 1850, when chloroform was given to a fifty-year-old man who underwent a lithotomy operation, but only after a joint consultation among the whole of the surgical staff. It was successful, but there is no further mention of using chloroform in the hospital records until 2 May 1851, when another patient was given the drug. Even at this time, four years after Simpson's discovery, nearly all the major operations were still being performed without an anaesthetic at Bristol Infirmary, for as Munro Smith comments, "so powerful a drug was looked upon with fear".

The Infirmary appointed its first Honorary Instructor in Anaesthetics over fifty years later in 1902, and two years later an Honorary Anaesthetist was appointed, which demonstrates dramatically, the by no means rare, suspicion.

# CHAPTER 9

## The first death

Snow was profoundly saddened when he read of the death of 28 January1848, of a fifteen-year-old girl, Hannah Greener, who came from Durham. She was the first victim of the new anaesthetic, chloroform, and died suddenly whilst undergoing a relatively minor, if painful, operation, the removal of an ingrowing toenail, in Newcastle Infirmary, the hospital in which Snow had undertaken his first clinical training.

The girl was seated in a chair for the operation. She was given the chloroform on a folded handkerchief and two minutes later she was dead. The surgeon dashed cold water on her face and put some brandy in her mouth, but to no avail. She was bled a little, but without results.

> This first fatality under chloroform took place less than three months since the first successful operation under the drug. Hannah, a healthy girl, had been successfully operated on for a minor matter under ether only a few months previously. The surgeon, a Mr Megginson, who gave the anaesthetic on 28 January, describes the sequence of events thus:

"She appeared to dread the operation, and fretted a good deal… the inhalation (patient seated in chair)… was done from a handkerchief on which a teaspoonful of chloroform had been poured… In about a half a minute… finding her insensible I requested Mr Lloyd to begin the operation. At the termination of the semi-lunar incision she gave a kick or twitch, which caused me to think the chloroform had not sufficient effect. I was proceeding to apply more to the handkerchief, when her lips, which had previously been of good colour, became suddenly blanched and she spluttered at the mouth, as if in epilepsy… I threw down the handkerchief, dashed cold water in her face, and gave her some internally, followed

by brandy without, however, the least effect. We laid her on the floor opened a vein in her arm, and the jugular vein, but no blood flowed. The whole process of inhalation, operation, venesection and death could not, I should say, have occupied more than two minutes…"

These chilling words must have had a stunning effect on Snow when he read them in his London Medical Gazette. The tragedy aroused a great deal of concern among both medical and lay people. A post mortem showed that Hannah's lungs were "in a very high state of congestion… the stomach as distended with food… the heart contained dark fluid blood in both cavities…" At the inquest on the girl, the distinguished Newcastle surgeon, Sir John Fife, one of the founding fathers of the Newcastle Medical School, said that Miss Greener had died from congestion of the lungs, due to the inhalation of chloroform, and thought it was probably due to "some peculiarity in the constitution", which could not have been detected prior to the operation either in the lungs or nervous system.

Following on this evidence, the inquest jury returned a verdict that, Hannah Greener, died from "congestion of the lungs due to the inhalation of chloroform". As might have been expected, James Young Simpson was affronted by the suggestion that his discovery, chloroform, was unsafe and in fact highly dangerous. He shot off a letter to the Lancet, in which he said, that in his opinion the hapless, Hannah Greener had fallen into a state of syncope at the time the surgeon was operating. He said she could not have swallowed the water and brandy forced through her lips to revive her. He pointed out that the alarming symptoms appeared after the chloroform soaked handkerchief had been removed from the patient's face. He said the effects of the chloroform then continued until cessation of respiration altogether.

After this apologia for chloroform from Simpson, it was inevitable that Snow should want to air his opinions on the subject. In the next issue of the Lancet, Snow wrote that whereas he agreed with Simpson that water and brandy should not have been given to the patient, he did not agree that she had suffered syncope, nor that she had probably suffocated on the water and brandy given to her by the surgeon.

Snow considered that there had been a "kind of asphyxia" liable to be induced when the effects of chloroform had been carried too far. Snow claimed that, Fife, in his evidence to the inquest on the girl, was wrong in his diagnosis and he was aggrieved that Fife's remarks might set back, for a long time, the use of chloroform, which was only just becoming known to medical men. Snow wrote:

"I look on the result (the girl's death) as only what was to be apprehended, from the over-rapid action of chloroform when administered on a handkerchief… and consider that the danger may be avoided by adopting another method. I have observed that the effects of the vapour may accumulate for about twenty seconds after the inhalation is discontinued, and this accumulation will be more formidable in proportion to the quantity of vapour that is being inhaled at the moment, and the velocity with which the symptoms were being induced."

Snow concluded that Hannah Greener had died from an overdose of chloroform resulting in paralysis of the respiratory muscles. From this point on, Snow made a careful study of deaths from chloroform and time after time published his warnings in medical journals, but they went largely unheeded. Snow exhorted those giving anaesthetics to pay more attention to the patient's respiration than the pulse. He warned: "The respiration ceases while the circulation is still vigorous" and he cautioned that in these cases the patient died "as if by asphyxia."

Snow contributed no less than sixteen papers to the London Medical Gazette following Hannah Greener's death between 19 May 1848 and April 1851 on narcotism, and the inhalation of vapour. He was convinced as to the unsuitability of most of those administering anaesthesia. Many had little or no medical training whatsoever. Snow was so upset over this cavalier attitude to his own speciality, and of course it should be borne in mind that he was after all the first professional anaesthetist in the country, that he told his friend Ward Richardson:

"There would be a great uproar if a student were, to undertake on the operating table, to tie the femoral artery, and were to open the femoral vein. Yet at some of our hospitals, the administration of chloroform has been entrusted to the porter who would only grin in ignorance if informed each time that his services were required, he performed the grand act of suspending for a time the oxidation of the patient's whole body and of inducing temporary death. And, that same porter would tell you if you asked him the composition of chloroform, that it was, "smelling stuff".

Snow firmly disagreed with Simpson's suggestion that Hannah Greener died from syncope, and the attempts to revive her in his customary mild manner using the words "it seems improbable". He offered a different explanation of the girl's death. He had constantly emphasised the danger of faulty administration and especially the risk of inducing a state of deep anaesthesia (what he termed snoring sleep) with rapidity. Least the narcotism should, "proceed a degree further on account of the cumulative property of the vapour after it is discontinued". He did not go along with Simpson's idea that the girl died from "some undiscoverable peculiarity in the patient," which had caused her death. His views were clearly expressed in his article in the Lancet in 1848. Snow wrote:

"My view of the matter holds out more hope for the future. I look on the result as only what was to be apprehended from the over rapid action of chloroform, when administered on a handkerchief… I have observed that the effects of the vapour may accumulate for about twenty seconds after the inhalation is discontinued, and this accumulation will be the more formidable in proportion to the quantity of vapour that is being inhaled at the moment, and the velocity with which the symptoms were being induced…"

In the case under consideration (the Greener case), when the girl had inhaled for about half a minute, there was rigidity of the arm (indicating considerable anaesthesia)… supposing that the cloth was removed at that very instant… if the vapour was inhaled of the same strength during the thirty seconds, its effects might increase at the same pace for twenty seconds longer; and at the end of fifty seconds. Within a few months of Hannah Greener's death, Snow read, with disbelief, that there had been a second death from the anaesthetic. This time it was the case of a twenty-two-year-old man who was having some teeth stumps removed by a surgeon – dentist in London. He had been given one and a half drachms of chloroform through an inhaler by a maidservant in the dentist's household, of which the patient was a member.

The dentist claimed afterwards that he operated under chloroform or ether on 700 to 800 occasions without a mishap. At the inquest on the patient, the unfortunate servant girl, who was given the drug via the inhaler, he remarked:

"I usually administer chloroform to the ladies while the footman attends to the gentlemen".

This remarkable state of affairs, bearing out Snow's claim that far too many unqualified people were being press ganged into giving anaesthetics, was revealed in the Lancet during 1848. The first death of a patient under chloroform in a London hospital occurred in George Ward, St Thomas' Hospital, on 10 October 1849. On this occasion the patient was a forty-three-year-old man, John Shorter, who like Hannah Greener died whilst undergoing a relatively minor operation, removal of a great toenail. Interestingly, it was not until 1878, nearly thirty years afterwards, that the hospital appointed their first full time anaesthetist.

In 1853, Manchester Royal Infirmary had decided that, "in future, only one person should administer chloroform, this deadly though valuable agent, whilst a second person scrutinised the effects of the drug on the patient". Yet it was not only the unskilled who suffered the misfortune of patient dying under the anaesthetic. In 1854, an Assistant Apothecary at St George's, using Snow's inhaler, suffered the traumatic experience of his patient dying under the influence of chloroform anaesthesia. He had been appointed to administer chloroform in all surgical operations. It is impossible to calculate how many patients died due entirely on chloroform inhalation, but in spring 1852, Snow estimated that the total up that time was eighteen for the country as a whole. Snow made a valiant attempt to keep a record of the first deaths from anaesthesia from 1846 onwards. He managed to track down a total of fifty deaths in Britain and "other parts of the world" during the first ten years of ether, and chloroform in this

country and abroad. Unfortunately, he died shortly after publishing his findings and no one seems seriously to have pursued this important line of inquiry.

In his list of chloroform casualties, Snow includes twenty-five from England and Wales, six from Scotland and nineteen from Europe and the rest of the world. The overseas figures must have been only a portion of the true total of casualties, but Snow had done his best considering the lack of communications in those days. The ages of the victims ranged between eight and sixty-five with the highest mortality rate from fifteen to forty-five years. Snow explained that there were only two deaths a year from chloroform from 1848-58. Some forty years later, ninety-six people died as the result of chloroform inhalation and this represented deterioration, despite the larger number of operations being performed.

Artificial respiration was widely used in an endeavour to revive patients who had collapsed under chloroform anaesthesia. In each case, where it was used, apparently it was unsuccessful, according to Snow's records, and this was in spite of the fact that in two of the cases Marshall Hall's revolutionary method of performing prone or postural artificial respiration had been used. Snow was bitterly disappointed over the apparent failure of artificial respiration and particularly so in respect of the Marshall Hall method, of which he thought highly, describing it as "the most ready and effective mode of performing artificial respiration". William Fergusson had used mouth-to-mouth resuscitation successfully on a sixty-year-old woman during a minor operation he was performing, during which she became distressed from the chloroform inhalation.

Chloroform would have fallen into disrepute and probably disuse had it not been for the determined pressure brought on the medical profession by Snow and his small band of supporters, who insisted that the drug was a boon to mankind if properly administered. Whilst certain London, and a few provincial hospitals were using chloroform on a regular basis in the early 1850s, there was still a hard core of medical men who resisted the drug. For example, although chloroform was first used at Bristol Royal Infirmary in the summer of 1850, a year later some operations were still being performed without anaesthetic.

An interesting sidelight on the use of chloroform is contained in Army Medical records. We are told that Inspector General of Hospitals, Sir George Hall, instructed his Medical Officers, in Crimea, that chloroform, which had been introduced into the Army in 1850, and was then in common use in military hospitals, should not be for patients with severe shock from serious gunshot wounds. He added: "However barbarous it may appear, the smart of the knife is a powerful stimulant and it is much better to hear a man bawl lustily, than to see him sink silently into his grave".

Though they may have been something in what Hall said, his advice upset many of the younger Medical Officers, who considered that Hall was out of touch with modern surgical techniques. In fact, most Medical Officers ignored their chief's advice and chloroform was used extensively throughout the Crimean War, using in most cases, a Snow inhaler. During 1854, many recent inventions in medical equipment and appliances were sent out to Crimea for trial and report, including Snow's chloroform inhaler and electro-magnet coil machines to stimulate weakly patients who were undergoing surgery with chloroform.

Chloroform was universally employed, except in minor operations and the consensus of military medical opinion was favourable to its use. There was a strong minority of surgeons who refused to use the drug; where there had been massive injuries, resulting in heavy blood loss, because from experience they had found that these cases frequently did not recover because of the depressing nature of chloroform anaesthesia. During the Indian Mutiny in 1857, medicine supplies were lost in the fighting and the Medical Officers were left with only one small bottle of chloroform from which thirty drops were used at a time. He did acknowledge, however, that chloroform had an important role in general surgery. Like Snow, he was not at all happy with its indiscriminate use in midwifery. He commented: "In order merely to relive the natural pains of labour, patients are recklessly brought into a condition having between it and death the very narrowest limits".

Gream, like most of the critics of chloroform, had little idea of the physiological implications of the drug, but he paid Snow the compliment by admitting that his "judicious and valuable observations are in marked contrast to the heedless claims and assertions of Professor Simpson". This was a compliment indeed. Snow was, however, unwise in his criticism of Sibson who claimed that the patient in the chair undergoing surgery ran a greater risk of death from chloroform than the prostrate patient. Snow's attitude to this proposition is summed up in his statement:

"There is no objection when that (the seated position) is the most convenient for the operator… although the horizontal position is certainly the best for the patient under an operation in all circumstances. I consider that the sitting posture is by no means a source of danger when chloroform is given, if the ordinary precaution be used… of placing the patient horizontally if symptoms of faintness come on…"

Here we see the manifestation of ambivalence occasionally shown by Snow, whether to favour the surgeon or the patient!

But Snow did not make claims lightly. He had records of 949 cases in which he had given chloroform to seated patients, mostly dental it is agreed, and he found no ill effects from chloroform anaesthesia. Snow commented: "I am not aware of any inconvenience from chloroform in any of the cases of tooth-drawing (867) excepting sickness, which in a very few of the cases have been troublesome for some time".

Simpson's principal enthusiasm over chloroform was its use in midwifery. Although, there was an initial interest from some doctors for chloroform many remained loyal to ether and almost as many refrained from using anaesthesia at all. There was particularly firm resistance to chloroform being used in natural childbirth cases. It transpired, therefore, that not only the Church but many of his medical colleagues too, rounded on Simpson quoting the Holy Scriptures: "In sorrow shalt thou bring forth children". Many medical men felt that anaesthesia in ordinary childbirth cases was unnatural and that there was a moral aspect to the experiences, namely that pain should be borne with fortitude.

Simpson undoubtedly attracted strong criticism from his colleagues, because when he introduced chloroform inhalation in obstetrics, he kept the patient unconscious at once and kept her under the drug until the end of labour as if she were undergoing a major operation. Snow felt this was too Draconian a method to adopt in ordinary childbirth and that there was danger from overdose of chloroform should labour be protracted.

This question of chloroform in labour and in general surgery was hotly aired in lay and medical press. Snow found an unexpected ally in this dispute in Dr G T Gream, Physician-accoucheur to Queen Charlotte's Lying-in Hospital and a prominent West End physician. He was one of the most influential opponents of chloroform in midwifery. He claimed that the drug, when given in labour, retarded delivery which could bring problems. Snow erroneously did not see any risk from anaesthetics for a patient in a seated position, but his friend Sibson, did see hazards in this mode of operating under ether or chloroform. Sibson has since been proved correct, but Snow declared at the time:

"There is no objection when that (being seated) is the most convenient to the operator… although the horizontal position is certainly the best for the patient under an operation in all circumstances. I consider that the sitting posture is by no means a source of danger, when chloroform is given, if the ordinary precaution be used… of placing the patient horizontally if symptoms of faintness come on…"

Snow made this comment in light of his own personal experience of no less than 949 cases, in which he had given chloroform to patients who were seated during the operation, mostly dental procedures and found that no ill effects ensued.

Some surgeons felt that minor operations like those of dentistry did not justify the use of a dangerous drug like chloroform. But Snow had given chloroform in 867 cases involving dental extractions and he commented:

"I am not aware of any inconvenience from the chloroform in any of the cases of tooth-drawing, excepting sickness and vomiting, which in a very few of the cases have been troublesome for sometime."

Snow would have heartily approved the report of the governors of his old hospital, Newcastle Infirmary, which in 1850 said:

"After the painful contemplation of such an amount of human suffering as the list of operations presents, that to learn that in all of them, and in many other equally painful cases the soporific effect of chloroform have always blessed the sufferers with happy oblivion of their woes, and often substituted in the place of excruciating pain, dreams of happier bygone times."

Rather romantic language, one might think today, but nevertheless accurate. Considerable controversy raged around the introduction of anaesthetic techniques, particularly over the use of chloroform and its effects on mortality. At first there were, of course, no changes at least in the type of surgery being performed, but as time went on and surgeons gained experiences, they began to take advantage of the longer time in which a patient could safely be kept under the influence of anaesthetic, in order to develop new surgical techniques and operations.

Coates at Salisbury Infirmary, for example, found in his twelve-year study, that it is six years before the introduction of ether and six years after that mortality in operations had plunged from 22.5 percent to 9.25 percent, a notable reduction by any standards. And the mortality rates at London's hospitals were similar in comparative terms, which was in direct conflict with the views of the noted physician James Arnott who claimed that, not only was chloroform a dangerous substance, but that delayed recovery in the patient. He published controversial statistics purporting to show that the mortality in surgical operations since the introduction of anaesthetics had increased from twenty-one to thirty-four percent.

This statement was in direct conflict with the experiences of Snow and Coates. He drew up his statistics from the books of the largest London hospitals over a three-year period. Between 1848 and 1852, Snow studied the causes of death from chloroform with the assistance, at one period, of Francis Sibson carrying out a series of experiments involving the administration of chloroform. The two men

carefully assessed the case histories of those patients who had died under the drug. Sibson commented: "We must regard chloroform as one of the most uncontrollable narcotic poisons, when its action is pushed so far as to suspend circulation and respiration".

He noted that three out of four of the victims had been in a sitting position during surgery and concluded that chloroform should not be given to a patient in the seated position. And, he stressed that during an operation the chloroformist should "give his undivided attention to the state of the eyes, lips, pulse and respiration." Sibson seeing the need for this close observation on patients condemned the then prevalent practice of surgeons giving the anaesthetic themselves.

One of Snow's most important discoveries, often overlooked, is that too small a dose of chloroform was equally likely to kill a patient as an overdose. Medical men firmly believed at that time that an overdose was the fatal factor. At first Snow's "small dose" theory was not taken seriously, but time vindicated his theory. During the first few years after the introduction of chloroform, several deaths occurred under the anaesthetic during quite minor routine operations.

As early as 1847, he had argued that the vapour of ether did not, as many thought, produce a kind of asphyxia, by excluding oxygen from the lungs but altered the composition of the blood to as to reduce to a minimum the oxidation of nervous and other tissues. In 1851, he added something more to the proposition when he wrote:

"Chloroform, ether and similar substances when present in the blood in certain quantities, have the effect of limiting those combinations between the oxygen of the arterial blood and the tissues of the body, which are essential to sensation, volition, and in short, all animal functions. The substances modify, and in larger quantities arrest the animal functions in the same way and by the same power, that they modify and arrest combustion…" when they are mixed in certain quantities with the atmospheric air."

Snow considered the following experiment, the best observation he had ever made: Richardson says:

"Placing a taper, during one of our experiments, in a bottle through which chloroform vapour was diffused, and watching the declining flame, he at once said 'there now, is all that occurs in narcotism; but to submit the candle to the action of the narcotic without extinguishing it altogether, you must neither expose it too much vapour at once, nor subject it to the vapour too long; and this is all you can provide against in submitting a man to the same influence. I could illustrate all the meaning of this great practical discovery on a farthing candle but I fear the experiment would be thought rather commonplace." Scientifically, Snow did not know why a small dose of chloroform could be as lethal as an overdose and, indeed, it was not until 1911, that all the mystery was solved by Goodman Levy. Dr Levy demonstrated that the combination of light chloroform anaesthesia and an excess of adrenaline into the bloodstream caused by the patient's anxiety and fear of an operation produced fatal ventricular fibrillation.

Snow also stressed the greater rapidity of the action of chloroform compared with ether. He found it took four or five minutes for ether to manifest its effects, whereas chloroform manifested them much quicker giving the administrator little time to note its effects. Furthermore, chloroform possessed a cumulative effect and this could be disastrous if too much was given to a patient and, of course, Snow later found giving too little of the gas could be equally disastrous.

In an address to the Royal College of Physicians, Snow demonstrated the effects of narcotic vapour depending on the quantity of air with which it was mixed and on other physical conditions. He warned:

"Insensibility is not caused so much by giving a dose, as by performing a process… the great point to be observed in causing insensibility by any narcotic vapour is to present to the patient, such a mixture of vapour and air as will produce its effects gradually, and enable the medical man to stop at the right moment."

And he brought in his views on chloroform and midwifery in this statement:

"Complete anaesthesia is never introduced in midwifery unless in some cases of operative delivery… there is not the same necessity for an accurate means of regulating the proportion of vapour in the air, which the patient is breathing during labour, where but a trifling amount of narcotism requires to be induced as in surgical operations, where a deeper effect is necessary. Still, I find the inhaler much more convenient for application than a handkerchief, and it contains a supply of chloroform, which lasts for some time thereby saving the trouble of constantly pouring out more."

Snow might be accused of double standards for having told the members of the College that the inhaler was more convenient. He deigned to use the humble handkerchief drop method when he gave chloroform for the delivery of a Royal child a few years later.

During 1848, Snow published in the Lancet, a description of his latest inhaler comprising a balloon containing over 2000 cubic inches of hydrogen with a tap, the whole being attached to a face piece with valves. A measured quantity of chloroform was introduced into the balloon and then filled up with air from bellows. The patient was instructed to inhale from the balloon mouthpiece. The exact proportion

of vapour in the air was known and Snow discovered that three-percent vapour-induced insensibility in two minutes.

Snow used this apparatus on a number of occasions, but found that although it efficiently controlled the flow of anaesthetic to the patient, it had one serious drawback; the balloon or bag projected in front of the patient's face and got in the way of the operating surgeon. It was not until thirteen years later that this problem was overcome by Snow's successor, John Clover, who designed an inhaler based on Snow's balloon apparatus, incorporating a pillow like bag, which the anaesthetist slung over his back so keeping it out of the operating field.

During 1848, Snow undertook tests on a variety of substances in his search for a narcotic vapour, which "having the physical properties and practicability of chloroform, should in its physiological effects resemble ether, in not producing by the act of the administrator, paralysis of the heart." Snow firmly believed that one day he or someone would discover an anaesthetic, which could be inhaled with perfect safety and, which would destroy sensation without destroying consciousness. Snow later experimented with substances likely to serve as local anaesthetics. His researches into the quest for the perfect anaesthetic involved chloroform and ether, ethyl nitrate, carbon disulphide, benzene, tribromomethane, ethyl bromide and Dutch liquid (chloride of hydrocarbon-dichlorethane), most of them were tried out on patients on a lengthy series of clinical trials.

Despite Snow's regular flow of articles on chloroform and its dangers, fatal cases involving the drug continued to occur with depressing regularity. His first comprehensive study of chloroform fatalities, ironically, was published in Simpson's home territory, in the Edinburgh Medical and Surgical Journal in 1849. His article entitled "On fatal cases on inhalation of chloroform" stressed the foolhardiness of administering chloroform by the Simpson method. He attributed the numerous deaths arising in part to the haphazard technique used by Simpson and his Scottish colleagues, and also to the cumulative effect of the larger doses that were still being used. He advised that the best way to tackle a case of chloroform overdose was to perform artificial respiration in an efficient and careful manner.

Although the number of fatalities from chloroform increased alarmingly, the total was not very great, considering the general lack of understanding among the medical men of the problems of anaesthesia. The number of chloroform deaths reported in the literature worldwide was 393, between 1847 and 1880, and about ten-percent of these were post-operative deaths. Deaths during that period from other anaesthetics totalled only forty-eight.

As a result of the continuing fatalities, two schools of thought sprang up as regards to anaesthesia – the "clinical school" led by James Young Simpson, with his chloroform on handkerchief method and later used by Joseph Lister and the "scientific school" headed by John Snow, with his inhaler controlling the flow of anaesthetic and air, who was succeeded by Clover after his death.

It is interesting to note Lister's view on the Simpson method he used himself, which he termed the "open" method as compared with Snow's "closed" method. He said the "open" method was simple and therefore the best. Simpson, Syme and Lister were champions of the "open" method for many years, although Lister later modified his method of administration. Snow's method being quantitative and based on exhaustive experimentation was, of course, preferable, but it required a measure of expertise, which was not apparently made available in practice or hospital, but left to any person who happened to be doing nothing at the moment the anaesthesia was required, an assistant, porter, unqualified or qualified, all were likely to be pressed into service.

Snow later recalled an occasion when he saw Clover, then Resident Medical Officer at university College Hospital, place a towel on a patient's head under which lint soaked in chloroform was held. As neither facial nor respiratory signs could be seen during the administration, the chloroformist had to rely on the pulse. Snow was taken aback by this spectacle but Clover, to his credit, had no fatalities, although his successors were less successful on occasions with this self-same method of giving chloroform.

John Clover is worth a closer look at for he took on the mantle of Snow on the latters' death in 1858. Clover was in many ways a tragic figure but undoubtedly one of the great pioneers in anaesthesia. From his late teens, Clover had suffered from tuberculosis and his poor health had prevented him pursuing his private practice in London's Cavendish Place. He had little scope after that and took on the post of "chloroformist" at Westminster Hospital with which Snow was, of course, closely connected. Clover also became lecturer on anaesthetics at University College Hospital.

He had many ideas in common with Snow and carried out experiments with chloroform and ether. Nearly twenty years after Snow's death Clover made his name with an apparatus, which used Nitrous Oxide followed by ether and ether vapour with air and this inhaler remained virtually unchanged until the end of World War I. He gave anaesthesia to Florence Nightingale, Sir Robert Peel, the Princess of Wales and Emperor Louis Napoleon. One of the most remarkable aspects of Snow's life in London was the way in which he became the most sought after anaesthetist in the capital from 1847, until his death eleven years later. Within a couple of years of the discovery of chloroform, Snow was giving ether and

chloroform for almost all the top names in London surgical practice, either at their hospitals or their private practices.

A list of thirty or more surgeons, for whom Snow worked, reads like a Who's Who of the greatest names in British surgery of the Victorian era. Several of these surgeons belonged to that exclusive set the "original" 300 Fellows of the Royal College of Surgeons. They were in fact Founder Fellows and, as such, enjoyed the highest distinction any surgeon could have at that period. Surgeons, for whom Snow worked included Avery, Bowman, Brodie, Cook, Astley Cooper, Bransby Cooper, Coulson, Cutler, Erichsen, Farish, Fergusson, G J Guthrie, Caesar Hawkins, Hawthorne, Prescott Hewett, Johnson, Judd, Robert Keate, Aston Key, Henry Lee, Robert Liston, Nunn, Paget, Partridge, Pollock, Quain, Salmon, Henry Smith, Tatum, Wade and Ure.

Through his contacts with these surgeons, Snow very rapidly established himself as the country's first professional anaesthetist. Yet, he was never attached to any particular hospital as a staff member. He went in and out of various London hospitals with his bag containing his inhaler and ancillary apparatus and similarly visited the surgeons' private patients in their own homes.

It is pretty certain that no medical men, then or since, has worked for so many great surgeons in this country.

## 10

## CHOLERA
## The second outbreak 1848

When cholera struck London for the second time, it was in September 1848, by which time Snow had acquired considerable expertise as a medical scientist, probably London's greatest at this period. The epidemic arose at a time when he was deeply engaged in his research into anaesthetic agents. The first confirmed case of cholera in the capital was on 28 September, and the patient was a seaman on leave from his ship, which was with the Baltic Fleet. The disease had, apparently, been rampant in the fleet during the early part of that summer. Snow recalled the plight of a fellow general practitioner, a Dr J R Lynch, who in the previous year, had died whilst looking after a large number of patients who had contracted a virulent fever in the London area. It was not so much the nature of the fever that interested, Snow as the conditions in which it flourished.

He had read a report by the valiant, Dr Lynch into the outbreak. Lynch said that in one small cellar he found eighteen people lying on wet, dirty straw. There was no window. In one house he counted 81 people and in another sixty-one in different stages of fever lying on straw in corners. This appalling picture depicts only too clearly the living conditions of the poor in Snow's time. Dr Lynch wrote: "The upper classes avoided the poor for fear of disease, but they were victims of their own ignorance."

Mansion houses were equally unhygienic; grubby and potential hotbeds of disease, as much as the slums and stinking cesspools of the poor, and near enough to each other to be dangerous.

The government was more prepared for the second cholera outbreak and since the first epidemic the new Poor Law Unions had been formed and gave rudimentary medical aid to the poor and destitute. But the most significant advance was the passing of the 1848 Public Health Act, earlier that year, which set up a new Board of Health for London. It was manned by a small but dedicated band of civil servants to co-ordinate operations in the event of a fresh outbreak of cholera. It had barely reached the statute book before its ability and powers were to be put to the test with a vengeance. In fact, the ensuing months were to almost ruin the health of its leading lights, those formidable public health pioneers, Edwin Chadwick and Dr Southwood Smith. Both men were devotees of the "sanitary idea" and it was their determined efforts, which resulted in the setting up of the Sanitary Commission in 1839.

Following the accession of the young Queen Victoria in 1837, groups of public spirited intellectuals stirred the national conscience over the need for measures for the prevention and control of disease. The Industrial Revolution had brought in its wake the rapid growth of certain towns, and with it overcrowding, unsanitary dwellings, squalor and pestilence. The researches of three medical men, Southwood Smith, Neil Arnott and James P Kay had inspired Chadwick and the Earl of Shaftesbury, best remembered for his great humanitarian work for destitute children.

As a result, Chadwick published his famous reports of 1842, on the health of the labouring classes, which led to Parliament passing the first Public Health Act in 1848. The principal benefit of this Act was the setting up of the General Board of Health through, which the state became directly responsible for the health of the nation in times of plague.

One of Chadwick's most fortuitous suggestions was the appointment of forty-one-year-old medical statistician, William Farr to compile statistics under the new Registrar-General. Farr was to become a

good friend of John Snow, and provided him with facts and figures, which greatly assisted him in later work on cholera. Farr, who was six years older than Snow, had entered the Registrar-General's office in 1839, when he started publishing his notable "letters" on the causes of death in England.

Despite the fact that the new General Board of Health operated on the false premise that disease was caused by "filth" through the miasmatic hazes rising from decaying matter – the famous and compelling "miasmatic" theory of the period – they had considerable success. They failed to understand contagion and microorganisms but so did the vast majority of the medical profession whose advice they heeded.

Their efforts in getting slum filth cleared was a considerable step forward, even if the Board did not appreciate why this should prevent disease, other than the "miasmatic" theory. The odd man out, who could see much clearer than his contemporaries, that the "miasmatic" theory was too simple, was John Snow and his Bristol counterpart in the study of typhoid, William Budd. Incidentally, Farr, who was apprenticed to an apothecary-surgeon in Shrewsbury, was a medical student at "that Godless place" University College, London, and a licentiate of the Society of Apothecaries.

He was elected a Fellow of the Royal Society in 1855. It was during the 1848 London cholera outbreak that Snow was to show that cholera, was a water borne disease, with additional and conclusive proof in the ensuing outbreak in 1854.

When cholera struck London for the second time in September 1848, Snow was an established physician and medical scientist. As soon as he learned of the fresh outbreak of the disease, he suspended work on anaesthesia to tackle his new challenge. An emergency situation had arisen in the capital and provinces with the arrival of the epidemic in September. The first confirmed case of cholera occurred in London on 28 September and involved a seaman on leave from a ship of the Baltic Fleet. The disease had apparently been rampant in the fleet during the early part of the summer.

Although, the government was a little more prepared for this outbreak than the 1831 epidemic, which took the whole country by surprise, there was still colossal ignorance among the medical profession as to the nature of this deadly disease. There had been progress since the first epidemic, however, for the new Poor Law Unions afforded medical aid to the poor and destitute. Also, the new Board of Health in London set up very recently under the Public Act 1848 had enlisted the services of a small but dedicated band of civil servants, to co-ordinate plans in the case of a fresh outbreak of cholera. This central organisation had reasonable contacts with local boards of health. The new outbreak all but ruined the health of the ubiquitous public health pioneers on the Board, Sir Edwin Chadwick, Dr Southwood Smith and Anthony Ashley Cooper.

The "sanitary idea" dominated the thinking of both men, and the pressure resulted in the setting up of the Sanitary Commission in 1839. Edwin Chadwick was not a medical man. He was a barrister and journalist who became a professional civil servant from 1832, and was a leading member of the small band of middle class reformers who had pressed for the Poor Law and Sanitary Reform Measures. After 1840, he played an increasingly important role in public health but was often at odds with the medical profession whom he accused of "lacking objectively."

Dr Southwood Smith, an Edinburgh medical graduate and physician to the London Fever hospital, was one of the supporters of the campaign to obtain adequate cadavers for the training of medical students, which led to the passing of the Anatomy Act 1832. Smith was a loyal supporter of Chadwick and a champion of hygiene and public health. Anthony Ashley Cooper was already well known as a philanthropist and factory reformer and pioneer in child welfare. A member of Parliament for Dorset, and later Bath, he later became Lord Shaftesbury.

He is remembered for his work towards the passing of the Coal Mines Act 1842 prohibiting, among other things, employment of women and children underground. He also helped to establish the "Ragged Schools, which brought education to the poorest children and later supported Florence Nightingale in her reforming zeal to provide better conditions for soldiers.

At this time, the first Medical Officer of health for London was appointed. He was John, later Sir John Simon, and his contribution to the public health is probably the most notable from the Nineteenth Century. Simon, son of a stockbroker, studied medicine at King's College, London, and was a surgeon at St Thomas' for a time having also served as a lecturer on pathology. Even during his early days at St Thomas', surgeon Simon took an interest in "sanitary matters." He was to become Medical Officer of the Board of Health in 1855. In his reports, Simon constantly warned of the dangers ahead if nothing was done about the pollution of the Thames and the need of sewers.

Although, primarily a surgeon and pathologist on the staff of St Thomas' Hospital, he became famous as a public health reformer. He was fearless in his comments on the appalling conditions of the time. It was he who also urged the value of vaccination, which was made compulsory in 1853. Among his influential friends was John Ruskin. Chadwick, Southwood Smith and Simon had little time to prepare their plans to tackle the latest cholera outbreak with the Public Health Act only just having reached the statute book. The Act, including the Nuisances Removal Act, specifically aimed at cholera

proposed improvement in drainage, sewage disposal, cleansing of streets and paving in towns, subject to local government control.

Snow as usual, was the odd man out. This was a role he was to occupy throughout his short life. But even Snow appreciated the revolutionary nature of his theory and with the caution one had come to expect of this remarkable man, he took his ideas to two of London's leading physiologists and researchers, Edmund Parkes and Alfred Baring Garrod, who were colleagues at University College Hospital and had considerable experiences in the analysis of the body fluids in cholera. Parkes became one of Snow's most discerning critics, but was not averse to having his own findings on cholera corrected by Snow. Parkes is worth closer attention because he was later to have an enormous effect on the health of the British Army. Parkes, who was related to the famous potter, Josiah Wedgwood, had qualified as a doctor not long after Snow and after running a modest practice in Harley Street, was appointed Professor of Clinical Medicine at University College. Snow knew of Parkes' work from a treatise he had published two years earlier on cholera.

The distinguished physician, Sir William Jenner, described Parkes' paper as "one of the most remarkable works in medical literature." In fact, it added little to current knowledge of cholera, but was valuable as a synthesis of knowledge and theories up to that time, and therefore invaluable as a research guide. Alfred Baring Garrod was the same age as Parkes and was an assistant physician at UCH. He was a dedicated chemist and physician and during the cholera outbreak year became the first person to discover that there was an increase of uric acid in the blood of patients suffering from gout. Like Snow, he was a member of the Westminster Medical Society. Snow was impressed with the studies carried out by Parkes and Garrod on the body fluids of cholera patients. He used their findings to support his own pathological theories in his book on cholera published in 1855.

Unfortunately, neither Parkes nor Garrod were impressed with Snow's theory that cholera was water borne. Yet, once his theory had become accepted, Parkes made every endeavour to see that Snow received the proper recognition for his discovery. Snow was particularly interested to read in Spring of 1849, that Dr Garrod was able to show, by chemical analysis, whether a specimen of blood had come from a cholera sufferer or not. From this paper and his own researches, Snow was able to announce: "There is a good deal of evidence to show that plague, typhoid fever and yellow fever diseases, in which the blood is affected, are propagated in the same way as cholera." He also stressed that nothing aided the rapid spread of cholera more than lack of personal cleanliness and scarcity of pure water. One of the more curious theories advanced at this time was the "fungoid theory", which emanated from a group of physicians and scientists in Bristol, led by William Budd, a physician at the city's Royal Infirmary. It appears that the intense interest aroused in the new science of microscopy had a lot to do with the emergence of the theory.

Budd emerged as a firm supporter of the idea that fungi, was responsible for cholera, but Snow remained on the sidelines and ensured that, at no time, did he become directly embroiled in the cholera fungus controversy. He had aligned himself with Budd, Swayne and Brittan, he would have fallen with them, when the time came, for their fungus theory to be discredited. In his book "On the mode of communication of cholera," Snow said he did not wish to be misunderstood as supporting the theory that "veritable animals or animalcules," were responsible for the spread of cholera. He preferred, he said, to "appeal to that general tendency to continuity of molecular changes by which combustion, putrefaction, fermentation and various processes in organised beings are kept up".

His theory that cholera was communicated through drinking water was first published on 29 August 1849 and proposed that a contagious element attacked the intestinal mucosa without passing into the blood stream. He explained: "Such an agent could only enter the body by being swallowed and left in the vomit or stools, the chain of infection being completed by the faecal contamination of food and water."

It so happened that a fungus, which appeared to support Snow's views, had been discovered a few weeks before Snow's water theory had been published. Brittan and Swayne told the Bristol Medico-Chirurgical Society of "peculiar microscopic objects in the characteristic rice water discharges of persons affected with malignant cholera."

In an address to the Westminster Medical Society, Snow was guarded in his remarks on the Bristol theory and though he thought that the discovery of microscopic cells tended to confirm his view of the nature of cholera, he was not sure they were the real cause and reserved his judgement. This is as far as he ever went in accepting the fungus theory and in light of subsequent events it is as well that he went no further along this path.

Snow's theory on molecular changes as an important aspect of cholera transmission was based n his extensive reading of the work in Liebig, whose influence on his work he often acknowledged. But, to give Budd his due, he always maintained that Snow was the first to develop and publish the part played by water in the diffusion of cholera, "this very important conclusion."

At the back of Snow's mind, as he researched the mode of communication of cholera, were the experiences he had gained in his toxicological studies. His theory was a pathological one and he drew an analogy between cholera and irritant poisons, which occurs in Christison's famous "Treaties on Poisons" published 1835, which Snow knew well. One thing is certain, the fungus theorists set back any ready acceptance there might have been of Snow's water borne theory and so delayed the true mode of communication of the disease. Snow was certainly not impressed about the theory, and had little to say about it. Yet it had a large number of adherents, mainly because it relied upon the new enthusiasm for the microscope, which although widely used in scientific circles had little significance for the medical profession. The "microsopists," as they were called, ploughed a lonely furrow.

William Budd was the author of many articles on the nature and propagation of zymotic diseases. He was a leading advocate of stringent disinfection and sanitary precautions. He was at one with Snow on these factors as well as stressing the importance of the supply of pure water. He was one of the most dedicated supporters of Bristol Waterworks. Budd enjoyed fame as the pioneer in the study of typhoid in much the same way as Snow with Cholera. Budd proved beyond dispute that typhoid fever was contagious and propagated chiefly by faecal discharges. In his interesting book "Typhoid Fever" published in 1873, he traced the course of an outbreak of typhoid in North Tawton, Devon, his birthplace, and showed how a number of cases which occurred in various localities had been transferred in definite ways from case to case including contaminated water, bedding and clothing. But before that, in 1849, he published a book entitled "Malignant Cholera" at about the same time as Snow published his first edition of "On Cholera".

Yet Budd, generously conceded, that Snow had prior claim to the water borne theory of cholera. William Budd was said by, Professor John Tyndall the eminent physicist and friend of Joseph Lister and Thomas Hurley, to be a man "of the highest genius" and that "there was no physician in England, who during his lifetime, had shown anything like Budd's penetration of zymotic disease."

Whilst Budd and his colleagues believed that cholera was spread through a fungus, they claimed to have identified under the microscope, from samples of water in cholera stricken districts of Bristol, Snow was trying to get medical men to accept his own theory. The so-called "Snow Theory" was that the cholera infection was ingested through contaminated water and invaded the gut. The infection, he claimed, was evacuated, passed into the sewage system and somehow leaked into the water supply so completing the cycle. Faecal contamination of food and water was a vital principle of Snow's theory.

It is surprising that Snow did not launch an attack on the fungus theory and its supporters. Yet when Snow and John Swayne, another Bristolian doctor and microscopist shared the same platform at a meeting of the Westminster Medical Society, Snow said little about the fungus theory expounded by Swayne. As it turned out, he was wise not to ally himself with the fungus theorists as this line of thinking was soon in disrepute. With hindsight, it is easy to ridicule the fungus theorists, but they were working in the dark thirty years before, Kock finally resolved the cholera problem with the discovery of the causative organism Cholera Vibrio. What Budd and his friends saw under the microscope when they examined the stools of cholera patients, were almost certainly epithelial cells, starch granules and fat globules. At the same time as Snow shunned the fungus theory, he also rejected absolutely, the idea that cholera was spread through contaminated air.

His theory was propagated in his slim first edition of On Cholera, but the bulk of the medical profession was not yet ready for his theory. During 1850, Snow and a friend, a Mr Tucker, helped lay the foundations for the Epidemiological Society, which spent a good deal of its early deliberations on the registration and nomenclature of diseases. One of the early members, along with Snow, was his good friend and first biographer, Benjamin Ward Richardson.

Prior to his approach to Parkes and Garrod late in 1848, Snow does not to appear to have given any serious thought to cholera and was deeply involved in his search for the "perfect" anaesthetic.

During the cholera outbreak in the autumn of that year, the new Board of Health of London issued orders and regulations to local health boards up and down the country. The board members worked round the clock and Southwood Smith, for example, was near to a state of collapse from fatigue; Anthony Ashley Cooper and Edwin Chadwick were both ill from overstrain, and they were not helped by the constant sniping from The Times, The Lancet and the Royal College of Physicians who criticised his efforts. The local Boards of Guardians too, were critical, probably because, they felt their independence was threatened by the Board. It is strange that two advanced thinkers like Southwood, Smith and Chadwick should have been supporters of the outdated Miasmetic theory, namely, that diseases like cholera were carried in bad air, hence Chadwick's aphorism "all smell is disease". Nothing that Snow or his supporters said or did had much effect on their thinking at that time.

It is easy to criticise them, at this instance in time, for their stubbornness and short sighted policy, but it was not until, Koch established that the true cause of cholera was the Vibrio Cholera, it was nearly half a century later that the medical profession was aware of the true source of the disease.

Snow quickly realised that the fresh outbreak of cholera had occurred in similar places to that of the 1832 outbreak. In Bermondsey, for example, the self-same open sewer was again the starting off point for the disease in that area. In Oxford, the first cases broke out in the county prison.

The Board of Health, however, was alerted to the weakness of the Miasmatic Theory when they learned of the appalling outbreak in the South Wales mining town of Merthyr Tydfil, a densely populated area with great poverty. The town's 50,000 inhabitants, dependent on the iron and coal industries, were living in conditions entirely without drainage, piped water, their sole water supplies being from pump wells. The living conditions of the people, most of who were employed in the pits and iron works, would have been familiar to Snow from his Killingworth colliery days. The workers lived in filthy, airless, dark and totally unsanitary hovels, belonging to their employers. By mid-June of 1849, twenty people a day were dying from cholera and the eventual total of deaths was 1,849.

Snow told his colleagues that when he tackled the outbreak at Killingworth in 1831-2, there were no privies in the coal pits and the workers took their food to work with them in the mine, because of their long working stints. They, inevitably, ate these meals with unwashed hands and without knife or fork. Snow had been told by his brother Robert, a mining official, that colliers in his mine worked underground for eight or nine hours at a stretch. He said their sustenance usually comprised "a supply of cake and sometimes meat." All of them had a bottle containing a quart of some drink, usually cold tea or beer.

Robert told his brother: "I fear that our colliers are no better than others as regards cleanliness. The pit is one huge privy and of course the men always take their victuals with unwashed hands." In his book On Cholera, Snow, describing the 1831-2 outbreak, writes of miners at Killingworth Colliery "dropping like ninepins" in the pit and that he was called to tend them "after having had profuse discharges from the stomach and bowels. When fast approaching to a state of collapse, men were brought up from some of the pits" comments Snow, acidly.

Snow's remark that miners ran a special risk from cholera outbreaks brought a sharp response from William Baly, a colleague of the fashionable London physician Sir William Withey Gull, who declared otherwise. Baly had been a physician to Mill Bank Prison for several years and was an authority on prison hygiene, and in particular on that prison scourge, dysentery. More importantly, Baly was a member of the influential cholera committee of the Royal College of Physicians, and along with Simpson and Farr represented a powerful "sanitary" lobby. In his report to the Prison Commissioners, Baly attacked Snow's suggestion that miners were particularly affected by cholera saying: "that the miners' wives and children who did not work or eat in the mines, were attacked in equally as large numbers as their men folk."

Snow read the report and came back irritatedly: "This is only what ought to occur from the propagation of the cholera in the crowded dwellings of the pitmen. The only effect of its communication in the pits, would be that the men and boys in the family would have the cholera a day or two earlier, than the women and children." Snow said it was not unlikely that some cases of cholera, without any apparent connection with previous cases, might have been communicated through food. "It is the practice of the poor people who gain a living by selling fruit and other articles in the streets, to keep their stock in very crowded rooms in which they live. I often saw baskets of fruit pushed under the beds of sick patients in close proximity with the chamber utensils." Snow commented, after visiting the outpatients of a medical charity. But the poorest elements of society were not the sole sufferers from risk of disease due to lack of hygiene for the wealthy, too, lacked the most elementary options of hygiene. Yet they, too, were potential victims of cholera for Snow comments: "The mixture of the cholera evacuations with the water used for drinking and culinary purposes, either by permeating the ground and getting into wells, or by running along channels and sewers into rivers from which entire towns are sometimes supplied with water" and these water supplies included the homes of the wealthiest as well as the poorest in the metropolis - so all were at risk.

One of the most moving contemporary reports on the fears of the ordinary man in the street, is the petition sent to The Times newspaper and published by them on 5 July 1849. With dignified simplicity, fifty-four of the men folk living in the Soho area, one of the worst hit areas, signed the letter, which was published unedited. The signatories all lived in the little streets, courts and alleyways of the Church Lane and Carrier Street district. The desperation and poignant appeal to the authorities is obvious in the words of the spokesman for the group in his uneducated but telling language. The letter appeared as follows:

The Editur of the The Times Paper,

Sur,

*"May we beg and beseach your proteckshion and power. We are, Sur, as it may be, livin in a Wilderniss, so far as the rest of London knows anything of us, or as the rich and great people care*

*about. We live in muck and filthe. We aint got no privis, no dustbins, no drains, no water-splies, and no drain or suer in the hole place. The Suer company, in Greek Street, Soho Square, all great, rich, and powerful men, take no notice whatsomedever of our complaints. The stenche of a gully-hole is disgustin. We all of us suffur, and numbers are ill, and if the Colera comes Lord help us.*

*Some gentlemans comed yesterday, and we thought they were comishoners from the Suer Company, but they were complainging of the noosance and stenche our lanes and corts was to them in New Oxford Street. They was much surprized to see the cellar in No.12 Carrier Street, in our lane, where a child was dyin from fever and wouldnot beleave that sixty persons sleep in it every night. This here cellar you couldent swing a cat in, and the rent is five shillings a week; but theare are greate many sich deare cellars. Sur, we hope you will let us have our complaints put into your influenshall paper, and make these landlords or our houses and these comishoners (the friends we spose of the landlords) make our houses decent for Christions to live in.*

*Preaye, Sur, com and see us, for we are livin like piggs, and it aint faire we shoulde be so ill treated. We are your repeckfull servents in Church Lane, Carrier St and other corts."*

.. Tuesday Juley 3, 1849.

The letter, no doubt, stirred a few consciences and simply confirmed what people like John Snow already knew about the plight of the poor folk of London. One interesting feature of the 1848-9 epidemic, which erupted in September 1848, was the minimal effect the cholera had on institutions like prisons and asylums. The outbreak of the disease started in Southwark district and spread like wildfire from Chelsea to Greenwich, and even to a convict hulk on the Thames at Woolwich. These sporadic and widely separated outbreaks gave comfort to the Miasmatists!

One institution, which did not however, escape the disease, was the large orphanage of Tooting, where in December 1848, cholera struck the home of more than 1,000 boys and girls who were living under appalling conditions. They were underfed, ill clad, many subject to sweated labour, living in accommodation one-sixth of the size, which was necessary for growing children. They were crammed three in a bed. Snow was shattered on learning of these conditions. He was well aware of individual overcrowding in houses and tenements but had never before the Tooting experience seen, nor experienced, anything like this in a public institution.

He was appalled to discover, during his investigation of the outbreak at the orphanage, that those children who contracted cholera fouled their beds, also occupied by other inmates, and vomited over their bedfellows. Snow later commented: "Under these circumstances, and when it is remembered that children get their hands into everything and are constantly putting their fingers in their mouths, it is not surprising that the malady spread." But Snow, who always tried to be fair, said he believed those in charge of the orphanage paid as much attention as possible to cleanliness in a building crowded with children. Sadly, the outbreak had disastrous consequences, for within a fortnight of the first case of cholera in the orphanage, 200 of the children, one-fifth of the total population of the home became ill, and twenty were dying daily, until the staggering total of 180 deaths was reached before the outbreak subsided.

There was, as might have been expected, an outcry by the public over this disastrous incident, and vitriolic articles appeared in the newspapers and magazines. Among the critics was novelist, Charles Dickens, who had personal knowledge of life in a Victorian orphanage. At the same time as the orphanage outbreak, several London Hospitals were swamped with cholera patients. It was very different from the 1831-2 cholera epidemic when the hospitals had refused to admit cholera victims. Some of the worst affected areas were Southwark, Lambeth, Bethnal Green, St Giles and Rotherhithe areas with their cramped, noisome little streets, alleyways, courtyards and abominable housing conditions.

By the time the epidemic was on the wane in December 1849, it was reported that the total death roll from cholera in England and Wales was 72,180, and if Scotland and Ireland had been included, the total would have been nearly 130,000. One bright spot in the whole outbreak was the heroism and devotion of a number of doctors who, like some of their predecessors in the epidemic seventeen years earlier, remained in the stricken capital and other cities to minister to the sick and dying without a thought of their own safety. Not so worthy were those fashionable physicians and surgeons who upped and went, in the wake of their wealthy patients, to the safety of the seaside and country well away from London. When the final count was taken of the 1848-9 outbreak, over half a million people had been stricken with the disease, a quarter of them dying from it.

Snow worked heroically throughout the epidemic. He had little sleep or rest as he dashed from street to street, house to house, tending his own and other patients of fellow doctors who were grossly

over-stretched. All the time, he was making voluminous notes and tackling the problem in a scientific manner, as he was able, with the limited knowledge and resources available, at that period in medical history. One of the most extraordinary features of the epidemic, which he discovered on his rounds, was the effect of the epidemic on a row of genteel, middle class houses in the Wandsworth area. Extraordinary, because the high rate of mortality was unexpected in this type of residence as compared with slum dwellings.

Snow visited every house, Nos 1-17, Albion Terrace, off Wandsworth Road, occupied by professional and skilled men and comfortably off trade's people. Most of the houses were detached, but the water supply serving them had become contaminated by the contents of the drains and cesspools of the houses. Cholera seeped into nearly all the dwellings in which the water was thus tainted and into no others. Snow's investigations revealed that all seventeen houses were supplied with water from a copious spring in the road in front of the terrace, which was channelled through pipes into the houses. The fist case broke out in No 13, on 28 July, two days after a drain had burst near No 8 during a storm. The unfortunate woman occupant of No13, who was the first victim of cholera in the road, died after an illness lasting three to four days. During the ensuing three days, there were numerous outbreaks of cholera in Albion Terrace and in ten of the houses there was a total of twenty deaths.

One of the local general practitioners, with whom Snow was working in this district, was surgeon, Mr Wimprisess, one of the valiant bands of ordinary doctors whose names have long been forgotten. Wimpriss had several patients living in Albion Terrace. He told Snow, after the outbreak, that there had been six deaths at No 6 where seven people had contracted the disease. Snow commented that the excreta from the first patient must have entered the drains linked with the water supply to all the houses. When the outbreak escalated alarmingly, Mr Wimpriss consulted Snow, who personally tested a sample of water taken from No's 1-7 and also deposits from the tanks at the back of the houses, which contained the water from the spring in the road by the drains. A lead pipe took the water from each tank to a pump in each back kitchen. There was a cesspool behind each house, under the privy, four feet away from the water tank. Snow reported that "the water was offensive, and the tanks possessed the odour of privy soil very distinctly." Many of the patients told Snow that they had suspected tainted water after drinking it.

After officials had investigated the Albion Terrace outbreak, which had created much greater alarm than the number affected might seem to have merited, the General Board of Health, published a report blaming the outbreak on an open sewer in Battersea Fields 400 feet away, which they claimed had "a disagreeable odour". The report also referred to the "very disagreeable odour" from the back kitchen sinks in the houses affected following the storm and to the rubbish in the cellar of the house No 13, the first affected dwelling. The Miasmatists had a field day following this report, for the Board's observations appeared to support their theories. Snow was appalled at the wrong thinking in the report – he was convinced that they were totally adrift from the reality of the situation with which he had, after all, first-hand experience, being one of the most expert, if not the most expert, investigator on the scene at the time of the outbreak. He was not going to let these misleading observations pass without comment. He wrote acidly, that the bad smells and refuse, so beloved of the Miasmatists, were not responsible for the Albion Terrace outbreak, but the state of the water, which had conducted the cholera to most, if not all, of the affected dwellings.

The Board, to their credit, did however subsequently retract their Miasmatic approach and blamed contaminated water for the outbreak, thus vindicating Snow's contention all along that Albion Terrace inhabitants had been the victims of a water borne disease. Snow was not the only medical man in London to suspect water as the carrier of the disease, for on 30 August, 1849, a Dr Lloyd told South London Medical Society of his experiences during an outbreak of cholera in Silver Street, Rotherhithe, when thirty-eight out of the eighty residents died from the disease within a fortnight, during July. This occurred in an area where there had been little cholera.

He told the meeting that the contents of all the privies in that street ran into a drain, which led into the River Thames. The residents obtained their water from a well close to the end of the drain, the contents of which contaminated the water supply. To his lasting credit, this Dr Lloyd compelled the authorities to fill up the well and thereafter cholera ceased in that street. Shades of A J Cronin's hero in his book The Citadel. Snow cites in his book on cholera, several horrific instances of cholera attacks, including that in a Salford Street, in which twenty-six people fell victims to cholera. All of twenty-five perished due to a blocked sewer close to a pump well, which had leaked into the water supply. Similar disastrous incidents occurred in places as far apart as Ilford and Bath, in which Snow took a keen professional interest.

Whilst Snow was working under demanding conditions in London during this outbreak and, at the same time, trying to keep statistics and tend his patients, Dr William Farr had discovered a remarkable coincidence between the mortality from cholera in the various districts of London in 1849, and the elevation of the ground in those areas. He claimed that the higher districts had suffered less from the disease than the lowest areas. His theory, however, was shattered by the fact that several towns in

elevated positions had suffered badly from the disease. Snow learned from a colleague in his native city of York, who had kept in touch with him for several years, that in mid July of 1849, cholera first appeared in the city and was prevalent in some narrow streets near the River Ouse, called the Water Lanes. From time immemorial, inhabitants had fetched their water from the river at a place near, which one of the chief sewers of the city emptied itself. Recently, a public convenience had been built, the contents of which, washed every morning into the river just above the spot where the Water Lanes residents obtained their water. In a short time twenty to thirty people died in that area.

Snow obtained similar data from contacts in numerous towns up and down the country including Exeter, Hull, Dumfries, Paisley, Glasgow and Newcastle, to mention a few. When the final toll of the disease became known – 53,293 were dead in the country as a whole, of which nearly a third were children under fifteen, Snow commented:

"The higher proportion of deaths amongst children in the houses supplied with the impure water from the Thames at Battersea Fields probably arose from circumstances that children are very fond of drinking water in warm weather. I have often heard such remarks, as the following, in making my inquiries on the south district of London: "My children like water better than tea or anything else. I cannot keep them away from the water butt," or "the child that is dead (from cholera) used to drink a great deal of that water. She was big enough to reach the butt herself." Snow did not hold firmly to his water borne theory of the transmission of cholera to the exclusion of all other theories, which he carefully considered and made subjects of experiments. In fact, at one stage, he proposed that cholera might arise from contamination through the medium of flies and other insects, although such a proposition tended to weaken his principal theory in the eyes of many medical men. However, Snow having one might think with commendable open mind "tried everything once," and systematically abandoned them one by one, leaving him with his original water borne theory in tact.

Snow had a prodigious correspondence with medical men and scientists up and down the country, at this period, and in addition to his valuable York contact during the cholera outbreak, he received information from another old friend, a Dr Embleton, of Newcastle upon Tyne concerning the water supply at Newburn, which had the misfortune to be the worst affected place in the 1832 cholera epidemic when 325 out of its 550 inhabitants contracted the disease and fifty-five died.

Embleton told Snow that Newburn drew water from three wells, two of which were little used and the third was derived from the workings of an old coalmine. He said this water was generally good when first drawn but became putrid after it had been kept for two days. Snow claimed that there was a good deal of evidence to show that the plague, typhoid fever and yellow fever, all diseases in which the blood was affected, were propagated in the same way as cholera. He was well aware of the encouragement to the spread of cholera through overcrowding. He said that among the poor, where a whole family lived, slept, cooked, ate and washed in a single room, cholera had been found to spread rapidly once introduced. Still, more so in common lodging houses in which several families were crowded into a single room. On the homes of the better off citizens, Snow had this to say, however: "When on the other hand cholera is introduced into the better kind of houses as it often is… it hardly ever spreads from one member of the family to another. The constant use of the hand basin and towel and the fact of the apartments for cooking and eating being distinct from the sick room are the cause of this. Nothing has been found to favour the extension of cholera more than want of personal cleanliness, whether arising from habit or scarcity of water."

Snow in his personal researches and visitations to patients had discovered that:

"The bed linen nearly always became wetted by the cholera evacuations and as these are devoid of the usual colour and odour, the hands of the person waiting on the patient become soiled without their knowing it; and unless these persons are scrupulously clean in their habits, and wash their hands before tailing food, they must accidentally swallow some of the excretion and leave some on the food they handle or prepare which has to be eaten by the rest of the family, who amongst the working classes often have to take their meals in the sick room."

Dr William Guy, of King's College Hospital, made an interesting survey of the occupations of 4,312 males of over fifteen years of age, who died from cholera in London during the 1848-9 epidemic. They included 299 sailors, many of whom drew water from the River Thames like the fifty-three coal porters and hawkers; 102 weavers who were crowded in tiny apartments in Spitalfields, a most unhealthy community; and sixty-seven hawkers who may have moved around, but dossed down in crowded lodging houses. Footmen and men servants twenty-five, physicians and surgeons sixteen, merchants eleven. It is interesting to note that only two undertakers, or one in 325 died. Snow, as expected, had something to say about Guy's statistics. He observed that only one master brewer died, according to Guy's figures, although there must have been thousands of brewery workers in the capital. Snow said he had only met with two or three deaths among the brewers during the fatal weeks of 1849 and later epidemics. He comments: "The reason for this probably, is that they never drink water and are therefore exempted from imbibing the cholera poison in that vehicle".

He observed that the great prevalence of cholera, along the course of rivers, had been well known for a quarter of a century. “Rivers always receive the refuse of those living on the banks and they nearly always supply, at the same time, the drinking water of the community so situated. Absence of drainage promotes the prevalence of cholera.” Snow also pointed out that the disease seemed to flourish better on clay soil than on primitive rocks, sandstone or gravel. Apart from researching into the method of the propagation and diffusion of cholera, Snow laid down useful preventive measures to check the spread of the disease. He cautioned the people tending the cholera victims to observe strict rules of cleanliness. He insisted on a hand basin with water and towel being placed in each sick room he visited, so that each member of the family might wash their hands before eating food.

He advised the placing of all soiled bed linen and body linen in water immediately after removal, and that bedding should be exposed to a temperature of more than 212 degrees Fahrenheit. Snow also warned that care should be taken to ensure that water for drinking and preparing food should not become contaminated by the contents of cesspools, house drains or sewers, and advocated boiling water before drinking or using in cooking. These simple rules of hygiene might seem hardly worth mentioning today, but in Snow’s time they were virtually ignored in most households and not only the poorer ones either. When a cholera patient recovered, Snow had them moved from their usually crowded living room in other than well-to-do homes, to another apartment. He also recommended that colliers should work shorter shifts so that they could go home for meals, avoiding the necessity of taking food into the mines.

Apart from his advice to individuals over cholera outbreaks, Snow also took a broader view of preventive measures. He advocated the provision of good drainage, an ample supply of clean, uncontaminated water, model lodgings for vagrants and sufficient room for the poor, the inculcation of habits of personal domestic cleanliness and the checking of ships arriving from infected places. His gospel of perfection fell on fallow ground for the most part. It was to be a very long time before they were taken seriously. It is surprising that Snow’s meticulous scientific methods and research did not lead him to the germ theory, for in August 1849, he suggested that the agent causing cholera was cellular in these terms:

“Some matter, which multiplies itself in the gut by the appropriation of surrounding matter, in virtue of molecular changes going on within it, or capable of going on as soon as it is placed in congenial circumstances.”

Snow returned to this theme during the 1853 cholera epidemic, but still did not grasp the idea of a germ being the causative agent.

## Benjamin Richardson

The year 1849 proved to be one of the busiest in Snow's career, for in addition to his routine daily work of attending his own private patients, giving anaesthetics in various hospitals and private practices of surgeons, he was still a visiting physician for two hospitals, looking after sick club patients, writing numerous articles for the medical journals and continuing his research into anaesthetic agents. How he ever found the time to pack all these varied activities into his daily life is remarkable. He thrived on hard work and as soon as he had finished with his work on the cholera outbreak, he set about in earnest to discover "a perfect anaesthetic." He published a vast number of papers, describing his experiments with various anaesthetic agents in the London Medical Gazette between 1848 and 1851, when the magazine closed down.

They were well-researched papers, which added to Snow's standing as a medical scientist. But the plain fact is, as one of his contemporaries remarked, "the papers, with all their merit, were more talked about than read." Perhaps they are most memorable for the vast variety of experiments with original information. During the year, Snow learned that his beloved Westminster Medical Society, then an old established foundation, was to combine with the city's oldest societies, the London Medical Society. One issue of the London Medical Journal wrote on the use of chloroform in surgical operations and midwifery. He declared that chloroform afforded no risk whatever if left to skilled hands. About the same time Simpson, in Edinburgh, received support form his old enemy James Syme who, after initial doubts over the drug, decided he would use chloroform in surgery, and generously admitted that Simpson had been right all along in his statement that, chloroform not only saved patients pain in undergoing an operation but also protected them to an extent from the effects of shock.

But there were others who remained unconvinced and at a meeting of the Westminster Medical Society with Snow in the audience, a speaker claimed that mothers undergoing chloroform anaesthesia in childbirth used, "obscene and disgusting language" and suggested this should dissuade doctors from using the vapour. This battle between the pro-chloroform lobby and the anti-chloroform protagonists was to continue for at least another four or five years. But between them Snow and Simpson managed to convince the profession, eventually, that chloroform was a great boon to mankind, and safe in expert hands when used either for general surgery of midwifery. There is no record of Snow ever having met Simpson, but they were each well aware of the other's opinions and theories on anaesthesia through the medium of the medical journals. Simpson made something of a crusade of his discovery of chloroform and did not take kindly to any criticism of its usefulness in midwifery and surgery. His position as a professor of one of Europe's leading medical schools added weight to his crusader.

Simpson and Snow were opposites in characters, the former forceful, ebullient, sociable and imposing, the latter diffident, withdrawn, solitary. In fact, Snow had little contact, socially, with any medical colleagues and therefore his ideas, as brilliant as they might have been, were disseminated through medical journals and lectures which, if the truth be known, attracted only a small proportion of the practising doctors in the country. In the first month of the new year, 1850, Snow read with considerable interest, a newspaper report on two criminal trials, in which women had been convicted of robbing men, using chloroform to first stupefy their victims. Both crimes occurred in London and in each case it was claimed that chloroform had been poured onto handkerchief and held over the victims' nose and mouth.

These were the first recorded cases of chloroform being used in the furtherance of crime, and as might be expected, the matter was raised in Parliament, some MPs declaring roundly that they considered chloroform "a new and dangerous weapon in the hands of the criminal classes, which could make robbery so simple." Snow went on the warpath. He did not see why a perfectly acceptable anaesthetic gas, when handled professionally, should be destroyed through the antics of unscrupulous thieves and self-seeking politicians. His target for attack was Lord Campbell, who had put forward a Bill to the House, which recommended condign punishment for the unlawful use of chloroform. One might think there was nothing objectionable about such a measure, but Snow, like some other medical men who had used chloroform successfully, saw this move as a threat to its future use, at a period when the bulk of the medical profession still viewed chloroform with considerable suspicion.

Snow contributed two interesting articles on the topic to the London Medical Gazette, during the year, one entitled The alleged employment of chloroform by thieves. In addition, that year he wrote his paper, On narcotism by the inhalation of various medical substances.

On 5 March 1851, Snow wrote to Lord Campbell:

"My Lord:

More than four years have elapsed since the discovery was made. But it would be truly unfortunate if first notice of this great discovery by the British Legislature, should be in a new penal law for crimes supposed to be committed through the means is supplies even though the Law should not point to Sulpheric Ether itself but to that medicine (chloroform) which on account of certain slight advantages has, in a great measure, superseded it. There is no reason to believe that chloroform has been employed in more than two instances with criminal intent, and so far from aiding the perpetration of the crime, it has led to the immediate detection of the offender on both occasions."

And Snow goes on:

"It is evident that chloroform cannot be given to a person in his sober senses without his knowledge and full consent, except by main force."

It is worth taking a look at the two cases to which Snow refers in his letter to Lord Campbell. Elizabeth Smith and Margaret Higgins robbed a man in Spitalfields in January 1850, using a chloroform soaked handkerchief. Each of them was convicted and transported for fifteen years. There was the case of, Charlotte Williams, who robbed a man on London Bridge using chloroform on a handkerchief. She was also convicted and transported for ten years, although there was no conclusive proof before the court that chloroform had, in fact, been used. In addition to writing to Campbell, and publishing erudite articles in medical journals on the subject of crime and chloroform, Snow published his comments in pamphlet form and his views were brought to the notice of a wider audience through the columns of "The Times."

Snow complained that if the Campbell Bill became law, numerous false and frivolous charges would constantly be preferred against innocent people or against guilty people who were in fact blameless of administering a volatile narcotic by inhalation. He felt that a drunken man could use the excuse when robbed, and he was convinced that in the case of the two women transported, the cases had not been proved. Despite Snow's protests the intrepid Lord Campbell did not alter his stance, and the Bill became law the following session as the Prevention of Offences Act. Ten years later, the Offences Against the Person Act was passed which superseded the Campbell Act, but still making it an indictable offence to use chloroform or attempt to use it "or any other stupefying to overpowering drug"…

This setback did not, however, deter Snow from his continuing researches at the Brompton Hospital in his seemingly unending quest for the perfect anaesthetic. At this hospital, he carried out his experiments with morphia and stramonium, inhaled with the aid of heat; hydrocyanic acid, and conia, inhaled at normal temperature. The results of these experiments were subsequently published in the London Journal of Medicine in January 1851. Between 1848 and 1851, Snow had published articles in the London Medical Gazette, giving results of a great number of experiments he had performed on animals. From these he determined the proportion of various anaesthetic vapours in the blood during the different stages of insensibility.

Snow proved that the quantity of vapour in the blood necessary to cause any particular degree of anaesthesia bore a constant relationship to the quantity that the blood would dissolve. As a result he formulated what became known as "Snow's Rule", namely that the more soluble a volatile substance, greater was the quantity required to produce a given effect. Snow was an inveterate experimenter. When trying out various gases for anaesthetic purposes, he first ascertained the boiling point of the substance under investigation, then the point of saturation of air with the vapour at different temperature; then the effects of inhalation of the vapour by animals and finally the quantity required to be inspired with the air breathed to produce insensibility.

When Snow found a gas which produced insensibility well in animals he tried it to its extremes in animals of different kinds. He observed that death in extreme cases resulted primarily from cessation of the heart or the respiration. Once he was satisfied that a substance had possibilities through animal experimentation he then tried it out on himself. His friends frequently protested to him o over the risks he took with this self-experimentation although they admired his courage and enthusiasm in his quest for the perfect anaesthetic. As might he expected their entreaties fell upon deaf ears. Snow knew what he was about and he considered that these initial personal trials were part of his duty to suffering humanity. Snow had never performed experiments on animals without very carefully mitigating the infliction of unnecessary suffering.

After some five years of research, Snow was able to publish in the London Medical Gazette in 1851 his observations on the physiology of anaesthesia. Snow was so skilled in discerning the properties of volatile agents that given the boiling point of any chemical substance he could predict whether or not its vapour would produce narcotism when inhaled. Among the many substances with which he experimented were carbonic acid, carbonic oxide, cyanogen, hydrocyanic acid, Dutch liquid, ammonia,

nitrogen, amylovinic, ether, puffball smoke, allyle, cyanide of ethyl, chloride of ether and other compounds.

Snow was endeavouring, to put it in his own words, to "seek a narcotic vapour having the physical properties and practicability of chloroform in its physiological effects but resembling ether in not producing paralysis of the heart if there was an accident of administration". By this time Snow was famous as a professional anaesthetist in London. He worked for many of the leading surgeons in London at their operating sessions at the great hospitals and in private practice. His name was kept constantly before the medical profession through his many articles published in the medical journals…

Yet it came as a big surprise to him one day in April 1850, when a messenger from Buckingham Palace called at his modest home in Frith Street, Soho. Apparently, the medical staff of the Royal Household was anxious to know if Snow would be available to give an anaesthetic, if required, at the impending birth of Queen Victoria's latest child. Nothing came of the inquiry and the child, Prince Arthur, was born without Snow's intervention. Around 1850, Snow made the acquaintance of a remarkable young medical man who was to take the keenest interest in his work and carry the torch for him after his death. He was twenty-two years old, Benjamin Ward Richardson, who was to make a name for himself as a physiologist, anaesthetist, public health pioneer and Snow's first biographer. The influence of Ward Richardson on Snow, and vice versa, cannot be too strongly stressed and hitherto this aspect of Snow's life and career has not been explored in any detail. Snow, normally a diffident, private individual who made friends with great difficulty, found a soul mate in Richardson, probably the first since his friend of his student days, Joshua Parsons, who had left London many years previously.

Snow and Richardson had similar backgrounds and interests. Both came from the provinces, were former apprentices and dedicated vegetarians and teetotallers. Born in Somerby, Leicestershire in 1828, Richardson, after an apprenticeship to a local surgeon, entered Anderson's College, Glasgow in 1847 as a student attending lectures by the famous anatomist Robert Knox. Whilst a student in Glasgow, Richardson was one of the first to witness a surgical operation, under ether anaesthesia at the Royal Infirmary. Richardson developed an illness, whilst in Glasgow, which caused him to move South where, although not yet full qualified, he worked as an assistant to general practitioners in Saffron Walden, Narborough, near Leicester, and finally Barnes, around 1849.

It was whilst Richardson was at Barnes that Snow first met him. Richardson was working for a well-known local practitioner, Dr Robert Willis, who had a large number of wealthy and influential patients, but unusually for pupils, Richardson did not live in with his master but had a small house of his own in Mortlake. The precocious young Richardson, who intrigued both Willis and Snow with his great enthusiasm for physiological experimentation, had set up a small laboratory adjoining his bedroom, which had shelves of bottles of specimens, chemicals, apparatus, a good microscope and a balance and an old electrical battery, which Benjamin Franklin had used for his London lectures in the previous century.

Willis dubbed this little laboratory "the life shop" and it naturally aroused a great deal of interest among the more progressive and scientifically minded medical acquaintances. When Richardson had completed his daily rounds as Willis' assistant, the prescriptions dispensed and the days work entered in the ledger, he retired to his laboratory to continue his researches into chemistry, physiology and anaesthetics. Willis would enter the laboratory and watch the experiments and help when necessary. As soon as he heard of Richardson's unusual dedication to science, Snow and a Dr Edward Crisp, both of London, travelled to Mortlake to Richardson's laboratory whenever they could find the time from their own practices. They discovered that in addition to his equipment, Richardson had a good scientific and medical library. The young medical scientist investigated many cases and often had as many as twenty specimens in bottles on his shelves, Snow frequently making his observations on them.

Richardson's early contact with ether, the first anaesthetic used in Britain, aroused in him a keen interest in anaesthetics, an interest he shared with Snow, who by that time was an acknowledged authority on the subject. He and Snow collected and tested many substances with narcotic properties between the years 1850-8. Richardson toured many English hospitals and calculated that the average death rate from chloroform was 1 - 2,500 cases. A committee was set up by the Royal College of Surgeons to discover a way of preventing deaths from chloroform in operations.

One of research projects carried out by Richardson at Mortlake was into the effects caused by the smoke of the Puff Ball or "Devil's Snuffbox," which in its dry state was used by surgeons to stem haemorrhage. He found that it produced unconsciousness in many lower animals and he performed operations on them under its influence. Richardson read a paper on the subject to the Medical Society and the vapour, which was analysed by Snow, Thornton Herapath of Bristol and Richardson himself, was found to contain the narcotisic agent carbonic acid. From this, Richardson subsequently developed his famous lethal chamber for animals, one of which was set up at Battersea Dogs' Home in 1883, a notable humanitarian piece of work.

Whilst at Mortlake, Richardson had been studying hard for a degree and he gained the MD of St Andrews in 1854. Whilst at Mortlake, Richardson had become a welcome figure in the gypsy's colony on Barnes Common, which he visited both in his medical capacity and at someone deeply interested in people. In 1854, he moved from Mortlake, having gained his qualification as a physician, into London where he was to work for forty years. He had already made the acquaintance of several of the leading medical figures of the metropolis, including Richard Bright, Benjamin Brodie, William Fergusson and Richard Owen. Richardson undoubtedly owed his ability to enter these lofty realms as a mere provincial unknown, to his master Willis, who was distinguished in London medical circles. Willis once said he took on Richardson as his assistant because he wanted "an old young man" for his practice, one of the best in the south. Whilst he was at Mortlake, he became friendly with George Cruikshank and Thackeray at a literary club and maintained his connections with authors and journalists for the remainder of his life.

Richardson moved to London to take up an appointment at the Blenheim Street Dispensary and two years later held similar posts at the Metropolitan, Marylebone and Margaret Street Dispensaries. In 1856, he became physician to the Royal Infirmary for Disease of the Chest. This same year, he married a young woman, Mary J Smith, whom he had come to know in Mortlake, and they eventually had two sons and a daughter. A year earlier, he had founded and edited the Journal of Public Health. Between 1854-6, he lectured on forensic medicine and became the first lecturer in public hygiene and physiology at the Grosvenor Place School of Medicine, which adjoined St George's Hospital. He eventually became Dean of the School, which was closed down in 1865.

It was through his studies into anaesthetics, including alcohol, which converted him to temperance, for which he was an ardent campaigner along with Snow. Both Richardson and Snow were involved in "the sanitary idea" and were friendly with Chadwick and Farr. After Snow's death in 1858, Richardson carried on his friend's work into anaesthetics and produced a useful modification of a chloroform inhaler. Snow was very proud of his young protégé, when he received in 1854, the Medical Society of London's Fothergillian Gold Medal for his essay on "The diseases of the foetus in utero." Two years later he won the Astley Cooper Prize of 300 guineas for his essay on coagulation of the blood. Richardson ran a prosperous private practice from his home in Hinde Street and later Manchester Square, where John Hughlings Jackson "father" of British neurology had his home.

He was fascinated with the experiments of James Arnott, who had deadened parts of the body by the application of ice and salt to provide local anaesthesia. These were the first experiments with cold, as a means to providing anaesthesia, and therefore is an early example and method leading to modern cryo-surgery. Richardson tells us: "I described my ideas to Dr Snow who obtained for me carbonic acid, like fine snow, which so benumbed that it would have done for what I wanted but for the circumstance that it was too active; it not only benumbed and froze, but it sometimes killed outright." He tried to improve on the method by using narcotic liquids.

He invented a very useful ether spray, which was initially used successfully for dental extractions and then in an operation on a young man at the Great Northern Hospital, when surgeon William Adams successfully gouged out a carious part of his tibia without incurring any pain. The results of this operation soon became widely known and many surgeons turned up at the next operation by Adams using the Richardson spray. Richardson used it with success in a caesarean section performed by Dr Grennhalgh. Richardson says: "In a few months, use of the spray became almost universal, operations of a very formidable character being performed under it". But all this was long after the death of his friend John Snow. He had an inventive and original turn of mind. He produced various pieces of apparatus, including a double valve inhaler, the leather mouthpiece for which was made by a local shoemaker. Its use for operations showed that the tube running from the instrument which "answered well" to the other bottle was too narrow and was not "agreeably adaptable to the mouth."

He usually consulted Snow over his inventions, and when he showed his double valve inhaler, the older man added a larger tube and "other useful details."

The indefatigable Francis Sibson, took up Richardson's invention and replaced the hard leather mouthpiece with a thin lead piece. This change gave rise to the Sibson Inhaler, using Snow's wide diameter tube, and was adapted by Snow for his own chloroform flask. Richardson's brilliance was recognised by the award to him of the prestigious Fothergill Gold Medal of the Medical Society of London, of which both he and Snow were members. He now held various honorary appointments including that of Physician to the Royal Infirmary for Diseases of the Chest, in City Road, the Metropolitan Dispensary, the Marylebone and Margaret Street Dispensaries. In those places he gained an enormous experience of medical work among the very poor, as did John Snow and they compared their findings. Both men reached high office in the London Medical Society each serving as a President. Snow was denied official recognition despite his services to the Royal Family, but Richardson was knighted in 1893.

To sidetrack for a moment; Joseph Lister, pioneer of antiseptics and asepsis, used Richardson's hand operated spray when he was called to the Palace, to lance an under-arm abscess which was troubling Queen Victoria. Lister, himself no mean innovator, saw a way of using the rubber tube leading from the spray to the hand bulb as adaptable to make a new type of drainage tube for operations. This became the precursor of the familiar rubber drainage tube henceforth used so widely in British surgery. Richardson's active mind took him into some strange by-waters.

He tried to achieve painless operations by using a faradic electrical current, but without any real success. Then he invented a powerful light to try to see through the human body using magnesium ribbon. This too was unsuccessful, but he did have the satisfaction of living long enough to see the inception of Rontgen's X-rays in the year of his death in 1896.

Not long before Snow's death, Richardson, who was taken with the advantages of Laennec's stethoscope invented in Paris in 1819, formed a London society, which he called the Society for the study of chest disease." Snow, whom Richardson several times described as "a genius," joined him in social evenings at each other's home in turn. Snow's in Sackville Street, and Richardson's in Hinde Street. A number of London's best-known physicians and surgeons attended these "working teas." Richardson says: "We met in the evenings at each other houses in turn and partook of tea and light refreshments, and then proceeded to work.. Most of us, if not all, were engaged in hospital practice. We were able to request some patients to come to us, and the case was carefully examined and by this means the patient benefited by our combined experiences, as we were by our observations."

Through this remarkable clinical exchange a great many physicians, deeply interested in chest diseases, were bound together including Richardson, Snow, William Baly, who was tragically killed in a railway accident in 1861, Francis Webb, Andrew Clark, Francis Sibson and Risden Bennett. It would be interesting to know if other specialities were discussed in domestic circumstances, such as these. Enough has been said on, Ward Richardson, to demonstrate his remarkable Catholicism in medical matters, without referring in detail to his other interests outside medicine, such as archaeology, cycling, writing poems and songs. How did such people find the time and energy!

## 12

## CHOLERA
## The Third Outbreak 1854

Britain's third, and in many respects, the most spectacular outbreak of cholera, reached its shores in August 1854. On this occasion London bore the brunt of the epidemic, sustaining over half of the total deaths in the country as a whole. As on previous occasions, it was the poor folk who were hardest hit. In London the worst affected area was Soho, an area well known to Snow, who had lived there for several years, Southwark and Lambeth on the south of the Thames. Snow later described this outbreak as "the most terrible outbreak of cholera which ever occurred in this Kingdom."

The 1854 outbreak started quietly enough, with a few sporadic cases near Golden Square, Soho, during the latter part of August, the first appearing on 18 August with a terrifying force. On the last day of the month there erupted an outbreak of cholera, which took everyone by surprise, including Snow who had experience of the two previous outbreaks. The outbreak was quite beyond the resources of the local medical fraternity. They were unable to cope adequately with what turned out to be the most horrifying days in British epidemiological history. Within two days, 197 people had died from the disease and over a period of ten days in the Golden Square area alone, no less than 500 inhabitants succumbed.

Snow was astonished at the speed at which the disease spread among the people living in an area, which was after all, only about 250 yards. Snow commented on the remarkable suddenness of the eruption and its spread thus: "Mortality in this limited area probably equals any that has ever occurred in this country, even the Plague, and it was much more sudden as the greater number of cases terminated in a few hours."

He agreed with fellow practitioners that mortality would have been much greater had not so many people fled the district when the first cases erupted. People with furnished lodgings left first, followed by those who fled their premises and found other accommodation. Snow noted that many houses were closed, owing to the death of the proprietor and small and large tradesmen sent away their families. In less than six days from the onset of the epidemic the most afflicted streets were deserted by three-quarters of their inhabitants.

Snow, however, along with a loyal band of colleagues, stuck to their posts and remained in the area visiting affected homes and treating cholera victims. They looked askance on the more fashionable physicians who had fled London with their wealthy patron-patients. In contrast, Snow, and some other

valiant doctors worked round the clock giving no thought for their own welfare. Some of them, sadly, died as a result of their labours.

Happily, Snow survived to make a meticulous survey of every household in the area in which cholera occurred, to which he was called or referred by other general practitioners.

Snow immediately set to work to find the cause of the rapid spread of the disease, which had struck people from all walks of life, from the gentlefolk to the street sweepers. Snow quickly realised that it all depended on which water supply they received in their homes, out of two main suppliers in the Soho district area of the capital.

Snow in his customary, thorough manner, trudged the streets in the place he once lived in, knocking on doors, asking questions, seeing the sufferers unmindful of any personal risk. He had a job to do and was oblivious to any infections that might be around him. He discovered, during his tour, one very important factor. During the first month of the epidemic, 286 people died in houses supplied with water by the Southward and Vauxhall Water Company. Only fifteen people died in homes supplied by the rival water suppliers, the Lambeth Water Company, whose pipes went down the same streets as the Southwark company.

Snow, investigating the involvement of these two companies in water supplies to the area, discovered that the Southwark and Vauxhall company supplied water to 40,000 homes, and the Lambeth company to 26,000 dwellings. Snow calculated that cholera was fourteen times more fatal in the homes supplied by Southwark company than those taking water from the Lambeth company. It is however, the Broad Street pump incident for which Snow is best remembered, although it was only one episode in his long campaign against cholera.

Between 1832 and 1849, many changes had taken place in water supplies in London, including the formation of the Southward and Vauxhall water company, which took its water from the Thames at Battersea Fields, about half a mile above Vauxhall Bridge. The Lambeth water company then obtained its supplies from opposite Hungerford Market, and they had a small reservoir at Brixton.

The river, however, had become heavily polluted due partly through an increase of population and the abolition of cesspools and the almost universal adoption of water closets in their place. The Thames, in 1849, was more impure at Battersea Fields that it had been in 1832 at London Bridge. In 1850, a Dr Hassall published his results of a microscopic examination of the water supplies in London, which clearly demonstrated that the water supplied by companies on the Surrey side of the capital, namely Southwark, Vauxhall, and Lambeth was by far the worst of all supplies from the Thames.

The Lambeth company heeded the warning and wisely moved their waterworks to Thames Ditton in 1852, where the water was free from the London sewage. By 1849, the Chelsea water company had rendered their water, to a great extent of innocuous, though careful, filtration and reservoirs. But the Southwark and Vauxhall company continued to draw water from grossly contaminated river water, regardless of the risks. Their profit motive was paramount.

Snow was not alone in discovering that the Southwark and Vauxhall company's water was severely contaminated. Sir John Simon, London's medical officer, made his own tests on the water and described it as "the filthiest stuff ever drunk by a civilised community."

The Lambeth company might have shared the vitriolic attack with its competitor had it not, two years earlier, fortuitously moved its water works from Lambeth to the rural area of Thames Ditton. Due to this move their water was free from the contamination of London's sewage.

Snow, who had the experience of the 1832 and the 1848 cholera epidemics behind him, set about tackling this latest outbreak with fantastic devotion, and boundless energy. He took upon himself the formidable task of following up every case in which someone had died from the disease, in the areas served by both the Southwark and the Lambeth water companies, a huge area in which in part was occupied by both companies.

He was fortunate that he was able to compile comparative mortality figures in south London, because in certain streets badly affected by the epidemic the water mains of both companies ran down those streets, whether they served the wealthy or the poor. In his book on cholera, published in 1855, Snow observed: "No experiment could have been devised, which would more thoroughly test the effect of water supply on the progress of cholera…" no fewer than 30,000 people of every age and occupation, of every rank, were divided by Snow into two groups.

The Broad Street outbreak was the first indication of the virulence and catastrophic proportions of the latest epidemic. The street is today called Broadwick Street, and it has altered a great deal since Snow's days. The infamous Broad Street pump, has gone and in its place stands a pleasant public house named, The John Snow. It is ironic, because Snow was a lifelong teetotaller, but ever a practical man he would have enjoyed the joke.

The 500 fatalities all occurred within 250 yards of the Broad Street pump, close to the junction of Cambridge Street and Broad Street. It was several days before the true gravity of the outbreak in the

area became obvious. As each day went by the number of dead and dying swelled to alarming proportions.

By 30 August, only twelve people had died in the previous twelve-day period, which lulled the medical men into a false sense of security, but the picture changed dramatically the following day, when fifty-six people died on that one-day.

On 1 September, the number of dead rose to 143 and the following day 116 died. Thereafter, the daily fatalities decreased until they reached single figures by 10 September. Two days earlier a total of 523 had died from the disease.

Snow says that as soon as he encountered the terrifying loss of life from cholera on the night of 31 August - 1 September in that area, he suspected some contamination of the water, of the much-frequented pump in Broad Street:

"On examination of the water on the evening of the third of September I found so little impurity in it of an organic nature that I hesitated to come to a conclusion." Snow, however, was not easily diverted and he made further detailed inquiries and tested the water during the ensuing two days. He now found that the samples varied in the amount of organic impurity, which on close inspection was visible to the naked eye."

These findings compelled Snow to visit the General Register Officer, where he sought permission to make a list of deaths from cholera registered during the week ending 2 September in the Soho area, including Golden Square, Berwick Street and St Ann's districts. He found that eighty-nine deaths had been registered during that week in the three districts, seventy-nine of them on Friday and Saturday. He deduced from these figures that the outbreak started on Thursday.

Snow, visualising the vindication of his theory that the disease was water borne, immediately went to the Golden Square district and was astounded to find that nearly all the deaths had taken place among those living within a short distance of the Broad Street pump. In fact, he visited homes and found out for himself that sixty-one of the dead had used drinking water from the pump. In Snow's words: "The result of the inquiry then was that there had been no particular outbreak or increase in cholera in this part of London, except among persons who were in the habit of drinking the water of the pump well."

Snow then describes how he went along to the meeting of the Board of Guardians of St John's parish, which included Golden Square, on Thursday 7 September and requested an audience. There was nothing dramatic about the incident, as it often suggested in modern reports of the Golden Square pump episode. They granted his request and Snow quietly and determinedly explained to the incredulous meeting what he had found, and that in his opinion the culprit responsible for deaths from cholera in many cases in their parish was the Broad Street pump.

The guardians were convinced by Snow's sincere argument and they saw to it that the pump handle was removed the very next day. It should be made clear that contrary to some romantic tales about the Broad Street pump, the epidemic did not then cease forthwith. Snow never claimed that the removal of the pump handle stemmed the cholera epidemic in the area at peak.

The figures showed that such a contention was false. In fact, when the pump handle was removed the epidemic was already on the wane.

During his researches, Snow discovered that in addition to those who had died in their homes during the weekend of 2 September, a number of people had died in the Middlesex and other hospitals. The total number of deaths, he found, for 1and 2 September , was 197.

Broad Street was, of course, only a small patch of ground affected by cholera and Snow soon widened his researches to take in the whole of south London. He found other factors, which needed to be taken into account, as for example, that contaminated water might be taken with whiskey; meals in taverns, drinks in public houses, coffee shops and the like. A most disturbing discovery was that children liked water better than any other drink. Apparently, according to some parents, their children "could not be kept away from the water butt." One mother of a child who died from cholera told Snow: "She used to drink a great deal of that water. She was big enough to reach the butt herself."

Snow found out from the owner of a coffee shop, frequented by mechanics in the Broad Street area, that water from that street's pump was placed on the tables at lunchtime. The proprietor told Snow that she knew that nine of her customers had died from cholera. In some local sweet shops the water was mixed with a powder and sold as "Sherbert."

These dozens of unfortunate victims were however scattered over an area of activity, industrial and private. Snow wanted to see for himself the effect of the epidemic on a large concentrated community. He went along to the workhouse in Poland Street, which runs into Broad Street. The workhouse was surrounded, on three sides, with houses in which people had died from cholera. Yet, out of the 535 inmates of the workhouse, who were living cheek by jowl in by far from ideal conditions, only five contracted cholera and died.

Snow discovered that the reason for this slight mortality rate in a closed community was due to the fact that they took their water from their own pump well, which took water from the Grand Junction

Waterworks. The inmates had, therefore, no occasion to use the Broad Street pump nearby. Had they done, so Snow estimated, at least 100 of them would have perished.

Snow's next port of call in Broad Street was a brewery, for he wanted to test for himself the theory he had heard that no brewery worker had died from cholera in the locality. The brewery owner told Snow that over seventy men were employed on the premises but non-had had cholera. His employees were evidently allowed a ration of malt liquor, and in addition, they had access to a well in the brewery yard. They never used the Broad Street pump.

Yet, more research needed to be done and Snow went along to various business premises in Broad Street, including the percussion cap factory at no thirty-seven where 200 people were employed. Two tubs containing water were kept on the premises. The water was drawn from the Broad Street pump, and as a result, sixteen men and two women employees, who had drunk some of the water, had died in their own homes from cholera.

Snow was adept at getting other doctors to give him information on their cholera cases, and his friend and personal doctor, Mr John Marshall, the surgeon who had tended him in an earlier illness, gave him some interesting information about seven workmen employed by a dental mechanic in Broad Street. They had died, he found, after drinking water from the street's pump. They had usually drunk half a pint once or twice a day.

Another of Snow's contacts, Dr Fraser, told him about a man from Brighton, who visited No 6 Poland Street to see his brother, who was ill with cholera. By the time he got there his brother had died. It was 1 September, the peak of the epidemic, and although he was only in the house twenty minutes, he unwittingly signed his own death warrant. He took a hasty snack in the house, eating rump steak and washing it down with a tumbler of brandy of water. As might be guessed, the water was from the Broad Street pump nearby. The man went to Pentonville the next day and twenty-four hours later had died from cholera. Undoubtedly, the oddest case, which Snow encountered, was that of the widow, who liked the Broad Street pump water. The woman had formerly lived in the street and had developed a strong liking for the pump water. When she moved to another part of London, she arranged for bottles of the water to be delivered to her new home daily. On 31 August she drank her water as usual, but forty-eight hours later, she was dead from cholera. A niece who was visiting her also drank some of the water and she too later succumbed to the disease.

Snow was quick to point out that there were too many people who had drunk the Broad Street pump water, who had not contracted the disease, but he added: "This does not diminish the evidence respecting the influence of that water." The disease was no respecter of persons, well to do and poverty stricken alike, succumbed. It all depended on where they obtained their water, not where they lived or in what type of property. Snow found that out of 600 people who died in the Soho area, 100 of them were members of families of tradesmen and semi skilled occupations. Some 105 victims of the disease were taken to local hospitals and died there. Snow commented: "The greatest portion of the persons who died were tailors and other operatives, who work for shops about Broad Street and Regent Street, and the wives and children of the operatives. They were chiefly living in rooms which they rented by the week."

Snow, by drawing the attention of the authorities and individuals to the origin of the communication of the disease, saved countless lives and understandably was hailed as the hero of the epidemic. Of him, Ward Richardson said: "No-one but those who knew him intimately can conceive how he laboured, at what cost, and at what risk. Wherever cholera was visitant, there he was in the midst. For the time he laid aside as much as possible the emoluments of his practice; and when, even by early rising and late taking rest, he found that all that might be learned was not, from the physical implied, within the grasp of one man, he paid for qualified labour."

Richardson rightly forecast that cholera would one day be altogether banished from civilised countries, and that Snow had played a vital part in this. When Snow embarked on his study of the epidemic in the Broad Street area, he found his task was made that much more difficult, by the fact, that two different water companies had their mains running down certain streets, sometimes close together. The companies were the Lambeth company, whose supply came from the relatively uncontaminated Thames at Thames Ditton, and the Southward and Vauxhall water company whose supply was from the grossly contaminated Thames in the city centre.

The districts which suffered the most in the 1853 outbreak, were Southwark, Bermondsey, St Ann and Rotherhithe, whilst the least affected were Holborne new river, Strand, Hampstead, and Lewisham which did not have one death from cholera.

Snow noted that over 300,000 people of all ages, occupations and circumstances lived in the area supplied by the two water companies, whose water supplies went to houses large and small, serving families ranging from the wealthy to the poorest. Snow commented: "As there is no difference, whatever, either in the houses of the people receiving the supply of the two water companies, it is obvious no experiment could have been devised, which would more thoroughly test the water supply on the progress of cholera than this."

Snow was referring to the fact that he could discover how many folk died from cholera, which were on the books of one water company, as compared with those customers of the other company in the same streets where the pipes ran alongside. Said Snow: "To turn this grand experiment to account, all that was required was to learn the supply of water to each individual house, where a fatal attack of cholera might occur." And this he set about to do. He worked untiringly to carry out his "grand experiment." He grasped the opportunity to "make the investigation myself in order that I might have the most satisfactory proof of the truth, or fallacy, or the doctrine which I have been advocating for five years. I had no reason to doubt the correctness of the conclusions I had drawn from the great number of facts already in my possession. But I felt that the circumstances of the cholera poison passing down the sewers into a great river and being distributed through miles of pipes, and yet producing its specific effects, was a fact of a startling nature, and of so vast importance to the community, that it could not be too rigidly examined, or established on too firm a basis."

As soon as time and opportunity presented themselves, Snow availed himself for the help of the General Register Office, asking them to supply him with the addresses of people dying from cholera in those districts, supplied by both the Southwark and Vauxhall and the Lambeth water companies. In mid-August, 1854, he set to work in the Kennington sub-district of Lambeth. He found that up to 12 August, there had been forty-four deaths from cholera in the thirty-eight houses supplied by the Southwark and Vauxhall company, but only four deaths in the homes supplied by the Lambeth company.

> Snow told William Farr, the government statistician of his findings, and Farr requested all registrars in the southern districts of London to report the water supply of every house in which people were attacked by cholera, and where there was a death, after 26 August.

In the meantime, Snow was hard at work talking to householders and local doctors in Lambeth, Southwark and Newington. In these districts the water supplies came from both water companies and Snow found it far from an easy task to identify their customers. Some tenants could not remember the name of their supplier, others did not want to tell, for fear of the supply being cut off, and then there were the tenants who did not have water from either of the two companies, but from some private well. His task was becoming so tedious that Snow almost, in despair, cast around for some chemical that would separate the water from each company.

He perfected a test-using nitrate of silver, which helped in his quest to distinguish the water belonging to one company from that of the other. He enlisted the aid of apothecary, John Joseph Whiting to carry out similar tests in Bermondsey, Rotherhithe, Wandsworth and other areas supplied by the Southward and Vauxhall company, during the period 8 July to 5 August 1853.

Snow discovered that during the year 1853, the Southwark and Vauxhall water company supplied 40,046 houses, in which there were 286 deaths from cholera during the first month of the epidemic. The Lambeth company supplied 26,107 homes in the same period, with only fourteen deaths. This startling contrast was immediately pursued by Snow. It meant that cholera was 14 times more fatal, at this period, among those households taking water from the Southward and Vauxhall company, than those who were supplied by the Lambeth company. Snow observed:

"It is extremely worthy of remark, that whilst only 563 deaths from cholera occurred in the whole of the metropolis in the four weeks ending 5 August, more than half of them took place amongst the customers of the Southward and Vauxhall company and a great portion of the remaining deaths were those of mariners and persons employed amongst the shipping in the Thames, who almost invariably draw their drinking water from the river".

Snow investigated workhouses, prisons and orphanages. He found that in Stoke Newington workhouse, there were only two deaths out of the 650 inmates. Those premises took their water from Thames Ditton. There was only one death in Lambeth workhouse, which accommodated 1,000 people and their water, too, was from Thames Ditton, the source used by the Lambeth water company. At St George's workhouse, Southwark, which obtained its water from the Southward and Vauxhall company, six inmates out of 600 died from cholera before 26 August, when the epidemic was only one third through its course.

He knew that Bethlem mental hospital, Queen's Prison and another penitentiary with deep wells on their own premises, scarcely suffered at all from cholera in the 1849 epidemic, and no deaths at all were reported in 1853 outbreak. Snow says: "On the north side of the Thames, the mortality seems to have been influenced more by relative crowding and want of cleanly habits of the people, and by the accidental contamination of the pump-wells, than by the supply of the water companies."

Snow had a difficult time trying to convince the medical fraternity that cholera was, in fact, water-borne. Few were convinced at the time. "Medical men are not yet generally convinced that the disease is actually communicated from person to person, by the morbid matter being swallowed in the drinking water; otherwise, if the effect of contaminated water be admitted, it must lead to the conclusion that it acts by containing the true and specific cause of the malady."

Snow at this early stage realised that some microscopic influence was at work but was unable to make any real headway with the limited scientific knowledge of the day. Events had to wait upon, Ribertv Koch's discovery of the causative organism, the cholera vibrio.

"All the evidence proving the communication of cholera, through the medium of water, confirms its communication in the crowded habitations of the poor, in coal mines and other places by the hands getting soiled with the evacuations of the patients, and by small quantities of these evacuations being swallowed with the food." Snow reported.

He further observed: "The duration of cholera in a place is usually in a direct proportion to the number of the population. The disease remains but two or three weeks in a village; two or three months in a good-sized town, whilst in a great metropolis it often remains a whole year or longer."

He also noted the greater prevalence of the disease in the summer months when a much greater quantity of was being drunk, and usually, un-boiled at that. "It is not unlikely that insects, especially the common house flies, aid in spreading the disease" Snow commented.

Snow went deeply into the breakdown of the statistics on cholera deaths, which he obtained from the Registrar-General's office. For example, he found that out of the 334 deaths in the first month of the epidemic of which he obtained data, 286 of them were customers of the Southward and Vauxhall water company, and they included 147 males and 187 females.

Over a third of the victims were children… 127 under fifteen-years of age succumbed to the disease. On the other hand, Snow found that out of 229 deaths for the remainder of London during the same month, 140 of the victims were males and 89 females. Total casualties for London was 563, including 287 men and 276 women. He does not tell us the breakdown figures for children.

When Snow referred to the admission books of Middlesex Hospital, he found that eighty people died from cholera early in September. The greatest number of people attacked by the disease on any one day was on 1 September, when immediately after the outbreak began with 143. This was followed on 2 September with 127 deaths.

On 8 September, the day when the handle of the pump was removed in Broad Street, there were fourteen who died but four days later this had dwindled to one. One resident in the Broad Street area, told Snow that he had noticed that the water had become offensive both to smell and taste after it had been kept for about two days. Snow observed: "This, as I noticed before, is a characteristic of water contaminated sewerage."

Mr Gould, an eminent ornithologist who lived near Broad Street pump and drank the water from it, was out of town at the outset of the epidemic but returned home on Saturday morning, 2 September and sent for some water. He discovered it had an offensive smell, though perfectly transparent and fresh from the pump. Fortunately, he did not drink it. Snow was never certain whether the impurities in the water came from the sewers, drains or the cesspools. But on 12 September his next excursion was to a cholera trouble spot at Deptford. Some ninety people had died there in the span of a few days. These unfortunate people lived in about sixty small houses, at the north end of New Street and adjoining streets. It was a puzzling outbreak for their water came from Kent Water Works, and was of good quality. Snow carried out his usual thorough investigation and concluded that the outbreak was caused by a leakage of contaminated sewage, into the water pipes supplying those houses.

One of Snow's most profound statements deserves reproduction in full:

"All the instances so far described, had resulted from the contamination of a pump-well or some other limited supply of water, and the outbreaks of cholera resulting had been limited also. But when the water of a river becomes infected with cholera, evacuations emptied from on board ships or passing down drains and sewers, the communication of the disease, though generally less sudden and violent, is much more widely extended… each epidemic of cholera in London has borne a strict relation to the nature of the water supply, of its different districts, being modified only by poverty and the crowding and want of cleanliness which always attends it."

So far the narrative had concentrated on Snow's efforts during the epidemic but, of course, hospitals and doctors up and down the country were battling with the disease, although few of them ventured into the research that Snow and a few of his colleagues undertook.

The hospitals were sorely tried, taking in hordes of cholera patients in addition to their ordinary commitments. The part played during this outbreak by the ubiquitous, Florence Nightingale, is not well known but deserves a mention. During 1854, Miss Nightingale was in London on a visit to various hospitals to see for herself the nursing situation. She was only months away from her epic visit to the Crimea.

Many nurses died in their ministrations to the cholera patients in the hospitals. Miss Nightingale decided to help out at Middlesex Hospital. In no time at all she was supervising the medical and nursing care of the cholera patients there. The hospital had rapidly discharged its ordinary patients in order to take in the huge flow of cholera sufferers in the area.

They were being brought in every half hour from the Soho district, including Broad Street and according to Mrs Gaskell, who was a friend of Florence Nightingale: “the prostitutes came in perpetually – poor creatures staggering in off their beat. It took worse hold of them than any.” She tells us that Florence Nightingale was up day and night undressing them, putting “turpentine stupes” on them herself, coping with as many as she could. The women included filthy, drunken, cast-offs of society crazed with terror and pain. The rate of mortality, as might have been expected, was very high. Miss Nightingale, according to Mrs Gaskell, was never off her feet.

Two doctors at St George’s Hospital – Howship Dickinson and Henry Pitman – were typical of many hospital doctors, working in the epidemic until they almost dropped. Dickinson said that he and his colleague found themselves going round the wards “with a sort of unending revolution like a heavenly body.” And he goes on, “I shall never forget how quickly the beds were emptied by death and quickly refilled by those soon to follow their predecessors.”

No doubt the doctors welcomed the bottles of port and sherry supplied daily to them on the orders of the hospital authorities, during the epidemic.

The early weeks of the epidemic had so alarmed the local authorities in the Soho district that they set up a special committee to investigate the outbreak, and they appointed a small team of investigators to carry out a door-to-door survey of the area, bearing a questionnaire for the occupants of the cholera affected houses. The team included four doctors, two clergymen and a layman. Snow and his friend, Edwin Lankester were part of the medical element.

Lankester had a similar early background to that of Snow and was about his age. He too had trained as a doctor through provincial apprenticeship. A close friend of novelist, Charles Dickens, he lived in Golden Square, one of the worst hit districts in the epidemic. He was to make his name in the realm of the public health and wrote regularly on health and medical reform in Dickens’ newspaper, The Daily News.

Next to Snow, he was the most outstanding medical scientist of the day. He was to gain high honour, something Snow never courted or achieved, for Lankester was elected a Fellow of the Royal Society. An expert microscopist, he lectured for a time in anatomy and physiology at the Grosvenor Place Medical School. His expertise, in the examination of samples of water under microscope, was of immense help to the team’s investigations.

He confirmed Snow’s claim that the Broad Street pump was a focal point in the outbreak in that area. A portly, genial character full of bonhomie in contrast to Snow’s rather gloomy, reserved, introspective character, Lankester was a great admirer of Snow and fully supported his theories concerning cholera. The team eventually published their controversial report. It interested medical men but seemed to convince few. Views on it changed, however, when an entirely independent investigator, The Rev Henry Whitehead, corroborated the team’s findings.

Whitehead lived in the Broad Street area, and took a keen pastoral interest in the parish. He was also something of a scientist, and almost in parallel with the special team headed by Snow and Lankester, he conducted his own private survey of houses in the parish. He found that out of 896 people he checked, a total of ninety had died from cholera. An interesting piece of information came from Mr J York, a surveyor who opened up the Broad Street well and found that the main drain from No 40 Broad Street was only two-feet-6inches from the well, which supplied drinking water, and nine-feet-two-inches above the level of the water in the well. The discoloration of the soil and the “washed appearance” of the gravel, he said clearly indicated an avenue of pollution.

With the local authority report and Whitehead’s independent survey before them, the Board of Health had to sit up and take notice, particularly when both sets of investigators pointed to the Southward and Vauxhall water company as the culprit for the contaminated water.

In the House of Lords, grave dissatisfaction over the state of sanitation in London, was expressed by members, in light of the startling reports. Lord Normanby, had ten years previously, warned of the conditions saying that the greatest outcry would have come about had any owners of plantations in America housed their slaves in such a residences, as he had seen in the area around the Houses of Parliament. But no one had seriously heeded the peer’s comments.

What chance had Lord Normanby of impressing upon the House his views of London’s sanitation when in 1854, such eminent public health figures as Sir John Simon and Edwin Chadwick, brushed aside Snow’s theory that cholera was water borne, in favour of their miasmatist theories. In fact, four years later, Simon referred to Snow’s theory as, “Dr Snow’s peculiar doctrine as the contagiousness of cholera.”

Following the report from the special committee in the Soho area and that of the Rev Whitehead, there was an outcry, as one might have expected, from the factions with vested interests in water supplies in the capital. The waterworks companies were up in arms. They saw financial disaster facing them by severe condemnation of the Southward and Vauxhall company’s water supply. They feared orders for closure from the Health Board, until they carried out vastly expensive remedial works. Snow

was unconcerned over their protestations and during 1854, contributed four important and widely read papers to the Medical Times and Gazette, relating to the cholera epidemic. These articles were a precursor of his most famous work, published the following year entitled, "On the mode of communication of cholera," which was actually the second and much enlarged edition of his earlier slim volume with the same title. The latest work was 162 pages long. Sadly, it made little impression on the medical and public health fraternity. Snow was, indeed, a man out of his time.

Although 300 copies of the book were printed, only fifty-six were sold, and included among these were over a dozen copies, which Snow himself donated to his friends! The book sold at 10s 6d a copy and the end result was that Snow's financial reward for this important work, which had taken up so much of his time and thought, was a paltry £3.12.0.

A preserved ledger of Churchill's shows that it cost £9.13.6d to advertise the book in various medical journals and the cost of printing was £200. Snow must have wondered if it was all, worthwhile, because his first book, entitled, On the inhalation of the vapour of ether in surgical operations, published by Churchill in 1847; an eighty-eight-page book, was priced at 3.6d a copy and only 126 copies were sold.

One can understand the reluctance of medical men to buy the Ether book, published so soon after the introduction of an anaesthetic, which had all but been superseded a year afterwards by chloroform, which in many ways was a superior drug.

Snow probably accepted that rapidly changing circumstances at that period resulted in this book failing to attract the attention and sales he had hoped for. But he must have been much saddened over the failure of his book on cholera, considering the medical problems presented in three major epidemics in only twenty years. Despite its poor sales, the book is a classic even today. All Snow's epidemiological work is contained in this book on cholera, which explains forcibly that the spread of cholera during the 1854 outbreak, had nothing to do with "noxious air," but that it was an affection of the alimentary canal. Also, the violent vomiting and purging led to the ultimate collapse of the patient and unless curbed, ended in death.

Snow writes: "The morbid material producing cholera must be swallowed accidentally, for persons would not take it intentionally."

He stresses the importance of cleanliness and simple hygiene, and of the high risk of infection spreading among the poor, because of overcrowding and poor lighting in their hovels, where washing facilities were totally inadequate, if not absent. He said contamination was spread from person to person by hand to mouth, which he claimed, explained the relative immunity of medical men, who washed frequently during the day and never ate or drank anything in the homes of their cholera patients. The poor, however, were not the only victims say Snow. Even the wealthy could be at risk. "There is often a way open for it (cholera) to extend itself more widely and to reach the well-to-do classes of the community. I allude to the mixture of the cholera evacuations with the water used for drinking and culinary purposes, either by permeating the ground and getting into the wells, or by running along the channels and sewers into the rivers from which entire towns are sometimes supplied with water."

Snow was not oblivious of the fact that outbreaks of cholera occurred in places, which were a considerable distance apart, without the aid of human contacts or water, and that insects might be carriers, especially the common housefly. He was to be proved right, once Koch had postulated his germ theory some twenty-six-years later. But his book on cholera, instead of selling widely as he had hoped, merely had the effect of attracting to him such epithets as "defender of nuisances."

Peter Esmond Brown in his article, "Another look at John Snow" thinks that Snow's book failed because as he says "it was not worth buying". He claims that Snow's theory of the transmission of cholera was arrived at "almost intuitively," that it caught him unprepared and showed up his weaknesses. He says that whereas Snow's theory might be good the book, which put if forward, was "very bad." He seems to think that, Benjamin Ward Richardson did his friend, Snow a disservice in over-stating his case and qualities. One person who appreciated Snow's work, however, was Bristol's Dr George Budd, who had been sent a complimentary copy of the book by Snow. Budd carefully studied the book and wrote, as follows, to the author on 3 January1855:

"My Dear Dr Snow

I beg you will accept my best thanks for the copy you have been kind enough to send me of the second edition of your book. I believe that you have made out much that is true respecting the propagation of cholera and wish out Military Commanders in the Crimea could be persuaded to act upon the suggestions rendered by it, and earnestly try to arrest the pestilence instead of folding their hands, as people did under similar calamities, in the Dark Ages."

Dr Budd's references to the Crimea reveals the bitterness he felt over the Army, having ignored the proposals to prevent cholera, submitted by his gifted brother William Budd, who was a friend of Snow and a London physician of note.

William Budd had based his recommendations on Snow's observations on the disease, and sent them to military authorities, the previous August, without success. It is a pity the Army failed to heed Budd's recommendations, for during spring 1855, the disease swept through the Army in Crimea. Records show that 2,689 cases of cholera were reported, at that period, with a horrifying death list of 1,610, a mortality rate of almost sixty-percent. The epidemic was with them until the following March and precious little was done to mitigate this disastrous outbreak.

During summer, 1855, every military unit suffered, and yet most of their medical officers adhered to the ridiculous theory so widely held, that the disease was transmitted directly. To them water had no significance.

Lt General Sir Neil Cantlie, in his excellent two-volume work "A History of the Army Medical Department" says this of the Crimean campaign:

"It might have been hoped that Dr Snow's experiment of August, 1854, when he proved that cholera was transmitted by infected water, would have been taken to heart some six or nine months later, but its significance appeared to have been missed, even by that usually sound scientific observer the Director-General…"

The Director-General was Sir Andrew Smith, but he cannot be excused for his solemn rejection of Snow's proposals, which were sent to him with a trenchantly worded letter by William Budd, in December 1854. Budd had suggested that the excreta of sick soldiers and their clothing should be disinfected or destroyed, and that a pure water supply should be ensured.

In uncharacteristic manner, Smith brushed aside Budd's recommendation telling him that his medical officers in Crimea, "knew perfectly well what is most calculated to maintain the health of soldiers in camp and musters; and are equally well acquainted with the means most likely to arrest the spread of the disease."

Smith's touching faith in his medical officers was not borne out during the ensuing six months. Many lives would have been saved had Sir Andrew Smith, acted on Snow's writings on cholera, or on William Budd's impassioned plea to him to order certain precautions to be put in hand in the Crimea. Yet Smith showed unerringly good judgement when it came to supplying the Crimean troops with the latest medical and surgical appliances. In fact, in November 1855, he ordered a consignment to be sent to that theatre of war, including Snow's improved chloroform inhaler for anaesthesia, and electro-magnetic coil machines "for the stimulation of weakly patients receiving chloroform;" some washing machines and Liston splints. The kindest thing that can be said, about Smith's attitude to Snow's anti-cholera measures, was that he had a "blind spot" when it came to preventive medicine.

It is remarkable how Snow managed to find the time for all his activities outside his clinical and anaesthetic practices. By 1855, he was counted as one of the most active members of several of London's leading medical societies, including of course his favourite, the Medical Society of London, the Medical and Chirurgical Society, the Pathological Society, the Epidemiological Society and the British Medical Association. What is more he was a frequent lecturer and commentator at all of them.

On 10 March, 1855, Snow received a high honour, which he cherished for the rest of his life. He was elected President of the Medical Society of London, an office he apparently carried through with great success. At the Society's annual dinner he spoke feelingly of his own career and professional strife. He said what success he had enjoyed in his career had originated in his acquaintance with the Society.

Next to this society Snow, had the highest regard for his membership of the Epidemiological Society, founded five years earlier on the initiative of a Mr Tucker with Snow's help. Snow was a member of the Society's council and a frequent contributor to its transactions. He often found himself at odds with fellow members over his highly individual, and to some, eccentric, ideas, but he always retained their friendship. The position Snow adopted with regards to epidemiologist, was original and in direct opposition to the views of many eminent men, like John Simon, Chadwick and Edmund Parkes, to mention but only three, in the field of public health where they enjoyed considerable scientific and political influence.

Even his good friend and admirer Richardson, on one occasion with carefully controlled exasperation declared:

"I must admit that Dr Snow's views on the spread of epidemics were extreme in character, but from the slight which they too hastily received, these were not, I believe, properly understood."

And none more controversial than Snow's declaration to the Medical Society of London, that the origins of various morbid growths such as cancer, he believed, were all of local origin; that they arose in the parts of the body where they were found, from some perversion of nutrition and that the constitutional effects were secondary to, and dependent on, the local disorder.

That same year that he was elected President of the Medical Society of London, Snow, with his newly found authority, went to the Houses of Parliament to give evidence before a Parliamentary Select Committee on the public Health Nuisances Removal Bill. He told the committee, in no uncertain

manner, that the current and largely accepted "Miasmatic" theory, that bad smells carried disease, was "bunkum."

Snow told the MPs: "Whereas, a bad smell could not, of itself, give rise to a specific disease, so offensive industries conducted in a place away from it (the disease) should not be proceeded against by the ordinary law." He denied that blood poisoning could be caused by inhaling air, contaminated by putrid matter, which subsequently brought a sharp rejoinder from Wakley and his "Lancet".

The Journal commented:

"Dr Snow claims to have discovered that the law of the propagation of cholera is the drinking of sewage water. His theory of course displaces all other theories, which attribute to the great efficacy in the spread of cholera to bad drainage and atmospheric impurities… the fact is that the well, whence Dr Snow draws all sanitary truth, is the main sewer. His specus or den is a drain… he had fallen down through a gully hole and has never since been able to get out again…"

The Lancet was not alone in attacking Snow over his dismissal of the miasmatic theory. His evidence on the nuisances Removal Bill gave comfort to the factory masters and back street industrialists, but drew sharp criticism from newspapers and various social welfare experts. His evidence before the select committee was interpreted by the newspapers as "encouragement, or perpetuation, of certain offensive trades and acts and occupations injuries to public health."

Among individual assailants was Edwin Chadwick, who should have paid more attention to the article that Snow contributed to the first issue of "The Sanitary Review" entitled "The comparative mortality for town and rural districts." At about this time Snow was busily investigating the adulteration of bread with alum. During this busy year in his life, Snow also contributed various articles to medical journals, including the cholera outbreak among troops in Crimea; the causes and prevention of deaths from chloroform; and the "supposed influence of offensive trades on mortality", a successor to Charles Turner Thackrah's pioneer work on a similar topic published in Leeds twenty-three-years earlier.

The 1848-9, cholera outbreak had brought a blast of criticism from the public who were outraged that more had not been done by the health authorities. They were admirably supported in their demands for something to be done by Snow himself, Southwood Smith, and that indefatigable battler for children's welfare Lord Shaftesbury. Against formidable opposition from industrialists, landowners and reactionaries in Parliament they achieved notable success in the public health field. The first shot in the battle to improve living conditions for ordinary folk came in the mammoth report, published by the Board of Health, concerning the 1848-9 outbreak in which it was noted that, contaminated water might have been responsible for the spread of disease as far as Bermondsey was concerned, but taking the matter no further. Snow must have been gratified to read that piece in a government report, considering his fight with their Health Board members in the past, over the Masmatist theory they had adhered to with determination.

The official, who went out of his way to help Snow in his cholera, investigations was William Farr, who admired Snow's work and the admiration was mutual. Farr had noted that high areas of land had suffered less from cholera during the outbreak, than the low-lying parts. Although, this theory was subsequently found to have little substance in practice, it was only part of Farr's excellent statistical work that encouraged Snow to investigate every conceivable aspect of the outbreak. During the autumn of 1849, Snow published his first book, a work on cholera, a thirty-two page booklet entitled On the Mode of Communication of Cholera, which was to be the one which his great work on cholera, published six years later, would be based. Although a slim volume, the work is notable for Snow's brilliant analytical methods at a time when medical statistics were very much a hit and miss affair, although later improved immensely by Farr's pioneering work in this field.

The book on cholera was sandwiched in between Snow's voluminous writings on anaesthetics. His cholera treatise attracted a good deal of attention from the medical profession and rightly so, for it was the first thorough study of the disease in this country based on painstaking research on a scientific basis. It was the first public revelation of his theory, that cholera was water borne, and which later became known as "Dr Snow's Theory." Considering that the large majority of medical men still adhered to the time honoured Masmatist theory of disease, it is not surprising that, although many of his colleagues found his book on cholera interesting, they were unconvinced. Furthermore, Snow's temperament and timid personality was not conducive to his launching a campaign on his theory, against the immensely powerful and tough Miamatist lobby.

Snow's theory was as follows: "Innumerable examples show that cholera can be communicated from the sick to the healthy. Diseases which are communicated from person to person are caused by some material, which has the property of increasing and multiplying in the system of the persons it attacks."

The theory continues: “This material, or morbid matter, may be transmitted to a distance, for example, on soiled linen; in other words proximity to the patient and to his ‘emanation’ is not essential. Cholera invariably commences with an affection of the alimentary canal. It follows, that the morbid material producing cholera, must be introduced into the alimentary canal, and not through some other system, for example, the lungs.”

From this statement of the thinking behind Snow’s theory, it is obvious that he was demolishing the Miasmatist theory, and although it may be difficult to appreciate the position in which he found himself, in light of today’s medical and scientific knowledge, there is no doubt his declaration that cholera was water borne was nothing less than a bombshell in the medical world. A bombshell, which disturbs existing comfortable theories, held by the majority, does not normally become seriously considered. And that happened to Snow, his theory was noted and then shelved, following the 1848-9 epidemic. Nevertheless, the book brought his name to the forefront of London’s medical world, and ensured that he was now recognised as an original thinker. Its publication did more than that, however, it prepared him for the next cholera onslaught in 1854.

This is not to say that Snow did not have followers of his theory, he did, and a considerable number but scattered throughout the country. They too saw the sense of his proposal, that the cholera contaminated faeces of patients, could in turn contaminate the public water supply, where there was some leakage or link between those supplies and the sewage, and give the disease to the healthy who used those water supplies for drinking.

Snow’s little book, On Cholera, received a mixed reception on its publication. Some of the medical journals approved its message, but others were not convinced that it took the medical profession any further. For example, the Lancet, said of it: “His views must be received with great limitation,” yet went on to urge its readers to study Snow’s observations for themselves.

The London Medical Gazette, to which publication Snow was a regular contributor, was kinder to their correspondent saying: “Dr Snow strikes out a new path.” But they added that the booklet did no more than “raise a probability.” We do not know how Snow received this scepticism over his theory, but he must have been pleased to obtain support from an unexpected source, the leader of the Brisolian Fungus theory supporters, Dr William Budd, a distinguished local physician.

But Snow, in characteristically modest manner, had acknowledged already that his book with it revolutionary water transmission theory, was his own idea in these words:

“These opinions respecting the cause of cholera, are brought forward not as matters of certainty, but as containing a greater amount of probability in their favour, than any other in the present state of our knowledge.”

In his book, Snow tells us: “the disease is found to spread most, where the facilities for this mode of communication are greatest – among the poor, eating, living and sleeping in cramped and crowded quarters. In the better kind of houses it hardly ever spreads from one member of the family to another. Want of light in some of the dwellings of the poor has often been commented on, as increasing the prevalence of cholera. Deficiency of light is a great obstacle to cleanliness; it prevents dirt from being seen and it must aid very much the contamination of the food with cholera evacuations. On the other hand, the post-mortem inspection of the bodies of cholera patients has hardly ever been followed by the disease, this being a duty that is necessarily followed by careful washing of the hands; and it is not the habit of medical men to be taking food on such an occasion.”

Here, Snow pre-empts the aseptic methods of nearly half a century later and particularly those of Semmelweiss, without appreciating the true significance of the hand washing ritual, he mentions concerning post-mortems! Snow further said this of cholera: “If the cholera had no other means of communication… it would be constrained to confine itself chiefly to the crowded dwellings of the poor, and would be continually liable to die out accidentally in a place, for want of the opportunity to reach fresh victims; but there is often a way open for it to extend itself more widely, and to reach the well-to-do classes of the community. I allude to the mixture of the cholera evacuations with the water used for drinking.”

Snow wrote: “Cholera travels along the great tracks of human intercourse, never going faster than people travel and generally more slowly.” And he added: “In extending to a fresh island or continent, it always appears first at a seaport. It never attacks the crews of ships going from a country free of cholera to one where the disease is prevailing, till they have entered a port, or had intercourse with the shore.”

Snow was impressed with the contents of a forgotten dissertation by a Dr O’Shaugnesssy, published after the 1832 cholera outbreak, in which were set out, analyses of blood samples of cholera victims. A similar approach was to be adopted by Parkes and Garrod, sixteen years later. Their findings, however, were more thorough and exact in their report published in the London Journal of Medicine in May 1849, they demonstrated that whereas water in blood of a healthy person was on average 785 points in 1,000, in the blood of a cholera patient it was down to 733 points. Dr Garrod felt that a chemical analysis would determine whether or not a blood specimen was from a cholera patient. Also, he and Parkes

discovered that the amount of solid constituents of the blood, relative to the water content, increased from the normal 215 points in healthy people to 267 in cholera patients. They also analysed the cholera patients' evacuations.

In September 1849, at about the same time as Snow's booklet on cholera, Budd has published a book entitled "Malignant cholera, its mode of propagation and its prevention," drawing upon the results of the 1832 epidemic in Bristol. He was convinced that the cholera organism was ingested into the intestines, and that such organisms were taken into the body from the air, food, but principally through infected drinking water. Although, this set up the argument that Budd had discovered, that cholera was transmitted through water, Budd himself always awarded priority for the discovery to Snow, for his slightly earlier publication of the fact.

When the cholera fungus theory, championed by Budd, Baly, Gull, Swayne and Britton was eclipsed, Snow's own theory suffered as a result because it involved the medium of water. It took Snow some time to recover from the effects of the destruction of the fungus theory, although, we have no evidence that he at any time supported that theory. To be fair to Snow, his views on contagion were derived from his hero Liebig, whose influence on this thinking he acknowledged on a number of occasions. His later concept of molecular changes bore the stamp of Liebig's theories. The fact that he did not adopt the fashionable fungus theory probably saved his reputation, but the final solution had to wait upon Koch's discovery of the vibrio cholera.

About this time, numerous theories were advanced as to the possible causative factor of cholera, including animalcules and fungi, bad smells, a specific but unidentifiable poison, electricity, ozone and zymotic or humoral involvement.

## 13

## The Most Terrible Outbreak

During 1854, John Snow was in an excellent position to test his theories on cholera, which in fact, were little different from those he had entertained in 1849. He was however now in a position to embark upon more intense research and gather evidence in support of his theories.

Broad Street, not far from his home in Sackville Street, happened to be the centre of what Snow dubbed "the cholera field," and the scene of an incident, which to this day is linked with his name – the Broad Street pump affair. The so called "cholera field" was bordered by Great Marlborough Street, Dean Street, Brewer Street, King Street, and within this small area, there erupted, what Snow himself described as, " the most terrible outbreak of cholera which ever occurred in this Kingdom."

There were over 500 fatal cases in this small area alone within a period of ten days. Yellow flags, warning of the pestilence, were put up in the streets and shop windows. Broad Street, for example, was filled with placards relating to the epidemic and precautions to be taken. Everywhere instructions from the new Board of Health were posted in shop windows, churches, chapels, schools and on walls. The streets ran awash with pungently smelling lime, put down by the parish authorities, which each evening, washed down the roads and streets with this powerful disinfectant.

Armed with the names and addresses of the first eighty-nine cases provided by his friend William Farr, director at the General Register Office, he set off on his painstaking door to door inquiries, again completely oblivious of any personal risk he might be running of contracting the disease himself. He quizzed the households on the dates of onset of the disease and discovered that between 19 and 29 August, there had been nine fatal cases. On 30 August, there were eight, but by the following day, 31 August, Snow was

appalled to find the total deaths had suddenly shot up to fifty-six, and by the next day 143. On 2 September, the total moved down slightly to 116 fatalities, and from this crisis point the number of deaths declined to five by 11 September.

Snow found that between 30 August and 11 September, there had been a total of 540 new cases, but from 12 to 30 September, only twenty-two, so it appeared that the epidemic was at last petering out. He discovered in his inquiries that nearly all the deaths had occurred within a short distance of the Broad Street pump. He estimated that at least sixty-nine of the victims had drunk water from this well-known and popular public water source. Thus began the saga of the Broad Street pump.

His suspicions over this pump were immediately aroused, as it supplied a large number of households in the neighbourhood. On 7 September, he went to St James parish vestry, where he knew the Board of Guardians were sitting. After some initial difficulty, he managed to persuade them to remove the handle of the Broad Street pump, which was within their jurisdiction, and so was born the legend of John Snow and the Broad Street pump.

It is sad to demolish a nice little legend, but in fact, when Snow demanded that the pump handle to be removed, the epidemic was already on the wane and it rapidly diminished following the removal of the handle. Nevertheless, many lives must have been saved by that cavalier action on the part of Snow.

The St James Guardians were, however, not prepared to accept everything John Snow had told them and so they set in motion their own investigations into the Broad Street Pump. They sent an engineer to examine the foundations of the pump at the suggestion of that public health pioneer Edwin Lankester, who, incidentally became the first Medical Officer of Health for St James district.

The guardians set up a committee of inquiry which, laudably included John Snow and twenty-nine-year old, Rev. Henry Whitehead who had, with commendable foresight and courage, made his own door to door inquiries into the cholera outbreak on the same lines as Snow. He was much concerned over the epidemic among his parishioners. He was serving his curacy at St Luke's in nearby Berwick Street, which was part of the Broad Street district. Like Snow, as he went on his rounds making voluminous notes at the various households, he also gave selfless attention to the sick and bereaved in those households.

Strangely enough, Whitehead was not overly impressed with Snow's arguments concerning cholera contained in his book, "On Cholera," published in 1853. He told Snow that in his opinion an intensive inquiry would reveal the falsity of Snow's attribution of the spread of the disease in their district to the Broad Street pump.

It was stating the obvious when the investigating committee finally, having read Whitehead's report and that of Snow, came to the conclusion that the cholera outbreak in the Broad Street area was "in some manner attributable to the use of impure water of the well in Broad Street." Whitehead, in his report, generously admitted that Snow had been correct all along. He praised his methods and his work during the outbreak.

Many years later, in 1874, some sixteen years after Snow's death, Whitehead, speaking at a dinner, told the guests: "Dr John Snow was a great benefactor, in my opinion, to the human race as has appeared in the present century."

No greater accolade could have been bestowed upon any one, than this spontaneous tribute from a man, who at one time demonstrated the greatest scepticism of Snow's theories. It was a generous gesture. Whitehead had grown to admire the quiet little man from Sackville Street. He once described the, "calm, prophetic way in which he spoke of the ultimate result of his doctrine on cholera." And of the time, Snow told him: "You and I may not live to see the day, and my name may be forgotten when it comes, but the time will arrive when the great outbreaks of cholera will be a thing of the past, and it is the knowledge of the way in which the disease is propagated, which will cause them to disappear." And of course, he was subsequently proved right.

Incidentally, Whitehead kept a portrait of Snow on his study wall for many years after the doctor's death to, "remind him of his friend's outstanding research work which saved so many lives."

He thereupon embarked upon his own investigation of the Broad Street pump and the area around. How he managed to find the time from his pastoral duties is intriguing, but then the Victorians managed to do a great deal when one studies the lives of professional men.

In 1854, he finally published his own account of the Broad Street area epidemic with the title, "The Cholera in Berwick Street." It was a carefully researched and objective report, in which he mentions that there was "no panic" among the people living in the area, which was virtually decimated by the disease. He described the epidemic as, "limited in its extent, brief in its duration, and continually, on the wane from the moment of its appearance." That is precisely what Snow, too, found in his researches. Whitehead was aided in his work by the local surveyor, Mr M J York who on opening up the Broad Street well found that the main drain from Nr 40 Broad Street, was only two-feet-six-inch from the well and nine-feet-two-inch above the level of water in the well. The discoloration of the soil, and washed gravel, indicated an avenue of pollution.

Whitehead must have been dismayed when he came to write his report for hitherto, he had not given credence to Snow's theory, that contaminated water from the well was the bete noir in the local cholera outbreak. Now he admitted ruefully: "Slowly, and I may add, reluctantly, I found that the use of this water (Broad Street pump supply) was connected with the commencement and continuance of the outburst." Whitehead had been shaken to find that out of the 896 residents of the area, ninety had died from cholera.

Despite both reports of Whitehead and Snow indicating the Broad Street pump as the source of the virulent outbreak of cholera in the area, the Medical Committee of the General Board of Health remained unconvinced, and sent three Inspectors to the district for yet a third report. And as staggering as it might appear now, they rejected out of hand Snow's explanation of the outbreak commenting: "After careful inquiry, we see no reason to adopt this belief (Snow's contention that the source of the infection was the pump)…"

Snow and his fellow investigators were puzzled initially, that the outbreaks in the district, which seemed to spread from person to person, yet left some like himself and fellow medical visitors to affected families, untouched. And furthermore, variations in the prevalence of the disease, in a particular locality, simply increased their bafflement.

A wide variety of contributory factors were put forward and some local authorities blamed low-lying spots and filthy environments. They failed to notice, however, that cholera did not spare some of the well-to-do areas, and the homes of the wealthy. Farr stressed the importance of elevation and drainage and climatic conditions were of absorbing interest to other investigators.

As a result of his intensive investigations and research, John Snow reiterated what became known as "Snow's theory," which he had first advanced in tentative form as long ago as 1849.

He set out his theory as follows: "that cholera propagates itself by a 'morbid matter,' which passing from patient in his evacuations is accidentally swallowed by other persons as a pollution of food or water, that an increase of the swallowed germ of the disease takes place in the interior of the stomach and bowels giving rise to the essential actions of cholera, as at first a local derangement and that the 'morbid matter' of cholera having the property of reproduction its own kind must necessarily have some sort of structure, most likely that of a cell."

Many could not accept the Snow theory, including Sir John Simon, who described it rather patronisingly as, "a peculiar doctrine." Neither could Florence Nightingale or Edwin Chadwick. And they were not alone among the eminents in the medical world, who held tight to the "Miasmatic" theory. It was not until Pasteur in the 1860s and Kock in the 1880s that the "Snow theory" was verified.

Simon, for example, for some time considered that Snow's theory "lacked scientific verification," and was like many others who supported the "sanitary idea" of the view that the Snow theory was inimical to the cause of public health, because if people accepted that poisoned air was not the cause of cholera as they proposed, then the authorities would stop cleaning the streets of filth.

Wade Frost comments, however: "John Snow's analysis of the epidemiology of cholera, was nearly perfect and led him to the confident conclusion that the specific cause of the disease was a parasitic micro-organism now know to be Vibrio Cholera."

He comments: "His argument has the permanence of a masterpiece in the ordering and analysis of a kind of evidence, which enters at some stage and in some degree, into every problem in epidemiology." But it took Snow a long, dreary path to discover what has, since Pasteur's day, been directly observed through modern bacteriological methods.

Snow would however have been the first to admit the debt he owed to his friend, William Farr at the Statistics Office. It was the dedicated and industrious Farr who produced, for Snow's information, statistics relating to the epidemics of 1848/9 and 1853/4. Snow used the information to the best possible advantage and as a result many lives were saved.

Wade Frost says that Snow's account of the cholera outbreak in his second edition of, On Cholera, should be read, "once as a story of exploration, many times as a lesson in epidemiology." A Bradford Hill, writing in the Proceedings of the Royal Medical Society in 1955, describes Snow's, On Cholera, as a "classic that must always fascinate and inspire the student of epidemiology and preventive medicine."

The essential difference between the first and second editions of Cholera is that the larger, 1955 edition, contains a great deal of new evidence, including the analysis of mortality, as related to several water supplies of parts of London in the 1832, 1849 and 1854/5 outbreaks.

In October 1856, Snow published what amounted to an addendum to his second edition of On Cholera. It was a nineteen page paper in the Journal of Public Health and Sanitary Review entitled, On Cholera and the water supply in the South districts of London, in 1854.

About the same time, statistics of the people using the two main water supplies in the southern districts of London were published in a report following an official inquiry, conducted by the General Board of Health, which confirmed Snow's findings and demonstrated his knowledge and mastery of statistics, aided and backed by Farr.

Snow's proposition that cholera was due to a specific microorganism, and propagated in the human intestinal tract, and disseminated by ingestion of excreta was not new. Several medical men of the period had a similar view, but had not persisted with the theory and developed it to the extent that Snow achieved. Evidence that his theory, was an advancement on the current propositions, can be seen in the practice of his medical contemporaries to refer to his theory as, "Dr Snow's Theory." In lectures and discussions, his theory was quoted as authoritative.

Snow explains his theory of dissemination of cholera in water in the first edition of his book, On Cholera, published in 1849 as follows:

"Many medical men… admit the influence of the water, without admitting the special effect of the new element introduced into it – viz., the cholera evacuations, in communicating the disease.

"They look upon the bad water as only a predisposing cause, making the disease more prevalent amongst those who use it – a view which, in a hygienic sense, is calculated to be to some extent as useful

as the admission, of what I believe, to be the real truth, but which, I think, will be found to be untenable, when the circumstances are closely examined."

After Snow's evidence indicting the water supply of the Southwark and Vauxhall Company had been published, none but the most intransigent could deny the influence of contaminated water. And after 1856, Snow's book, and the official inquiry, left little room for argument. Whereas, most medical men accepted Snow's contention that water was the carrier of cholera, they were not so ready to accept his theory as to what was the disease element in the water. Sir John Simon, in his report as Medical Officer to the General Board of Health, concluded that, "under the specific influence which determines an epidemic period, faecalised drinking water and faecalised air may breed and convey the poison…"

Thus, Snow had still not got over to his colleagues his "germ cell theory," Even Farr was cautious over his acceptance of Snow's germ theory. But even twenty-years on, eminent authorities were still referring to contaminated water as "a predisposing cause" of cholera. So Snow was, as many have long suspected, a man ahead of his time.

William Budd, of Bristol, was probably the only contemporary of Snow who fully accepted his theory as well as his facts. Despite the fact that Budd, had arrived at similar conclusions concerning cholera as early as 1849, he generously allowed Snow the full credit for a more complete development of the theory.

It is said, but so often the lot of the pioneer, that his theories are acknowledged long after his death. Sir John Simon, who had so peremptorily brushed aside Snow's "pollution of water" theory during Snow's lifetime declared, thirty-two years after Snow's demise, that his theory was, "the most important truth yet acquired by medical science for the prevention of epidemics of cholera." How Snow would have loved to have heard that admission!

During his last years, Snow ploughed his lonely furrow pursuing his studies, not only into cholera, which had cleared the scene for the time being, but into other infectious diseases and also his incessant quest for the perfect anaesthetic. He used, for his research into other infectious diseases, the two principles he had established for cholera, namely that water was the vehicle of the dissemination of the specific infection, and that effluvia from dead organic matter, was of no consequence. This last proposition was hearsay in his day and brought the wrath of a large proportion of the medical profession on his head. He was unmoved. After all, he had facts and figures to back his theory. Many thought he was using them for his own ends.

But undeterred, he first showed, through his study of the Registrar-General's data, that mortality among the workers, in such notoriously offensive trades as tanning, and soap boiling, were generally no higher that in the corresponding ages in the whole group of men and boys employed in industry. He uses the Registrar-General's figures to demonstrate that, prior to improvements in the water supply of the southern districts of London, which were completed in 1855, the mortality rates from all causes were mostly from typhoid fever, typhus and diarrhoea in the area, consistently exceeded the rates in the districts north of the Thames. From the time of the change in water supply in this relationship was reversed, the rate of mortality being lower in the southern districts than in the north. Wade Hampton Frost in light of this type of study at which Snow was adept, comments: "He was a man singularly endowed with an ability to think in straight lines and had the courage to follow his own thought. In medicine these abilities placed him in the front ranks of his day; in epidemiology they carried him a generation beyond it."

P E Brown in his article Autumn Loiterer, which he felt was needed to afford some balance to the previous adulatory assessment, of Snow the man and his work, he says: "Looked at more closely, it becomes increasingly clear that Snow the epidemiologist, was in a very different position from Snow the anaesthetist. His early training had equipped him remarkably well for the opportunities presented by ether and chloroform, whilst his theory on the transmission of cholera arrived at almost intuitively caught him unprepared and showed up his weakness."

Brown goes on to say that John Snow, familiar to most readers, was "largely concocted in the imagination of his friend and biographer, Benjamin Ward Richardson." In this respect Brown has a point, but his assertion that Snow's theory over cholera transmission by water was intuitive, does not lessen the fact that he was the first positively to establish that the disease, was transmitted by water and that furthermore the disease was in the form of a, micro organism. Considering how long it was after Snow, that Pasteur and Kock, were carrying out their historic researches, Brown is scarcely fair to Snow.

The brilliant methods adopted by Snow in tackling the outbreaks of cholera in the Broad Street area, are patently visible to all who care to look at the map that he included in the second edition of this book, On Cholera. On this map, he placed black spots, marking the location of the various pumps supplying water to the inhabitants of the Golden Square area and adjacent districts, with each fatal case plotted at the place where it occurred.

As far as is known, this was the first time a spot map had been used in epidemiological researches, says Charles Edward Amory Winslow, in his book, The conquest of epidemic disease. It was not for nothing that Snow was one of the most esteemed members of the Epidemiological Society.

It must be acknowledged, of course, that Snow was feeling his way throughout the two major cholera epidemics, whereas with his research into anaesthetics he was as Brown quite rightly asserts, very well prepared for the advent of anaesthesia. Ironically, Snow is popularly remembered as the, "Broad Street Pump" hero and his tremendous work in the early days of anaesthesia is largely forgotten, except perhaps by the medical historians and interested anaesthetists.

Among the cases Snow was called in for, were hare lip, which was commonly performed, perineal incision, which was often, for venereal disease cases along with phimosis, removal of sequestra in bone necrosis, amputations of limbs, removal of toenails, tonsils, cancers of the nose, face, lios, custs and amongst the most forbidding of operations, removal of the upper jaw.

As already stated, abdominal operations were impracticable in those pre-Listerian days, but a few were in the operating lists in Snow's time, namely removal of ovarian cyst, the ovariotomy, which made the name of an obscure American surgeon, Ephraim McDowell, a Scottish graduate, when he performed it without anaesthetic in 1809, and tapping for a similar cyst. Another forty-years were to pass before surgeons felt safe in "going into the abdomen."

One aspect of Snow's Diaries stands out, namely his modest manner of entering Royal baby deliveries, alongside the cases of a coachman or street sweeper with no elaboration of the former or diminution of the latter. As an example, the entry for the day before he gave chloroform to Queen Victoria for the birth of Prince Leopald, Snow cites the case of a butler, and the entry following that of the Queen relates to "a gentleman." The twenty lines entry for the Queen is unexceptional in Snow's diaries.

## 14

## Royal Command

In 1851, the inventive genius of the British people was on display to the works at the impressive Great Exhibition in the Crystal Palace, itself a magnificent advertisement for British craftsmanship and ingenuity. The Great Exhibition, attracted visitors from all parts of the world to the twenty-one acres site, which had 17,000 exhibits, including medical and scientific apparatus.

Six million people attended the "greatest show on earth," which had been opened by Queen Victoria. The dominating theme was manufacturing with the fine arts prominently featured. One of the attractions was the famous Koh-I-noor diamond. For Snow and his colleagues, the main interest at the exhibition was in the latest scientific equipment, including anaesthetic inhalers.

During the following year, Snow made an important discovery, which for some strange reason became eclipsed by his other work. It was while he was conducting experiments into a new anaesthetic substance on rabbits, that he hit upon endotracheal anaesthesia, which many may imagine is a modern procedure. In his own words Snow tells us: "I administered the drug to a young rabbit in a jar, and then opened the trachea and tied a tube through, which the animal breathed air from a bladder until a return to consciousness was imminent, when a second bladder containing air and ten-percent chloroform vapour was substituted for the first. Meanwhile, the lungs and heart had been exposed and were under observation."

Snow's first opportunity to try out the endotrachael method of anaesthesia, came soon afterwards at St George's Hospital, where Richard Partridge operated on a four year old boy who was believed to have swallowed a button, which had lodged in some part of his air passage.

Whilst Partridge, one of the hospital's most skilful surgeons, performed a laryngotomy to find the foreign body, Snow gave the child patient chloroform using a sponge soaked in the vapour, which he held close to the tube, that had been inserted into the larynx. This historic operation signalled the introduction into British anaesthetic practice, endotracheal anaesthesia. From this rough and ready innovation, later anaesthetists developed the modern technique.

This incident was incidentally, one of those rare occasions when Snow laid aside his inhaler and used the much despised sponge, which Simpson relied on for most of his career. The inhaler was, of course, in any event, useless for this type of case. The sponge had to be resorted to in other special cases, including removal of tumours of the jaw, and it was a favoured method of inducing "twilight sleep" in midwifery.

Snow never ceased to find uses for the substances with which he experimented in his tireless quest for the perfect anaesthetic. At the end of 1851, he carried out some experiments with chloroform to help

mental patients. He knew of several cases in which the drug had been administered in acute mania, calming the patient and producing sleep.

"I have administered it in two cases with the same temporary advantage" he wrote. "In one of the cases the patient was persuaded to inhale it; in the other he had to be held by three keepers till he was unconscious."

Snow told of a well-known and eminent scientist who became insane and refused to take food. After he had been made unconscious with chloroform, he would take a meal, "just after recovering from its effects and the chloroform was given before every meal for a long time."

He describes three psychiatric cases in which chloroform was used, as a diagnostic device, to distinguish, "hysterical paralysis," from that of organic origin; to get patients who had refused to eat to take a meal after coming round from the anaesthetic; and to calm severely disturbed patients.

He records three cases illustrating the above claims. The first concerned a twenty-five-year-old, domestic servant girl, a patient of Dr Chowne, of Charing Cross Hospital, who kept her left knee in a semi-flexed position and would not allow it to be moved.

She had been in hospital for two months. Snow comments: "It was evident that there was nothing the matter with her limbs and that it was only influenced by her volition, which was prevented by the hysteria under which she was labouring." After chloroform inhalation, she recovered normal use of the limb. A month before Snow had given chloroform in the same hospital, Charing Cross, to a woman of thirty-three-years of age, who for several months had been unable to open her mouth or to speak, and had paralysis of the left arm and leg.

Chloroform proved that she was not hysterical nor an impostor and that was indeed, organically sick. In a case two years later, Snow gave chloroform to a girl of fifteen, who had distortion of the limbs and trunk, which came at the end of a long period that had begun with a fever. The chloroform administered to her showed that the disorders were not feigned, and a few weeks later the unfortunate girl died.

Early in March 1852, Snow found himself being honoured by the society with which he had had so many years connection, the London Medical Society, which had of course absorbed his beloved Westminster Medical Society. He was elected Orator, and it so happened that the year was the eightieth anniversary of the foundation of the old Westminster Medical Society. He gave his oration at a celebratory dinner at the Thatched House Tavern. Later that year, he moved from his rather cramped quarters in Frith Street, to elegant premises at 18 Sackville Street. Early in 1853, Snow received a royal summons through the palace medical staff. He was asked by Sir James Clark, Physician-in-ordinary to Queen Victoria if he would be prepared to administer chloroform to Her Majesty for the birth of her next child, which was expected in April.

Clark had been requested to arrange for anaesthesia, either by Prince Albert of Victoria or both of them. There had been a previous occasion when the question of chloroform for the Queen in labour had cropped up in the palace, namely for the birth of Prince Arthur, and Snow's name had been suggested. This proposal, however, came to nothing and Snow was not called in.

Sir James Clark was not at all taken with the idea of giving chloroform to the Queen for childbirth, but he did acknowledge that Snow was the best man for the role of anaesthetist if the Royal couple insisted. Clark was known to Snow, only through his immense reputation. He was probably the country's leading physician at the time and despite an unfortunate episode earlier in his career, he was highly regarded by the Royal Family and most of his colleagues.

A tall, distinguished figure, he had a colourful career, having originally started out on life as a lawyer in his native Scotland. He subsequently gave up this career and studied medicine, qualifying in Edinburgh. He later joined the Royal Navy and subsequently spent a short while, in practice in Rome, where he came to know the poet John Keats, himself a former medical man. During Keats' final illness, Clark was at hand to look after him.

Clark's courtly manner attracted the attention of Prince Leopold, alter King of the Belgiums, whom Clark met on his wanderings, and he was appointed the Prince's personal physician. Leopold also obtained for him an appointment as physician to the Duchess of Kent. When Victoria came to the throne, she appointed Clark her Physician-in-ordinary, and he was knighted in 1837. Although, he tended the Queen well, midwifery was not his forte.

He found himself in the midst of a storm when he was called to the bedside of Lady Flora Hastings, and diagnosed a large abdominal tumour as pregnancy. The inference infuriated the young woman's family, who demanded an official medical examination. Clark is reputed to have behaved, "most rudely," at this examination, which showed that Lady Flora was not pregnant, and indeed had a large abdominal tumour.

Clark's high handed manner over this serious gaffe, and the Queen's silence on the subject of Lady Flora's humiliation at court, brought unpopularity to the Royal Household for a time. Public opinion turned against the Queen when she refused to dismiss Clark. Lady Flora died from her condition within two years.

The scandal died down however, and Clarke's career suffered not a jot. He had an obsession about fresh air, and tried to persuade the Queen to install "air conditioning" in the Palace using an air blower, but his offer was turned down. His style of medicine was Georgian, involving blood letting purging, blisters and emetics. Clark was once described as having added nothing to medical knowledge, but that he behaved with integrity.

The Prince had undoubtedly been influenced, to a considerable extent, by his good friend and adviser, Baron Christian Frederick Stockmar, himself a former medical man, who had gained distinction as a military surgeon in the Napoleonic wars, at which period he met Prince Leopold of Coburg.

Stockmar was called in, as Prince Leopold's personal physician, to the Prince's wife Charlotte in 1817, for her first, and as things turned out, tragic and fatal confinement. Stockmar had no deep obstetrical knowledge, and after all Sir Richard Croft, the principal obstetrician attending the Princess, was a competent and distinguished midwifery expert, so he left it to him. Sadly, things went badly wrong in her case and Leopold in desperation called in Stockmar, who found the Princess dying.

He had arrived in England the previous year with Leopold, on his marriage to Charlotte, daughter of King George IV. He subsequently became the trusted advisor of Prince Albert and the young Queen Victoria. Stockmar, Albert and Victoria were not overly impressed with Clark's cautions concerning chloroform for childbirth, and having ascertained that John Snow was the leading authority on anaesthesia in London, the die was cast.

Another member of the Royal Medical Household, whom Snow came to know well, was Dr Charles Locock, the Queen's Accoucheur, the leading midwifery expert in London. He was on the staff of St Bartholomew's Hospital, a Fellow of the Royal College of Physicians, and attended Westminster Lying-in hospital. He was a staunch supporter of Florence Nightingale. His colleague for Royal midwifery was Scotsman Robert Fergusson, Professor of Obstetrics at King's College and a friend of Sir Walter Scott. He had assisted Dr Locock, at the births of all the Queen's seven children, to the time of the delivery to which Snow was summoned.

It was probably Prince Albert, who was the instigator of the idea that John Snow should give the Queen chloroform for the birth of her eighth child, because Victoria had, in the past, complained of "really very severe" pains at the births of her first son Albert Edward. Prince Albert was unusually well read for a nobleman and followed the latest advances in science and medicine with keen interest. He often discussed these topics with his closest friend and confidante Baron Stockmar, himself a physician. It is more than likely that Albert had read some of Snow's contributions to the medical journals on chloroform and its uses in midwifery, and discussed them with his wife and Stockmar.

After discussion with Clark and Locock the Prince decided to invite Snow to the Palace, to discuss the matter in more detail. Snow duly attended the Palace and gave his views to Prince Albert, who was deeply interested and well informed during a discussion, which lasted more than an hour. Impressed by his depth of knowledge and quiet, reassuring manner, the Prince told Snow he would like him to be prepared to be called to the palace, as soon as the Queen entered labour.

A little after 10.00am on 7 April, Snow received a note from Sir James Clark asking him to go to the Palace immediately. Snow gathered together his anaesthetic apparatus, the large bottle of chloroform, and the inhaler, and put them in a large bag and called a hackney cab to take him to Buckingham Palace. On arrival he was ushered in through a side entrance and escorted to the anteroom, next to the Queen's bedroom.

The medical team was assembled, Clark, Locock, Fergusson and the two midwives, the remarkable Mrs Lilly, who had attended all the Queen's confinements, and Mrs Innocent. Snow was summoned into the bedroom whilst Clark and Ferguson remained at hand in the anteroom, should their services be required in the case of any complications.

Snow joined Locock and the two midwives in the lying-in room, where he saw the Queen of England lying in her white, draped, four-poster bed. She had a cheery smile and greeting for her attendants. Snow stood at the head of the bed awaiting Dr Locock's instructions. Meanwhile, the traditional assembly of state personalities had gathered in the ante-room, including the Archbishop of Canterbury, the Home Secretary, Lords of the Privy Council, the Duke of Norfolk and a few others.

What happened next has puzzled some students of Snow's life and work. He had consistently criticised Simpson, Syme and others for using the slaphappy method of giving chloroform on a piece of rag or a sponge, yet, although he took his inhaler to the Palace, once he was called into the Queen's bedroom to administer the anaesthetic he abandoned his own apparatus and resorted to a chloroform soaked handkerchief, placed over the Queen's mouth and nose. This action led to accusations of hypocrisy against Snow for his advocating one method – the controlled, or inhaler method on the one

hand – and yet resorted to the method he criticised on the other with the most important patient in the land.

In fact, however, Snow was not being hypocritical. A careful reading of his works shows that he approved the administration of chloroform, "a la Simpson", be it handkerchief, sponge or rag, for intermittent anaesthesia in midwifery cases principally, but the inhaler in general surgical operations. Snow never took risks and one may safely assume that this approach was correct as well as efficacious.

In the early days of 1847, Snow wrote: "Where the pain is not greater than the patient is willing to bear cheerfully, there is no occasion to use chloroform; but when the patient is anxious to be spared the pain I can see no valid objection to the use of this agent, even in the most favourable cases."

The Queen, tired of the ordeal of having borne several children, desired such relief and said so, in no uncertain manner.

When Sir James Clark hesitated, expressing doubts on the wisdom of chloroform in childbirth in the presence of Victoria and her husband, the monarch interjected tartly, "We are having his baby and we are having chloroform."

The best account of the birth of the thirty-three-year old Queen's first baby using chloroform, "twilight sleep," is that of Snow himself, written in his diary in plain, unvarnished words, with no greater fuss than any other entry concerning his attendance on a patient recorded in the diaries:

"…administered chloroform to the Queen in her confinement… 12.20pm by the clock in the Queen's bedroom. I commenced to give a little chloroform with each pain, by pouring fifteen mm by measure, in a folded handkerchief. The first stage of labour was nearly over when the chloroform was commenced. Her Majesty expressed great relief from the application, pains being very trifling during the uterine contractions, and whilst between the period of contractions, 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 retarded labour somewhat. Infant was born 1.13pm and chloroform therefore inhaled for fifty-three minutes."

The baby, the future Prince Leopold, was delivered without any ill effects and became the first Royal baby ever to be born with the aid of anaesthesia. The Queen in her diary said:

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

After the delivery, Sir James Clark, who seems to have had a rapid change of heart over chloroform in midwifery, wrote to James Young Simpson, describing the successful administration to the Queen thus:

"The Queen had chloroform exhibited to her during her last confinement… It was not at any time given so strongly as to render the Queen insensible, and an ounce of chloroform was scarcely consumed during the whole time. Her Majesty was greatly pleased with the effect, and she certainly never has had a better recovery."

One of the greatest services the Queen ever did for her subjects, was to fly in the face of the opposition from the church, over the use of anaesthesia and take chloroform for the birth of Prince Leopold. Leading churchmen, and some high government officials, firmly believed that chloroform offended against the Biblical exhortation "in sorrow thou shalt bring forth children."

This attitude had been around since the discovery of ether, and Simpson, no mean Biblical scholar himself, smartly replied to his church critics: "the Lord caused a deep sleep to fall upon Adam." But, perhaps, the Queen herself established the respectability of chloroform, describing it as "blessedly." In any event, from that moment every woman in the land saw the opportunity of obtaining relief from the pain of childbirth, and henceforth chloroform administration in midwifery became known as anaesthesia, "a la Reine."

It was fortunate for Snow that, neither he nor the other medical attendants at Victoria's confinement, were aware that the baby they had just delivered was, in fact, later found to be a haemophiliac. Had this knowledge been made public shortly after the child's birth, it goes without saying that chloroform would have been blamed in light of knowledge of the disease in those days.

Had that happened, Snow would have been ruined, not to mention those eminent medical men, who had condoned him giving the anaesthetic. Snow happily never knew how near he was to disaster that day he left the palace following the Prince's successful birth.

Snow would have read, with satisfaction, the Court Circular news of the birth, which ran:

"…We understand that chloroform was administered by Dr Snow during the last part of the labour, with very satisfactory effects; and that the Queen expressed herself as, grateful for the discovery of this means of alleviating and preventing pain."

Oddly enough, The Lancet, normally in the vanguard of the latest medical developments, was extraordinarily late in publishing comments on the first Royal birth using chloroform. It took Thomas

Wakley, five weeks to say something about it and when he did it was a self-righteous attack on Snow and his followers. In The Lancet issue of 7 April, 1853, an article appeared saying:

"Intense astonishment has been excited throughout the profession, by the rumour that Her Majesty, during her last labour, had been placed under the influence of chloroform, an agent which has unquestionably caused instantaneous death in a considerable number of cases."

Wakley, who cannot have read the Court Circular, in as much as he described the use of chloroform at the Queen's confinement as, "a rumour," his article went on to describe the administration of the anaesthetic, if it were true, as "an awful responsibility." He claimed the use of chloroform in normal labour, was never justified in any circumstances.

Wakley was probably unaware that, at the time Snow gave the chloroform to the Queen, he had already deeply researched deaths from the anaesthetic and did not take on his Royal commitment lightly.

The British Medical Journal, however, had some words of comfort for Snow, for in their issue of April 15th, they reported:

*"Dr Snow administered chloroform to the Queen… for the last hour of parturition… Her Majesty was never completely insensible. Should further information be required we are confident that Dr Snow will, with his usual courtesy, afford it to all such as consider themselves entitled to ask it… we may in the meantime state, as in our own humble opinion, that the cautious inhalation of the vapour of chloroform during labour is entirely free from danger, and calculated to afford merciful relief from pain in one of the most agonising trials of humanity…"*

Snow weathered the storm well and never lost favour with the Royal Family, for four years later, almost to the day, he was again summoned to the Palace, this time to give the Queen chloroform for the birth of Princess Beatrice.

In the meantime, however, the controversy over the use of chloroform in childbirth continued unabated, and several eminent medical men were solidly against its use in midwifery.

Robert Lee, Lecturer in Midwifery at St George's Hospital, the place where Snow was a regular visiting anaesthetist, condemned the giving of chloroform to women in childbirth as, "a most unnatural practice," because it "destroyed consciousness in women during labour." He maintained, that the "pains and sorrows" of labour exerted "a most powerful and salutary influence upon women's religious and moral character and upon all their future relations in life."

In the Lancet, Lee published an account of seventeen cases, in which chloroform had been used, and had produced serious after-effects. Lee claimed this revealed the drug to be, "a treacherous gift of science," and that its use was, "an ignominious and disgraceful practice," and Lee went on to proclaim that its use was, "a systematic concealment of the truth… conceited or ignorant women of fashion, make a pastime of this as other quackeries… young and inexperienced mothers were decoyed to their destruction…"

This was by no means an isolated attack on the use of chloroform in deliveries, and many obstetricians, like Lee, shared the same views and taught their students to abhor such practices.

John Snow was not going to stand aside and allow his work over the years, to get anaesthetic accepted, to be attacked, particularly after the Queen had come out of it successfully. He wrote to the medical journals saying Lee's remarks were, "to be regretted."

He devoted less than twenty lines in his neat small writing to the event. It is, in fact, sandwiched between two of his ordinary run of the mill cases. The day after he had attended the Queen, Snow went along to Montpelier Street to give chloroform to, "a gentlemen operated upon by Mr Lane, for a cancerous ulcer on the side of his nose."

Amid the upsurge of interest in the new pain reliever shown by women all over the country, were Snow's own female patients. One of them tried to quiz Snow over his attendance on the Queen, at the birth of Prince Leopold. She demanded to know what the Queen thought of the anaesthetic. Snow demurred, but during the administration of the chloroform she became loquacious. She told Snow firmly; "I will inhale no more vapour unless you tell me what the Queen said, word for word, when she was taking it."

In his typical dry style, Snow told her: "Her Majesty asked no questions until she had breathed very much longer than you have, and if you go on in loyal imitation I will tell you everything." She followed his instructions and in a few seconds forgot all about the Queen. When she came to, Snow had already left the house for his dinner, leaving her questions unanswered!

The year 1853, was to prove of particular importance in Snow's life. He had received Royal approval for his anaesthetic skill, and had moved up in the social scale by leaving Frith Street, and taking up residence in the very fashionable and elite 18 Sackville Street. He also had been elected vice-president of the eighty-year-old Medical Society, of which Snow, was of course, a loyal member for many years.

Snow still lived the life of a confirmed bachelor, but now with his improved position, had engaged the services of an excellent housekeeper, Jane Weatherburn, who was to be with him in his final illness

and death five years later. He had a few close friends, but had never developed many social graces. His work was his life. Yet he loved children and was always pleased to be invited to friends' houses, where he could romp with the children as a genial and relaxed "Uncle John."

On one occasion he had been invited to Buckingham Palace following the birth of Prince Leopold. He was clad awkwardly, in conventional court dress, with his floppy velvet hat and breeches, stockings and buckled shoes with a sword at his side. A small child, whose family was known to Snow, cried out, "Oh! Isn't Doctor Snow pretty, mama." One of Snow's most erudite observations containing a germ of the idea, which Koch later made famous was contained in Snow's address to the London Medical Society, when he came to give his address as newly elected vice-president.

In 1853, Snow departed from his customary commentaries on observation, and experiment to speculate on the nature of the causative factor in cholera. His theories were contained in a deeply researched and brilliantly presented lecture entitled, "Continuous Molecular Changes," which was subsequently published by Churchill that same year. It was one of the most outstanding lectures to have been given at the London Medical Society for some years by the Orator.

He had spent nearly twelve months in preparing it and its content has never been properly appreciated. His paper reflects the development and contemporary ideas, which flowed from Liebig's work. Snow ranges over a wide field, far beyond a purely chemical consideration, including transference, or continuity, combustion, fermentation and heredity. One of the most interesting developments of the time is Snow's stern observation, on the responsibilities of parents in bringing up children. He explains that he chose the words, "molecular," intending to cover, "physical" "chemical" and "vital".

It is intriguing, at this distance in time, to see how close Snow was to the germ theory, and yet not equipped to bridge the gap, as did Koch and Pasteur. In his book on cholera, he commented that the material cause of every communicable disease resembles a species of living being, in that both depend on, and in fact, consists of a series of continuous molecular changes, "occurring in suitable materials." Some think he was, in fact, closer to Henle than Koch in his general theory of infection, whose views in 1840 had not been widely accepted.

Early in 1854, a further attack was launched on chloroform by a talented physician, James Arnott, a former Superintendent of the medical establishment in the colony of St Helena. It came in the form of a booklet entitled, "The Question Considered," and it aroused a good deal of interest in the medical profession.

Arnott, in his booklet, asked the direct question: "Is it justified to administer chloroform in surgical operations, after its having already proved suddenly fatal in upwards of fifty cases, when pain can be safely prevented, without loss of consciousness, by momentary benumbing cold?"

The author, was in fact, advocating the use of a new method of anaesthesia, devised by himself, and therefore he had a vested interest in attacking chloroform. In any event, it is not known where he found fourteen additional cases of deaths from chloroform, over and above thirty-six cases researched by Snow, up the end of 1853. Snow only found forty-three up to the end of 1854, and so it can only be assumed that Arnott had found others from, perhaps, foreign medical literature. Snow was not, of course, infallible and could have overlooked, say, three or four fatalities, but not as many as fourteen and he was a wide reader of medical literature, so where Arnott found his fourteen other casualties we do not know.

This apart, there is no doubt that Arnott, like some other medical men, was apprehensive over the relatively new anaesthetic and indeed he had worked on an alternative method of anaesthetic, namely the modern sounding, "freezing" method.

Arnott was no newcomer to the anaesthesia scene. As early as 1848, shortly after the discovery and use of both ether and chloroform, he had introduced freezing, or as it was known then, "congelation" in medical practice as a substitute for chloroform in particular, which he viewed as much more dangerous than ether. Many dentists adopted Arnott's freezing method in preference to vapour. His method was to mix ice and salt and he claimed it was perfectly safe when administered properly. Snow might have added, wryly, and so was chloroform!

Arnott claimed that the freezing method could be used in all external operations – and in those days surgical operations were little else but external – and for the first stage of amputations. Arnott's method appealed to Benjamin Ward Richardson, who eighteen years later designed a more convenient way of achieving the same results by freezing, using an ether spray, which could be more exactly applied to a required operation site, and could even be made to freeze the deeper structures in stages in advance of the scalpel. This, as a result, obtained more efficient anaesthesia in amputations, than was possible by ice and salt bags, said Richardson.

Arnott advocated his ice and salt method in The Lancet of 10 February 1855, as an answer to Syme's claim that heart disease was unimportant in patients receiving chloroform. Arnott said, acidly: "To kill another patient by chloroform for the extraction of a tonsil, for example, would now, as the

public is aware of its danger, be culpable homicide." Arnott was referring to four fairly recent deaths from chloroform. Challenged about his total of fifty chloroform deaths, Arnott retorted that, "many chloroform deaths in private practice were not reported."

Arnott, who was sixty, had trained in Edinburgh, studied in Vienna and Paris and had been attached to Middlesex Hospital for twenty years before moving to University College Hospital, where he lectured on surgery and also had links with King's College Hospital.

He had been President of the Royal College of Surgeons from 1850 to 1851 - and he was to occupy the same prestigious office nine years later – and was a prime mover in establishing the Licentiateship in dental surgery. He was, therefore, a distinguished and widely experienced practitioner, whose work was respected over a wide spectrum of London's medical life.

Snow, either inspired by Arnott's work in the late 1840s, or though his own initiative, also researched the freezing method of anaesthesia in the early 1850s, but from the viewpoint of a purely "local" anaesthetic. In a lecture he gave on the subject of local anaesthesia he gave in April 1854, to Physiological Society, of which he was vice-president, he referred to James Arnott's use of crushed ice and salt to the part of the body to be anaesthetised.

Snow told the meeting that he favoured using a chloroform soaked piece of lint on the operation site, covering it with oiled silk to prevent rapid evaporation. This method, however, proved unsatisfactory and Snow eventually abandoned it and continued his quest for better inhaled and locally applied anaesthetics. His preliminary work on local anaesthesia was continued with considerable success, as stated earlier by Ward Richardson, who achieved some fame for his ether spray. But Arnott may be acknowledged as the founder of modern cryo-surgery.

Snow had however, made a careful note of Arnott's pamphlet published in 1852, on the internal application of a low temperature in Asiatic Cholera, an idea foreshadowing the therapeutic use of hypothermia. Whether, in fact, Snow made use of this method in the London cholera outbreak of two years later, we do not know, but he was likely to have used anything, to relieve the suffering of hundreds in his bailwick.

It never ceases to surprise the modern medical historian how, in a period of poor communications, the news of medical discoveries and practices spread around the country and even to USA and the continent. For example, an unknown provincial surgeon who enjoyed some eminence in his own town, entered the chloroform fray with some panache, publishing a monograph on his own experiences with chloroform as a direct answer to Arnott's criticisms from the metropolis.

He was William Martin Coates, a member of a Salisbury dynasty of medical men who served their local hospital, the old established Infirmary, in an honorary capacity. Coates, who had never met Snow and was not likely to have the pleasure, nevertheless shared his anxieties and indeed those of Arnott, over the seemingly unnecessary deaths from chloroform. Arnott, in support of his freezing method of anaesthesia, had cited in both medical and lay press, the fifty cases in which the patients had died, when under chloroform, and Coates read them with horror.

Although Coates is unlikely ever to have met Snow or Arnott, he had carried on correspondence through the columns of medical journals, particularly The Lancet between 1851 and 1853, on the dangers of chloroform, although he used it freely himself.

In his interesting booklet entitled, On Chloroform and its safe administration, published in Salisbury in 1858, about the time of Snow's death, Coates, who had at one time taught anatomy and midwifery at L'ecole pratique de medicine in Paris, stated that from 1851 to 1853, through the pages of The Lancet, he had, "ventured to call attention to the fact that chloroform was being used in quantities and by methods which were dangerous to life." He added, that one quarter of the dose usually employed produced, "all the results aimed at, and lessened the perils in a proportionate degree." He deplored the fact that his method of administration had not been adopted.

Snow and Coates both adopted cautious methods in the administration of chloroform, and what is more important, made careful studies of quantitative methods and physiological data concerning the drug. Neither of them were overly pleased at Arnotts scare mongering details, of high mortality from chloroform in some London hospitals, as true as it might have been. Arnott had dealt a serious blow to users of chloroform, at a time when they felt they were gaining ground, among their fellow medical men. The Arnott revelations undoubtedly spread some alarm and despondency among doctors and patients alike. Neither Snow nor Coates were going to lie down and see chloroform blamed for situations in which incompetence and unskilled handling had a vital part to play, in the management of anaesthesia.

Following on Arnott's scare figures, which showed that, since its introduction in 1847, chloroform had increased mortality in major operations, from twenty-one to thirty-four percent in the largest London hospitals.

Martin Coates had this to say about Arnott's scare mongering:

"A great addition to the terror of the effects of chloroform, has been made by some tables published by Dr James Arnott, and very extensively circulated by the aid of the press…"

More and more patients refused to have chloroform for their operations, or refused the operation altogether, and so put their health and lives at risk in many cases. Undoubtedly Arnott's scare figures had a serious effect on anaesthetic, which was by no means universally accepted, even as late as 1858, and Arnott was, after all trying to get his own method of "freezing" anaesthesia accepted in its place, and one must remember that internal operations would rarely, if ever, be undertaken, with the exception of ovariotomy.

Coates was so incensed that he was determined to show, that even if the London hospitals had got it wrong over chloroform, a humble provincial hospital like Salisbury Infirmary had got it right, and he made a study of all cases in which chloroform was used between 1847 and 1858, and found that contrary to Arnott's experience, the Salisbury hospital had only six percent mortality from chloroform, given in amputation operations, as compared with twenty-one-percent to thirty-four-percent in the leading London Hospitals.

Yet Coates showed that prior to the introduction of ether anaesthesia, in late 1846, both the leading London hospitals and Salisbury Infirmary, had a very similar mortality rate in amputation operations, namely twenty-one and twenty-two percent respectively.

Coates had warned, as did Snow, in The Lancet in 1851 and 1853, that chloroform was being used in quantities, and by methods, which were dangerous to life. Coates pointed out in a monograph he published in 1858 entitled, On Chloroform and its safe administration, that whereas, London surgeons gave between one and two drachms doses of chloroform to patients, Coates gave a quarter less than this. He comments: "In London generally, the towel, sponge, handkerchief, lint or an instrument by which the chloroform is brought close to the mouth and nose, have been employed, whereas, we have used Snow's inhaler, in which the chloroform becomes mixed with air in due proportions." Thus, a provincial hospital saw before some of London's greatest hospitals, the wisdom of Snow's methods in administering chloroform.

Arnott, a Fellow of the Royal Society, who had joined the staff of UCH after nearly twenty-years at the Middlesex Hospital, was a forbidding figure of some standing in London medical circles, and students were said to stand in awe of him, especially on his ward round, when to be inattentive was, "as safe as if you had worried a lion loose in the ward…" A skilled clinician, he claimed that chloroform was not only immediately dangerous in operations, but that it rendered the subsequent progress of the patients less satisfactory, than when they were performed without it. Interestingly enough, he made no such derogatory remarks about ether.

It was not simply a question of over dosage of chloroform, which worried both Snow and Coates; there was also the question of the method of administering the drug.

When Coates' monograph was published, Snow had been dead for only four months. They had never met; they may have corresponded.

Coates makes several references to Snow in his monograph on chloroform. Coates, who virtually introduced the Snow chloroform inhaler into Salisbury Infirmary, saw the wisdom of careful manipulation of the apparatus saying: "It can be conceived, though with difficulty, that in the hands of the late Dr Snow, or in those of one equally experienced and intelligent, danger may be avoided by a skilful management of the valves, even when a drachms is put into the instrument; but it is evident that the great desideratum, is a method by which a person of ordinary experience and skill may employ this agent safely." And his own solution was to, "employ the smallest dose capable, of producing the desired result." This was his fifteen minims rule, with the customary one drachms or four times greater quantity, used by London hospital surgeons.

On Arnott's alternative suggestion to chloroform, "freezing" Coates comments: "When we consider that the insensibility thus induced cannot extend far beneath the skin, of what use would it be after the first incision in amputation, herniotomy or lithotomy?" His oratorical lecture was entitled, "On continuous molecular changes, more particularly in relation to epidemic diseases." This address was, later that year, published by Churchill, at the request of the Society. Dated 26 March, 1853, it only ran to thirty-eight pages, but it aroused considerable interest. In it, Snow, sets out his view that, "nothing assists the communication of disease more than the want of cleanliness and this has been particularly observed in regard to plague, cholera, yellow fever and continued fevers."

This paper had taken Snow a year to write, the longest time he had ever spent on an article or address, and was undoubtedly one of his best. It was enthusiastically received, mainly because of its originality and the conviction Snow brought to his ideas, that the poisons of intermittent fever and perhaps yellow fever and cholera, were carried directly into the alimentary system.

## The Amylene Disaster

Sometime during 1856, Snow's uncle Charles Empson in Bath, wrote to his nephew inviting him to join him in a trip to France, which he had to make, on business. Empson seems to have had some sort of British Government post; we know nothing of its nature, but it might have been diplomatic. In any event, he knew Paris very well, having made several previous trips, and this was to be the first time Snow had ever travelled abroad.

Snow readily accepted the invitation and the two men went to Paris. Empson was personally acquainted with Emperor Napoleon III, whom he had first met when, as Prince Louis Napoleon, he had, "retired" to England when persona non grata in his own country. Prince Louis, probably met Empson when the latter was living in Bath and had become a prominent citizen. Louis, who is believed to have been in Bath for the waters to treat his rheumatism, took rooms at 55 Pulteney Street. He visited various entertainment establishments during his stay, no doubt including Empson's fashionable private museum.

On arrival in Paris, Empson was treated as an honoured guest at Court, and introduced Snow, who was then treated similarly. Empson learned, during this visit, that the Institute of France, an august body of learning, was offering a prize of £1,200 to anyone who could put forward a new method of prevention or cure of cholera. At Empson's behest, Snow submitted his book, "On the mode of communicating of cholera," which had been published the previous year.

An erroneous entry in the Dictionary of National Biography over this particular prize in Snow's biography, has led to the perpetuation of a myth, still quoted today in articles on him. Sadly, Snow did not win the prize, as stated in the Dictionary of National Biography. In fact his name never appeared in the Judge's list and he received no acknowledgement for his important contribution. It was a bitter blow for Snow and Empson.

On his return home, Snow picked up the threads of the research into anaesthetic substances. His energies were directed mainly to the Dutch Liquid (Ethylene Chloride), Ethylene and Amylene, an anaesthetic hydrocarbon, this latter substance giving him the most encouragement.

He found Amylene was the easiest to administer, and seemed superior to both chloroform and ether. Unfortunately, Snow made a serious misjudgement by not accounting sufficiently for the drug's insolubility. He discovered this weakness under tragic circumstances, at a later stage in his research.

In the meantime, he enthused over Amylene, thinking he had, at long last, found the perfect anaesthetic. He had discovered that the vapour destroyed sensation without destroying consciousness. It was not a new drug, it had been discovered twelve years earlier by the French scientist Antoione-Jerome Balard, the man who had previously discovered Bromine and Amyl Nitrite.

Snow tried out Amylene on himself and animals, and found that it took about three or four drachms of the liquid to bring about insensibility, in an adult. Snow calculated that in surgical operations, an adult patient would need to inhale fifteen-percent of the vapour with air. He was interested to discover that it needed more than a double dose, about forty-percent Amylene, to produce sudden death, whereas, as little as sixteen to twenty-percent inhalation of chloroform – twice its normal strength – was fatal. Snow was so impressed with this wide margin of "safety," that he was blinded to the inherent danger lurking in the drug's insolubility.

Snow was, naturally, anxious to carry out clinical tests with his new found wonder anaesthetic, and the opportunity arose in November of that year, 1856, when he heard that two, fourteen-year-old boys needed teeth extractions at King's College Hospital. On 10 November, he went along to the hospital armed with his inhaler and a bottle of Amylene. Snow tended each youth in turn, placing his mask over their faces. He used only a few drachms of Amylene and neither boy lost consciousness. Snow records in his diary: "In neither was pain altogether prevented. The results, however, were favourable." We do not have the comments of the boy patients!

Less than a month later, on 4 December, the drug was again tried out at the same hospital. Snow again gave the gas to four patients, for the extraction of teeth. Snow reports that the results were, "perfectly satisfactory." On 11 and 13 December and Amylene was again given, in surgical operations, to treat several patients with buck-teeth (exodontia) and the results he says were "favourable."

Snow broke off his research early in April in 1857, when he was told to stand by for another summons to Buckingham Palace, for an impending confinement of the Queen. On 14 April, Snow received his summons and went to the Palace to give Queen Victoria chloroform for the birth of her last child Princess Beatrice. Unknown to Snow or the Royal Family, at that time, was that Beatrice would eventually to be shown to be a carrier of haemophilia, like her sister Alice. As it turned out, Beatrice was the most unfortunate of the family's carriers, for she had four children, including two haemophiliac

sons and a carrier daughter. It is interesting to note, at this point, that over a century was to pass before a British Queen would give birth, namely Queen Elizabeth II, with Prince Andrew in 1960.

Snow seems to have given a repeat performance of his anaesthetic administration on the first occasion, dropping the chloroform on to a handkerchief and placing it over the Queen's nose and mouth. Princess Beatrice was born without incident. This was the last occasion on which Snow was to attend a Royal birth, and it seems very singular indeed that he received not a single Royal honour for delivering two Royal babies. If anyone should have received a knighthood or some similar honour, it is John Snow. The risks he took were enormous, and had anything had gone wrong he would have been utterly destroyed and chloroform within. But the modest Snow has never revealed what his thoughts were, on failing to receive an honour. Perhaps, he placed little value on them. We shall never know.

The day following the Princess' birth, Snow was back at his laboratory bench, working on his research into Amylene.

Snow seemed pleased with Amylene, and his notes state that, "during inhalation of Amylene, the patient is often entirely regardless of the surgeon's knife, whilst the edges of the eyelids retain their full sensibility." By early 1857, Snow was convinced he had found the perfect anaesthetic – then disaster struck towards the end of April. Snow had no good reason to expect this fatality, the first in his career as an anaesthetist. Amylene, after the first dental case, had been administered in over 140 cases with complete success. Snow was a cautious man by nature, and knew of so many disastrous results from colleagues' mishandling of ether and chloroform, that he was slow to laud Amylene, before it had been well tried and tested.

Among the operations successfully performed under Amylene, had been removal of fungus of the testicle, excision of diseased glands from the groin, two of tenotomy. Then that fateful operation, at St George's Hospital late in April, when a surgeon was operating for a relatively uncomplicated case of fistula-in-ano. Snow gave his 144th Amylene anaesthetic on this occasion, without any misgivings, for it was a healthy patient, but the patient died.

The effect of this death on Snow can be imagined. He had given, in total, something approaching 4,000 anaesthetics, mostly chloroform, and now his hope for the future of anaesthetics had failed him – he was truly devastated. He derived some comfort from his work on chloroform, which so far had not let him down. By June 1857, he had compiled notes of chloroform administered to 186 babies under one year of age, which had shown no ill effects and made a similar record for older children, with their similar successes recorded. He also recorded the interesting fact that, non of the 949 patients to whom he had given chloroform in the seated position, had suffered any ill effects.

Snow's surgeon colleagues had, in the meantime, persuaded him to continue using Amylene as he had, after all, used it with complete success in 143 cases prior to the first fatality. After that fatality, Snow had gradually reduced the power of his inhaler by withdrawing some of the bibulous, or blotting paper, which soaked up and held the anaesthetic liquid. In fact, he had by this method, diminished the evaporating surface by half or less. He used his, "reduced power" Amylene inhaler for over ninety more cases, after the first death and, comments Snow: "I never had occasion to feel a moments uneasiness about it."

On 30 July Snow went along to St George's Hospital for a routine operating session by his old friend, Mr Caesar Hawkins. One of the patients was a twenty-four-year-old tailor, who had been in the hospital for several months. He had had three epithelial tumours removed in separate operations, under chloroform - the last of them being performed three weeks before 30 July.

On that day he needed a small epithelial tumour removing from his back, and he inhaled Amylene from Snow's inhaler, without difficulty, in about twenty-one minutes. He appeared to be unconscious and Snow told Hawkins he might begin the operation. Snow takes up the story from this point: "The man was lying on his right side and was turned a little more on his face, when he burst into a kind of hysterical excitement, laughed loudly, and was with difficulty held on the table. It lasted about a minute."

Snow says, after this bout subsided he gave the patient a little more Amylene, although the patient had not recovered consciousness. Mr Hawkins began the operation, which lasted only two minutes. The patient's breathing, says Snow, had "a snoring character," and he had a small pulse. Less than an ounce of Amylene had been poured out, and all of it was not used. Mouth to mouth resuscitation was used, followed by Dr Marshall's method of artificial respiration, and was continued by the House Surgeon and others for about one and a half hours, without success, the patient died.

Snow says, the crisis clearly commenced at the heart, and this was similar, in effect, to those cases in which chloroform had been the anaesthetic in a fatality. This second death under Amylene, was reported by Snow in the Medical Times and Gazette during August 1857. In it he comments: "whilst I have been very successful in avoiding accidents from chloroform, I have been very unsuccessful in

avoiding them from Amylene." He says given on a handkerchief or sponge he believed that Amylene would be safer than chloroform, owing to the greater cold produced during its evaporation.

The fact the patient was face down at the time, was dismissed by Snow, who said he had several times given Amylene and chloroform to patients who were face down, without ill effects.

He had determined the principle that the air, which the patient should breathe, should not contain more that about fifteen percent of Amylene vapour, and he had, for many years, limited chloroform to five-percent. "I still believe that if Amylene, were administered by measured quantity in a balloon or bag of known size, a sudden accident would not happen, except by measuring a wrong quantity," says Snow. But whatever faith or hopes he had for Amylene were to be dashed. It eventually disappeared totally from the anaesthesia scene.

Snow details his experience and hopes for Amylene in his posthumous work, On Chloroform, listing it with other drugs he tried out. It is difficult to see where Snow had gone wrong in his initial researches. The deaths affected him very seriously and may, in some measure, have contributed to the serious illness, which struck him down later that same year.

Richardson had his own ideas about Amylene's failure. He says: "He (Snow) had not, in Amylene, accounted sufficiently for its insolubility, and it was not until I ventured to show him the separation of Amylene in blood that he fully realised the danger."

Snow himself eventually felt that the real problem was the unstable boiling point of Amylene.

Snow, depressed and not in the best of health, felt completely disheartened over the April fatality from Amylene, but his colleagues had managed to persuade him to continue using the gas, at least until further research had been completed on its use and risks. He had, after all, used Amylene completely successfully in 143 cases before the first fatality. He had now decided to reduce the power of the inhaler by withdrawing some of the bibulous (blotting) paper, which soaked up and held the liquid anaesthetic. In effect he had diminished the evaporating surface by half or less and used this "lower power" inhaler in the ninety cases following the first death and had no further anxiety over its use. In fact, two months after the first fatality he records that he gave Amylene to a thirty-year-old army officer for operations for haemorrhoids and phimosis, performed by surgeon Henry Lee. In his diary notebook Snow writes: "Patient suddenly refused to inhale any longer as he was becoming unconscious. He was, however, persuaded to begin again after two or three minutes and was soon unconscious. As Mr Lee was stitching the wound the patient, having become somewhat quieter, suddenly jumped up, probably from the Amylene, having been exhausted. He was made to inhale a little more. He remembers nothing of this and was very cheerful afterwards."

A pretty daunting experience one might think, but the incident reveals the most uncharacteristic lapse by Snow in allowing the anaesthetic to run out as he did. Could it have been mere miscalculation, due to having to use an excess amount of the drug, or had he been ultra cautious in the initial dose?

An earlier case that day, in which Snow gave Amylene to a four-year-old boy for an operation of lithotomy, was entirely successful however. The strain of the year's heavy commitments, and the grave set back in April with Amylene, told on Snow, and he suffered bouts of haematemsis, treated by his friend Dr George Budd. In December, his health broke down altogether, shortly after he had experimented with his latest drug, Chlorate of Ethyl. This drug had proved very useful in clinical trials, when Snow gave it for William Fergusson, who operated on a young woman to remove a tumour from the angle of her jaw; for William Bowman, when reuniting a fracture of the tibia and fibula sustained by a little boy; and Henry Lees' operation on a young man's tibia.

He also gave Amylene successfully for Mr Avery, who operated on patients with necrosis of the tibia, two with harelip, two with fistula-in-ano, one with a naevus on the forehead, one for the removal of a fatty tumour and a tenotomy.

One evening shortly before Christmas, Snow was suddenly seized with vertigo and sickness and had to go to bed for twenty-four-hours. He afterwards felt better and returned to his research, much against the will of his anxious housekeeper, Jane Weatherburn.

His condition was much more serious than he had at first thought, and during the ensuing week he began to complain to Jane, and to a few of his colleagues, that he was suffering from numbness in his extremities and left hand. During the early part of 1858, Snow found that he had to take things much more slowly and he attended his beloved societies with less frequency. He had managed to complete an article he was writing on drainage and water supply in connection with public health, and this was, in fact, published in the Medical Times and Gazette in February. The following month he wrote what was to be his last article before his death. It dealt with the recent death from chloroform of a patient at Bristol, and was published in the British Medical Journal on 20 March.

During the next few months, he managed to write slowly and spasmodically the final chapters of his book, On chloroform and other anaesthetics, about which more will be said later.

On the evening of Tuesday 8 June, 1858, he went to a meeting of the Royal Medical and Chirurgical Society, and the following evening visited the home of the colourful Irishman, Dr Richard Quain, who

was a little younger than Snow and was Physician at Brompton Hospital, where it will be recalled Snow had been allowed to carry out clinical experiments with his new anaesthetic, Amylene.

Quain, a Fellow of the Royal College of Physicians, became famous for his editorship of the best selling, "Dictionary of Medicine," to which most of the leading medical experts of the day had contributed. Quain had organised that evening meeting for certain members of the Royal Medical Chirurgical Society to discuss chest diseases. Snow was in good form and took an active part in the lively debates. Colleagues were later to recall that he "looked very well."

> The day after the meeting, Snow went to bed about 11.30pm. On awakening the next morning, he complained to his housekeeper, of feeling giddy. He declined any breakfast and later went downstairs and rested on the sofa. He later ate a good meal and sat at his desk to write the final sentences of his book, On Chloroform. He had virtually completed the last line of the whole book when he suffered a severe heart attack, and fell from his chair. He lost all power in his left arm and leg, and his mouth was drawn down on one side when his housekeeper, who had heard the thud of his fall, rushed to his aid. She noticed that the last word he had written of his book was appropriately enough, "exit."

Mrs Weatherburn pleaded with him to let her summon medical assistance, but Snow refused, demanding to be helped to the sofa where he remained for the next twenty-four-hours. He complained of pain over the lower end of his sternum and tried to relive it with frequent inhalations of ether. He did not eat or sleep and his housekeeper was anxious and distressed over his rapidly deteriorating condition. At 6.00am on Friday 11 June, Snow suddenly began to wretch and vomit blood, at which point Mrs Weatherburn did not hesitate. She sent for Dr George Budd, who arrived shortly afterwards with his colleague, Dr Charles Murchison, who although was only twenty-eight-years-old, had an impressive record. A talented Edinburgh graduate, a house surgeon to James Syme and a Doctor of Medicine, he had only three years earlier returned from service as a surgeon in India and Burma, with the Bengal Army of the Honourable East India Company. He was Assistant Physician to Budd, at King's College Hospital, and was to make his name in the study of fevers and diseases of the liver.

The two physicians examined their sick friend, who had complete paralysis of the left side of the body, but no loss of sensibility. His memory and consciousness were unimpaired, but he complained of pain and tenderness in the epigastrium, and of suffering bouts of hiccups and haematemesia. Budd and Murchison decided to prescribe palliative medicine, but were privately fearful of the prognosis and Snow, himself, must have realised that his end was near.

Budd frequently called upon Snow to check his progress, and after a lapse of three days found his pulse and respiration were rapid. He had been vomiting and had hiccups and his face and extremities were livid. He had bouts of delirium, and two days later on 16 June, at 11.00 am, his breathing became stertorous and he lapsed into unconsciousness and died at 3.00pm, with both Budd and Murchison present. He was only forty-five.

Budd was a well-known London medical character. He was firty-seven years of age, a Professor of Medicine at King's College, and one of the first two physicians, who had been appointed to the new King's college Hospital.

He came from a remarkable Bristol family. He was one of the nine sons of Samuel Budd, surgeon of North Tawton, Devon, seven of whom entered the medical profession. George studied at Cambridge, in Paris and at London's Middlesex Hospital, where he was one of the first to draw the attention of the medical profession to Laennec's new invention, the stethoscope.

It was through his pioneering work on cholera among seamen, during his first years with the Dreadnought Seamen's Hospital in Greenwich, where he was a physician, that he first met John Snow. He was a brilliant teacher and an authority on diseases of the liver and of the stomach, publishing standard works on both topics.

It so happened that George's younger brother, William Budd, who was physician at Bristol Royal Infirmary in 1847, had been described as, "the new type of scientific physician." Mention has already been made of Budd and his fellow "fungus" theorists, in the chapter on the 1848 cholera epidemic. In the mid 1850s, he enjoyed a similar reputation to that of Snow, for his pioneering work on typhoid, which he found was contagious and spread chiefly through faexal discharges.

Snow's last case of all was at the end of that same day, when he went to give anaesthetic for William Bowman, who excised the right eye and performed iridecromy on the other, an elderly sea captain who lived in Bolton Row.

It is fascinating to trace the work of a nineteenth physician and surgeon through the pages of John Snow's diaries, in the first volume of which contains 223 pages, the second 179 and the third and final diary forty-nine making a total of 451 pages, involving over 4,000 anaesthetics and not one fatality from anaesthesia recorded! The diaries have not as yet been published, but an avid researcher, George Cole, began an analysis of Snow's work during the ten years he was a professional anaesthetist, but unfortunately he did not complete his task.

It was subsequently discovered at the post mortem, that Snow had an old illness of the lungs; that his kidneys were much contracted and granular with numerous cysts; the right kidney having been almost entirely converted into a cyst; an old ulcer of the duodenum and congested stomach. The death certificate declared that the cause of death was, "Apoplexy Paralysis (sixteen days), chronic disease of the kidney."

We know for certain that Snow's brother, Tom, the clergyman from Greetland, Halifax, was present at Snow's passing and there may have been other relatives. Tom was chaplain at Halifax debtor's prison at that time.

Snow's brothers and sisters, who appreciated his close friendship with John, asked Richardson to take on their brother's practice as an anaesthetist, as a gesture of their gratitude to him for supporting Snow. Richardson politely, but firmly, declined the offer saying that, "he was a physician and had no wish to become a specialist anaesthetist, in spite of his deep interest in the subject."

Snow's practice, in fact, passed into the eminently suitable hands of Joseph Clover, who had succeeded him in giving anaesthetics at University College Hospital, when Clover was Apothecary (resident Medical Officer). During the years 1848-1852, Clover gave many anaesthetics, both chloroform and ether. He recalled that following the death of a patient from chloroform, the hospital's medical committee laid down the rule that only the RMO, wherever practicable, should give anaesthetics.

A limited number of people were permitted to give them, including House Physician Joseph Lister. At the time of Snow's death, Clover was a Fellow of the Royal College of Surgeons and was struggling to carry on in private practice, in Cavendish Place, between frequent bouts of ill health. Although, he had no wish to be a professional anaesthetist, he found himself relinquishing surgical work in favour of anaesthesia. He admirably took on the mantle of John Snow, and carried the torch for anaesthesia and the speciality. When he finally relinquished the hard life of a surgeon, he became "Chloroformist" to Westminster Hospital and did important work on Nitrous Oxide.

He gave anaesthetics to Florence Nightingale, the Princess of Wales, Sir Robert Peel and the Emperor Louis Napoleon who lived at Chislehurst.

## Conclusion

During the first forty years of anaesthesia in Britain, Snow and Clover between them, did more for the benefit of the world's suffering millions than almost anyone of their generation. Clover invented a chloroform inhaler, a bag like device, which he slung over one shoulder to keep it away from the field of operation. Although clumsy in appearance and use, it had advantages over Snow's inhaler and was used for many years.

The funeral of John Snow took place at Brompton Cemetery, and immediately afterwards his friend and mentor, Benjamin Ward Richardson who had been deeply saddened by his death, set about planning a memorial stone for him.

Almost a year later, Richardson, now Sir Benjamin Ward Richardson, had published in the British Medical Journal of 21 May, 1859 a letter announcing that he and a few professional friends had got together a place "a plain but durable monument in Brompton Cemetery over John Snow's grave." This he said would serve as "a lasting and fitting memorial of the esteem in which he was held by those of his professional brethren, who had the pleasure of his friendship." He said a committee had been formed and subscriptions invited. Eventually, a handsome memorial stone was erected over the grave, but sadly could not been as "durable" as Richardson had hoped for, as it was severely damaged during an air raid in 1941.

To their credit, the Association of Anaesthetist of Great Britain and Ireland, saw to it that the original memorial was replaced by a replica, this time in Portland stone, which is still standing.

Snow's death was announced peremptorily and unfeelingly by The Lancet in their issue of 26 June, 1858 thus: "Dr John Snow died at noon on 16 June instant at his house in Sackville Street, from an attack of apoplexy. His research on chloroform and other anaesthetics were appreciated by the profession." That was it! Where is the acknowledgement of his great work on cholera, as the first man to discover that cholera was water borne; and to quote George Edwards who gave the first John Snow Memorial Lecture for the Association of Anaesthetists: "… a far from sufficient tribute to a man whose fame has steadily increased over the following hundred years, a man, in fact, whose memory now commands more respect than that of any of his professional contemporaries."

There is no doubt that Snow converted anaesthesia from a mere mechanical procedure, into a scientific speciality. His life's work on the subject is contained in his last book published posthumously, thanks to the efforts of Richardson. Published some months after his death, Snow's masterpiece

contains the brief biography of the author written by Richardson. It was hardly subjective in contrast, but it is a useful quarry for medical historians. The memoir is coloured as one might expect by a grieving friend and colleague, not to say worshipper. It was compiled hurriedly and contains some rather far-fetched observations and not a few inaccuracies, including something as basic as the hero's date of birth. Richardson puts it as 15 June, 1813, but it was in fact 15 March, 1813.

Snow, who had never earned more than £1,000 a year, left estate valued at £1,500 and his executors were his brothers, William and Robert. Snow requested that his property be sold and that part of the proceeds should go towards providing an annuity of £20 a year, for the lifetime of his housekeeper. The remainder was to be invested in stocks and securities from, which was to be paid an annual income, via a Trust Fund to his widowed mother, Mrs Fanny Snow, who was at that time living in Heworth, York.

Snow also directed that on the death of his mother, the trustees should hold the estate in benefit for seven people: Uncle Charles Empson, who was still living in Bath, his brothers William, Robert and Thomas, and sisters Mary, Hannah and Sarah who had married Matthew Collier of Osbaldwick, near York. Each was to have the same share. Whilst the family was sorting out Snow's will, his friend, Ward Richardson completed the few lines necessary to prepare his manuscript, On Chloroform, for the publisher Churchill, and it was published later in that year. The 443-page book, Snow's largest work, was prefaced with a short biography or memoir of the author, by Richardson himself. It is this memoir, which has been the quarry from which subsequent writers have drawn their information on Snow, although, it is not wholly accurate, and is as one might expect, somewhat biased in favour of the subject.

A good deal of the content of the vast number of articles published by Snow over the previous eleven years, concerned with chloroform and anaesthetics generally, was incorporated in the book, which bore the ponderous full title: On Chloroform and other anaesthetics: their action and administration." The book, which had been edited as well as completed by Richardson, is today a collector's item.

It was a notable book, incorporating a vast amount of original research and thought. Richardson later said that Snow had latterly devoted as much time as possible to completing the work, as he suspected he had little time left. In the respect, his timing was perfect. Oddly enough, having just written the last paragraph and completed the work "exit," he suffered the final cerebral accident, which cost him his life.

In about 300 pages of his book, Snow sets out the scientific methods he employed in his research into anaesthetics, ever since the inception of ether; his observations and his experiments. It was to be the fist comprehensive book on anaesthetics ever published in this country. It was received with mixed feelings by the medical press. The British Medical Journal took Snow to task for devoting forty-seven pages of the book to the description of the manner of administering chloroform in a number of surgical operations.

One of the most interesting parts of the book is that dealing with the fifty cases Snow had studied in, which patients had died from chloroform. Snow, himself, did not have a single chloroform death out of a total of 4,000 patients to whom he administered the drug.

He was the only person who attempted to keep a record of chloroform deaths during the first decade the drug was used in British medicine, and after his death no one seems to have carried on his excellent work. His list of fifty cases included those, which had come to his notice from Britain and several other countries. Undoubtedly there were others of which he had no knowledge, because of the lack of co-ordinated research and problems of communication in those days.

An interesting comment on John Snow and times, comes from Sir Ian Fraser, the distinguished Belfast surgeon, who in giving the tenth John Snow Memorial Lecture in 1967, recalled his own experiences with anaesthesia in the early 1920s. He told his audience: "Anaesthesia, after a wonderful start in 1846 -7, first with ether and then with chloroform, ran a very static course, until well into this century. As far as I could see, as a student and house surgeon, anaesthetics differed little from those of John Snow, the drop bottle and open mark with the layers of gauze carefully counted.

It was the resident student who gave the anaesthetic, whilst the house surgeon assisted and vice-versa in other cases. Along the lines of communication from the student to the chief, regular information was given regarding the size of the pupil and its ability to contract, and if they were not fully satisfied, the eye was widely opened and inspected by all three. This does not seem so long ago, but few surgeons would accept this now and certainly no patients."

# Appendix A - The inhaler

The illustration of the inhaler shows it being used by a young woman with an alarmingly constricting bodice! The inhaler looked like a black cigar box. It was made of tin, japanned and half of it contained a spiral vaporizer, the other half containing warm water when in use, and to store the breathing tube, face piece and valve, when not in use. When anaesthesia centenary was celebrated in 1946, there was, on display, a replica of this Snow inhaler, which is said to have worked quite satisfactorily when put into practice.

It was a portable, easily and cheaply made inhaler, which as Snow pointed out to the members, any one of them could have made, and he placed no restriction on any copies of his invention. Snow never had the slightest notion of profiting from any of his innovations. He stressed the advantage of the new apparatus; the water warmed to a suitable temperature at all times and in the required strength. He said that when the heat of the water in the inhaler was fifty degrees Fahrenheit, a mixture of thirty-percent of ether in air was usually satisfactory for the patients. He found he could put children under within three or four minutes with ether, but adults needed three or four minutes using between six drachms and one ounce of liquid ether.

Whilst demonstrating his new improved inhaler, Snow took the opportunity of telling his colleagues, that his most recent experiments had shown, that ether vapour did not produce a kind of asphyxia as many thought, by excluding oxygen from the lungs, but altered the composition of the blood so as to reduce to a minimum.

He tested out the inhaler on animals and on himself and was well satisfied that it was the best so far invented. He decided to take it along to the next meeting of the Westminster Medical Society on 16 January. The speed at which Snow worked to produce a high quality inhaler for an anaesthetic of unknown hazards, is quite remarkable.

The apparatus comprised a rather curious metal bottle, which was held in the hand, the heat of which was sufficient to help the evaporation of the ether. To the bottle was attached a flexible tube and face piece. This then was the apparatus, which Snow "deposited on the table," at the society's meeting. Snow explained that when the patient inhaled, his breath passed over the surface of the ether, through a long spiral track. His research into the production of this new and much improved inhaler, had also helped him solve the problem of the minimum necessary diameter of the flexible tube, leading from the vaporizer to the patient.

It is interesting to learn that Dr Ivan Magill, the distinguished anaesthetist seventy-four-years later, faced the same problem when he removed the Boyle breathing bag from the face piece to the machine. He too worked out the answer and found that his findings agreed with those of Snow. Snow continued to experiment with inhalers until not long afterwards, he produced the apparatus for which he is best known, as is illustrated in several articles on the inventor. It was his final model and served very well for very many years, and was eventually, widely used in London and provincial hospitals.

As early as 1847, he had argued that the vapour of ether did not, as many thought, produce a kind of asphyxia by excluding oxygen from the lungs, but altered the composition of the blood, so as to reduce to a minimum the oxidation of nervous and other tissues. In 1851, he added something more to the proposition when he wrote:

"Chloroform, ether, and similar substances, when present in the blood in certain quantities, have the effect of limiting those combinations, between the oxygen of the arterial blood and the tissues of the body. These are essential to sensation, volition and in short, all quantities arrest the animal functions in the same way and by the same power that they modify and arrest combustion… when they are mixed in certain quantities with the atmospheric air." According to Richardson, Snow considered the following experiment the best observation he had ever made, Richardson says: "Placing a taper, during one of our experiments, in a bottle through which chloroform vapour was diffused, and watching the declining flame, he at once said "there now, to the action of the narcotic without extinguishing it altogether, you must neither expose it to too much vapour at once, nor subject it to the vapour too long; and this is all you can provide against in submitting a man to the same influence. I could illustrate all the meaning of this great practical discovery on a farthing candle, but I fear the experiment would be thought rather commonplace."

Despite the impetus given to anaesthesia by the work of John Snow, over a period of ten years, between 1847 and 1858, there were surprisingly few improvements up to 1900, and these came about with surprising slowness. His numerous articles and addresses to learned medical societies, not to mention his great book, On Chloroform, seems to have fallen on stony ground. They may well have

been read with interest, but few sought to emulate Snow's example to forge ahead with the invention of better apparatus, or devise new methods of administration.

In fact, the first half of the century, anaesthesia was largely a long running argument on the relative merits of chloroform and ether.

In his book, On Cholera, Snow gives charts and tables on his findings, which make fascinating reading even today, when cholera is a thing of the past, as far as epidemics in this country are concerned.

He reproduces an interesting map, showing the position of various pumps supplying water in the affected area of Soho and indicating where deaths occurred. Included on the map are Golden Square, St James' and Berwick Street, St Ann, Soho extending from Wardour Street to Dean Street, and part of St James' Square, enclosed by Marylebone Street, Titchfield Street, Great Windmill Street and Brewer Street.

Snow uses black rectangles indicating the deaths from cholera, registered in the six weeks 19 August - 30 September, the most significant period, plus those cases taken to Middlesex, University College and Charing Cross hospitals, and other parts of London, where known. The tables reveal the terrifying escalation of the disease over a forty-eight-hour period, during the three weeks peak of the outbreak.

Snow records only one death on 26 August, the start of the outbreak. Suddenly, five days later the total dead was fifty-six. The next, 1 September, which will go down in public health history as the blackest day in London's health history, since the Great Plague, a total of 143 perished in the Soho area alone. The following day the total slid downwards to 116, and thereafter until only one case was recorded on 12 September. During the ensuing fortnight there was a worrying resurgence of the disease, involving eighteen to forty-five deaths, but then the outbreak subsided.

Particular attention should be paid to Snow's table as regards the Broad Street pump episode. The figures show quite clearly that, as Snow himself said, the worst of the outbreak had already passed when he requested the removal of the pump handle. The toll of lives from cholera was 611 in the Broad Street area alone by the time the epidemic had ended.

**Illustration: Snow's invention, the anesthetist ether mask**

# Appendix B - The diaries

Among the most fascinating medical documents of the last century are the John Snow Diaries, three quarto sized notebooks, containing the details of over 4,000 cases, in which Snow gave chloroform and a few other anaesthetics during a ten-year period of 1848-1858.

These notebooks have sometimes been referred to as, "the lost" diaries of John Snow, because they were not known to anyone from 1858, except Ward Richardson. He took charge of them and kept them in his own library until his death at the age of sixty-eight in 1896, some thirty-eight years after Snow's death. Then his daughter-in-law, Mrs Aubrey Richardson, who had them in her family, generously presented them to the Royal College of Physicians, where they rest today.

The Diaries deserve much closer study than they have so far received, if only because they are a record of much of the work of Britain's first professional anaesthetist and public health pioneer. They give a vivid account of medical life in the mid Nineteenth Century, involving many illustrious names in surgery, as well as Snow's own humble record of his own patients, in a modest general practice. The meticulously kept notebooks, in Snow's neat, small handwriting, are a reflection of a man whom Ward Richardson described as, "the most impersonation of order" who had his time and place for everything.

It would be tempting to quote many of the cases set out in brief, no nonsense style by the author if the diaries, but this temptation must be resisted, if only for the reason that, one day someone may see fit to reproduce the whole series of Snow's notebooks. Suffice to glance at a cross-section of his cases. The early entries relate to his general practice, and not long afterwards these give way to innumerable cases in which Snow acts as anaesthetist. Snow records every case in which he gave chloroform, and a few cases involving

other anaesthetics. He described the effect of the anaesthetic on the patient, with useful hints on "dangers avoided or chanced." Unfortunately, the first forty-seven of his cases are missing, but it is a minor loss, for there is a wealth of detail in the ensuing 4,285 cases, during the period of 17 July, 1848 to 5 June, 1858 when Snow sadly died at the height of his fame as an anaesthetist. The last entry, by this dedicated man in this final diary, was written only twelve days before his death.

The notebooks are an invaluable record of a specialist physician's practice, during the middle of the Nineteenth Century, and it is a truly remarkable record that out of 4,000 cases, Snow did not witness a single death from the administration of ether or chloroform. The only shadow over an otherwise impeccable career as the country's first professional anaesthetist, came at the very end of Snow's career, when two of his patients died from the effects of a new drug he was trying out, Amylene which had, at first sight, seemed a "miracle" anaesthetic.

Snow usually records the age, sex and often the occupation of the patient, and it is interesting to note that what we today regard as major operations, were not performed in those pre-Listerine days, because of the high mortality risk. Snow gave a total of 138 anaesthetics, mostly chloroform, during the last six months of 1848, when the extant diaries begin; 248 in the year 1849; 260 in 1850; 363 in 1851 and 445 in 1852, with an average annual total thereafter of 450 to the final year 1858. These figures clearly show the increase of chloroform, principally from its inception, and over the ensuing decade.

The early entries in Snow's notebooks refer to his own private practice patients, but as the number of anaesthetics given increased, so his general practice decreased and we find that his usual weekly average only involved ten patients. He had, of course, considerable hospital commitments and his private research into anaesthesia and later into cholera, occupied a good deal of what spare time he enjoyed. There were, of course, his regular addresses to the medical societies and his writings.

Snow does not seem to have taken many holidays, for in the notebooks spanning ten-years, there is no gap in the entries for more than a fortnight each year, and then this break came in September in most years. Presumably he went home to York during that brief respite. His diaries reveal that he gave chloroform for medical conditions, apart from anaesthesia, as for example, in cases of dysmenorrheoa, pregnancy complications, convulsions, trigeminal neuralgia and lockjaw, with apparently indifferent results in most cases!

As remarked earlier, Snow gave anaesthetics for a large number of eminent London surgeons. Among the most common operations of the day, were those for the removal of "the stone." He gave chloroform for the first stage of this formidable operation namely, "sounding" for the stone and then the ensuing operation of removing either the lithotomy, involving a perennial incision, or lithotrity involving the insertion of trans-urethra of a horrifying instrument called a lithotrite, which was equipped with evil looking jaws at the end of a tube, which grasped the stone and crushed it in situ. One sympathises with Napoleon III who had this operation.

One of our Twentieth Century surgeons, Sir Ian Fraser, comments on the fiendishly difficult operation of lithotomy – "cutting for the stone" – saying it would "strike terror into the heart of any modern surgeon." Well, that being said, it should be remembered that most of the surgeons for whom

Snow worked, were famous for the operation, and some measure of that fame must have been their singular success with the operation, particularly in the pre-anaesthetic days.

No less than thirty eminent surgeons, most of whom were attached to the great London hospitals as well as having their own very lucrative private practices, called on Snow to give anaesthesia. Their names pop up in the diaries, forming a gallery of the famous surgeons of the day, illustrious names like Brodie, Fergusson and Caesar Hawkins to mention only three. Snow appears to have had one or two of the "upper classes," among his patients, and he seems to have spent a good deal of time treating members of the Hogarth family, which may have been the same family into which Charles Dickens married. During the period covered by the notebooks, Snow made many visits to the Hogarths, and an entry of 31 May, 1851 reads: "Visited Mrs Hogarth's children." This was for some infectious complaint, probably measles. Six years later we still find entries of his visits to the Hogarth's. In fact, in 1857, Snow records that he gave chloroform to thirteen-year-old George Hogarth, whilst Mr Henry Smith operated on him for "congenital phymosis." The operation was a success and Snow writes: "there was a little sickness afterwards which did not continue."

The first case recorded in the Diaries is dated 17 July, 1848 and Snow writes "Visit to Mr Allen, 5 Alderham Terrace, tested pulse and urine. Patient told to take Caster Oil and continue Decoct Ginchona with Liq. Pot." About six weeks later Snow records that he was at St George's Hospital, where he gave chloroform for four operations shared between Caesar Hawkins and Cutler. An entry for 14 October 1848, shows that Snow was giving chloroform for William Ferguson, at King's College Hospital, and a fortnight later he went along to St George's Hospital to give chloroform to fourteen-year-old, Master William Webb whilst, Caesar Hawkins performed on him a lithotomy, for the removal of bladder stones. The operation took only ten minutes and Snow comments in his diaries: "A good deal of chloroform was taken… the patient was sick and troublesome next morning…"

An interesting entry appears in July of 1849, for during the cholera epidemic of that year, Snow treated certain cases of cholera with chloroform. On 22 November of that year, Snow went to 17 Princes Gate, Hyde Park, to give chloroform to General Caulfield for lithotrity, performed by Sir Benjamin Brodie, then the leading surgeon in London, and Surgeon to the Royal Household. Snow notes that in this case the chloroform produced, "some rigidity and slight struggling, and the patient could not be made quite insensible without, now and then, rendering the breathing stertorous." Snow writes: "The patient regained consciousness five to ten minutes after the operation, without sick-up or other sequela."

On 25 April 1850, Snow tells us that he gave chloroform to the Marquis of Anlesey, for neuralgic pains in a tooth stump. The following year on 17 April, Snow gave the vapour to the eleven-year-old son of Mr Sidney Gurney, of 17 Russell Square, for fistyla-in-ano operation, performed by Mr Farish, who had formerly worked at St Bartholomew's Hospital and was a classical scholar and friend of Snow.

Snow reported that after the operation, Master Gurney, "vomited on breakfast of about four or five hours before, probably kept in the stomach due to anxiety." Of particular interest is a case reported on 23 April 1851, in which Snow gave chloroform to a woman in labour, who had a minor claim to fame, for she had been given chloroform by none other than the famous, James Young Simpson in 1848 for her delivery. Snow, suitably impressed, entered this fact in his diary.

The most notable entry in Snow's diaries is that relating to his administration of chloroform to Queen Victoria for the birth of Prince Leopald in 1853, which has been described in an earlier chapter. This was, of course, the first time any member of the Royal Family had been given an anaesthetic.

Four years later, almost to the day, Snow was again called to the Palace to give chloroform to the Queen, this time for the birth of Princess Beatrice on 14 April 1857. This entry in Snow's diary is shorter than that for Prince Leopold's birth. It seems that Snow arrived at the Palace a little late on this occasion, because he records that Prince Albert, had "previously administered a very little chloroform on a handkerchief, about 9.00am or 10.00am."

Snow's last recorded cases prior to his death are as follows:-

1857 Saturday 5 June: Chloroform administered at 9 Manchester Square to Mr Worsley (43)… Mr Salmon operated for fistula-in-ano. Administered chloroform at Dr Little's for a two and a half-year-old child with club foot… tenotomy. Also administered chloroform for dentist.

At Kings College Hospital, gave chloroform for Mr Fergusson, for clubfoot case and harelip. Also an operation for false joint of the femur.

Gave chloroform at Lanham Place to Mr Brigham, surgeon from Lancashire, Mr Fergusson operated on the prepuce and glands penis for cancer.

Prescribed for a thirty-one-year-old woman patient for anaemia and debility.

Snow's last case of all was at the end of that same day, when he went to give anaesthetic for William Fergusson, who excised the right eye and performed iridecromy on the other, an elderly sea

captain who lived in Bolton Row. Snow went home after his hard day's work and never gave an anaesthetic again, for eleven days later, on 16 June he died.

It is fascinating to trace the work of a Nineteenth Century physician and surgeon, through the pages of John Snow's diaries, the first volume of which contains 223 pages, the second 179 and the third and final diary fourty-nine, making a total of 451 pages involving over 4,000 anaesthetics and not one fatality from anaesthesia recorded!

The diaries have not as yet been published, but an avid researcher, George Cole, began an analysis of Snow's work during the ten years he was a professional anaesthetist, but unfortunately he did not complete his task.

It is incredible that despite the exhortations of John Snow in lectures and articles published in the medical press between 1847 and 1858, the majority of patients undergoing surgery were being anaesthetised by members of the, "rag and bottle" brigade, some using the sponge instead of the rag, a la Simpson.

Snow's warnings of the dangers of ether and chloroform went largely unheeded, as indeed did those of his successor, Clover, for many years. The administration of anaesthetics was still left in the tender hands of unqualified, untrained people largely attendants and medical students. It is not to be wondered that the mortality rate began to rise alarmingly, as more and more anaesthetics were given. In other words, the more surgeons who took up the use of ether and chloroform, the greater risk to the patient.

The position was no better in the USA, where Scottish trained surgeons led the field and no doubt adhered to the beloved Simpson method of rag and bottle, which had undoubtedly proved simple and efficaciously in midwifery and general surgery, but was plainly a very risky business, with no control over flow and effect of the gases. A measure of the stubbornness of the medical profession, both in the USA and Britain, to adopt scientific methods with the administration of the gases, may be judged from an interesting comment by the distinguished neuro-surgeon, Harvey Cushing, who was a medical student at the Massachusetts General Hospital, Boston in 1892-5.

Remembering that this was fourty-five years after Snow's persistent warnings, which must have been current in the USA as well as Britain, because of close personal links between notable medical men in both countries. It is remarkable to read that young Cushing, as a first medical student, was occasionally giving ether to patients undergoing serious surgical operations.

An acute observer, Cushing even in those embryonic days of his medical career, like Snow, nearly half a century earlier, became greatly disturbed by the inadequacy of the methods then in use, for administering the volatile anaesthetics. Cushing, through Fulton's biography of the surgeon, tells us that, "untrained and inexperienced students were often enlisted to give the ether sponge, and the surgeon, generally impatient, insisted upon a depth of anaesthesia, so profound that there was frequently but a small margin of safety."

Cushing wrote with feeling, for previously he, like some of his student contemporaries, had had the searing experience of seeing their patient die on the table during the administration of ether. Cushing, however, to his great credit, decided to do something about it. He and his fellow student, Amory Codman, worked out a system of continuous recording, which enabled both the anaesthetist and the surgeon to tell at a glance, the condition of the patient, as indicated by pulse and respiration. There was no convenient method, at that time, for estimating blood pressure, but Cushing later "imported" the Riva-Ricci pneumatic device for recording blood pressure to the USA. This instrument was, therefore, used by Codman and himself in their monitoring, during anaesthesia. These charts, without a doubt, are one of the principle contributions by the Americans to the technique of surgery.

**Snow's table of fatalities in the broad street area**

| | |
|---|---|
| 26 August | one fatal attack |
| one fatal attack | |
| one fatal attack | |
| one fatal attack | |
| 8 fatal attacks | |
| 56 fatal attacks | |
| | |
| 1 September | 143 fatal attacks |
| 116 fatal attacks | |
| 54 fatal attacks | |
| 46 fatal attacks | |
| 36 fatal attacks | |
| 20 fatal attacks | |
| 28 fatal attacks | |

| | |
|---|---|
| 12 fatal attacks | (pump handle removed this day) |
| 11 fatal attacks | |
| 5 fatal attacks | |
| 5 fatal attacks | |
| 1 fatal attack | |
| 3 fatal attacks | |
| 18 fatal attacks | |
| | |
| Date Unknown | 45 fatal attacks |