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oooOooo

We are saddened to report the deaths of the following members of the Society: Dr Brian Whittard, Dr Peter JF Baskett, Dr JAG Horton, Dr David C White.
HISTORY OF ANAESTHESIA SOCIETY

2008 Summer Scientific Meeting, National Centre for Early Music, York

27-28 June 2008

Organizer: Dr Paul Goulden

The Organizer is very grateful for the assistance of Ms Jane Matthews, Secretary to the Department of Anaesthesia at Dewsbury & District Hospital, Ms Gill Baldwin of NCEM, as well as Jean and Natalie Goulden.

The Society would like to thank the following for generous support:

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Proceedings of the History of Anaesthesia Society
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The Society acknowledges with thanks the photographs taken by Dr Geoff Hall-Davies.
# HISTORY OF ANAESTHESIA SOCIETY

## Council and Officers – July 2008

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EDITORIAL

The York meeting, organized by Paul Goulden, was a success in every sense of the word. The venue was the National Centre for Early Music, formerly St Margaret’s church in Walmgate. Stained glass windows and stone archways in the refurbished 12th century building created a memorable atmosphere.

The meeting was opened by David Wilkinson, and began with a tribute to the late T Cecil Gray. This was followed by a taster of The Times digital archive and a fascinating account of a naval anaesthetist’s experiences at Gallipoli in World War I. The second session of the morning included a look at pioneering experimental anaesthesia in Leeds, and then three papers on the background, synthesis and introduction of diazepam.

After lunch there were two sessions of trainees’ papers (six in all), which included some excellent research. The AGM was then conducted smoothly: notably the Presidential badge passed from David Wilkinson to Tony Wildsmith, and Adrian Padfield (after a citation by David Zuck) was elected an Honorary Member. The annual black tie dinner was held in the same venue and was thoroughly enjoyed.

The second day began with a synopsis of the evolution of the Boyle pattern anaesthetic machine from the ergonomic point of view; next was a look at pulmonary aspiration during anaesthesia in John Snow’s time. The guest lecture by Les Woodcock on Joseph Priestley’s discoveries was outstanding.

The meeting concluded with “The Blessed Chloroform Lecture” entitled “John Snow’s London” delivered by David Zuck. This was a remarkable piece of research into the layout of London in Snow’s time, his work and experiences including previously unrecorded exploitation of his skill by the London Zoo!

Alistair G McKenzie
Hon Editor

FUTURE EVENTS

2009  29-30 May. HAS Summer Meeting, Bath
       Contact: Dr Patrick Magee (patrick.magee1953@btinternet.com)

2009  1-3 October. 7th International Symposium on the History of Anaesthesia, Heraklion, Crete, Greece
       Contact: Prof Helen Askitopoulou (www.isha2009.com)
Speakers at York

Dr Anne Florence
Prof Sir MK Sykes
Dr F Casale
Dr PME Drury
Dr Ann Ferguson
Prof A Dronsfield
Dr A Padfield
Dr Ashish Gopakumar
Dr I Ahmed
Members and guests attending York meeting

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**Guest Lecturer:**
Prof Les Woodcock, Manchester
As we gather here today to mark the sesqui-centenary of the death of one great pioneer, John Snow who made chloroform anaesthesia acceptable in clinical practice, it is my, albeit sad, privilege to pay tribute to another great pioneer, Thomas Cecil Gray who died peacefully on the 5th January, 2008 in his 95th year.

Cecil was born at the Clock Inn on Scotland Road, Liverpool where his father was the Publican, on the 11th March 1913. A devout Catholic Cecil was educated initially at the Convent of the Sacre Coeur in Bath and subsequently at the Preparatory and Senior Schools at Ampleforth, the Benedictine College in North Yorkshire. It was his intention to enter the Monastery on completion of his school days. Alas, within two months of becoming a novice monk it became apparent to all, except Cecil, that this was not to be his vocation. Consequently, to the chagrin of his mother, he returned to Liverpool in 1931 to study medicine. On graduating from Liverpool University in 1937 he became a trainee in General Practice in the city before purchasing a practice in Wallasey with help from his father. At this time many General Practitioners were also part-time anaesthetists. Fascinated by the specialty, Cecil worked and studied under the guidance of Dr Robert J Minnitt, rapidly collecting the 1000 cases required for the DA examination which he passed in 1941. He immediately became a full-time anaesthetist in several Liverpool hospitals and a demonstrator in anaesthesia at the University of Liverpool.

Very early in his career as a full time anaesthetist, Cecil and John Halton, a GP colleague with a substantial anaesthetic practice in both dental and thoracic surgery, set out to investigate the feasibility of neuromuscular blockade. The paralysing properties of wourali, the South American Indian arrow poison were described in the 16th century by Sir Walter Raleigh, but it was not used medicinally until 1845, when, Sir Arnold Knight, at that time a physician in Liverpool, successfully treated cases of tetanus and hydrophobia. It is most likely that Knight had obtained a sample of the crude distillate from the Chondodendrum tomentosum (curare), traditionally stored in a bamboo tube, from Charles Waterton of Walton Hall, Wakefield who had experimented with this poison during his ‘Wanderings in South America’.

In 1935, while working in the laboratory of the distinguished neurophysiologist, Sir Henry Dale, Harold King isolated the active constituent of this distillate
which he named d-tubocurarine. Initially manufactured in the United States, it was marketed as Intocostrin and was first used in clinical anaesthesia in Montreal in January 1942 by Dr Harold Griffiths and his assistant, Dr Enid Johnson.

Taking his responsibilities seriously, John Halton, the local Medical Officer to the RAF, was a frequent visitor to the USAF base at Burtonwood where he successfully persuaded USAF personnel to obtain a sample of Intocostrin for his use in thoracic surgery as he thought that it might overcome the disadvantages of using barbiturate as the sole agent. A sample was delivered in November 1944. Alas, John Halton soon found that the solution was unstable and consequently of unreliable potency.

Meanwhile, Cecil Gray had obtained a sample of the powdered form of d-tubocurarine, produced by Burroughs-Wellcome, which Dr Rod Gregory was using for animal studies in the Department of Physiology. Cecil sterilised the powder prior to dissolving it in water. After administering it to each other, Gray and Halton found that this preparation was safe, producing beneficial relaxation with easily achievable full recovery of muscular tone. Consequently they introduced it to their respective clinical practices.

By April 1945 they fully appreciated the great potential of d-tubocurarine chloride (curare) and within 12 months had collected a series of 1049 cases; the majority had undergone thoracic surgery with a significant number of abdominal, head and neck and orthopaedic cases included. After pre-medication with a comparatively low dose of morphine, sleep was induced with an intravenous barbiturate followed by the curare. Initially barbiturates were used sparingly to maintain a constant level of hypnosis. Cecil assisted ventilation manually, delivering a mixture of nitrous oxide and oxygen by squeezing a large reservoir bag. The muscle relaxation, resulting from the curare induced inhibition of acetylcholine activity at the neuromuscular junction, was excellent. They were not, however, convinced that the anti-cholinesterase, physostigmine, was particularly useful for the return of normal muscle tone as they were both now aware that curare was completely detoxicated in the liver and rapidly excreted by the kidneys with no evidence of latent toxicity. They did, however, recommend that it should be available at all times.

There were two deaths in the early stages of the study which may have been related to the occurrence of hypoxaemia induced myocardial anoxia. This emphasised the importance of adequate oxygenation throughout and limitation of opiate use. Synergism occurred with both ether and cyclopropane; in
particular, they observed increased contraction and irritability of the gut which was not seen with barbiturates.

Their first public dissertation “A Milestone in Anaesthesia – d-tubocurarine” was presented to the Anaesthetics Section of the Royal Society of Medicine on 1st March 1946. They declared that curare was beneficial, as an adjuvant to barbiturates, for every thoracic and abdominal operation. It was of particular benefit in the poor risk patient and in the presence of peripheral circulatory insufficiency as it avoided the necessity for deep planes of anaesthesia and for thus high doses of opiates. The preparation of curare, available from Burroughs–Wellcome, in nearby Crewe, was of constant potency producing good muscle relaxation during light planes of anaesthesia. They did, however, stress that adequate ventilation and oxygenation were essential for the safety of the technique. They warned that “The road lies open before us, and with a grave and insistent warning to the inexperienced that we are dealing with one of the most potent poisons known, we venture to say that we have past yet another milestone, and the distance to our goal is considerably shortened.”

Many hours of discussion on the use and potential dangers of d-tubocurarine followed within the hallowed walls of 1 Wimpole Street occupying many of the regular monthly sessions of the Section. This pioneering advance was, initially, treated with suspicion and scepticism.

On the 12th April, 1948 Cecil Gray presented a detailed report of the use of curare in 8500 cases anaesthetised by a group of enthusiastic colleagues within the Liverpool Region who had willingly adopted the technique of hypnosis, muscle relaxation and controlled ventilation with the mild anaesthetic and analgesic, nitrous oxide and oxygen. The anti-cholinesterase, prostigmine, was now used routinely for reversal of curare with atropine added to eliminate its parasympathetic activity. Hyperventilation to achieve significant hypocarbia did not feature as an essential component of the technique until it was described by Geddes and Gray in 1959. The absence of serious morbidity or mortality attributable to the drug fully supported Cecil’s belief that curare, while probably the most potentially dangerous drug in use at that time was, obviously, one of the least toxic. Bronchospasm was the only untoward event encountered on two occasions in this large series. The first occurred in a severe asthmatic and the second during bronchoscopy under very light anaesthesia. It was strongly felt that curare could not be implicated.

Meanwhile Gray and Gregory had studied the effects of Intocostrin on the heart-lung preparation of a dog. Using concentrations far in excess of those used in clinical practice they found no deterioration in cardiac activity even when
thiopentone and adrenaline were administered singly or in combination, or hypoxia induced. There was evidence of improvement in contractility when cardiac activity was deliberately impaired. 4

The basic principles of this pioneering work which became known as the ‘Liverpool Technique’, a triad of hypnosis, muscle relaxation and reflex depression with controlled ventilation using nitrous oxide and oxygen to provide a degree of hypocapnia has survived with modification, nationally and internationally, to this day. Advances in pharmacology and physiology have enhanced the safety and universal acceptability of this technique of anaesthesia. With the advent of new inhalational agents, in particular, hyperventilation is no longer necessary and, over the years, a multitude of new neuromuscular blocking agents have replaced curare.

Cecil Gray must also be remembered for his major contribution to education and standards of training in anaesthesia. Acutely aware of the inevitable changes in the practice of medicine and, in particular, anaesthesia which would follow the establishment of the National Health Service in 1948 he saw an obvious need for the specialty to develop an examination structure similar to the Royal Colleges of Physicians and Surgeons. Formal training to a high standard and post-graduate education in anaesthesia was essential. Following his appointment as Reader and Head of the Department of Anaesthesia in the University of Liverpool he opened negotiations with the Dean of the Liverpool Medical School and the Board of Clinical Studies which culminated in enrolment for the first Post-graduate Course in Anaesthesia in October 1948. Most of the surgeons tacitly agreed to the presence of trainees in the operating theatre. The following year the proposals for a full-time course received official recognition by the Hospital Authorities. They empowered the Academic Department to select junior staff for employment in the hospitals of the Region. It was agreed that all trainees would be free to attend lectures until 11.00 am each day including Saturday. All participants were required to have had previous experience in anaesthesia. This unique course, the first in the United Kingdom, rapidly became extremely popular and over-subscribed.

By 1952 the course had expanded its horizons with the recruitment of students from Singapore, Malaysia, Hong Kong, the Indian subcontinent, South Africa and Australia. Financed by their own governments these doctors held supernumerary posts in hospitals throughout the region, providing an enthusiastic, reliable and valuable service.

Cecil’s profound interest in medical education and organisational ability was recognised by his election as a Founder Member of the Board of the Faculty of
Anaesthetists of the Royal College of Surgeons in 1948 and subsequently as Dean of the Faculty in 1964. In 1959 he was appointed to a Personal Chair in Anaesthesia in the University of Liverpool and in 1966 became its first Post-graduate Dean, remaining in this role until 1970. He was subsequently appointed Dean of the Faculty of Medicine from 1970 until his retirement from the Chair of Anaesthesia in 1976.

He wrote numerous papers and edited several text books. His last publication in 2003 was the biography of Dr Richard Formby, the founder of the Liverpool Medical School initially at the Royal Institution before it moved to the Infirmary in 1844.

Cecil was invited to deliver numerous eponymous lectures. The first was the Clover Lecture of 1954 entitled the ‘Disintegration of the Nervous System’, a ‘perversion’ of the title of Sir Charles Sherrington’s great work ‘The Integration of the Nervous System’ published in 1906 while he was Holt Professor of Physiology in Liverpool. In his lecture Cecil outlined the animal research and clinical experience which had lead to the development of the theory of the triad of anaesthesia and a technique for the safe use of curare in anaesthesia. This contribution made by Cecil Gray and his departmental colleagues to the understanding of the nature of the state of anaesthesia and the practical application of neuromuscular blocking drugs was as significant for anaesthesia as that of Sherrington was for neurophysiology.  

Many honours, national and international, were bestowed upon him. Probably, one of the most significant was the award of the Sims Commonwealth Travelling Professor. As the first anaesthetist to receive this award from the three Royal Colleges of Physicians, Surgeons and Obstetricians and Gynaecologists it provided the opportunity for him and his wife to travel to Australia for 3 months to engage in educational activities and the interchange of ideas.

Cecil was President of the Anaesthetic Section of the Royal Society of Medicine, The Association of Anaesthetists of Great Britain and Ireland, the Liverpool Society of Anaesthetists and the Liverpool Medical Institution and was actively involved with the Medical Defence Union for many years as Vice-President and subsequently Honorary Treasurer. He also devoted time to serve on the Liverpool Bench between 1966 and 1983.

Cecil, a man with great charm, talent and boundless energy, was a gifted teacher with the ability to inspire students, trainees and colleagues with devotion and enthusiasm. No problem was insurmountable. His advice, either deliberately
sought or volunteered, was always sound; consequently he had a profound influence on the careers of many whose subsequent progress he followed assiduously with pride. A good friend and mentor of many, friendships made were enduring even when he might have thought that a friend had gone astray. Many years ago at an International Congress, many thousand miles from here, one of his ‘prize trainees’, whose own research supported the views of an Australian colleague that ‘Normocarbia was a desirable goal’, dared to argue with the Chairman of the session, knowing that he, himself, firmly believed that hyperventilation induced hypocarbia was the ideal goal. He graciously conceded the argument and retired to the Bar with the two renegades. This did not end life-long friendship, respect and admiration.

A devoted family man, Cecil was a generous, entertaining host with a wicked sense of humour, a true native of Liverpool. An accomplished pianist and opera lover his musical interests included membership of the Royal Liverpool Philharmonic Society, Liverpool Welsh Choral Society and the Verdi Society. He also had a passion for amateur dramatics and was a player and producer with the Irish Players for over twenty years. Cecil will be greatly missed by many.

References

2. Geddes IC, Gray TC. Hyperventilation for the maintenance of anaesthesia. *Lancet* 1959; 2: 4-6
ANAESTHESIA AND “THE TIMES”
Keith Sykes, Emeritus Professor, University of Oxford, Budleigh Salterton, Devon

Many Public Libraries now provide their readers with free online access to their catalogue and to a range of reference material. Among the many reference sources that can be accessed from my Devon Library Service are the Dictionary of National Biography, the Encyclopaedia Britannica Online, the Oxford English Dictionary, British Standards Online, Newsbank UK Newspapers, over 120 dictionaries and reference books in Oxford Reference Online, and the Times Digital Archive 1785 to 1985. This paper discusses reports relevant to anaesthesia published in The Times over this period.

Access to the site is provided by the library card number. There are a number of search options and, for the purposes of this communication, the Business, Editorial and Commentary, Features, News and People sections of the paper were searched over the whole 200-year period using the subject headings:

- anaesthesia OR anaesthetic OR anaesthetist
- ether OR chloroform OR nitrous oxide
- anaesthesia AND nitrous oxide OR laughing gas
- anaesthesia OR pain relief AND surgery
- ether OR chloroform AND pain relief during surgery
- John Snow
- J.T.Clover.

The searches yielded a list of articles ordered according to their date, with the oldest first. The article could be viewed as an isolated column of text with the keywords highlighted in red, or it could be displayed in its original position on the microfiche copy of the page. The article could then be saved, printed or dispatched as an email attachment. The database could also be searched by date of publication. This yielded a vertical display, with each page displayed sequentially as a thumbnail (similar to a pdf file); a list of the main topics on each page was displayed in blue type to the right of the thumbnail, and by clicking on one of these one could highlight the area of interest for subsequent display and retrieval.

Early references to anaesthesia

There were surprisingly few references to anaesthesia during the nineteenth century. The first reports were of surgery under ether anaesthesia in Bristol and Ashton-under-Lyne in January and February 1847, and in March 1847 there was a report of an inquest in Grantham into a death after ether anaesthesia. On
Saturday November 20th 1847, under the title "Ether superseded", there was a copy of the report in the Edinburgh Mercury of Simpson’s discovery and use of chloroform, and there was a description of the use of chloroform in an obstetric case in Taunton on January 8th 1848. On February 3rd 1848 there was a detailed report of the inquest into Hannah Greener’s death under chloroform, and on February 14th another report of a death under chloroform in Aberdeen. In November 1848 there was a report from Carlisle of a death in a patient who used chloroform to relieve the symptoms of asthma.

On January 4th 1850 there was a detailed report of an inquest into a death under chloroform at Guy’s Hospital in London. This precipitated an opinionated letter from “An Edinburgh Surgeon” and a similar reply from “A London Surgeon”. There were further reports of death during chloroform anaesthesia over the ensuing years. On January 4th 1859, The Times quoted an article in The Westminster Review for January 1859 in which it was estimated that 1.2 million anaesthetics had been administered in the UK, USA, France and Germany during the previous ten years. During this period there were 68 recorded deaths from chloroform, 2 from ether, 1 from a mixture of ether and chloroform, 1 from a mixture of chloroform and alcohol, and 2 from amylene.

There were, however, other items of more general interest. In 1848 there were letters reporting the use of chloroform in the treatment of tetanus and hydrophobia, and several communications about its use by thieves. In 1850 a leopard was anaesthetised with chloroform administered on a rag on the end of a stick for the amputation of a leg, and in 1853 the drug was administered to patients with cholera. In 1855 there was much discussion about the use of anaesthesia in battle casualties, one opponent advocating “the smart of the knife as a stimulant”. On February 5th 1855 Col. Napier responded to these criticisms by forwarding a careful analysis made by Professor James Young Simpson of Edinburgh (misprinted “T.Y.Simpson”) that refuted the claims that the use of chloroform was dangerous in battle casualties. The debate on the safety of chloroform continued unabated and on July 23rd 1875 J.T.Clover wrote to say that he still used both ether and chloroform and had not yet made up his mind concerning the relative merits of the two agents. There were letters from John Snow concerning the water supply at Newcastle on November 11th 1853 and another on London’s water supply on June 26th 1856.

On September 4th 1858, in a letter entitled “Chloroform in dentistry superseded”, Joseph Snape, Dentist to the Chester Infirmary, described how he had extracted over 150 teeth painlessly under electrical anaesthesia. On September 18th, James D. Morrison, who claimed that he was the first person to whom Simpson had administered chloroform in Edinburgh, gave a reference to
his earlier description of a technique for electrical anaesthesia published in April 1857 and stated that he had been granted a Patent for his machine in December 1857. However, there was no further report on the use of electrical anaesthesia until March 17th 1961 when The Times Medical Correspondent described the two successful cases reported in the Journal of the American Medical Association in January 1961, and provided a balanced review of the subject. I remember seeing this article at the time and subsequently attempted to use the technique to anaesthetise greyhounds when studying the effects of inhalation anaesthetics on the pulmonary circulation. It proved to be as useless as The Times Medical Correspondent had predicted!

Ether drinking in Ireland

Another communication that was picked up in the search was concerned with ether drinking in Ireland. On October 15th 1890 there was a report of an address to the Society for the Study of Inebriety that detailed the extent of this problem. It was reported that ether drinking had been common over the past 30 years or so and that it took place mainly within a 40 square-mile area of the southern part of Londonderry. Methylated ether provided by London manufacturing chemists was smuggled in 10-gallon drums labeled “Drugs” to avoid paying the extra carriage rate on explosive ether. Over two tons of the ether was openly transported by rail each year and more conveyed secretly, the profit to the entrepreneurs being over 100%. A “draught” (about half a glass-full) cost a penny and imbiber's, who were of both sexes, young and old, often drank up to one pint per day. There was a strong smell of ether in railway carriages and in towns on market days and children often smelt of ether when they came to school. The onset of intoxication was rapid and resulted in violence and stupor; recovery was equally rapid so several “draughts” might be taken each day. Repeated ingestion led to chronic gastritis and indigestion, and accidental death while inebriated was not uncommon. There were also deaths from fires and explosions when the drinker lit his pipe!

This problem was considered further by the House of Commons Committee on British and Foreign Spirits and the deliberations of this Committee were reported in The Times on March 12th 1891. The last paragraph of the report is worth quoting: “After some evidence in regard to the subject of rum the Committee adjourned until next Tuesday when it is believed that Dr Bell will produce his long-promised analysis of the whisky supplied to the House of Lords and the House of Commons”!

The debate about the dangers of chloroform continued throughout the nineteenth century and first half of the twentieth, and the Hyderabad Commission featured
prominently in the correspondence columns. Goodman Levy’s theories about the dangers of light anaesthesia were discussed by The Times Medical Correspondent on April 12th 1917, and he suggested that the problem should be tackled by the Medical Research Committee.

Some anniversaries

The Times noted the 50th Anniversary of the discovery of anaesthesia with articles on October 7th and 16th 1896. The Centenary was marked by an Editorial on July 5th 1946 and on October 16th there was a report of the Centennial meeting in London. This was followed on November 1st by a report of the Dinner celebrating the Centenary and a note that anaesthetists had petitioned the BMA for the formation of a group concerned with anaesthesia. The importance of the introduction of curare into anaesthetic practice was noted in an erudite article by The Times Medical Correspondent entitled “Arrow Poison in Anaesthesia”. This was published on November 2nd 1957 and noted the award of the Nobel Prize to Daniel Bovet. It also recorded that curare had been used to reduce the spasms accompanying electroconvulsive therapy at the Middlesex Hospital in 1939. On June 16th 1958 a correspondent provided an entertaining article entitled “Chloroform for Queen Victoria” to mark the previous year’s centennial of the administration of chloroform to Queen Victoria by John Snow.

Deaths under anaesthesia

During the second half of the 20th century there continued to be reports of deaths associated with anaesthesia, both in the hospital and in the dental chair, and public interest peaked on August 19th 1982 when The Times published an article by its Medical Correspondent entitled “Anaesthesia could cost 900 lives each year”. This summarised the results of the study “Mortality associated with Anaesthesia”, edited by J.N.Lunn and W.W.Mushin, that had just been published by the Nuffield Provincial Hospitals Trust for the Association of Anaesthetists of Great Britain and Ireland. The staggering figure of 900 deaths per year was derived by adding the 280 deaths directly due to anaesthesia to the 600 in which anaesthesia was considered to have contributed to the death. The criticisms of the standard of anaesthetic practice made by Lunn and Mushin provoked further revelations on August 12th when the paper published a News item by the Medical Correspondent headed “Anaesthetic mistakes still causing deaths” and this was accompanied by an outspoken Editorial entitled “Bored to death”. The author of the Editorial rightly emphasised that although better facilities would help improve patient care, they could not compensate for
carelessness. The writer concluded that much of the trouble was due to the fact that the practice of anaesthetics was not exciting work and that an element of boredom could easily lead to careless practice unless there was an effective system of medical discipline. This provoked a spirited response from one of the authors of the report, J.N.Lunn, and several other anaesthetists. Surprisingly, this Editorial did not appear in any of the searches and was only picked up by the references to it in the Correspondence columns.

**Conclusion**

It is probable that a number of references to anaesthesia have been missed because of the use of a limited number of search terms. The majority of the references were to deaths or complications of anaesthesia and there were few articles documenting progress in the subject. Perhaps this is not surprising when one considers the huge amount of information contained in each issue of the paper. The great difficulty in undertaking this sort of search is that there are always fascinating headlines and stories in neighbouring columns that provide a vibrant description of life at the time. Just to take one example, on August 12th 1982, when the Editorial “Bored to death” was published, there were the following major headlines:

**Killer dies in electric chair**  
**Unions hint at worse to come in health dispute**  
**“State of siege” atmosphere as 1000 strike at hospital**  
**Union dilemma over private care**  
**Record awaits lone sailor in 9 ft yacht**  
**200 saved as London tube train catches fire**  
**Kray funeral recalls old days**  
**Petrol prices still not the highest (178p per gallon, 40p/l)**  
**Marilyn Monroe death enquiry reopened**  
**A soft landing for the Mary Rose**

**Pay: the Union split is showing**

**Mrs Thatcher heading for an unhappy autumn**

We live in eventful times!
At the Dundee meeting last year (2007), Dr Armitage began his talk with a health warning - “Never go near an old-style Ward Sister clearing out cupboards!” - to which I would add – "never go near an old-style lady cleaning flooded cellars!"  A chance visit to a dear friend landed me with a box belonging to a distant medical relative of hers saying “You're a doctor, have this”. The box contained various papers including a diary and photo albums in rather damp and mouldy condition, which had belonged to a Dr John Lambert.

He was born on 2nd January 1880 and grew up in Cambridge where he went to school and was later to study medicine at Downing College. He then went to the London Hospital where he qualified, as gold medallist, in 1904 and where he did his house jobs and was later Casualty Officer and Resident Anaesthetist. He did a stint as a school doctor in Brighton and then at Lancing College, but on the declaration of war on 4th August 1914, he immediately joined the Navy as Temporary Surgeon Lieutenant.

He was sent to HMS 'Ganges', in fact the Naval Sick Quarters at Shotley, Suffolk (the Navy seems to have a penchant for calling anything a ship), where he treated wounded sailors from the Battle of Heligoland and wrote a paper “Shell Wounds in Modern Warfare”. He was later posted to the hospital ship Rewa, ferrying wounded soldiers from France. The Rewa was a triple screw turbine of 7300 tonnes, built in 1906 for The British India Steam Navigation Company, who had named, still owned and manned her: thus some of the crew were from the Far East (termed Laskars). She was taken over in 1914 as a troopship and then converted into a hospital ship with two theatres and three operating tables, and 250 beds of which 40 were for officers.

On 16th June 1915 the Rewa left Plymouth for Gallipoli and Dr Lambert started his daily diary on loose sheets of Rewa notepaper written in ink with small handwriting, not easy to read.

The Gallipoli Campaign started as an attempt by the Navy, when Churchill was First Lord of the Admiralty, to force the Dardenelles (the Hellespont of ancient times) to prevent Turkey and the Ottoman Empire from entering the war on the German side. At the time, Turkey was run by a group of young army officers who had deposed the Sultan in 1908 (hence the term “Young Turk”).
In November 1914 an apparently successful naval bombardment of the forts at the entrance of the Dardenelles created the need to have the Army consolidate the expected Naval success. Admiral Wemyss was sent to the rather bleak Greek island of Lemnos, whose only attribute was a large natural harbour at Mudros, to establish a base from scratch, 3000 miles from Britain, 700 from Malta and 500 from Alexandria to accommodate the forthcoming troops.

In March 1915 the Navy tried again but were repulsed with some loss as the Turks, with German help, had improved the defences by laying mines covered by mobile howitzers. Suddenly, what had been planned as mainly a Naval undertaking with Army support, became a major Army operation with inadequate troops, poor intelligence or logistic support and a divided command between the Navy and the Army. When this attack was launched on three fronts on the 25th April 1915, it met with unexpected stiff resistance on unchartered, difficult terrain causing a large number of casualties for which they had been totally unprepared. Hospital ships, including the Rewa were urgently sent to the area. Their role was to stand off the beaches and receive the wounded transferred to them by barges or lighters. On board a doctor would assess each one as:

a) WALKERS – the walking wounded who would be cleaned up, wounds dressed, usually stopping on board for 12 hours before being sent off on barges to an Advance Base, i.e. Mudros;

b) COT CASES – the more severely ill needing surgery and/or admission. When the ship was full of cot cases, it would take them to a Base Hospital, i.e. Alexandria.

Diary entries

25th June 1915 – The 'Rewa' arrives at Mudros harbour, which is full of ships at anchor protected by antisubmarine nets. Immediately it receives 150 sick and wounded followed by 120 more. "Men are weary, very dirty and very tired. I operated on one with shrapnel in the shoulder. All but 28 are discharged to Mudros."

27th June 1915 – "170 Australians arrived followed by many more, many with diarrhoea, dystentry, very dirty and frail. Terrific lack of organisation is evident. 280 discharged to Durban Castle."

28th June 1915 – The Rewa sails off Cape Helles in the middle of a huge battle. "This is the most eventful day of my life up till the present. The sea is full of ships. Battleships, with escorting destroyers, fire raising enormous clouds of dust and smoke. Explosions rock the 'Rewa' anchored ¾ mile from shore."
Howitzer battles between 'Gallipoli Bill' and 'Asiatic Lizzie'. The upturned hull of the 'Majestic' (sunk by a German submarine) is 200 yards away, the remains for the 'River Clyde' (used as a landing craft in the April attack). The naval bombardment, as a prelude to the attack, stops and is replaced by rifle and maxims for the whole day into the night with star shells, gun flashes, exploding shells, signal lights and camp fires visible from the ship. Barges bring in the wounded, the smell of the dead and decaying bodies, a plague of flies. Operating from 8 am to 9 pm with five minutes for Bovril and restart at 10 pm til 1 am. Three operating tables working. Wounds of head, neck, comminuted fractures of femur and humerus. Septic wounds with filthy parts of clothing, maggots and some gas gangrene because wounded 24-48 hours before treatment. Many Indian soldiers also. The ship is full and sails while we are operating."

2nd July 1915 – "Arrive in Alexandria, but three other hospital ships are waiting so diverted to Malta. Bury 15 corpses at sea. Captain and ratings are supposed to do it, but its a gruesome task with maggots and the smell of gas gangrene and quick decomposition, so burial services are hasty with little ceremony."

5th July 1915 – "Arrive in Malta at 7 am, anchor in quarantine harbour, discharge patients to 'Bighi', the large Military Hospital. It takes all day till 9 pm, discharging with hand hoist onto lighters, tiring work under hot sun. Days off in Malta while ship is disinfected."

11th July 1915 – "Arrive off Gallipoli and receive 50 patients, mainly facial injury. Giving anaesthetics mainly chlorofom or chloroform with ether 1:2. Patients go through the first stage quickly with little vomiting. No reliance of pupil size as many had Morphia given with field dressing, the only certain index is the corneal upper lid reflex and the depth of respiration. Battleship 'Prince George' approached within 1 mile of us firing 6 and 12 inch shells making our ship vibrate and raising enormous clouds of funereal yellowish-black dust on the terrain. Balloon spotter is up. At night lighters and small tugs bring patients and carry troops, stores and ammunition ashore. Turks fire random shots, some fall near ships. Other hospital ships 'Asturia', 'Bretagne', 'Canada' standing by."

17th July 1915 – "Ship full, sails for Alexandria. Lady Carnavon and attendants from Red Cross come to comfort patients."

27th July 1915 – "Off Anzac beach, wounded arrive mainly Australians and New Zealanders. Usually on arrival patients don't look in pain, mainly horribly dirty with the yellow-white Gallipoli dust on their clothes and faces. Always flies. They are relieved to get on board with good food instead of the standard bully
beef and beans. Padre acts as commissioner and director and good friend to soldiers. 'Walkers' taken to Mudros by flat sweeper. Burial of dead at sea by trawlers. German plane drops a few bombs near shore; big splashes but no damage."

31st July 1915 – "Sudden night attack, heavy firing, shrapnel shells whizzing around ship. Wounded arriving and operating. We go to Mudros to collect 300-400 walkers and sail for Alexandria."

8th August 1915 – "Due to leave Alexandria but due to the silly action of HMG we are sent to collect 5000 bedding and mattresses for Mudros. Very poor administration, no notice of this and they leave matters to take their own course."

11th August 1915 – "Arrive at Mudros and start disembarking the cargo of bedding. Orders to leave urgently as attack on Suvla on 8th has caused many casualties with 12,000 wounded and men are waiting to get off the beaches. Our unloading is taking a long time. We have wasted more time at Mudros than any other port."

13th August 1915 – "Off Suvla Bay, the battle is still raging, from the ship we can see fusiliers taking up positions, a group of stragglers and wounded cut off by snipers, trenches and open field, rifle and maxim fire pretty constant. Bullets 'phutt' into water close to ship or on deck. Busy day, 3 operating tables at work, 1 hour sleep, discharge walkers to Mudros by lighter and soon filled up again. We take them to Mudros and came back again."

21st August 1915 – "New battle at Suvla. HMS 'Venerable' with monitors and destroyers inside antisubmarine boom stretched across most of the bay. Only transporters and "blistered cruisers" outside. Much bombardment, maxim, rifle fire, whole area covered by smoke dust and bush fires. Explosions of incoming shells onto beach near depot scatter mules and horses. Cases arriving at 11 pm have been wounded at 3-4 pm and could only be removed from trenches at dusk. Working around the clock with only half an hour breaks. The boat deck is thronged with cases, operating and 20 cases are lying waiting outside, it is the busiest and most rapid intake we have ever had taking 300 cot and 400 walkers in 16 hours, mainly Lancaster, Manchester and Dublin fusiliers. We take them to Mudros where they are transferred to the Curnader 'Alumnia' and we return to Suvla. Attacks and counter-attacks, many casualties."

26th August 1915 – "I receive a letter from Col Gosling that my brother Stan has been killed by a shell. This is the terror of the men in exposed areas of the
camps on Suvla and Anzac, where random shells kill 5 men every day. I got leave to go ashore to a beach and saw him lying there where the shell had struck him. Death arriving by a nod of the head. Kneeling with the padre who said the official prayer and can hardly believe that he is gone and buried on a spine of land in Suvla Bay."

30th August 1915 – "Full up and go to Mudros where we take up 350 more cases for removal to England. Most people are pleased."

9th September 1915 – "The Rewa docks at Plymouth after 86 days at sea, 43 of which were spent on station off Gallipoli beaches. 7400 patients were treated of whom 3600 were carried to base hospitals, 3600 discharged, 149 died on board. 500 operations were performed. There were no anaesthetic deaths."

Aftermath

GALLIPOLI was evacuated in December 1915 without loss of life, in the only well planned and well executed action of the whole campaign which lasted eight months, saw 250,000 casualties among British, Dominion and French forces of which 46,000 died. The Turks lost twice that number.

THE REWA returned to Mudros to care for the sick and wounded and while ferrying patients to the UK, was torpedoed and sunk in the Bristol Channel on 4th January 1918. All were evacuated safely. Dr Lambert lost all his possessions including medical equipment and possibly other diaries. He got £100 compensation for the loss (£10,000 in today’s money).

DR JOHN LAMBERT - After the sinking of the Rewa he was posted to HMS Pembroke = Ambulance train No 3. He was demobbed on 28th March 1919 with the rank of Surgeon Commander and granted the OBE in August 1919. He obtained the post of Medical Officer at Wellington College, Berks where he remained, living in a house on the premises for 27 years until he retired in 1946. In 1917 he had married Alice Lockhart, a Sister on the Rewa, who died in 1938 and then married Vera Pledger. He had no children. He died suddenly in 1958 at the age of 78.

THE DIARIES – At the suggestion of Dr Aileen Adams, Mrs Rosemary Pledger donated them to the Naval History Museum in Portsmouth.
Introduction

Thomas Nunneley (1809-1870) was a surgeon in Leeds. Apprenticed in Wellingborough (Northants), he went to Guy’s Hospital, where he was taught by Astley Cooper. He qualified MRCS, LSA in 1832, and studied in Paris for a time. He applied unsuccessfully for a post as House Surgeon in Leeds, but found an opening in General Practice. Soon afterwards he was appointed Surgeon to the Eye and Ear Hospital. He lectured in Anatomy and Physiology at Leeds School of Medicine, and was appointed Surgeon to the Leeds General Infirmary in 1864. He was one of the 300 elected Fellows of the Royal College of Surgeons in 1843. Among other things he was active in the British Medical Association, a member for three years of Leeds Town Council, and active also in Leeds Philosophical and Literary Society.

De Mortuis ……

A number of flattering comments have been made about him. In Plarr’s *Lives of the Fellows* it is stated that ‘he was a surgeon who operated with equal ability, judgment and skill……He was clear, vigorous and logical as a writer, and was a man of decided character.’ (Is this a double-edged compliment?). The *Lancet* obituary begins: ‘Great general ability and force of character as a man, and unusual vigour of thought and practical efficiency as a surgeon’ and continues later: ‘……as a representative of the cause of medicine as a science and as a profession, he stood forth like a solitary Roman Centurion left in defence of the wall of Hadrian. He was an enlightened as well as a public-spirited man. ……His reputation was ever on the increase.’

The *British Medical Journal* continued in much the same vein: ‘in Leeds his reputation as a GP was high, and as an operator he displayed an equal ability, judgment, and skill in all classes of cases. ……His attainments as a physiologist were great and his knowledge was regarded as exact and extensive. ……He was a frequent contributor to the *British Medical Journal* and an active member of the British Medical Association from its Formation (in 1855). ……His distinguished abilities and high attainments naturally drew around him a large circle of friends and admirers. ……All must feel that he was an honour to his profession’. These effusive comments recall the Latin phrase *De mortuis nil nisi bonum* (broadly, speak nothing but good of the dead), a maxim attributed to...
Chilo, one of the so-called Wise Men of Greece from the 6th century BC.

The entry in the Dictionary of National Biography is free of any critical comment, but there were one or two clouds on the horizon. The British Medical Journal obituary^3 said that: ‘He was a man of strong feeling, somewhat impetuous in action. The straightforward, uncompromising manner in which he promulgated his opinions may not always have been palatable to those who held the opposite views……’ In 1858 the sales of his book The Organs of Vision, their Anatomy and Physiology were spoilt by adverse criticism due to personal animosity, according to Plarr’s Lives of the Fellows. As we shall see, Stanley Sykes later wrote some uncomplimentary things about Nunneley.

**On Anaesthesia and Anaesthetic Substances**

Why am I talking to the History of Anaesthesia Society about a surgeon? One reason is that he wrote a book with the above title^4. This was published in 1849, which is early in the history of anaesthesia, three years in fact after the pioneering events in Boston. I looked at copy which is in the Brotherton Library in the University of Leeds. He carried out animal experiments on 34 substances, plus mixtures. They were given by inhalation, via the stomach and rectum, by intravenous injection, and by local to the skin. Although he speculated that the mode of action was on peripheral nerves, eventually spreading to spine and brain, some pertinent points were made. He recognised the dangers of chloroform and felt that concentration was important. He thought that some fatal cases were not reported or that other excuses were made. He believed in simple apparatus for inhalation: a fine linen handkerchief folded like a funnel (i.e. the Edinburgh Technique). He had been in touch with John Snow, who sent him accounts of some experiments and emphasised that the stomach should not be full.

As antidotes to overdose he suggested moderate interrupted compression of the chest and upward pressure on abdominal viscera to ’change air in the lungs’. A stream of air might be not too forcibly blown through a small tube into the larynx for a minute or two.

**Stanley Sykes**

However Stanley Sykes took a more critical view. In Essays on the First Hundred Years of Anaesthesia^5 Sykes described Nunneley as ‘a specialist in everything’, which has a slightly mocking air about it, although he qualified it by saying that many medical men of his age fitted that description, and that his capacity for work must have been tremendous. But he points out that Nunneley
made 363 experiments, and because he used well over 30 different substances and some mixtures, some were only used a few times.\textsuperscript{8}

Some of the substances were surprising choices; they included hydrocyanic acid, camphor, oil of turpentine, creosote and sulphuretted hydrogen. He had good results with coal gas, but Sykes writes: ‘He thought the latter [coal gas] was cheap, which it was, effective, which it was - often permanently so - safe, which is doubtful\textsuperscript{6}…….The advice that “no hesitation need be felt in employing it” was on the basis of six experiments\textsuperscript{7}.

He said that ethylene was not likely to be used in practice, and that ‘life is speedily destroyed by from 20 to 25 per cent’. Sykes thought that this was due to the experimental method, in which the animals were put in a jar filled with gas or vapour, and thus hypoxia and hypercarbia were factors. He had personally given ethylene in over 1000 cases, with occasional concentrations as high as 88\%, without ill-effects\textsuperscript{8}.

\textbf{Further Details}

Other predictions by Nunneley were that ether ‘which was for some time almost exclusively used has now almost ceased to be employed; it will hereafter, I apprehend, be rarely used’, and ‘nitrous oxide never could be employed as an anaesthetic, and that the inhalation of it is not altogether so harmless as is generally supposed’. Sykes commented that ‘the above examples illustrate the extreme uncertainty of any attempt to foretell the future. Potential prophets should always remember that a very numerous and prosperous tribe of bookmakers and turf accountants have for many years made their living out of this simple fact\textsuperscript{9}.

Nunneley had two fires in his experimental work. One arose from inserting a glowing splinter of wood into a jar of oxygen, and the other from inspecting a jar of volatile and inflammable liquid with a lighted candle. He also, in the year before he died, made the following statement: ‘during the last three years, since the antiseptic treatment has been in vogue, I have not allowed one of my patients to be treated with carbolic acid; while my colleagues have very extensively employed it……..my cases without it are as good as theirs with it’\textsuperscript{10}. Lister, in reply, dismissed this ‘as of small moment’ since he hadn’t troubled to try it.\textsuperscript{11}

He died in June 1870, having been confined to bed for ten days. The \textit{British Medical Journal} published a fairly detailed post-mortem;\textsuperscript{12} the diagnosis was renal failure. The report suggested that he had been unwell for a few years, and
that he was in the habit of leaving his place of work, having a quiet vomit, and then returning.

Conclusion

I have referred to an individual who attracted differences of opinion, the less flattering one admittedly nearly 100 years later. But it lends some support to the view that the phrase de mortuis nil nisi bonum should sometimes be changed to de mortuis nil nisi bunkum.

References

6. *ibid*; 108
8. *ibid*; ref 5: 151
9. *ibid*; ref 7: 152
10. *ibid*; ref 5: 108
11. *London Times and Medical Gazette*. 1869; 265
Leo Henryk Sternbach (7th May 1998 – 28th September 2005)

Dr Ann Ferguson
Retired Consultant Anaesthetist, Broadstairs

Leo Sternbach was one of history’s most prolific drug designers and it is fitting that he should be remembered now, as it is 100 years since his birth. Most material has come from Good Chemistry – The Life and Legacy of Valium Inventor, Leo Sternbach.¹

Before the First World War, the European map was very different from its present plan. The Austro-Hungarian Empire reached from Switzerland in the west to the Russian border in the east, and from north of Prague and Krakow in the north to way down the Adriatic coast in the south.²

Parents

Michael Abraham Sternbach traveled in 1906 from Krakow, where he had been working as a pharmacist, to Abbazia on the Adriatic coast, to open a pharmacy. This was a shrewd move, as Abbazia, now known as Opatija - both names mean “Abbey” - was a cosmopolitan town, a thriving spa, a bathing resort and centre for thalassotherapy. Many businessmen had settled there. Puccini, Mahler and Bejamino Gili were all regular visitors. Isadora Duncan got inspiration for some of her dance moves from the movement of the trees in the town. Theodor Billroth sent patients there to recuperate, and often visited himself.³

Pioshka (Piri) Cohn came from Hungary to Abbazia, to visit her grandmother at her villa, met Michael Abraham and married him in 1907. He was 35, and she was 17. His native language was Polish and hers Hungarian, so they communicated in German. They were both Jewish, although they were not devout. They quickly had two sons, Leo and Guyszi.⁴

Childhood

This upper middle class family were quite well off, and lived in a 3rd floor flat with 4 rooms heated by Dutch style wood burners, and cooked on a wood stove. They had electric light, except in the kitchen, and bathed once a week in the local public baths. They had enough money to employ a maid, and an assistant in the pharmacy. At primary school the boys first became aware of anti-Semitic feelings.⁵
Abbazia was untouched by the fighting of The First World War, but it did bring some changes, the family could no longer employ a maid or an assistant in the shop, and there were food and clothing shortages. At the end of the war, Abbazia became Italian, and was occupied by Italian soldiers.

Sternbach later wrote

“The Italian troops were very nice to us children. They gave us many rounds of carbine shells which we opened, and we emptied many of them onto a flat rock, and burned it. It was consumed in a few seconds and gave a strong 2-4ft high yellow flame. Under these conditions it did not explode.

We also found some 1/2 inch diameter glass tubes which we stuck into the ground and filled with gunpowder and set light to it. The burning bits of gunpowder flew out of the tube and gave a cascade-like effect.

The source of many interesting experiments was also provided by calcium carbide which was used for the lights of the Italian motor trucks. This produced acetylene on contact with water. We stole it or got it from Italian soldiers and used it in the following manner.

We punctured the flat undamaged end of a small used tin can and put this can over a few pieces of carbide which were moistened. Urine lent itself very well to this purpose. The acetylene formed, creating an explosive mixture with the air still present in the can. A burning match held to the tiny opening gave a nice explosion and the can was blown high into the air.”

As Italian was now the official language of the region, the two boys could no longer go to school, so for a time they were privately educated, but this proved very unsatisfactory, and so Leo at the age of 13 was moved to Villach, where the education was in German, but the anti-Semitism was such that he was quickly moved at the age of 14 to Graz, but life was worse there, especially as the Rabbi made him attend religious instruction, and study Hebrew, which he never mastered.

He was next sent to Bielsko-Biała in Poland to finish his schooling, and there he had to cram in Polish. He was much happier here. So, by the age of 18 he had had to work in two languages and four countries, and had been separated since the age of 13 from his parents.
University

In 1926 the rest of the family returned to Krakow, as their life was becoming too difficult in the now Italian Abbazia, and Michael opened another pharmacy, but it was a difficult time, especially as Gyuszi died of scarlet fever at the age of 15. Leo enrolled at the university to read pharmacy, which he was only allowed to study because his father was a pharmacist. He got a degree within three years, and then was allowed to go on to study organic chemistry, obtaining his doctorate in 1931.

He managed to gain a position as a research assistant and lecturer in Krakow, but by 1936 the position he occupied had to be filled by a Christian, so he applied, successfully, for a scholarship financed by a Jewish textile magnate. With this money he moved to Vienna, at the age of 29, in 1937, to work with Professor Wolfgang Pauli and Professor Sigmund Frankel, but this only lasted a few months. He attended a lecture by Professor Ruzicka on the male sex hormone, and decided he wanted to work for him, so he moved to Zurich, in October 1937 to the Federal Institute of Technology, still with the scholarship.

Marriage

In Zurich, he met his future wife, Herta Kreuzer, a Christian, and they married in 1940. She was 20, he was 32. She lost her Swiss nationality on marriage, and became Polish. His parents remained in Krakow, his father died early in 1940, and his mother was hidden by Christian friends for the whole of the war.

Hoffmann-La Roche and move to USA

In 1939 the scholarship ran out, and he gained support from the Rockerfeller Foundation. Hoffmann-La Roche were looking for a research chemist, so he applied, and started work for them in Basel in 1940, working on the synthesis of riboflavin, vitamin B. As Europe was becoming uncomfortable, and it was by no means certain that Switzerland would not be invaded, Roche’s director Barell, decided to move most of their scientists to New Jersey, in the USA. Leo was one of those chosen to go, and he got an American visa on the grounds that he was Italian born Austrian and a specialist on the synthesis of vitamins and therefore indispensable to the war effort. He and Herta were given Swiss aliens passports, valid for three months, which did not mention the holders nationality or religion.

They went through France in a sealed railway carriage, crossed the border at Port Bou, where Walter Benjamin, the famous Jewish philosopher, having been denied entry to Spain the previous year, died of a morphine overdose. However,
Fig. 1 Leo Sternbach’s journey from 1908 to 1941
the Sternbachs seem to have had no problem at the border. They took a bus to Barcelona, but had a puncture in the freezing cold mountains, a train from there to Madrid and after a few days rest, train to Lisbon. They crossed on the Serpa Pinto, a Portuguese ship, on which, as Portugal was neutral, they should be safe (see Figure 1). The crossing took 11 days. On the 22nd June 1941 they landed in New Jersey, in Jersey City, which must have been wonderful for them, landing within site of the Statue of Liberty.

Research at Nutley

Roche’s works were in Nutley, previously home to the Nutley notable Annie Oakley. They lived in Upper Montclair which was later twinned with Graz – which Sternbach later called one of history’s bad jokes. Life was very different they needed a car, and had to learn to drive, but on July 11th Sternbach wrote to his mother in Law

“I believe we will be happy here”.

He worked for Roche for the rest of his life, as a senior group chief from 1959-65, a section chief 1965-67, director of medicinal chemistry 1966-73 and then a consultant from 1973 to 2003. They had two boys, Michael born 1943 and Daniel in 1949. Herta became an American citizen in 1946 and Leo in 1947. In the late 1940s he synthesized Biotin and Arfonad (trimetaphan). This was followed by Librium (1960) and Valium (1963). He retired in 1973, but continued to go into the laboratory (see Figure 2). In all he worked at Roche for more than 60 years, finally giving up in 2,000, at the age of 92. He was responsible for 240 patents covering 5,093 abroad, and he made the company what it is. He never became very rich, but was happy with what he achieved, because he felt that he had managed to help the sick.

His co-worker Carl Mason, when asked why Sternbach still visited his office decades after his retirement, said of him

“He goes into the house he built”.21

His son Michael said

“He is in love with his wife, two sons, and chemistry. In daily life he appears to be endowed with an extraordinary impracticality”.22

He was listed by the US and World report as one of the most 25 important people of the 20th century, along with Louis Armstrong. He was a ramrod straight man, bespectacled, with a shock of white hair, sparkling blue eyes and a piquant sense of humour, he would occasionally ski into his office. He was obstinate, fired by optimism, self-confident, trusted his instincts, and was an unshakeable realist:

“Life is how it is”.25
Fig. 2 Leo Sternbach (1908-2005)
(Photograph courtesy of Roche)
This was what someone at Roche said of him:

“He was one of the nicest men I have ever known”.

Acknowledgements

I would like to thank Martin Hirsch and all the staff at Roche who were so helpful in providing me with material for this paper.

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The need for an anxiolytic to promote cardiovascular stability in trauma

The story of diazepam starts on the battlefields of World War II. The severe blood loss of wartime injuries highlighted the limitations of diethyl ether anaesthesia. While the safest agent of the time for major surgery, it was seen as directly contributing to surgical shock. Compounded by severe blood loss, this could be fatal for even fit, if terrified, young soldiers, confronted with a sense of suffocation by the anaesthetic mask.

These problems had been recognized since at least the 1880’s. Anxiolytic and potentiating drugs had been sought by chemists and physicians, to reduce the dose of ether required and thus to limit the degree of surgical shock caused by the anaesthetic. Morphine, tribromoethanol and scopolamine had all been found wanting. Despite these efforts, the challenge remained in the early 1950s.

Laborit and chlorpromazine

Henri Laborit was a 37 year old surgeon working in Paris in 1951. He thought that “surgical shock” might be minimised by inducing a state of ‘hibernation’, with the patient’s metabolism slowed by cooling, and calmness induced with medication. He chose to focus on antihistamines for the latter effect and approached the pharmaceutical firm Rhône-Poulenc for recently developed compounds to evaluate for this purpose. They gave him a sample of the drug then only known as 4560RP. Laborit found it not only potentiated anaesthesia, but also had another remarkable effect. Instead of patients anxiously awaiting the mask, he noted that they showed a certain “uninterest” in whatever was to follow. He suggested that this “euphoric quietude” might have applications in psychiatry and this was soon confirmed.\(^1\) Experimental drug 4560RP was christened chlorpromazine and proved dramatically effective in treating schizophrenia. Earlier ‘treatments’ for this condition had been essentially ineffective. People with schizophrenia spent many years in mental asylums, with little prospect of recovery. Treatment with chlorpromazine offered relief of symptoms for many and the prospect of returning to their communities or even employment. For Rhône-Poulenc chlorpromazine was a money-spinner. By
1956 it was being taken by 4 million patients per year in the USA and contributed $75 million annually to the company’s profits. This dramatic success provoked other drug companies to seek potentially profitable cures for other psychiatric conditions. Roche in Nutley, New Jersey, decided to seek a chemical remedy to alleviate chronic anxiety more effectively than the existing treatment with sedative agents, such as chloral hydrate or one of the barbiturates. Spearheading this research was Leo Sternbach.

Researches by Sternbach, working for Roche

Until quite recently, drug research was very much a haphazard affair. Companies maintained large “libraries” of chemicals developed in-house or bought in, usually from university research labs. Some of these would be trialled against a particular disease and if one showed promise, then its relatives would be synthesised in the hope of capitalising on the initial success. The alternative approach was to construct possible lead compounds possessing structural features common to drugs that had proved successful in allied areas of therapy.

Azo dyes and intermediates

Neither method came close to providing Roche with its desired anxiolytic and one senses a certain desperation in Sternbach’s decision to reinvestigate some of the chemicals from his Krakow period in the hope of discovering a lead compound. He later connected this 1930s work with a project to develop synthetic dye intermediates, possibly remembering the close connection between dyes and the early chemotherapeutic agents:

- Methylene blue was used by Paul Ehrlich to treat malaria as early as 1891, and subsequently used to alleviate manic states
- Salvarsan (1909), the first successful treatment for syphilis was thought (at the time) to be based on the –As=As- grouping, not very dissimilar from the –N=N- link in azo dyes
- Trypan red was the fore-runner of most of the trypanocides of the early 20th century
- Prontosil rubrum (a red azo dye) introduced by Gerhard Domagk in 1934, was the parent of the first class of effective antibiotic drugs, the sulfonamides.

However, it is difficult to discern a dyestuffs aspect in any of Sternbach’s pre-war papers. True, the odd coloured molecule makes an appearance (Scheme 1), but none was developed sufficiently to make it remotely act as a useful fabric dye.
Moreover, Karol Dziewonski, his research chief, had no interest to speak of in dye chemistry. His main preoccupations were the chemistry of quinoline and a somewhat obscure hydrocarbon, acenaphthene.

\[ \text{Quinoline} \quad \text{Acenaphthene} \]

We suspect that, in a time-honoured fashion, he was given a problem to investigate and to see what he might make of it. The reaction between 1-naphthylamine and benzoyl chloride was known to give 1-benzoyleaminonaphthalene by attack on the NH\textsubscript{2} group. Sternbach’s extension was to see if, by using more “forcing” conditions, the benzoyl group (C\textsubscript{6}H\textsubscript{5}CO, more often written as PhCO with “Ph” representing a benzene ring) might be made to attack the naphthalene part of the naphthylamine molecule. Such chemistry had been known since Charles Friedel and James Mason Crafts reported the reaction that bears their names in 1877.\textsuperscript{6} The substitution of PhCO for an H of the aromatic moiety is facilitated by a variety of catalysts such as AlCl\textsubscript{3} or ZnCl\textsubscript{2}. Using the latter, Sternbach was able to make the PhCO substitute in both the 2- and the 4-positions.\textsuperscript{5}
Sternbach noted that the closeness of the groups on the 1- and 2-positions might lead to some form of bridging and yield a string of hitherto unknown compounds, a common goal of 20th century synthetic chemistry. He devoted significant effort to rid his molecules of the PhCO groups in the 4-position (a distracting feature, as these might preferentially react with the NH.COPh groups on adjacent molecules, leading to difficult-to-work-with polymers). He was successful, achieved the desired bridging, and termed his product a “hept-1,2,6-oxodiazine” (Scheme 2).

So, in the mid-1950s Sternbach prepared some 50 new hept-1,2,6-oxodiazines in his Roche laboratory. In particular he sought, firstly, to incorporate a chlorine
atom on the aromatic nucleus as this was a feature of many psychotropic drugs, including chlorpromazine itself and, secondly, to introduce a tertiary amino function. This grouping is associated with many alkaloids, most of which have profound physiological effects, but \([\text{as } -\text{CH}_2\text{CH}_2\text{CH}_2\text{N(CH}_3)_2\text{]}\) it is a feature of the chlorpromazine molecule and as such might prove a useful adjunct in his quest for a novel and profitable anxiolytic. Sternbach prepared a hept-oxodiazine containing the relatively reactive \(-\text{CH}_2\text{Cl}\) group. This would react with a variety of secondary amines to form the required tertiary amino derivative (Scheme 3).

![Scheme 3: Early "hept-1,2,6-oxodiazines" tested for pharmacological action](image)

But none of his derivatives showed the sought-after biological activity and the work was abandoned.

**Serendipity: chlordiazepoxide (Librium)**

Some two years later, during a periodic lab tidy-up, it was noticed that one of his compounds had not been sent for testing. Possibly the fact that it was reputed to be a secondary amino derivative, and not a tertiary one, may have contributed to his reluctance to have it tested. So, with no real expectation of success, it was sent to Lowell Randall, Head of Roche’s Pharmacological Department, for evaluation. Sternbach records the result:

“Within a few days this compound was found to possess very pronounced pharmacological properties coupled with a low toxicity. It has a particularly interesting spectrum in tests indicating central nervous system depressant activity…. These promising properties prompted the synthesis of many closely related compounds none of which, however, was significantly superior to the first member of the series”.
The compound had been prepared simply by treating the $\text{-CH}_2\text{Cl}$ starting material in Scheme 3 with methylamine to yield, allegedly, the following species:

![Chemical structure 1](image1)

As labelled up and sent for testing

Whilst the testing was going on, Sternbach was reflecting on the correctness of the formula he had attached to the sample vial. Formulations of this type (i.e. a seven membered ring containing a N-O-C-N- grouping had been accepted and unchallenged for most of the century, but some of its chemical properties were not in accord with this structure. The oxygen atom, bonded on one side by N and linked on the other by carbon, should display an inertness much in the same way that it does in ether with its C-O-C linkage. But it is removed completely from Sternbach’s molecule simply by warming it with phosphorus trichloride, which ends up as POCl$_3$. The oxygen must clearly only be loosely attached to the ring system. Sternbach revised the formula for his precursor compound to:

![Chemical structure 2](image2)

No longer could it be regarded as a hept-1,2,6-oxodiazine. From henceforth this would be a quinazoline-3-oxide. But the chemistry had a further surprise in store for the Sternbach team. With the correct formula for the precursor, only a moment’s thought, apparently, was necessary to deduce the structure of the material in the vial:

![Chemical structure 3](image3)

But the transformation was no so straightforward. The immediate $\text{-CH}_2\text{Cl}$ precursor was correctly formulated, but the reaction with methylamine took a totally unexpected pathway: the CH$_2$ of the $\text{-CH}_2\text{Cl}$ group actually entered the right-hand ring, giving enlargement back to a seven membered heterocycle.
The product sent for pharmacological testing and which yielded such promising results in fact had the structure of a benzodiazepine:

![Structural formula of benzodiazepine](image)

**chlorodiazepoxide**

While animal studies indicated that therapeutic doses were far lower than lethal doses, giving a much greater margin of safety than barbiturates, the initial clinical trials in 1958 were disappointing. The doses used proved very sedating in the subjects, mostly elderly institutionalized patients, most of whom developed slurred speech and ataxia. Fortunately, some American psychiatrists (notably Dr Irvin Cohen, working in Galveston, Texas) decided to use it in lower doses with their out-patients suffering from anxiety and moderate depression. Willy Haefely, a neuropharmacologist working for Roche, takes up the story:

“A high rate of improvement of symptoms associated with anxiety and tension was found. Sleep was improved. In spite of obvious uncertainties about the optimal dose, the side effects were mild…..and (could be) avoided by adjustment of doses. Increase of appetite, interest in social activity and verbal productivity as well as a feeling of well-being suggested some form of psycho-stimulant effect. The interest of clinicians in chlorodiazepoxide grew enormously and, within a time which appears incredibly short today, experience with thousands of patients accumulated. The compound was introduced in the USA in February 1960 under the trade-name Librium…. The rapid onset of a therapeutic effect in low doses with only minor side effects convinced physicians and patients alike and, perhaps with the suggestive trade-name, led within a very short time to an enthusiastic acceptance of chlorodiazepoxide which surpassed the most optimistic predictions”.

Effective though Librium was, Roche was troubled by the reports of its side-effects. In particular, sudden discontinuation was apt to precipitate seizures in some patients.

*Diazepam (Valium) and other benzodiazepines*

Thus the company embarked on an intensive search, again with Leo Sternbach at the helm, to synthesise Librium-like drugs with improved properties and
fewer side-effects. Somewhat surprisingly, neither the N-oxide grouping nor the exocyclic amino-methyl function was essential for the drug action. Crucial was the presence of the seven-membered ring containing two nitrogen atoms separated by a two membered carbon chain (CH₂ group or a CH₂ derivative). One of the first species to be sent off for evaluation was the relatively simple species, diazepam.

This entered medical practice in 1963 and, marketed as Valium, revolutionised the treatment for anxiety. Roche had achieved its goal. But the story does not end there: as a relaxant, it soon found a place in the anaesthetist’s armoury of drugs. In low doses it would calm a patiently pre-operatively and in higher dosages would induce yet more relaxation and a handy amnesia. And at even higher doses it would act as a general anaesthetic. A raft of analogues were developed for use in anaesthetic practice, of which two have particularly stood the test of time: Lorazepam (as a premedication agent) and Midazolam (as a peri-operative intravenous sedative, and for longer term sedation in intensive care settings).

Benzodiazepines as adjuncts to anaesthesia

Our introduction referred to diethyl ether inducing surgical shock. The idea that an anaesthetic agent should, of itself, cause shock is now unfamiliar. Shock is a
consequence of inadequate tissue oxygenation due to inadequate perfusion. Causes are clustered into the cardiogenic, hypovolaemic or septic. However, an earlier generation also included cold, pain, fear and asphyxia as causes of surgical shock, suggesting a common mechanism of sympathetic stimulation causing, effectively, reduced blood volume. Studies in 1936 on consenting (if less than fully informed) volunteer patients and medical students were among those supporting this hypothesis. This explains the contemporary concern to reduce surgical shock by addressing patients’ fears before anaesthesia - and thus the success of benzodiazepines, as combined anxiolytics and anaesthetics.

Acknowledgement

We have addressed the chemical aspects of the diazepam story before and we thank the editor of Education in Chemistry for permission to travel over part of the same ground again.

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THE INTRODUCTION AND USE OF IV DIAZEPAM IN 
ANAESTHESIA AND DENTISTRY
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Appearance in the clinical literature

In *The Lancet* April 1965, Hendrickse and Sherman from Ibadan had a Preliminary Communication ‘The Therapeutic Use of Diazepam in Tetanus’. They administered 4.4 mg/kg in 24hrs via a stomach tube, and considered it better than phenobarbitone plus chlorpromazine or phenobarbitone plus diazepam. At the end of May 1965 a letter in response by Kazin followed from Trinidad. He gave IV diazepam 10mg 3 hourly for tetanus; it relieved opisthotonus immediately. An overlooked but detailed paper by Campan and Espagno had been read at the XIV Congrès Français, May 1964 and is the first description of IV diazepam as an anaesthetic. They used up to 80 mgs diluted with dextrose solution at 10mg/min (1mg/kg in fit & 0.5mg/kg in frail patients), for 139 assorted operations together with neurolept drugs, relaxants and pethidine & N2O as analgesics. There is a full account of the effects and side-effects, but not of venous problems. In *The Lancet* December 1965, Stovner and Endresen’s letter: ‘Diazepam in I-V Anaesthesia’ from Oslo is the first report in English. After premedication with morphine and hyoscine they used 0.2–0.5mg/kg for induction. It did not allow intubation, produce abdominal relaxation, or potentiate neuro-muscular blockade. Anaesthesia lasted 30-60 minutes. Injection pain was noted and they diluted the drug in 5% dextrose to alleviate it.

Three letters followed under the same title in *The Lancet*. The first in January 1966 was from Bruce (Hartlepool) who was convinced of the analgesic properties of IV diazepam, equating it to morphine. Dowell (Sunderland) wrote in February that he used oral diazepam syrup as pre-medication for children and thought it better than chlordiazepoxide (extolled by Inglis & Barrow). In May 1966, six months after the Norwegians’ letter, Cushman wrote from Bulawayo that diazepam was good for IV induction in emergencies and shocked patients, at a dose of 0.1–0.2 mg/kg. However, at least 0.5mg/kg was needed for the healthy African male.

The *British Medical Journal* got into the act in October 1966 with two papers: ‘Tetanus in childhood - report of a therapeutic trial of diazepam’, by Hendrickse & Sherman from Ibadan (a fuller version of *The Lancet* article in April 1965) and, ‘Experience with diazepam in tetanus’, by Femi-Pearse from Lagos. The latter used a range of doses dependent on the severity of the condition. In 1968
a letter came from Mount Vernon describing the use of oral diazepam as a premed to relieve anxiety and comparing it favourably with chlordiazepoxide (Librium).

**Use in dental practice**

Dentists soon began to use diazepam. In a translation of a report from Paris in 1966 Valium was compared to the Jorgensen technique (which used IV pethidine, pentobarbitone and hyoscine). Valium was found to be best for shorter cases as ‘the action of the drug stops immediately and totally’(?!). Pain on injection was noted as it had been by the Norwegians in 1965. The manufacturers, Roche, sponsored a symposium in 1967 ‘Diazepam in anaesthesia’ at the Royal Society of Medicine (RSM) with lots of scientific details.

In the *British Dental Journal* 1968 there were two papers in sequence. The first by Rattray compared I-V diazepam favourably with the Jorgensen technique, noted the pain on injection and suggested dilution with up to twice the volume of sterile water. Mild precipitation occurred if more water was used. He used IV pethidine for painful extractions. Brown, Main & Murray Lawson in the second paper, combined methohexitone with diazepam in 68 out of the 108 patients studied. In 1969 a *British Dental Journal* report on a symposium on IV diazepam included Verrill’s description of ptosis as an indication of sedation.

**Use in medical practice**

As more use was made of various ‘scopes’, gastro-enterologists quickly took to using I-V diazepam to sedate their patients and it was also used in casualty for manipulation. Elderly bronchitics for OP cystoscopy benefited from the method but analgesia was needed if surgeons started causing pain such as diathermy of bladder papilloma. Soon IV diazepam superseded other methods of sedation in ophthalmology, orthopaedics and radiology. Pain on injection was widely recognised as a problem, but thrombophlebitis was often overlooked because the daycase patients only developed the condition later. Various ways of alleviating the pain and thrombophlebitis were advocated, but none were very successful until the solubilising agent was changed. In 1980 & 1983 papers in the *British Journal of Anaesthesia (BJA)* from Denmark and Sweden described using IV diazepam in an emulsion. It was marketed as Diazemuls but the launch of midazolam was imminent. At the RSM Section of Anaesthesia centenary meeting in June 2008, Brian Kay said that he’d suggested to ICI in 1977 that Intralipid should be
used as a vehicle for propofol; they turned the idea down but later used something similar.

**Personal experience**

Looking in my 1968 Hospital Medicine diary, I found I used IV diazepam several times when I was a registrar as an adjunct to epidurals and even noted pain up the arm after 20mg. I was working with Massey Dawkins who usually employed Evipan. After becoming a consultant in Sheffield in 1972, I used it more often: for GU patients in outpatients and having epidurals, and also at the Charles Clifford Dental Hospital. Roche had similar boxes and ampoules so that Valium looked like alcuronium. I recall an inadvertent injection of alcuronium instead of valium! I couldn’t find any personal attempts at preventing injection pain and thrombophlebitis before 1974, but in March that year I was upset to find that a fit male medical student (with me on attachment) had been given 30 mg of IV diazepam for dental extraction. Not only was this needless (he hadn’t asked for it, it was at least twice the dose I might have used and LA had worked perfectly), but the poor chap had a thrombosed cephalic vein from the antecubital fossa (ACF) to the clavipectoral fascia and possibly beyond. I described this to a colleague who showed me an X-ray of a patient’s arm after an IVP injection, with a column of dye in the same place. A tensed deltoid occludes the cephalic vein, causing the sporadic complaint of pain or burning at the top of a patient’s shoulder.

**Letter on adverse reactions**

I reported the side effect to the Committee on Safety of Medicines (CSM) and duly received an acknowledgement and copies of the data listing other reports of adverse reactions to diazepam. I was amazed to find only one instance of thrombosis after IV injection had been reported, but there were 18 cases of jaundice with 4 deaths. This was the time when the link between halothane and post-operative jaundice was becoming stronger. I wrote a letter to the *BJA* with these facts, urging that thrombophlebitis should be reported so the CSM should get a true picture of drug side effects. Graham Smith, then assistant editor *BJA*, replied pointing out that the CSM’s list of adverse reactions was ‘not for publication’ but suggesting I ask permission to publish the information. I wrote to the CSM and Dr Inman, Principal Medical Officer, replied asking me to remove the reference to jaundice in my *BJA* letter. He also suggested that the jaundiced patients might have had halothane after diazepam... Finally a reduced version of my letter was published in *BJA* 1974 46 p413. At this time I think that thrombophlebitis and thrombosis after IV diazepam was so common that no one thought of reporting any more.
Trial of another IV benzodiazepine

In 1974 I volunteered to be a subject in a trial of IV benzodiazepine carried out in Sheffield by Professor JA Thornton. First a psychologist did various tests, then I was given the IV injection (I don’t remember it being painful) and soon after I drifted off to sleep. When I awoke the psychologist tested me again asking questions I hadn’t been asked before, I thought. I’d been woken in the middle, had another set of tests of which I had no memory but I gave the correct answers! That particular drug never reached clinical use because it was very long lasting. I can date this to 1974 because 48 hours afterwards I fell asleep watching the World Cup football final. (Germany won, again).

Means of reducing thrombophlebitis from IV Valium

I had several ways of reducing vein pain and venous inflammation. The simplest if possible was to use a large vein on the medial side of the ACF and then aspirate blood into a large syringe before injecting the drug. Asking the patients to clench and unclench their fists to increase venous flow and reduce stasis also helped. I had a ‘conjuring trick’ when I lectured on IV sedation: I would draw up the Valium, add water making a cloudy mixture and then clear it with a drop of Epontol or Althesin. I employed this for patients with a history of venous complications but stopped when the link between Cremophor and anaphylaxis became clear.13

Sedation in dental surgery

I’m not sure when I started providing IV sedation for complex dental procedures, but in my diary there are dates from early 1977 using diazepam IV intermittently for two or more hours. Dosage varied depending on the size and nervousness of the individual patient. Generally I didn’t exceed 40 mg in divided dosage, although I remember a female patient who needed 130 mg + 30 mg pentazocine and then 100 mg methohexitone to keep her quiet. It turned out she was habituated to alcohol and oral diazepam. Several patients were regular attendees and I sedated one at least eight times progressing from diazepam to Diazemuls and then to midazolam.

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Acknowledgement

I extend grateful thanks to Dr Sally Weeks, Montreal for finding me a copy of the 3rd reference.
CHARLES JAMES FOX (1829-1896) –
his contribution to dentistry and to the development of nitrous oxide anaesthesia

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Charles James Fox has a place in the history of anaesthesia for the part he played in the introduction of nitrous oxide into dentistry, but he is also remembered by dentists as a pioneer in the formalisation of dentistry as a profession.

Early years

The son of a London physician of the same name, Fox was born in 1829 into a medical family, with eleven doctors and one chemist in his generation alone. At that time very few medically or surgically qualified people were engaged in the provision of dental services. Most were part-time practitioners, who functioned in such disparate occupations as barbers, wigmakers, blacksmiths and silversmiths, so dentistry was not recognised as a profession with its own special skills.

After he completed his training Fox married Elizabeth Anna Carkeet, and started to build up a successful West End practice, living and working at 24 Mortimer Street, near Cavendish Square (see Figure 1).

Fox’s influence in the establishment of dentistry as a profession

He became one of a small group of dentists, which included James Robinson and John Tomes, who realised that to achieve recognition they required a professional organization, education, training, a code of ethics, regulation of its members by the control of entry to an approved list, and the publication of scientific journals. In this they were influenced by the organisation of the medical and surgical professions, and passing of the 1858 Medical Act. Actually there emerged two reformist factions of the dental profession: the College of Dentists of England, and the Odontological Society of London. Fox became one of the first members of the College of Dentists, and was active in its administration, holding the office of librarian and curator of their museum. He was soon invited to join the Odontological Society of London also, and was one
of the very few practitioners who belonged to both groups. He made several attempts to unite these two opposing groups, but without success, until, in 1863, they merged to form the Odontological Society of Great Britain. Subsequently, in 1907, it became the Section of Odontology of the newly-formed Royal Society of Medicine.

Fox became one in the first group of practitioners to qualify with the new LDS RCS qualification in 1860. In its early days this did not bring its holder the right to have his name on the Medical Register, but in 1870, the General Medical Council allowed dentists with the LDS to be registered. But Fox had already achieved registration, because in 1864 he obtained the MRCS.

Apart from his private practice Fox was on the staff of the Dental Hospital of London, and was also one of the first dentists appointed at the Great Northern Hospital, which later became the Royal Northern, in Holloway Road. He also worked at the St. John’s and St. Elizabeth’s Hospital, and was consulting dental surgeon of the New Hospital for Women.

In 1866 Charles Fox founded the British Journal of Dental Science, and was its proprietor and editor until 1880. At that time this was the only dental periodical
and voice for practitioners, and his position gave him a platform from which to campaign for compulsory education and registration. He was very active within the Odontological Society of London, being a member of the council, honorary secretary, foreign secretary, and vice president in 1877-8.

**Philanthropic and educational work**

Fox had a strong social conscience. In 1855 he founded the second dental dispensary in Great Britain – the London Dental Dispensary, at Clarence Gardens⁵. Dental dispensaries were established ‘to assist the poor in the preservation of their teeth, and to extend to them such advantages, resulting from timely dental aid, as hitherto have been almost exclusively enjoyed by the better classes of society’⁵. These also facilitated teaching opportunities, providing dentists with the experience required to complete their professional education. Thus the dispensaries had both a service and an educational role, being a step towards the provision of organized teaching courses within dentistry, and a move away from the apprenticeship system of teaching.

When Fox founded the London Dental Dispensary in 1855, he used his own funds. It was first established in Clarence Gardens, a square to the east of Regent’s Park, but by 1859 it had moved to 476 New Oxford Street, and Fox was joined by John Tomes as consultant dental surgeon. Fox’s philanthropic example inspired a whole generation of young dentists who trained and worked there with him, and who went on to establish dispensaries in different parts of the country: Birmingham, Liverpool and Newcastle. These later became the dental teaching hospitals, and are currently centres for teaching, specialist training, and secondary care. There can be no doubt that Fox’s influence contributed to the establishment of many dental teaching institutions and hospitals.

His charitable instincts led him also to set up the Horace Wells Testimonial Fund in 1871, after discovering that the widow and son of Horace Wells were living in absolute poverty, but unfortunately the sum he was able to raise and send to Mrs. Wells in Hertford wasn’t significant⁶.

**Fox’s contribution to the use of nitrous oxide**

Fox would have been only seventeen when the first general anaesthetic was given in Great Britain, so he never had to work without its benefits. But chloroform had disadvantages, and Fox was an early enthusiast for the use of nitrous oxide as an anaesthetic for dental surgery.
He had met Thomas Evans (Figure 2), who was the American dentist who first introduced nitrous oxide to Britain in 1868, and he described in *The Lancet* how Dr. Evans, who lived in Paris, ‘had brought over a single bottle of liquid gas, and I had the pleasure of operating with it at the Dental Hospital of London, Mr. Clover administering the gas; but there the matter ended’. But following this Fox was keen to bring this new agent to Britain, and Joseph Clover (Figure 3) was a leading dental anaesthetist who shared his enthusiasm.

At the monthly meeting of the Odontological Society of Great Britain held on 6th April 1868, members heard the accounts of Dr. Evans’ experience of nitrous oxide as an anaesthetic agent, and as a result a Nitrous Oxide Committee was set up to ‘investigate the anaesthetic properties of nitrous oxide gas with powers to call in any other scientific aid, and to report the results of such investigations at some future meeting’. Fox, who was secretary of the Odontological Society at the time, became a valuable contributor within this committee. He was convinced of the safety of nitrous oxide as an anaesthetic, but he was one of the first to point out the disadvantages of the bulkiness of the gas, and the difficulty of conveying it from place to place. At that time it was either stored in large bags, or had to be prepared on the spot by the large and complicated Sprague’s chemical apparatus (Figure 4). So Fox became convinced that the answer was to persuade somebody to manufacture large cylinders in which the gas would be supplied in liquid form. He applied to a manufacturer in Paris, but got only an assurance that ‘it would be ready when certain difficulties were overcome’. Then he resorted to using the heavy iron bottles supplied by Mr Barth, but these would contain a maximum of only fifteen gallons.

Finally, Fox was inspired after he saw the large bottles of compressed hydrogen and oxygen, which were illustrated by Dr Thudichum. He suggested to Messrs. Coxeter and Son that if such cylinders could be filled similarly with liquefied nitrous oxide, it would solve the problem by making large quantities portable, so that the use of nitrous oxide anaesthesia could spread to other surgical specialities as well as dentistry. On 1st November 1869, Fox and Clover were asked to attend the company’s office to test the efficacy of the liquid gas. Following its success, the company succeeded in producing a hundred gallon vessel, from which Fox administered nitrous oxide to his patients at the Dental Hospital in London on 21st February 1870.

By May 1870, both Barth and Coxeter were manufacturing and supplying liquid nitrous oxide on a large scale. Soon afterwards this was copied by the New York company, Johnston Bros., and introduced onto the American market by 1873. Each vessel was stamped with its empty weight, so that clinicians were able to determine how much gas the vessel contained by weighing it. This was a
Fig. 2 Thomas W Evans (Source: AAGBI)

Fig. 3 Joseph Clover (Source: AAGBI)
Fig. 4 Sprague’s apparatus (Source: Fox CJ On Nitrous Oxide, 1869)

Fig. 5 Large iron cylinders manufactured by Coxeter & Son. Vessels A, B and C weighed in at 100, 50 and 25 gallons respectively. Above vessel B is a screw stopcock for controlling the outflow of gas at b. (Source: Lancet, 1870)
significant advantage. Messrs. Coxeter and Son supplied Fox with wrought iron vessels of forty five and ninety gallons capacity (compare with Figure 5). With the help of Coxeter, Fox devised a double sliding valve, which allowed the percentage of nitrous oxide to be regulated, and a mixture of nitrous oxide and air to be administered. The high pressure gas from the cylinder was received in a Cattlin bag (Figure 6), which was connected to the valve, and to a two-way stopcock and a Clover facemask (Figure 7). This was attached to each cylinder when in use. It received the first force of the liberated gas delivered through a small tube, which was in turn attached to a facemask. The outflow of the gas at ‘b’ was controlled by the handle, ‘e’ (see Figure 6).

Fox collected and analysed his own records of the use of nitrous oxide, and those of colleagues. He stressed that the use of nitrous oxide and air mixtures prevented hypoxia and accidents, and gave a detailed report on the use of nitrous oxide with air\(^9, 10, 14\). He was instrumental in the Odontological Society issuing a statement establishing that nitrous oxide was a safe substitute for chloroform in dental operations, and he continued to promote its use in his Editorials.

**The later years\(^{11, 12, 13}\)**

Fox suffered from severe asthma in his later years. He gave up dental practice around 1879, and retired from the Editorship of the BJDS in 1880. In appreciation of his many services to the dental profession, including the passing by Parliament of the Dentists’ Act, his colleagues presented him with a Testimonial and a Purse of 100 guineas\(^{15}\). The Foxes had five children. The oldest, also Charles James, followed in his father’s footsteps, and also edited the BDJS for a time. Fox’s marriage collapsed in 1880, and he emigrated to Canada, accompanied by a woman described as a dental assistant: Agatha Mary Fulker, twenty four years his junior. He lived first in Toronto and then tried his hand at farming after receiving a free grant of land at Woods, Ontario. But the local communities soon learned of his professional skills, and this triggered a move to Gravenhurst, a small town north of Toronto. He bought a house, which he named Holland House after the early home of his namesake, the famous politician. As a Catholic he was unable to divorce his wife, but after her death in 1890 he married Agatha. Tragically, she died in 1895, of an overdose of chloroform, which she had taken to relieve neuralgic pain, and he died on 4th January of the following year while inhaling chloroform to relieve a severe asthma attack.
Fig. 6  Cattlin bag connected to cylinder (Source: *Lancet*, 1870)

Fig. 7  Clover’s facepiece and two-way stopcock (Source: *Lancet*, 1870)
This man, who was so eminent in British dentistry, and to whom so much is owed, is buried in a remote cemetery in a small town in Ontario, Canada (Figure 8). His gravestone has recently been restored (Figure 9) by his great-nephew, Mr Brian Fox of Toronto. Despite widespread enquiries, we have not been able to find a portrait or photograph of the man himself.

**Acknowledgements**

In preparing this paper we are grateful for the assistance and advice we have received from:

- Dr D Zuck, UK and his brother, Dr J Zuck, Canada
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- Iris Millis – Heritage Assistant of the Association of Anaesthetists of Great Britain and Ireland
- Helen Nield, Amy Grinnell and Melanie Parker – from British Dental Association Library and Museum
- Royal College of Surgeons of England.
Fig. 8  St Paul’s cemetery where CJ Fox is laid to rest (Source: Mr B Fox)

Fig. 9  Gravestone of CJ Fox (Source: Mr B Fox)
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Anaesthesia today is a field equally dominated by both men and women. However this was not the case 150 years ago when the science world was ruled by Victorian men, who left no place for a woman thought to be incapable of scientific thought.

Anaesthesia was first administered in London on the 19th December 1846. Ether was administered by a dentist for the removal of a tooth and three days later the same anaesthetic was administered at University College, London for the amputation of a leg. The advent of anaesthetics was a major boost to the evolution of surgical practice.

Female doctors

Until 1877 only two women’s names were on the Medical Register, one of them being Dr Elizabeth Blackwell M.D. In 1874 the London School of Medicine was established and in 1877 clinical access for its students was granted at the Royal Free Hospital. The Enabling Bill, passed by Parliament in 1876, permitted Universities to admit women, and that opened infinite possibilities for these capable women. Progress for women in medicine was then imminent: graduates increased from the first (Dr Elizabeth Blackwell) in 1849, to 8201 women doctors in 1905.

Surgeons of the early twentieth century “recognized the importance of feminine qualities in the administration of anaesthetics” and motherly qualities, such as a soft voice and gentle touch, were considered among the most valuable in a female anaesthetist’s arsenal.

Notable women in anaesthesia

Louisa Aldrich-Blake

Dame Louisa Aldrich-Blake (1865 – 1925), graduated from the Royal Free Hospital, School of Medicine for Women in 1893 and went on to become the first British woman to obtain the degree of Master of Surgery. She was the first woman to hold the post of a surgical registrar and also acted as an anaesthetist. At the Royal Free Hospital she was initially “assistant anaesthetist”, but in 1895 she succeeded Dr Silk as anaesthetist.
Among her many firsts she was also one of the first to perform operations of the cervix and rectum. She was the Dean of the Royal Free Hospital, School of Medicine for Women from 1914 – 1925 and the Consultant Surgeon at the Royal Free Hospital from 1919 – 1925. Aldrich-Blake was devoted to training students of the Royal Free Hospital's School of Medicine for Women and she exercised an important influence on generations of women medical students. The climax of her career came in 1924 when she was made Dame Commander of the Order of the British Empire (see Figure 1).

![Memorial to Louisa Aldrich-Blake in Tavistock Square, London](Source: Wikipedia)

**Isabella Coler Herb**

Dr Isabella Coler Herb (1869 – 1943) obtained her medical degree from the Northwestern University Women’s Medical School in Chicago in 1892. Her earliest published work evaluated 1000 consecutive general anaesthetic cases for 1 year starting in 1897 and included audit of various aspects: male to female ratios, type of anaesthetic used (ether, chloroform or both) and the various categories of operations done. All her work contributed towards improving the quality of anaesthesia for patients. She was instrumental in developing the Department of Anaesthesiology at the Rush Medical College/ Presbyterian Hospital in Chicago. In her later journal articles she warned of the dangers of intravenous ether and defended the open method of administration of ether. In 1917, she described a new type of anaesthetic screen which provides excellent protection to the face, mask and endotracheal tube. She continued to contribute towards research in anaesthesia and in her obituary in *Anesthesia & Analgesia*.
tribute was paid to her as “a pioneer American Anesthetist and Dean of the women physicians in the speciality”.9

*Ruth Mansfield*

Dr Ruth E Mansfield (1901 -1994) obtained her Fellowship in Anaesthesia in 1936 and practised cardiac anaesthesia from its early days at the Brompton Hospital.3 During her time of service she contributed significantly to the developments in Thoracic Anaesthesia through various studies and articles. She co-authored the text book *Practical Anaesthesia for Lung Surgery* in 1967. Among the anaesthetic practices she discusses, Mansfield notes that in the 1950s, moderate hypothermia of 28-30 Celsius allowed up to 10 min of cardiac arrest in open heart procedures. This allowed time for closure of atrial septal defect and pulmonary valvulotomy.10

Hypothermia was achieved by surface cooling which required immersion of the patient, "complete with IV drips and connected to the anaesthetic apparatus," into a large bath of water and ice. She describes veno venous cooling as being more efficient - this involved inserting a cannula into the superior vena cava and another cannula into the inferior vena cava, hand pumping blood from one end to the other to cool patients.10

In *Memories of early days of open heart surgery in the UK and India* 10, she relates her experience as an anesthetist at mid century at the Royal Brompton Hospital and later after 1969 at Christian Medical College and Hospital, Vellore, India. She was conferred the M.B.E title for her services in India in 1977.11

*Virginia Apgar*

Dr Virginia Apgar (1909-1974) was one of Columbia University's first female M.D.s.12 She was one of the first American women to specialize in surgery and went on to become Columbia’s first ever full Professor of Anaesthesiology in 1949.12 She invented the Newborn Scoring System, also called the Apgar Score that assessed the health of newborns.13 The Apgar score is a simple and repeatable method that includes 5 criteria rated on a scale of 0-2. The criteria include heart rate, respiratory rate, muscle tone, colour, and reflex response of the newborn. Observations are done at 1 and 5 minute intervals and this has become standard and remains in wide use today. Dr Apgar (Figure 2) went on to relate the score more closely to the effects of labour, delivery, and maternal anaesthetics on the baby's condition. Along with her colleagues she demonstrated that babies with low levels of blood oxygen and highly acidic blood had low Apgar Scores. She also studied the effects of giving cyclopropane anaesthesia to the mother which resulted in an infant's low Apgar score.14
Among other things she developed teaching programs for residents in anaesthesiology. She continued to do further research in effects of maternal anaesthesia on the neonate.

She excelled not only in the field of medicine but also in the field of music. A gifted violinist and cellist, during her working years she played in three orchestras. She also built her own stringed instruments and is one of the only two anaesthesiologists to be honoured on a US stamp. She enjoyed a contented and fascinating life beyond medicine.

**Gertie Marx**

Dr Gertie Marx (1912 – 2004) graduated from the University of Bern, Switzerland in 1937 and then moved to USA. She introduced the era of epidural anaesthesia where fathers were allowed to be present during birth. She was considered the mother of obstetric anaesthesia. Notable studies by Dr Marx were: attempted prevention of hypotension from spinal anaesthesia by acute hydration, aortocaval compression syndrome, and regional anaesthesia for emergency caesarean sections. The Gertie Marx needle for epidural anaesthesia was often described as being developed by Dr Marx, but it was actually named in honour of her, and remains in wide use today. At the annual meeting of the Society for Obstetric Anaesthesia and Perinatology (SOAP) the Gertie Marx prize is awarded for the best scientific paper.
She received numerous awards and honours including the Distinguished Service Award from the American Society of Anesthesiologists in 1988 and from the American Society of Regional Anesthesia in 1990. Her most notable moment was in 1993 when she was awarded the College Medal from the Royal College of Anaesthetists, in a presentation made by Queen Elizabeth II.\textsuperscript{17}

\textit{Four women in neuroanaesthesia}

In the UK in 1960s interest in anaesthetic specialization increased. In 1965 the Neuroanaesthetists’ Travelling Club was founded and held its first meeting in Manchester. Four of the 33 neuroanaesthetists present were women.\textsuperscript{3} They were Dr Olive Jones (who was not only the first woman neuroanaesthetist, but also the first full time salaried specialist anaesthetist in UK), Dr Aileen Adams (who became the first woman Dean of the Faculty of Anaesthetists), Dr Jean Horton and Dr Betty Everitt. In 1993 the Club became the Neuroanaesthetists’ Society of Great Britain & Ireland and 38 members were women.\textsuperscript{3}

\textit{Katherine Lloyd Williams}

Dr Katherine Lloyd Williams (1897-1973) graduated in 1926 from the Royal Free School of Medicine. Starting out as a physiotherapist she later qualified as a doctor going on to become an anaesthetist to the Royal Free and Elizabeth Garrett Anderson Hospitals. She became the first woman Dean in the University of London in 1956.\textsuperscript{18} She served on the GMC for ten years\textsuperscript{18} and represented Medical Schools on the Senate for eight years.\textsuperscript{3} She was also a Founder Member of the Board of Faculty of Anaesthetists in 1948. As an anaesthetist her students remember her as being “unhurried, calm and understandingly explicit to the patients”.\textsuperscript{18}

\textit{Current practice}

Currently, the presence of women in medicine and anaesthesiology has changed dramatically. The rise in women in all specialities may have met with resistance due to family commitments. Therefore the introduction of flexible training has helped to balance responsibilities and help women achieve their best.

An excellent measure of success in leadership would be achieving the presidency of an organisation. After 160 years and countless women who excelled in their contributions to anaesthesia by virtue of their efforts and
qualities, today we have Dr Judith Hulf the current President and Dr Anna Maria Rollin a Vice-President of the Royal College of Anaesthetists.

In modern practice of anaesthesia gender is no longer a factor in the skill of an anaesthetist. However the important role of women in this field should not be understated. There is no doubt that all the women described above and the many more women anaesthetists out there have made a mark in this field that cannot be erased with the ink of time. To conclude this article I would just like to say that I am proud to be in this path paved by all these distinguished women, who continue to inspire me in every step of my career.

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THE BEGINNINGS OF INTRAVENOUS FLUID THERAPY

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SpR Northern School of Anaesthesia

Although the principle of intravenous fluid therapy was discovered and put to practice as early as the 1830s during the cholera epidemic, it took more than a hundred years for it to get established as a standard practice in medicine and surgery. This article aims to trace the evolution of intravenous therapy through history.

Blood transfusion

Transfusion Myths

The first hint of blood transfusion is in the Roman story of the Argonauts in which the princess Medea rejuvenates her father-in-law by exsanguinating and transfusing him with a magic potion.

Pope Innocent VIII was said to have received blood transfusion from three ten year old boys to cure his anaemia, which resulted in the death of both donors and recipients. Some historians claim that that there was no intravenous transfusion but the blood was infused orally.

Andreas Libavius in 1615 was the first person to recommend blood transfusion but never attempted it. Bloodletting was common practice during the period from 13th to 16th century.\textsuperscript{1,2,3,4}

First attempts at blood transfusion

Research and experimentation into blood transfusion began with Harvey’s discovery of the circulation of blood in 1616. The first authentic animal-to-animal blood transfusion was performed by Richard Lower in 1665 by connecting the carotid artery of a donor dog to the jugular vein of a recipient dog with a quill. He also claimed to have transfused a man called Arthur Coga with sheep blood in 1665.

The first published blood transfusion from animal to human was by Jean Baptiste Denis, physician to Louis XIV of France in 1667. He transfused sheep blood into a 16 year old boy. His fourth transfusion recipient developed a severe haemolytic reaction following transfusion of calf blood resulting in his death.
This incident resulted in the prohibition of animal to human transfusion in France, Britain and also by the Vatican.\textsuperscript{1,2,4}

\textit{Human to Human Transfusion}

In 1818, James Blundell, an obstetrician and physician, transfused blood into a man suffering from gastric carcinoma to treat his anaemia. The blood was collected from different physicians. He died because of haemolytic reactions. Blundell successfully saved a woman dying of postpartum haemorrhage by transfusing her husband’s blood. He performed ten transfusions, five of which were beneficial. He also invented many instruments for blood transfusion.

Blundell’s transfusion devices included the impellor, which consisted of cup, tube and syringe and the gravitator, consisting of a receptacle held high above the patient with an attached tube through which blood was injected to the patient. The first successful whole blood transfusion to treat haemophilia was performed by Samuel Armstrong Lane and Dr Blundell.\textsuperscript{(1,2,4)}

\textit{Discovery of blood groups}

Transfusions in the eighteenth century were plagued by complications. Break through in transfusion history came with the discovery of blood groups A, B, O (then called A, B, C) by Karl Landsteiner in 1900.\textsuperscript{5} The fourth blood group AB was described by Decastello and Sturli in 1902. In 1907, Ottenburg and Shultz first applied this information in an actual transfusion. Hektoen suggested in 1911 that blood groups be made the basis for selection of donors for blood transfusion.\textsuperscript{5} World War I experiences led to universal application of blood typing for selection of blood donors. Karl Landsteiner and A Wiener described the Rh system in 1940.\textsuperscript{1,4}

\textit{Anticoagulation and blood banks}

James Blundell advocated transfusion directly from artery to vein to prevent coagulation. Kimpton-Brown transfusion apparatus - paraffin coated gradient glass cylinder with horizontal side tube for suction - was commonly used till 1918.

Lewishon (1914) used citrate to prevent blood coagulation. He collected blood in a citrated flask and immediately transfused. Rous and Turner developed a solution of salt, isocitrate and dextrose to anticoagulate and preserve blood. The only problem was the mixture made the blood extremely dilute, so it had to be
removed prior to transfusion (1:1 solution: blood). The method was used throughout in World War II with minor variations.\textsuperscript{5}

In 1943, Loutit and Mollison introduced ACD (acid citrate dextrose) as a preservative, which was adopted by the army in 1945 (1:4 solution: blood ratio). CPD (citrate phosphate dextrose) was discovered in 1957, CPD with adenine in 1965 followed by CPDA1 in the 1980s. Bank blood was made possible because of effective preservation and refrigeration. In the 1960s glycerol was used widely for freezing that enabled long-term storage of blood.\textsuperscript{5}

In 1932 the first blood bank was established in Leningrad; but Bernard Fantus, who started the first American blood bank in Cook County (Chicago, USA) in 1937, was named as ‘Father of Blood Banks’. Blood was collected in reusable sterilised bottles till the early half of the twentieth century and complications like air embolism and pyrogenic reactions were common. Plastic bags invented in the latter half of the twentieth century were disposable, flexible and facilitated the separation of blood components and the concept of component therapy.\textsuperscript{1,4,5}

\textbf{Intravenous fluids}

\textit{Cholera epidemic and origins of intravenous fluid}

In 1831 cholera epidemic invaded Europe. Physicians observed black thick blood in collapsed cases and advocated blood letting, induced emesis and dosing with calomel as treatments. Dr. William Brooke O’Shaughnessy thought differently. He applied practical chemistry to find a cure. He found the blood from the victims was devoid of large proportions of water, neutral saline ingredients and free alkali. He also described that the stools contained all the salts deficient in the blood. Further he hypothesized that the cure lay in injection of solution of normal salts of the blood.\textsuperscript{4}

Thomas Latta put the idea into practice and infused six pints of saline solution to a patient with cholera. The solution was about half normal concentration of soda (NaCl) and sub-carbonate of soda (NaHCO\textsubscript{3}) and contained 58 meq of sodium, 49 meq of chloride, 9 meq of bicarbonate. Latta reported further cases: 8 out of the first 25 survived.\textsuperscript{4}

In spite being based on reason and science, intravenous saline was not accepted as a treatment in the further cholera pandemics (1852 and 1863) due to following reasons. Firstly, it was tried only in moribund patients leading to poorer outcomes; rehydration only resulted in more purging and the public thought that death was hastened by the treatment. Secondly the infusion of
saline was not repeated sufficiently to maintain fluid balance. Thirdly the saline that was injected was unsterile, chemically impure and hypotonic causing bacteraemia and haemolysis.\textsuperscript{1,3,4}

\textit{Improvements in late 19\textsuperscript{th} and in 20\textsuperscript{th} C}

The first isotonic solution consisting of sodium, potassium and calcium chloride was developed by Sydney Ringer, cardiovascular physiologist in 1876. He observed the improvement in muscle contraction when tap water was used instead of distilled water in saline bath solutions. In 1932, Alexis Hartmann introduced Hartmann’s solution by adding lactate to Ringer’s solution.\textsuperscript{1}

Even though the practice of sterilisation of medical equipment and fluids in 1890s reduced the incidence of bacteraemia, febrile reactions from the water source were common. So the intravenous therapy was used only in patients who were critically ill.

The pyrogens were discovered in 1923 as the cause of febrile reactions. In 1933 the Baxter Company started manufacturing intravenous fluids in vacuum bottles, which eliminated microbial growth and pyrogens. The medical needs produced by the two World Wars increased the awareness of fluid and blood replacement. By the end of World War II intravenous fluid therapy was established as a routine practice in the management of medical and surgical patients. Another breakthrough came with the invention of the disposable Rochester plastic needle. Till that time intravenous needles were sterilised, made of steel, had a styllet in them to keep the lumens open and had to be sharpened often to clear the barbs. David Massa, a resident in anaesthesiology in the Mayo Clinic discovered the Rochester plastic needle, the over-needle device. It revolutionized cannulation techniques by preventing infiltration into the tissues and leak in the IV site and allowing patient mobility.\textsuperscript{3}

\textit{Other Infusates}

<table>
<thead>
<tr>
<th>Water</th>
<th>In 1830 Russian physicians Herman and Jaehnichen injected 60 oz of distilled water to a cholera patient who died 2 hours later.\textsuperscript{1}</th>
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<tr>
<td>Milk</td>
<td>In 1854 cow’s milk, goat’s milk and later on human milk was attempted as it was thought that white corpuscles of milk were capable of being transformed into red blood corpuscles.\textsuperscript{1,5}</td>
</tr>
<tr>
<td>Coconut water</td>
<td>In Asia intravenous coconut water was given to wounded soldiers during Japanese invasion. Although sterile, the composition was similar to intracellular fluid, acidic and hypotonic making it a less ideal intravenous fluid \textsuperscript{6}</td>
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Conclusion

We all take intravenous fluids for granted. About 85% of people getting admitted to hospital receive intravenous therapy. Intravenous fluid and its accessories have become a billion pound industry, making it hard to believe that it is a recent development. This standard has evolved from centuries of legends, superstitions, scientific experiments and error, which were important components behind the development of the modern medical era.

References


Introduction

What did surgeons do before the anaesthetic? Famous artists have depicted varying scenes of barbaric experimental procedures that were carried out. These procedures were greatly restricted by operating time and the agonising pain of the operation. We can now appreciate how important analgesia is in the perioperative management of patients undergoing surgery of any kind. Through the 19th century there was a transformation in the way surgery was performed. Self experimentation was an important part of medical research at that time. We owe many of our current techniques in anaesthesia to a few of our brave colleagues from the past, who fearlessly and naively allowed themselves to be the subjects of their own clinical trials. Successfully or not, they worked relentlessly to improve conditions for surgery. They were not all self-righteous. Some of them became addicted to the very pharmaceuticals they wished to promote. Consider the tragic story of Horace Wells who was humiliated by his peers in a failed attempt to show nitrous oxide as an adequate anaesthetic, to the current day anaesthetists attempting to research the subject of awareness during anaesthesia.

In this article I will take a historical journey through the fascinating subject of self-experimentation in anaesthesia and describe some of the landmark discoveries attributable to it.

Humphrey Davy (1778-1829)

Thomas Beddoes 1760-1808 a physician and chemist first met Davy when he was only 19 yrs old. He was undergoing research in The Institute of Pneumatic Therapy in Bristol. He experimented with the use of oxygen in the treatment of tuberculosis. Realising Davy’s intellectual gift he soon invited him to be superintendent at the Institute. At a youthful 26 yrs of age Davy began a series of experiments on animals observing the effects of nitrous oxide gas. For years he had suffered from inflammation of the gums. On April 11th he noticed that upon inhaling the gas his pain diminished substantially. As well as successfully curing his painful gums, the nitrous made him laugh incessantly a property he rather enjoyed. This was the first suggestion of nitrous oxide’s possible use as an anaesthetic. Sadly he didn’t pursue this matter any further. Instead he introduced it to his friends as after dinner entertainment. It is said he was
inhaling 50 pints per day. His work prompted much interest throughout England. The American Gardner Colton 1814-1898 was a scientific travelling salesman. There is evidence he was medically trained but he never actually completed his degree. He travelled through American cities giving scientific lectures on the effects of nitrous oxide and many other inhaled substances. The word spread quickly. It was not long before nitrous oxide was being used for its analgesic properties without any long-term harm. It was also being abused in certain social circles on both sides of the Atlantic. Poets and literati were enjoying its euphoric effects in private company.

**Horace Wells (1815-1848)**

Horace Wells was a local dentist practicing in Connecticut who had attended one of Gardner’s exhibitions. He was so excited that he attempted to repeat the experiment the very next day. He gave some nitrous oxide to a young druggist’s shop assistant Samuel Cooley, who whilst enjoying the experience accidentally banged his chin. When the effect of the nitrous had worn off he could not recall any pain. Wells decided that this property could be used to help with teeth extractions. As it happened his own wisdom teeth were causing him a lot of pain and bother. He persuaded Colton to be involved in a clinical trial. The participants of the trial all convened at Well’s surgery. Colton the anaesthetist, John M Riggs (another local dentist) the surgeon, and Wells the patient. The operation was a success. Once Wells had recovered from the anaesthetic he proclaimed a “new era in tooth pulling”. He started to use nitrous oxide in his dental practice. He administered it through a wooden tube into the mouth with compressed nostrils. He wanted to bring nitrous oxide to the masses and was introduced by William Morton, a former partner to some of the surgeons at Massachussets General Hospital. Upon hearing the results of his own self-experimentation, he was soon invited to demonstrate the effects of nitrous oxide. In 1845 in an auditorium in Massachusetts General Hospital a patient who was having a dental extraction was anaesthetised with nitrous oxide. Sadly he was too light and so complained of pain during the procedure. Well’s was laughed out of the auditorium and was labelled a fraud. This didn’t stop Morton who believed that there was a better agent out there. Colton eventually became a depressive and when chloroform was discovered he was one of the first to try it. He became addicted to it and committed suicide.

**William Morton (1819-1868)**

Morton was another dentist working in Boston – he specialized in prosthetic work and performed numerous dental extractions. He witnessed Well’s failure with nitrous oxide and felt that ether might be a better alternative. He decided to
try it on himself, his dog and his two young assistants, and achieved successful anaesthesia - so he began to use it in his practice. Morton felt that it could be used outside dentistry and convinced his friend the surgeon, Henry Jacob Bigelow to use it for his procedures. After 37 successful general anesthetics they both decided to approach some of the senior surgeons at Massachusetts General Hospital once again. This time there was a very different outcome. Ether was successfully used to aid the surgical removal of a vascular tumour from the mandible of a young writer. The auditorium was renamed the Ether Dome and a new era in surgical anesthesia had begun. Morton was desperate to get a patent on his discovery but it wasn’t to be - his patent request was rejected and he gained no monitory reward and died penniless.

James Young Simpson (1811-1870)

Born 1811 in Bathgate, he enrolled at Edinburgh university aged 14. He studied Greek, Latin, and mathematics in his first year. In his second he became a medical student. He graduated in 1830. He spent months assisting in general practices across Scotland completing an MD in this time. He eventually became assistant to the professor of pathology. His real interest however was in obstetrics and gynaecology. In 1840 he was elected to the chair of midwifery. After the advent of ether anaesthesia in 1846 he wondered about its possible application during labour. He first used it on 19th Jan 1847 in a particularly difficult labour. There was difficulty delivering the baby’s head. The baby died after a long labour. The mother quickly regained consciousness and was devastated by her loss, she was however grateful to Simpson, as she had been completely insensible to the pains of her traumatic labour. The very same day Simpson received an important letter: he had been appointed the Queen’s Physician in Scotland. Although honoured by this news Simpson couldn’t stop thinking about the pain free labour. He faced a hard task convincing his peers of the benefits of ether in labour, not only on medical ground but moral ones too. With this Simpson set about finding a better agent that would provide a quicker induction and had a pleasant smell. He and his medical friends eagerly tested many substances in the autumn of 1847. David Waldie, a Liverpool apothecary suggested chloroform. Simpson and his colleagues, Matthews Duncan and George Keith inhaled chloroform in Simpson’s dining room on the evening of 4 November 1847. All three fell unconscious under the dinning room table and upon awakening Simpson congratulated himself on finding a superior anaesthetic agent. With a pocket handkerchief as a delivery system he used it successfully four days later on a patient during a labour. His dining room at 52 Queens Street Edinburgh is now a museum and is called the discovery room.
Muscle Relaxants

Intocostrin a curare-based drug was commonly being used to reduce the severity of induced convulsion therapy in psychiatry. Helen Barnes an anaesthetist in the emergency medical service in London thought that it could be used to relax the laryngeal muscles to aid tracheal intubations. She decided to test its efficacy on herself. She asked two colleagues to give her an IV injection of 4ml of Intocostrin. She was completely conscious and noted that her colleagues could easily perform laryngoscopy. There were common misconceptions regarding muscle relaxants during anaesthesia around this time. Anaesthetists were assuming that with muscle paralysis came a reduced level of consciousness. In 1946 Frederick Prescott, a pharmacologist at Westminster Hospital, asked two colleagues to paralyse him: 15mg of curare caused minor weakness in his arms, 20mg caused respiratory depression, 30mg caused severe paralysis. Prescott was unable to communicate: luckily his colleagues noticed the change in his skin colour and artificially ventilated him with a bag and mask. Once the experiment was over Prescott stated it had been such a harrowing experience that he would never want to go through it again. There could be no doubt that curare, although being effective at paralysing a patient - facilitating intubation and more desirable surgical condition, offered nothing in the way of analgesia or sedation. The results of his experiment were published in The Lancet.

Regional Techniques

In the summer of 1884 Sigmund Freud (1856-1939) was working as a junior doctor in neurology. He was busy investigating what was then a fairly new drug called cocaine. Cocaine had reached Europe from South America in the mid 1850’s well known to the local Indians as a euphoriant and stimulant. Freud’s studies led him to believe it might be a remedy for morphine addiction as well as a tonic for his psychoneurotic patients. He knew that cocaine deadened mucous membranes but was not sure of its effect on muscle contraction. He asked his eager assistant Carl Koller (1857-1944) to test these effects. Koller applied cocaine to his own tongue and was immediately struck by the numbness that proceeded. He started thinking that this property may lend itself to use as a local anaesthetic agent. He had an interest in ophthalmic surgery and he proceeded to experiment on laboratory animals and on himself, applying a small amount into the eye. He prepared a report, which was read by a friend (as he could not afford to travel) and published later in 1884. It was rapidly employed on patients in ophthalmology outpatient clinics for minor procedures and investigations.
Current Day

Isolated forearm technique

Anaesthetists have struggled for many years with the lack of a quantitative measure of the patient’s consciousness level and depth of anaesthesia. The few methods we do have are not always reliable. A group of doctors in the department of anaesthesia at Hull Royal Infirmary, are experimenting using the isolated forearm technique. These doctors are using themselves as subjects.

Caudwell Xtreme Everest Project

Doctors and scientists are using themselves as subjects to see the effect of extreme environments on their own physiological states in the hope it will aid our understanding of the pathophysiology of the critical care patient.

Conclusion

As we have seen medicine has benefited greatly from self-experimentation, doctors becoming the subjects of their own research. Lay and scientific communities alike are often unaware of these selfless contributions. Certainly all the people described have shown themselves undoubtedly to be committed to their specialty, at times risking their livelihood and indeed their lives to further knowledge in their field.

References

2. Fradin DB. We Have Conquered Pain: The Discovery of Anesthesia. New York: Margaret K McElderry Books, 1996; 100-110


*Editorial comment*

For the benefit of readers the definitive references for Helen Barnes and for Frederick Prescott are listed below.


Boyle’s legacy is a legend of origin, an asymmetric layout of anaesthetic machine, and a convention of machine use. Twenty years ago Boquet, Bushman, and Davenport’s design investigation concluded with “what we have now is what we are used to rather than the ideal”. The continued application of new technologies may prove that Boyle’s legacy now compromises both users and industry in the successful acceptance of new designs. The investigation is presented from the perspective of industrial design. Industrial design is concerned with the ideation and generation of physical form, aesthetics and human-product interactions. Designers are the producers of objects, observing others’ behaviour and work to provide products that not only gain a market edge and profit through visual form or style, but also make technology more transparent, useable and rewarding.

Designers look to the past to understand today’s context, and look to the future to comprehend the possibilities, endeavouring to elicit complex information from specialised professions whilst applying new technologies, often with varying success. Many designs go unseen remaining speculative prototypes, others become global ‘must haves’, some are insignificant and personal, others carry immense responsibilities to society. One thing is sure: many products carry a ‘path dependence’ such that in the pursuit of advancement, slow iterative design changes become difficult to shake off due to unchangeable formats derived from historical methods of use.

Left to right layout of the original Boyle’s apparatus

A common response from anaesthetists to the design layout of a contemporary anaesthesia machine is ‘the original designer was left handed’. This comment brings to mind visions of the Qwerty keyboard and other idiosyncratic products that have outlived their original intentions. The more this anecdote was quoted, the more we were drawn in to discover this ‘reason for being’. It was not the notion that the machine was asymmetrical, nor its ability to physically dominate
and contort the user\textsuperscript{2}, but that design may have forgotten this early innovator and his not un-peculiar attribute.

L Rendell-Baker, in the foreword to K Bryn Thomas’s book states “This layout with the Flowmeters on the left, and the outlet to the patient on the right, was designed by Boyle for convenient use of the machine on his left hand side, as he was left handed”\textsuperscript{3}.

Boyle’s remark ‘I devised the machine known as ‘Boyle’s Nitrous oxide Oxygen Ether Outfit’\textsuperscript{4} published in \textit{The Lancet} in 1917 places a self imposed ownership on this work, that he is not responsible for the parts but for the whole, not the components but the arrangement. This is very much a design statement, and equally a comment suggesting a self branding entrepreneurial status, not uncommon in the early 1900s.

So we have Boyle, the left handed Deviser, who likes convenience, therefore designs for himself. The history books reveal many steps of innovation leading to Boyle’s 1917 revelation, and Boyle himself acknowledges the earlier innovations of James Tayloe Gwathmey\textsuperscript{5}. In endeavouring to validate this current day anecdote, what is not revealed are the underlying drivers of behavioural use that justify the uptake and success of left handed authorship.

The question we propose is: did anaesthetists: adopt a left-hander: or did normal behaviour provide the stepping stone for adoption? Has Boyle’s left-handedness defined design or was the process already defined in standard operating behaviours?

Reflecting on how Boyle’s first ‘outfit’ was adopted, the design influences that brought about its acceptance and continuance are as follows.

a) The catalyst for design has been normal behaviour or ‘normal use’.

b) The close collaboration between technology, industry, and clinical advancements has resulted in a formula conducive to slow iterative change.

c) Early users and related staff took great joy in personalisation, customisation, and open critique of equipment.

d) Eponym developers have become brands signifying that their unique innovations or identifying layouts (in Boyle’s case flowmeter on left and outlet on right) are not physical permutations reflecting their anthropometric physiology, but derivatives of normal behaviour in the transition of technologies.
Link from earlier apparatus

Looking at several anaesthetist-innovators that predate Boyle’s first apparatus, a common thread is revealed in the depiction of operative ergonomics (Figure 1). Joseph Clover in the late 1800s applied an inhaler of his own design (manufactured by Coxeter and Sons, England) with his right hand on the inhaler and left on the patient’s pulse. James Tayloe Gwathmey in the early 1900s had his nitrous oxide/oxygen portable apparatus manufactured by Forreger in New York mounted to his left - an apparatus which Boyle had seen in 1913 and purchased on Gwathmey’s recommendation. As depicted in Figure 1, Marshall’s 1916 apparatus (made by Coxeters), could be left or right; but it sits in a similar pose to the last image, that of Boyle’s first apparatus (manufactured by Coxeters in 1917). There was obviously a prevalence of both left handed anaesthetists, and manufacturers willing to buck the right handed trend at the turn of last century.

![Clover](image1)
![Gwathmey](image2)
![Marshall](image3)
![Boyle](image4)

**Figure 1** JT Clover and bag (1860s), JT Gwathmey and apparatus (1914), G Marshall’s apparatus (1916), HEG Boyle’s apparatus (1917).
(Source: Thomas KB. *The Development of Anaesthetic Apparatus*. Oxford: Blackwell, 1975 – with permission from AAGBI)

Left handedness

Let us not forget that Boyle was a left-hander, so what of his predicament. Typically we design for the dominant user population; those outside of ‘industry defined percentiles’ suffer - this often means left-handers also suffer. Thus men cannot get trousers with left-handed zips, nor do many cheque-books come back to front. These are items that ‘although transportable’ retain no flexibility in their use.
At a time when only right-handed guitars were available, Jimi Hendrix the American guitarist chose to restring a ‘Fender’ and play it upside down. When Fender produced a left handed variation Jimi retained his ‘now normal approach’ as he had grown to accept the ergonomics and actually preferred the control knobs at the top rather than the bottom. This demonstrates the flexibility of an apparatus due to its size and form and that unlike trouser can be used symmetrically and still function.

A lathe, due to its size and task, is not flexible to personal usability. Users are constrained to enforced usability. These examples reveal that behaviours are driven by the task, and, dependent on physical format, users will manipulate equipment to their best advantage.

Clover, Gwathmey and Marshall were investigating for themselves as informed designers, thinking what came naturally to them, should be usable for others. These innovative anaesthetists were designing alongside manufacturers, products with functional controls to predicatively assist the safe delivery of anaesthesia by other anaesthetists. Whereas, Boyle published an iteration of Marshall’s apparatus under his own name, using drawings borrowed from Coxeters. One may say - ‘Boyle saw an opportunity and took it’.

**Ergonomics**

In the use of Gwathmey’s apparatus and the borrowing of Marshall’s ideas Boyle produced no concerted change that makes his left-handedness apparent. Lord George Wellesley the CEO of Coxeter and Sons was a pilot in WWI and in learning to fly would have become technically savvy. Lord George would be aware of design issues in both manufacturing and the more subtle requirements of interface controls and use. For Coxeter to have proceeded with a left handed design in a right handed world would seem like industry denial.

For the general population of anaesthetists to accept these early apparatuses, transition from mask and bottle anaesthesia to new equipment required trust in technologies. Habit became the ergonomic method of design and the route for acceptance is seen in the need for dexterity and control of those components most at risk, the interface of mask and patient in respect of both patient position and surgical procedure.

These habits of normal use in mask and bottle application provide some evidence as to the dexterity required and the hand positioning and we may envisage a normal transition of the left hand from drip bottle to apparatus manipulation (Figures 2-3).
Figure 2  (Courtesy of Geoffrey Kaye Museum of Anaesthetic History)

Figure 3  (Courtesy of Geoffrey Kaye Museum of Anaesthetic History)
This is not to say all anaesthetists practiced this way, but that the mask and bottle afforded ergonomic flexibility, in the transition to apparatus use this ergonomic normality could be retained without physical stress or ‘taking the eye off the ball’. The apparatus could be drawn close to the patient and with controls at an easy reach the right hand dominated the patient and mask whilst the left hand was consumed in the secondary task of apparatus adjustment.

**Evolution of the Boyle machine**

As the use of Boyle’s apparatus grew during the 1920s and 30s so too did the equipment allied to the task. Coxeters were producing and refining an apparatus that consisted of an assemblage of innovations, an assemblage of other prototypes and products. This assemblage now came under the design influence of both user anaesthetists and related staff, and the Boyle apparatus became the Boyle’s machine. Dr Deacon the medical superintendent at Edgeware hospital provided the most progressive and obvious of changes in 1931, a change that would initiate the evolution of Boyle’s apparatus from normal use and an inherent flexibility to a new definition of normal use but reduced flexibility. This was the addition of a table, a structure that integrated the required inhalers, masks, and agents with the apparatus in which to administer anaesthetic⁸: the umbrella stand became a dressing table. Deacon’s observations were well founded: with an increasing array of equipment needed to both use the machine and provide anaesthesia, at-the-ready storage space and a general tidy up was required.

The ergonomics of mask and bottle then gave way to new habits that arose from a need to use instruments and tools at the machine. These habits were becoming a derivative of mass-manufacture, new technologies and approaching standardisation - the dominant right hand had new tasks at the work bench. This seemingly simple modification has graduated to every manufacturer since. The significance of this now global design change implemented in 1931 brings together controls, both visual and functional, upon a furniture-like structure as a seemingly everlasting precedent for design.

Boyles left handed apparatus began it’s migration to its current neck twisting position on the right as an influence of normal behaviour’s reaction to technological change, a reaction to workarounds as the equipment increased in size and reduced in flexibility.

The significant shift from apparatus to machine defines an era where Boyles left-handed anecdote takes hold and is truly born. Whilst the apparatus on the left provided flexibility and normality, its growth in size and complexity to a machine in its table format became awkward and uncomfortable on the left –
therefore not normal, at a time when Boyle was no longer actively engaged in design.

**Use of the name ‘Boyle’**

Boyle’s name was valuable, and in the acquisition by BOC of both Coxeter and Charles King, Boyle’s name was trademarked to the Boyle’s machine\(^9\). Anaesthetists were now consumers and industry-produced machines were no longer prototypes or assemblages but branded products. The Boyle’s machine had reached it zenith as an amalgamation of 60 years of fine-tuning. This is the Boyle’s brand; the arrangement or format many will recognise and understand, a simple yet proven constitution sold and licensed throughout the commonwealth and the world.

Boyle’s legacy is twofold. First it defines the basic form and a convention of machine use. Second, is that a user can collaborate with industry. In this instance the evolution of technology has become the fulcrum. Progressively industry has unbalanced the relationship between user and product - instituting a growing reliance on ‘brand and form’ to overcome an increasing lamination of components and complexity in its search for safe controllable anaesthesia. This reverse ‘pass the parcel’ has become a detriment to the user, a battleground of hierarchies, and a breeding ground for signage\(^10\). Every continued technical iteration takes us further from our early anaesthetist-innovators’ simple intentions and closer to a new digital design legacy.

Boyle was used as a selling tool, a brand, and allowed this to happen. There is no better foresight than to have selected a leading anaesthetist who showed great interest in teaching, innovation and product development and the wish to assist others. Boyle although left-handed was right in his early ‘devising’ and adoption of his respected peers’ ideas. It could be seen by some that Boyle in elevating his anaesthesia credibility may have scratched the membrane of plagiarism in his devising and borrowing to publish. Contrary to this, the protection of intellectual property in visual form and arrangement is difficult to attain. Boyle would fit comfortably into the sharp end of today’s design teams, neither as an innovator nor visionary but as an informed user and driver of technology.

**Future development**

Whether the next generation of workstation/machines can establish a trustworthy relationship with anaesthetists is yet to be known. The present challenge for industry is in the justification and presentation of new features, and acceptance of these by anaesthetists, rather than a reliance on technologies
to ‘stretch to fit’ in overcoming the inadequacies of design. The irony may be that if new technology is to be accepted it must be placed within a recognisable format, therefore becoming usable, demonstrating that Boyle may continue to play a part in 21st century design.

Conclusion

It would seem that normal behaviour and early innovators in the transition of technology have played a stronger part in design ergonomics, through the placement of developmental stepping stones, than the singular notion of one man’s left handedness.

References

THE CURIOUS INCIDENT OF PULMONARY ASPIRATION IN SNOW’S LIFETIME

Dr J Roger Maltby
Professor Emeritus of Anaesthesia, University of Calgary

Snow was already well qualified and well known when he began giving ether anaesthesia in 1847. He had passed the MRCS and LSA examinations in 1838, graduated MB, BS London in 1843, obtained his MD London in 1844, and published eight papers in the London Medical Gazette and the Lancet between 1838 and 1846. He soon became a skilled clinical anaesthetist, and researched the basic and applied science of anaesthesia. He provided anaesthesia for surgeons’ operating sessions in many London hospitals; for private surgical practice in the surgeon’s rooms, the patient’s home or hotel room; for private dental practice in dentists’ consulting rooms; for his own obstetric practice; and occasionally for various medical conditions. His first book, on ether anaesthesia, was published in 1847. His second book, On Chloroform and Other Anaesthetics, covered every aspect of anaesthesia from 1846 to 1858 and was published soon after his death in June 1858. His clinical experience and research, attention to detail and knowledge of contemporary medical literature in the latter book provide reliable information on anaesthesia-related morbidity and mortality.

The commonly used anaesthetics in Snow’s lifetime were ether and chloroform, administered by open drop or by vaporiser and face mask. Both agents were likely to cause vomiting. Doctors, students and others who administered anaesthetics received no formal training. Protection of the airway by tracheal intubation and antacid prophylaxis remained far into the future. Patients depended on their own protective reflexes to prevent pulmonary aspiration. We might therefore speculate that vomiting and aspiration under anaesthesia was a frequent occurrence, and that the only preventive measure was preoperative fasting to ensure an empty stomach.

Snow’s fasting guidelines

“The only direction which it is usually requisite to give beforehand, to the patient who is to inhale chloroform, is to avoid taking a meal previous to the inhalation; for chloroform is very apt to cause vomiting, if inhaled whilst there is a quantity of food in the stomach. The sickness is not attended with any danger, but it constitutes an unpleasantness and inconvenience which it is desirable to avoid.”
His guidelines for surgical patients were determined by the time at which the surgeon scheduled the procedure:

“The best time of all for an operation under chloroform is before breakfast, but the customs and arrangements of this country do not often admit of this time being chosen, and it is unadvisable to make the patient fast beyond his usual hour. It answers very well to perform an operation about the time when the patient would be ready for another meal, or, if the time of operation fall two or three hours after the usual time of eating, to request the patient to make only a slender repast at the time, so as just to prevent the feeling of hunger.”

Snow wrote that the chief drawback to chloroform was the sickness which in many cases followed its use, and that sickness occurred equally often with ether. He did not refer to any danger of inhaling vomitus during anaesthesia. The greatest advantage of amylene, which he used towards the end of his career, was that postoperative vomiting occurred in only two of 238 patients compared with 22 out of 100 with chloroform. Furthermore, in his case books he frequently recorded postoperative sickness or vomiting, but never during surgery. The nearest approach to intraoperative vomiting was one case in 1853 in which an elderly man, who had undergone dental extractions, vomited before he recovered consciousness but soon felt quite well. Neither in his case books nor in his books on ether and chloroform did Snow mention breath holding and retching during anaesthesia as warning signs of impending vomiting.

His instructions for oral intake in labour were less restrictive than those for surgery, and are at variance from Mendelson’s recommendation of nothing by mouth during labour which anaesthetists have promoted for the past sixty years:

“These rules respecting food are, moreover, meant to apply only to the use of chloroform in surgical operations, and not to its employment during labour. One allows the patient all the nourishment that is desirable, intermitting the inhalation now and then for the purpose. And chloroform, given in this way, hardly ever causes sickness, but often alleviates it when present from physiological causes.”

**Snow’s review of 50 chloroform deaths**

Snow reviewed 50 case reports of sudden death under chloroform anaesthesia that were published in medical journals between 1848 and 1857. Thirty-one of the deaths occurred in the British Isles and 19 from the rest of the world. Several deaths were almost instantaneous, with descriptions that included “the face suddenly became pallid and deathlike” and “as if struck by lightening.” He
agreed with Sibson’s early observation on the first four cases that these were primary cardiac, not asphyxial, deaths:

“The heart, influenced by the poison [chloroform] ceased to contract, not from the cessation of respiration, for the heart in asphyxia will beat from one to three minutes after respiration has ceased, but from immediate death of the heart.”

In six cases the fatal symptoms appeared suddenly at the beginning of the chloroform inhalation before the patient lost consciousness, and in six they occurred just after the patient had lost consciousness when the inhalation was discontinued for surgery to commence. In 13 cases dangerous symptoms appeared after the patient had lost consciousness, and in 20 cases during the course of surgery. In five cases the time of death was not recorded. There was no mention of vomiting or premonitory signs of breath holding or retching. Various external stimuli were tried when the patients collapsed – ammonia by inhalation and direct application to “tender areas”, cold water to the face, wet towel on the chest and galvanism. Artificial respiration was attempted in 16 cases, but no patient showed more than minor, transient improvement. The techniques used were Marshall Hall’s rolling method, compressions of the chest, mouth-to-mouth or mouth-to-nose respiration, and tactile passage of a tracheal tube through the glottis.

Autopsies were performed in 32 cases. In six cases the lining of the epiglottis, larynx, trachea or bronchi was described as reddened or congested. In one of these cases (Hannah Greener) the stomach was distended with food, in another it contained 3 gills (350 mL) of partially digested food, and a third contained 1½ oz (45 mL) of thick dark fluid but there was no mention of food in the trachea or bronchi. Stomach contents were described in three of the cases. Snow concluded that the health and strength of patients who died were “quite equal to the average of the multitude who have inhaled this agent without ill effects.”

Alternative causes of death from chloroform were suggested, but Snow explained why he rejected them all. Patient idiosyncrasy, he suggested, was an undefined “something” in the person, and 11 of the 50 patients had previously taken chloroform uneventfully. Impure chloroform was not credible because, in every case, the chloroform was either found to be of good quality or chloroform from the same bottle had been used in other patients without ill effects. A faulty inhaler was possible but an inhaler was only used in 12 of the 50 patients. Four per cent chloroform vapour did not cause hypoxia because it would reduce oxygen in the inspired air by less than one per cent and higher chloroform concentrations would kill by toxicity, not asphyxia. Cough and glottic spasm were protective reflexes against too high a concentration of chloroform and, if prolonged closure of the glottis did occur, death would occur slowly from
asphyxia, not instantaneously as in the reported cases. The sitting position appeared to be coincidental because 31 of the 50 patients were supine, nine sitting and ten unspecified. He accepted that the tongue falling back could cause suffocation, but not until anaesthesia was so deep that the patient’s diaphragm was also paralysed. Finally, he commented that, before the use of narcotic vapour was known, there were numerous instances of sudden death during surgical operations, or just before intended ones, without any evident cause except fear or pain. Neither in the case reports, nor in Snow’s commentary, was the possibility of suffocation from vomiting and inhalation of gastric contents considered.

Data from Simpson

Simpson was also an avid reader, correspondent and contributor to the medical literature. By September 1848 he had collected details on 150 cases of chloroform use during labour from his own practice and more than 600 cases from 26 colleagues in the British Isles, Austria and Germany. Most of the colleagues administered chloroform intermittently with each contraction in prolonged, painful labour, but did not use it for quick, easy deliveries. They reported maternal deaths and stillbirths although they believed that these would have occurred with or without chloroform. No opponents of pain relief in normal labour on medical, moral or religious grounds referred to the danger of vomiting and aspiration.

Surgery in Snow’s era

Table 1 shows the range and frequency of surgical procedures for which Snow provided chloroform anaesthesia according to numbers tabulated by Shephard from Snow’s book. Snow administered more than four thousand chloroform anaesthetics, but the numbers are incomplete for some surgical procedures, pain relief in uncomplicated labour and medical conditions. The only intra-abdominal procedures for which Snow provided anaesthesia were 10 ovariotomies; seven of the patients died postoperatively. He did not anaesthetize for any Caesarean section.

Table 2 lists the first time a patient survived both the operation and the postoperative period of early abdominal operations. With the exception of ovarian tumours and subtotal abdominal hysterectomy, no other abdominal operation was successfully performed in Snow’s lifetime. Caesarean section was very rarely performed. Hellier, a Leeds obstetrician writing in 1904, quoted 1841 statistics for the British Isles as 30 cases with 27 deaths. There had not been a successful Caesarean section in Paris from 1787 to 1876 and British
mortality in the 1870s was 84 per cent. Nearly 50 years after Snow, Hellier himself had performed only seven Caesarean sections in four years.21

Table 1. Snow’s cases of chloroform anaesthesia

<table>
<thead>
<tr>
<th>Operation</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental extractions</td>
<td>1048</td>
</tr>
<tr>
<td>Harelip</td>
<td>147</td>
</tr>
<tr>
<td>Cataract and strabismus</td>
<td>142</td>
</tr>
<tr>
<td>Other head and neck surgery</td>
<td>226</td>
</tr>
<tr>
<td>Orthopaedic: amputation, debridement</td>
<td>527</td>
</tr>
<tr>
<td>Anal fissure, fistula, haemorrhoids</td>
<td>433</td>
</tr>
<tr>
<td>Bladder: stone, catheter, stricture</td>
<td>383</td>
</tr>
<tr>
<td>Other genitourinary</td>
<td>160</td>
</tr>
<tr>
<td>Breast</td>
<td>226</td>
</tr>
<tr>
<td>Tumours: skin, fat</td>
<td>224</td>
</tr>
<tr>
<td>Pregnancy version, forceps, foetal craniotomy</td>
<td>32</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>170</td>
</tr>
<tr>
<td>Ovarian tumour</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>3,508</td>
</tr>
</tbody>
</table>

Adapted from Shephard DA. John Snow Anaesthetist to a Queen and Epidemiologist to a Nation.16

Table 2. Abdominal operations: date of first successful procedure

<table>
<thead>
<tr>
<th>Operation</th>
<th>Date</th>
<th>Surgeon</th>
<th>Location</th>
<th>Sex</th>
<th>Age (yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovarian tumour</td>
<td>1809</td>
<td>McDowell</td>
<td>Danville KY, USA</td>
<td>F</td>
<td>46</td>
</tr>
<tr>
<td>Abdom hysterect.</td>
<td>1853</td>
<td>Burnham</td>
<td>Lowell MA, USA</td>
<td>F</td>
<td>-</td>
</tr>
<tr>
<td>Splenectomy</td>
<td>1867</td>
<td>Péan</td>
<td>Paris, France</td>
<td>F</td>
<td>20</td>
</tr>
<tr>
<td>Cholecystotomy</td>
<td>1868</td>
<td>Bobbs</td>
<td>Indiana, USA</td>
<td>F</td>
<td>30</td>
</tr>
<tr>
<td>Intussusception</td>
<td>1874</td>
<td>Hutchinson</td>
<td>London, England</td>
<td>M</td>
<td>2</td>
</tr>
<tr>
<td>Gastrectomy</td>
<td>1881</td>
<td>Billroth</td>
<td>Vienna, Austria</td>
<td>F</td>
<td>43</td>
</tr>
<tr>
<td>Cholecystectomy</td>
<td>1882</td>
<td>Langenbuch</td>
<td>Berlin, Germany</td>
<td>M</td>
<td>43</td>
</tr>
</tbody>
</table>
Discussion

The evidence from Snow’s case books and text books suggest that vomiting with aspiration did not occur during anaesthesia. Simpson’s review of obstetric anaesthesia is equally silent on this danger. The warning signs of breath holding and retching, as well as actual vomiting, could hardly have passed unnoticed and unrecorded for more than a decade. Surely resuscitators who used mouth-to-mouth or mouth-to-nose techniques would have noticed! The 50 almost instantaneous deaths in Snow’s detailed review are not consistent with aspiration of solid material, but are consistent with Levy’s later explanation of ventricular fibrillation in frightened patients under light chloroform anaesthesia. Simpson suggested that, in the case of Hannah Greener, attempted resuscitation by pouring water and brandy down her throat had caused death from drowning. He never mentioned regurgitation or vomiting. Nevertheless, in the context of aspiration of gastric contents Cotton and Smith quoted this case as “death under anaesthesia caused by aspiration” and in 1990 Coté quoted it as the basis for concern regarding pulmonary aspiration during general anaesthesia.

There remains the possibility of unrecognised silent pulmonary aspiration of gastric acid, Mendelson’s syndrome, in which onset of symptoms is delayed for several hours and death would be attributed to other causes. However, in Mendelson’s series no deaths occurred in the 40 patients who developed the syndrome.

If death from intraoperative vomiting did not occur we must seek an explanation. In Snow’s era almost all surgical procedures were very brief or brief, lasting from a few minutes to rarely more than half an hour. The anaesthetic was discontinued or given intermittently after the surgeon began cutting. Anaesthesia was light and patients recovered consciousness either during or very soon after surgery. In labour, at least in Snow’s hands, it was also given intermittently for pain relief. Ether or chloroform was administered via a face mask from a vaporiser or by the open drop method. Patients breathed spontaneously, and maintenance of a clear airway for short cases does not appear to have been a common problem. Stimulation of the gag reflex from oropharyngeal airway insertion or laryngoscopy was absent, as was stimulation from the surgeon’s handling of abdominal viscera except in the rare ovariectomy. Although every patient had what we now refer to as an unprotected airway, it appears that the patients’ own oesophageal sphincters and glottic and airway reflexes provided protection.
Nowadays, obstetrical patients, patients with gastroesophageal reflux, obesity, difficult intubation indicators and most emergency patients who undergo general anaesthesia are considered to be at high risk of pulmonary aspiration. High risk is not synonymous with frequent occurrence. In 1946, when Mendelson reviewed 44,016 obstetrical cases in 1936-45, tracheal intubation was rarely performed, the anaesthetist was often inexperienced, and intensive care was not available. Although pulmonary acid aspiration syndrome occurred in 40 patients, none of those patients died whereas two of the five who inhaled solid food did die. In 1956 Parker reported eight aspiration asphyxia deaths out of 205 maternal deaths in 215,000 confinements in Birmingham in 1943-52. No deaths occurred in 3,048 domiciliary forceps deliveries under open drop chloroform or ether.

It is possible that the explanation is simply one of the number of anaesthetics and the virtual absence of intra-abdominal surgery and Caesarean section. The number of operations was small and the procedures minor. Case reports of vomiting during laparotomy under chloroform anaesthesia appeared later in the 19th century. Non-fatal vomiting occurred during the first successful splenectomy in Paris in 1867. Sudden and profuse vomiting occurred, accompanied by dilated pupils and pallid face, during an ovarian cystectomy near Edinburgh in 1870, at which Simpson was the anaesthetist. It is not clear whether death was due to vomiting or primary cardiac arrest. Two years after Snow’s death the number of operations at Leeds General Infirmary was 179; by 1948 the number had increased a hundred-fold to 18,644. Snow’s cases were usually elective, and in his era stimulation of the gag reflex with an oropharyngeal airway, laryngoscope or endotracheal tube did not occur. Today, pulmonary aspiration of gastric contents is also rare and usually occurs in emergency patients with risk factors, or in whom tracheal intubation is difficult.

The curious incident in the Sherlock Holmes adventure of the race horse Silver Blaze was that the guard dog in the night time did not bark. It did not bark because it knew and trusted the trainer who came to take the horse from the stable in order to nobble it for its next race. The dog made a mistake, as did John Snow when he stated that vomiting presented no danger. Both may be forgiven for not foreseeing a rare event. It was not until 1862, four years after Snow’s death, that “a new cause of death under chloroform” was reported to the Obstetrical Society of Edinburgh. A soldier in the Burmese war in 1853, under chloroform anaesthesia after eating dinner, vomited during surgery for a gunshot wound to the thigh. He “subsequently sank and shortly died, apparently from exhaustion” but the autopsy showed the trachea to be filled with vomit. In the discussion that followed, members of the society remarked on the inconvenience and occasional danger of administering chloroform to patients who had eaten shortly before. They described cases but no details were recorded and there was no mention of a fatal outcome.
In conclusion, neither Snow nor other writers in his lifetime recorded vomiting with aspiration of gastric contents as an actual or potential danger under anaesthesia. Balfour’s case report in 1862 of a “new cause of death under chloroform” adds credence to this view. Factors that may have protected patients include brief surgical procedures, light anaesthesia, active laryngeal and cough reflexes, absence of airway manipulation, and almost complete absence of abdominal surgery.

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Joseph Priestley was born 1733 near Birstall, County of Yorkshire, in England. Above the door of his birthplace is the plaque (Figure 1) that states simply “Joseph Priestley: discoverer of oxygen was born on this site in 1733” This rather neglected and terse inscription seems to epitomize the institutionalised neglect of an immensely rich Priestley heritage.

Priestley didn’t just discover oxygen. He also made many other great discoveries in science and medicine. Many of these achievements are still not recognized in the history of science literature some remain largely unknown.

As a founding father of political libertarianism and religious reform with his promotion of Unitarianism, Priestley made momentous contributions to politics and religion. This is undoubtedly one reason for the neglect of his heritage by the British establishment of Church and State, but it may not be the only reason. After outlining many of Priestley’s undiscovered discoveries, below, it will be argued that his drive to understand chemical reactions using the theory of phlogiston, has predisposed historians of science against his research, believing that his refusal to concede the new chemistry of Lavoisier’s chemical revolution was unprincipled and unscientific. Nothing could be further from the truth; throughout his life, Priestley sought nothing but the truth.

It can be argued that it is the successive historians of science, writing over a period of 150 years, from the birth of thermodynamics to present, who themselves have misunderstood phlogiston theory, and hence prejudiced the Priestley case for recognition as a founding father of physical chemistry, biochemistry and medicine.

**Education and history**

Brought up as a Calvinist, like all dissenters Priestley was excluded from the English Universities of Oxford and Cambridge. After graduating at the Dissenters academy at Daventry, and three years as a Calvinist Minister in Suffolk, Priestley returned north to Nantwich in Cheshire. While a minister at Nantwich, he established a local school; it was his first successful educational venture. Believing that all students should have a good grasp of the English and its grammar before learning any other language and dismayed at the quality of
the instruction manuals available, and in 1761 Priestley wrote his own textbook \cite{2} *The Rudiments of English Grammar* “ (Figure 2). The book was very successful—it was reprinted for over fifty years. Priestley also quoted from the most famous English authors, encouraging the middle-class association between reading and pleasure. Priestley's innovations in the teaching and description of English grammar, particularly his efforts to disassociate it from Latin grammar, made his textbook revolutionary and has led twentieth-century scholars to describe him as "one of the great grammarians of his time. Rudiments influenced all of the major British grammarians of the late eighteenth century.

The resounding success of Priestley's book was one of the reasons that Priestley was offered the position of tutor in languages and literature at Warrington Academy. There he lectured on modern history, rhetoric, literary criticism and aesthetics.

In order to teach history effectively, Priestley invented the timeline of historiography. In 1765, he published “*A Chart of Biography*” \cite{3}, believing that this chart, and a subsequent publication *New chart of history* (1769) would allow students to "trace out distinctly the dependence of events to distribute them into such periods and divisions to place all past transactions of significance in a just and orderly manner. *Chart of Biography* covers a vast time span, from 1200 BC to 1800 AD, and includes two thousand names. In the last few years, Priestley is at last being formerly recognised as a founder of historiography, or the “history of history” with his invention of the timeline.

Priestley organized his list into six categories: statesmen and warriors; diviners and metaphysicians; mathematicians and physicians; poets and artists; orators and critics; and historians and antiquarians. Priestley's "principle of selection" was fame, not merit; therefore, as he mentions, the chart is a reflection of current opinion. Both charts were popular for decades: “*A new chart of history*” went through fifteen editions by 1816 . The trustees of Warrington were so impressed with Priestley's lectures and charts that they arranged for the University of Edinburgh to grant him a Doctorate in 1764. The Church of England religious Universities of Oxford and Cambridge would never have honoured a dissenter.

At Warrington he found time to start a new career as an historian of science. Influenced by his associate from the USA Benjamin Franklin, he began to research “*history of discoveries in electricity*”. He exposed many gaps in the understanding at the time; he was not content to be simply a historian of science,
Fig. 1 Inscription on the Priestley birthplace at Fieldhead near Leeds.

Fig. 2 “Rudiments of English Grammar”. Priestley’s first of 200 publications in education, scientific research, political theory and religious reform.
with so many unanswered questions. Around 1768 Priestley began to conduct laboratory experiments of his own; he became an experimental scientist.

Science and religion

In 1768 Priestley left Warrington to be appointed the Minister at Mill Hill Chapel in Leeds. Whilst at Leeds Priestley tried to reconcile science and religion. He was one of the first to recognize that all matter is made of atoms, held together by forces of attraction, but occupying fixed and finite volume due to forces of repulsion between atoms. Priestley expressed his disquiet at the concept of a spirit in his “Disquisitions” (Figure 3) a religious text published in 1768 whilst at Leeds. In this essentially religious publication, Priestley expounded his theory of matter as composed of atoms. His description of interatomic forces included predictions of atoms being “spherical”, “impenetrable”, “cohesive”, and stated “atoms must be divisible”, 40 years before Dalton, famous for “Dalton’s atomic theory”, said atoms were “indivisible”, and 140 years before Rutherford split the atom in 1919!

Like many champions of natural philosophy in eighteenth-century Britain, Priestley rejected the divinity of Christ and division of God into three persons, and went on to be a founding disciple of the Unitarian church. In his “Disquisitions” treatise, in which he questioned the existence of the spiritual relating to the material, Priestley denies the immortality of the soul on both scientific and biblical grounds. Instead, he argued that the functions in the body that had been assigned to an immaterial soul are merely to material structures in the brain and therefore will not outlive the cerebral tissue that produced them. From a religious standpoint, he believed that if the soul were immaterial and therefore immortal, the concept of the resurrection of the body would have no meaning since a person's essence would remain intact with or without his body. Hence, he concluded, though confirmation or rejection of spirit was impossible on the basis of observation, in all likelihood, man was an entirely material being. Jesus Christ, he argued, was just an ordinary person like any other human being.

Driven by unanswered questions raised by religious dogma, Priestley continued a relentless drive to observe the nature of materials, and especially the air we breathe. He also made essential inventions that led to his scientific discoveries. He invented the pneumatic trough and went on to perform great experiments relating to the discovery of gases. He investigated the solubility of carbon dioxide in water and went on to invent the process of carbonation or fizzy drinks industry. It’s well known that Priestley discovered oxygen, and all anaesthetists know that he had previously produced and characterised nitrous
oxide (laughing gas), the first surgical anaesthetic, in 1772. What is not popularly known is that he also discovered and characterised nine other gases, including ammonia. Other contributions to physical chemistry or the science of chemical and physical change, however, remain largely unknown. Seventy five years before Faraday, for example, Priestley decomposed his ammonia into hydrogen and nitrogen using electricity. This was the first demonstration of the connection between electricity and chemistry.

Science and politics

Whilst Chaplain at Mill Hill Chapel in Leeds, Priestley became first Secretary and founder of a subscription Library, where he would meet with his colleagues to read and debate the politics of the day. Priestley’s friends urged him to publish a work on the injustices borne by religious dissenters because of the British Laws that forbade non-members of the Church of England from holding any public office. Between 1660 and 1665, Parliament passed a series of laws that restricted the rights of dissenters: they could not hold political office, teach school, serve in the military or attend University (Oxford and Cambridge) unless they ascribed to the articles of the Church of England. Priestley, however, went much further; it was from this standpoint that Priestley wrote, arguably, his most important publication of his life, his “Essay on the First Principles of Government”.

In his “First principles essay” (Figure 4) Priestley scientifically analyses the requirement of maximum happiness, stability and prosperity in a civilised society. He gives a benchmark definition of political and civil liberties, and argue for protection of extensive civil liberties. He distinguishes between a private and a public sphere of governmental control; education and religion, in particular, he maintains, is a matter of private conscience and should not be administered by the state. Priestley’s fundamental maxim of politics was the need to limit state interference on individual liberty. Later in life, Priestley’s libertarianism was adopted by his friend Thomas Jefferson, founding father and third President of the USA. For early libertarians like Priestley and Jefferson, the "defining feature of liberal politics" was its emphasis on the separation of church and state. In a statement that articulates key elements of early libertarianism and anticipates utilitarian arguments, Priestley wrote: “It must necessarily be understood, therefore, that all people live in society for their mutual advantage; so that the good and happiness of the members, that is the majority of the members of any state, is the great standard by which everything relating to that state must finally be determined”.
Fig. 3 Priestley’s “Disquisitions relating to matter and spirit” mixes science and religion.

Fig. 4 Essay in which Priestley defined political, civil and religious liberty and laid the foundations of the Constitution of the United States of America.
It seems quite incredible, that at the same time Priestley was analyzing and writing about politics of civilization, he was doing experiments and preparing to publish his great work on electrostatics. In “History and present state of electricity”, Priestley deduced and published the inverse square law of force between electric charges, 17 years before French aristocrat de Coulomb, to whom history has credited the discovery. Now the name “Coulomb’s Law” is enshrined in the modern scientific literature, the credit cannot be reallocated.

“Coulomb’s law” is one of the most fundamental force laws in science because all matter is composed of charge particles, and it is this force that holds everything together. This discovery by Priestley, to any fundamental research scientist, would rank as an achievement much more important than his later discovery of oxygen. This is just one of many examples where historians of science have not been kind to Joseph Priestley. Besides Coulomb's law, Priestley published many other original observations and predictions, including a suggestion of black holes 200 years before Stephen Hawking in another classic publication that is hardly known “History and present state of Colour Light and Vision”.

**Medicine and phlogiston**

Priestley was a brilliant teacher and Unitarian minister. Although he was an amateur scientist, his experiments with electricity and later with gases had contributed enormously to the field of chemistry. Before Priestley the only known gases were air, carbon dioxide, which Priestley also characterized, inventing “fizzy water”, and hydrogen. In 1774, he reported the discovery of oxygen (Figure 6) which he had called “dephlogisticated air” in accord with the theory of phlogiston as the driving force for reactions of materials with air. In subsequent volumes of “Experiments and Observations”, he describes how he discovered and characterized ten more gases besides oxygen, and also many more fundamental chemical reactions.

No sooner had he isolated and characterized oxygen, he went on to investigate its role in the life of humans, animals and plants. His three volumes on “Experiments and Observations....” qualify Priestley as a founding father of Chemistry, alongside England’s founding fathers of Physics and Biology, Newton and Darwin respectively.

Soon after Priestley discovered “dephlogisticated air”, by heating mercuric oxide, he began to investigate the role of “dephlogisticated air” in plant and
Priestley’s momentous contribution to the science of electrostatics published in 1769\(^6\) was also published in French in 1772: French aristocrat de Coulomb republished “Priestley’s law” in 1786.

First of three Volumes describing many of Priestley’s great contributions to chemistry; contains the discovery and characterization of 9 other gases besides oxygen.\(^8\)
animal life. During the 15 year period that followed the discovery of oxygen, he embarked on an investigation into the role of oxygen in plant and animal life. He spent many hours observing the plant life at the village pond in Calne in Wiltshire, near to where he lived at the time he discovered oxygen. The pond is now known as Dr. Priestley’s pond. He first proposed the atmospheric balance, that plants produce “dephlogisticated air”. and animals consume it. And he went on to lay the foundations of photosynthesis by advocating the carbon cycle when he proposed that plants breathe in carbon dioxide and breathe out oxygen, just the opposite to animals. Only in recent decades has this contribution to biochemistry begun to be properly recognized by historians of biochemistry.

By now, Priestley’s discoveries of the “hospital gases” nitrous oxide and oxygen were beginning to attract the attention of the medical profession. Spanning this 15 year period, in two papers, dated 1776⁹ and 1790¹⁰, he first described and later modified his findings. In “Observations on Respiration and the Use of the Blood”, Priestley, was now beginning to write the earliest chemical equations dephlogisticated air (O₂) + blood = fixed air (CO₂) + phlogiston but he stubbornly refused to call his dephlogisticated air “oxygen”. Nonetheless, Priestley had discovered and described the profound implications for medicine: that animal and human life was sustained by the blood transporting oxygen around the body - a great achievement. He even described the “good” and “bad” blood, or red and blue blood, depending on whether the oxygenated bold was spent or not, i.e. whether it was entering or leaving the heart.

By 1790, however, Priestley had become, the last of the phlogistonists; ridiculed by his adversaries: “Priestley est stupide” was the call of the French school of antiphlogistonists. He was hence deemed to be stubborn and unprincipled by his many political opponents in the British Church and Monarchy establishments. By this time Priestley had adversaries in the field of science besides the increasing hostility towards him, and fear of his principles, by the British establishments of Church and Monarchy.

In his “Doctrine of Phlogiston” publication of 1796¹¹, which he pointedly addressed to the list of French antiphlogistonists, Priestley wrote as follows in his conclusion: “The phlogiston theory is not without its difficulties. The chief of them is that we are not able to ascertain the weight of phlogiston, or indeed that of the oxygenous principle. But neither do any of us pretend to have weighed light, or the element of heat, though we do not doubt but that they are properly substances, capable by their addition, or abstraction, of making great changes in the properties of bodies, and of being transmitted from one substance to another”
In 1885 the celebrated American mathematician and engineer J. Willard Gibbs finally applied the first and second laws of thermodynamics, discovered in the 1850’s, to explain why one chemical will react with another to form different compounds. Chemical reactions will take place in the direction of equilibrium until the Gibbs free energy of the reactants plus the products is a minimum. Then the reaction ceases. Stubborn, Priestley may have been, but not so stupid: a modern interpretation of Gibbs’ deductions from the 2nd law of thermodynamics (1895) shows phlogiston theory to be essentially correct. Phlogiston can be identified as the negative of that part of the internal energy of a material, i.e. Gibbs free energy, is given up on reaction with oxygen. Likewise, the total heat or energy content, enthalpy (“heat” is actually energy on the move) can be identified with the state function first proposed by Joseph Black, and adopted by Priestley, “caloric”.

Gibbs thermodynamic theory, as it was originally published, was not easy for non-experts, including most historians of science, to grasp. It took 10 years before his explanation of reactions recognised as essentially correct by the scientific community. In the 100 years that followed, all of Priestley’s great writings in which he referred to dephlogisticated air, will have been ignored by historians of science and regarded as nonsensical and unprincipled research borne out of Priestley’s stubbornness.

The antiphlogistonists, on the other hand, did not address the question of why chemical reactions take place. They ridiculed the phlogiston theory but had no replacement. Priestley adhered stubbornly to the theory until his dying day, because he instinctively knew that there had to be something to account for the propensity of elements to react with oxygen, and the variations in that propensity from one to another. We now know Priestley was not the last phlogistonist, but the first physical chemist.

Conclusion

Joseph Priestley was a polymath of great courage and tenacity. In a lifetime of scientific discovery, he advanced the politics of a civilized society, risking and surviving the wrath of his political enemies in the corrupt Church and Monarchy establishments of eighteenth century England. He had both “Friends and foes” in high positions. His foes were mainly supporters and forces of the monarch King George III and the Church of England. His friends were very wealthy and prominent industrialists with a dissenting background such as his brother-in-law, ironmaster John Wilkinson and his scientific experiment sponsor, wealthy industrialist Josiah Wedgwood. His great friends also included founding fathers
of the United States, Benjamin Franklin, and its first three Presidents who adopted many of Priestley’s libertarian principles in the American Constitution and Bill of Rights.

Despite this life of extraordinary diverse scientific discovery, in the eyes of the establishments of the day, Priestley died in 1804, "stubborn and stupid”, the last of the phlogistonists. He might have been stubborn, but one has to question whether someone who had achieved so much in his life could really be so stupid. If, as he surely did, Priestley honestly believed that chemical reactions were driven by phlogiston, particularly since Lavoisier and his antiphlogistonists had “proven” that it cannot exist, there must be more substance to the theory. We now know that phlogiston theory was essentially correct, “phlogiston” does indeed exist, and can be identified with Gibbs free energy.12 13

Would history have been kinder to Joseph Priestley, one wonders, if historians of science themselves had an understanding of Gibbs chemical potential and why reactions occur? Or, indeed, alternatively, would historians of science have allocated more credit and recognition to Priestley if he would have accepted the new “oxygenous principle” of Lavoisier and rejected phlogiston?

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THE BLESSED CHLOROFORM LECTURE, 2008

JOHN SNOW’S LONDON
Dr David Zuck
Past President HAS, London

The object of this lecture was to follow John Snow’s footsteps through the streets of London, and to see what is left of the places that were most important to him. For those not too familiar with the geography, John Snow’s clinical activities during his earlier years in London centred around Soho, and his later practice was mainly in the area between Hanover Square and Piccadilly. John Snow left his home in York in the early summer of 1836. He was 23 years old, and the London he was aiming for was very much different even from the London in which he died twenty-two years later. An 1843 map shows that the conurbation did not extend beyond the north of Regent’s Park. Beyond that there were small villages, Camden, Kentish Town, Highgate, and so on, surrounded by market gardens, farms, and open country. But round the north of the Park, as one follows the railway line to its terminus, not called Euston Station, but the Birmingham Railway Depot, one sees the shape of things to come. One effect is seen on a map of 1860, which shows that the same area north of the Park was all built up; and another was that with the introduction of the early morning milk trains from the country, the 20,000 resident cows, some living in cellars or attics, that used to supply London with milk, miasma, and much else, had disappeared.

Returning to 1843, in Gower Street, a little south of the Depot, was University College, originally called London University, which opened in 1828, and opposite it, University College Hospital, originally called the North London Hospital, built in 1834. The familiar cruciform building which still stands and is now part of London University dates from 1905.

Continuing south to the junction of Tottenham Court Road with Oxford Street, we see that there is no Charing Cross Road. Instead there is Crown Street, a narrow winding street that peters out into a number of even narrower alleyways. John Snow didn’t ever see Charing Cross Road. It was cut through in the 1880s, with the object of relieving traffic congestion – horse-drawn, of course, and it involved a massive slum clearance.

Student Years

John Snow arrived in London in the second half of September 1836, after visiting his uncle, Charles Empson, in Bath. He had completed his apprenticeship, and wanted to gain the General Practitioner qualifications,
Membership of the Royal College of Surgeons, and Licentiate of the Worshipful Society of Apothecaries. Before taking the exams, he had to complete an approved course of studies at a recognised medical school, and an approved hospital. He took lodgings at No. 11 Bateman Buildings, which he shared for some time with his fellow student and friend Joshua Parsons, and registered at the Hunterian, or Great Windmill Street, School of Medicine, and the Westminster Hospital.

Bateman Buildings were two facing terraces of houses on either side of an alley leading off the centre of the south side of Soho Square. They were built on the site of Monmouth House, bought and demolished by an ex-Lord Mayor of London, Lord Bateman, after whom the Buildings were named. Number 11 was the third from the southern end on the west side, and according to the Survey of London, the original numbers 9, 10, and 11 are still there. Since at least the beginning of 2008, numbers 9 to 11 have been shrouded in plastic sheeting; they are being gutted and rebuilt inside. Probably they resemble the others on that side, which match up very closely with the description in the Survey of London. Frith Street, named after John Frith, the builder who developed it, leads off the south-west corner of Soho Square, the entrance to Bateman Building is in the centre, and Greek Street leads off the south-east. For his lectures Snow enrolled at the Hunterian School of Medicine at 16 Great Windmill Street; this had been built by William Hunter in 1766, as part private house, part medical school, and there is a detailed description of it in the Survey of London. A very large-scale map of 1790 shows that number 16 occupied a much larger site than the surrounding houses, and this was of advantage for later developments. The only known representation of the Hunterian School is a water-colour which belongs to the Royal College of Surgeons, and there is a drawing by Rowlandson which is generally accepted to be of the Hunterian dissecting room; it shows the Hunter brothers, William and John, and probably Rowlandson himself. The Hunterian School was one of a number of private medical schools that flourished before the great voluntary hospitals established their own schools in the late 1840s. A successful school could be a lucrative source of income, and after Hunter’s death in 1783 the Great Windmill Street School passed through a number of hands, including Benjamin Brodie’s. In John Snow’s time it was no longer a private residence. The site of the Great Windmill School is now occupied by the Lyric Theatre, which dates from 1888, and fronts on to Shaftesbury Avenue. The side wall of the theatre is in Great Windmill Street, and is said to be the original and only remaining part of the medical school. It is marked by a blue plaque.

The Westminster Hospital, where Snow signed up for his clinical experience, was opposite Westminster Abbey. Although there had been a hospital of that name functioning in the area for more than a century, this was a new building,
opened in 1834. It moved to Fulham in 1993 and the site is now occupied by the Queen Elizabeth II Conference Centre.

Snow completed the required courses, and took and passed the MRCS exam in May 1838, at the very recently rebuilt Royal College of Surgeons. The actual exam wasn’t held in very high esteem. As shown by a cartoon of 1842, it was thought to exist largely for the financial benefit of the examiners. The only thing that was free was the facility for the candidate to relieve himself. The surgeons depicted include the President, Sir Benjamin Brodie, James Guthrie, William Lawrence, and Benjamin Travers, for all of whom Snow later anaesthetised.

Snow completed his basic qualifications by passing the examination for the Licence of the Worshipful Society of Apothecaries six months later, in October 1838. As the cartoon implied, the exams at both establishments were all oral; there were no written papers. The Apothecaries Hall is still there, quite accessible, and well worth a visit, for anyone who doesn’t already know it. The three registers where John Snow recorded the required courses he had completed are still preserved. There is the Candidates Registration Book, in which he recorded the attendance tickets he purchased for the lectures, and the dates of registration, the Candidates Declaration Book, which contains the certified list of lectures he attended, and there is his signature in the Candidates Qualification Book, which effectively is the Register of Licentiates.

**General Practice**

After qualifying, most people in Snow’s position would have returned home and put up their plate, or joined a local practice and married the principal’s daughter, but his ambition was obviously different. He stayed in the metropolis, and just moved 100 yards south, to 54 Frith Street. Although the site was very carefully identified by Dick Ellis, who was instrumental in organizing the blue plaque that was set up in 1987, it has recently been suggested that he was misled by a later renumbering, and that it was actually in the block nearer Soho Square. The original building on the site identified by Ellis was replaced in the early 20th Century.

As can be seen from the 1841 and 1851 Census returns, Snow rented his accommodation from Mrs. Sarah Williamson, who is described as a widow living on an annuity. There are a number of mistakes in the earlier return, but from the more accurate later one it can be seen that in 1841 John Snow was aged 28, Mrs. Williamson was 60, her daughter Eleanor was 38, and there was a general servant, Jane Wetherburn, aged 29, who was born in Berwick-upon-Tweed. When John Snow moved to Sackville Street in 1852, Jane Wetherburn
went with him as his housekeeper, and Benjamin Ward Richardson mentions the devoted care she gave him during his terminal illness. Otherwise we know nothing about Snow’s domestic arrangements, his meals, his laundry, and so on, but he must have been comfortable in his lodgings, since he stayed there for 14 years. We have no idea where he performed his experimental work; if it was in his rooms, then his landlady must have been very accommodating.

We don’t have a detailed record of Snow’s clinical activities before the start of his Case Books in July 1848, but we do know that from the time of his graduation he practiced in the Soho area as a general practitioner and obstetrician, and as a doctor for four insurance clubs. Also he worked as a voluntary outpatients visitor attached to Charing Cross Hospital, which means that he provided a free domiciliary consultation and follow-up service, but didn’t actually hold clinics or see patients in the hospital. Charing Cross Hospital was a magnificent building, designed by Decimus Burton, and opened in 1834. In 1973 the hospital moved to Fulham, but the building is still there. It is now a police station.

What would John Snow have seen during his daily rounds? There was much poverty in the district he served. A notorious area was Seven Dials, so called because at the junction of seven streets there had been a seven-faced clock. This was removed long before John Snow’s time, but it has recently been replaced by a replica. Around Seven Dials there was a street market where Snow would have bought the small mammals and birds that he used in his physiological investigations.

Notable innovations of the decade were the Penny Post, in 1840, with the ‘penny black’ stamp with Maltese Cross cancellation, although London had to wait another fifteen years for its first letter box. During the 1840s, with the development of the railways, the postal services, and the telegraph, the Victorians experienced a communications revolution that must have been even more remarkable to them than the internet has been to us, because they were totally unused to it.

In 1842 also came the remarkable innovation that provides us with a vivid chronicle of those times, the publication of the weekly magazine, the Illustrated London News. The proprietor sent 200 sandwich board men on to the streets of London, and sales mushroomed from day one. Soon it was illustrating the important events of the day at home and abroad; the completion, in 1843, of the layout of Trafalgar Square, with Nelson’s column being prepared, and his statue on display at Charing Cross. The Queen survived an assassination attempt by a very properly dressed would-be assassin, complete with stovepipe hat. Among improvements in public facilities were developments in transport, an improved
omnibus, though the position of the upstairs passengers looked very precarious, and a taxi meter, to safeguard being overcharging by cab drivers. Traffic congestion was bitterly complained about even then, and this eventually resulted in three major road developments, Charing Cross Road, Shaftesbury Avenue, and Kingsway, towards the end of the century. A regular feature was the famous London fog, wonderfully described by Dickens. Some of us will remember the great smog of December 1952, when the whole of London was at a standstill for five days, and hundreds of chronic chest sufferers died.

Entertainments of an improving nature may have included a visit to the Hunterian Museum at the Royal College of Surgeons, or as a good Yorkshireman John Snow might have favoured cricket at Lords, where the preparation of the pitch was by entirely organic sheep, and the teams were always properly top-hatted. Observing this ubiquity of the stovepipe hat brought home the fact that of course John Snow would never have gone out without one, and I thought it would illustrate this more vividly if I were able to produce one at the lecture.

John Snow was obviously ambitious to establish himself as something more than an ordinary surgeon-apothecary, because he studied for and passed the London MB on 23rd November 1843, taking the exam at University College, and the MD on 20th December the following year, becoming Doctor Snow. As a result he began to be consulted by neighbouring practitioners, but there was no dramatic improvement in his circumstances, so, perhaps to augment his income, he moved into the academic field.

In April 1846 he was appointed lecturer in forensic medicine at the Aldersgate Street Medical School, a post he held until it closed down four years later. The Aldersgate Street School was active between 1815 and 1850. It did not seem that there was a hope of locating its site, because the whole area was very badly bombed during WWII, and today not even the street plan is the same. But I found that the school had been virtually integral with the Aldersgate General Dispensary, which had been set up in 1770 at the instigation of John Coakley Lettson, to provide medical advice for the poor; and the Dispensary had been housed in a stately home designed by Inigo Jones, Shaftesbury House, or Hall. A striking feature were the eight pilasters along the front, which survived several remodellings. During the 18th Century Shaftesbury House lost its noble connections, becoming number 36 Aldersgate Street. The front part was converted into shops, while from 1775 the rear housed the General Dispensary. The Medical School was set up in 1815 on the initiative of Henry Clutterbuck, who was a physician on the staff of the Dispensary, to provide the teaching made necessary by the Apothecaries Act of 1815. The School was active until
1850, when it was overtaken by the development of the nearby medical school at Barts.

John Snow’s expertise in chemistry made him especially suitable for the toxicological aspect of forensic medicine; we know that he worked with the medical forensic scientist Alfred Swaine Taylor to develop a method of quantifying the content of chloroform in tissues.

From various clues it has been possible to pinpoint the position of Shaftesbury House on contemporary maps. It was almost opposite the Albion Tavern, highly regarded for the quality of its food. Around 1850, when the School closed, the Dispensary moved from Shaftesbury House to accommodation in Bartholomew’s Place, and functioned until 1941, when it was destroyed during an air raid. Today, the site of Shaftesbury House, and the Aldersgate Dispensary and Medical School, are occupied by Ironmonger’s Hall, just north of the Museum of London; and the Albion Tavern is remembered in Albion Way.

There was a link between the Aldersgate Dispensary and the Medical Society of London, with which John Snow was later prominently associated. Lettsom played an important part in the founding of both, and Henry Clutterbuck was President of the Society on three occasions.

From his student days John Snow had been very active in the affairs of the Westminster Medical Society, which had been an intrinsic part of the Great Windmill Street School, but when the school closed in 1839 its meeting place moved to Exeter Hall, a large establishment that was on the site now occupied by the Strand Palace Hotel, opposite the Savoy. It was a popular venue for large public meetings, secular or religious, and for concerts, but it had a number of small meeting rooms also. So John Snow would have been there, at a meeting of the Westminster Medical Society, every Saturday evening.

During the early 1840s John Snow designed a double-action bellows for the resuscitation of the newborn, which was made for him by John Read, whose premises were at Regent Circus North, which is now called Oxford Circus. Regent Circus South was the original name of Piccadilly Circus. Snow also designed a most innovative trocar and cannula for the drainage of pleural effusions, and this, also, was made for him by John Read.  

So life went on, in a fairly regular routine, until, on the morning of 28th December 1846, John Snow visited the home of the dentist James Robinson, and as a result, his life took a completely new direction.
General Anaesthesia

The story of the first ether anaesthetics in London will be well-known to members of the History of Anaesthesia Society. Francis Boott, who first received the news from the United States, lived at 24 Gower Street, now the site of Bonham Carter House, which belongs to the University of London, and James Robinson lived at 14 Gower Street, which is still there, and also belongs to London University. Both sites are marked with blue plaques. Some time on Saturday morning, 19th December, Robert Liston, senior surgeon at UCH, visited Boott’s house, where Robinson had administered one successful ether anaesthetic, and he observed two successive attempts that failed. The ether must have become too cold to vaporize adequately. With Liston was his protégé, the medical student William Squire, who was the nephew of a friend, Peter Squire, who ran a very successful chemist’s shop, and held the appointment by royal warrant of pharmacist to Queen Victoria and Prince Albert. So Liston and William Squire went to the shop, at 277 Oxford Street; and during that weekend Peter Squire devised the ether inhaler that was used for the amputation of a leg at University College Hospital on 21st December.

What I had never sought out was the exact location of Peter Squire’s shop, but I found that 277 Oxford Street is quite near Oxford Circus, rebuilt, as was to be expected in that locality. A few doors away, at 299, is a plaque, set up by the Royal Society of Chemistry, to mark the site of the Royal College of Chemistry, an establishment that John Snow would have been well aware of.

A little later I discovered from the Survey of London that the 277 I had photographed wasn’t the location of Peter Squire’s shop at all. Oxford Street had been re-numbered during the 1850s, and the original 277 was now 413, much nearer to Marble Arch. It turned out to be on the corner of Oxford Street and Duke Street, diagonally opposite from Selfridges; and the Survey, which is amazingly detailed, reproduced a drawing of the parade of which the shop was a part, with Squire designated as Chemist to the Queen. While I was trying to find a better illustration of the shop, I had an incredible piece of good luck that I couldn’t even have dreamed of fantasising about. An ex-colleague put me in touch with a neighbour of his who was looking for help with researching her family tree, who turned out to be Peter Squire’s great-great grand-daughter, Mrs Diana Douglas. As a result, and because of her great generosity, it has been possible to show an illustration of Peter Squire’s Royal Warrant, which was granted quite soon after Queen Victoria’s succession to the throne in June, and his warrant of appointment to Prince Albert quite soon after the Royal marriage in 1840; also a daguerrotype of Peter Squire taken in 1842, and two later representations.
The *Survey of London* also reproduces correspondence between Peter Squire and his landlords, the Grosvenor Estate. Squire wanted to rebuild the shop, modernise it, and enlarge it; after some delay he received permission, and work started in 1870. Comparing a watercolour painting belonging to Mrs. Douglas of Squire’s rebuilt shop with the description in the *Survey of London*, and with the building that is on the site today, I realised that although the ground floor has been altered, it is Peter Squire’s rebuilt shop, still there after nearly 150 years. See Figure 1. It is to be hoped that the Association, or the College, or both, will join with the History of Anaesthesia Society, to see that it gets a blue plaque, and perhaps even a preservation order. Getting sidetracked into the Squire family, about which I have learned quite a lot, was a temptation that had to be avoided, and a subject to be developed for a later occasion.

![Fig. 1 Peter’s Squire’s rebuilt shop as it is today (2007)](image-url)
Snow’s Anaesthetic Practice

During the early weeks of 1847 John Snow devised a much improved ether inhaler, and started to develop an anaesthetic practice. Initially he anaesthetised at St. George’s, which he continued to visit almost until the end of his life, and at University College Hospital, where he worked with Robert Liston himself, but this connection lasted only until August 1850. St. George’s, of course, was at Hyde Park Corner, and moved to Tooting in the early 1970s. When Snow started there it was virtually a new hospital, having opened in 1844 after a complete re-building. Today, it is an expensive hotel.

So Snow began to make a name for himself as a specialist in the art of etherisation; and he was invited to give what turned out to be a landmark lecture-demonstration at the prestigious United Service Institution, which was off Whitehall, opposite Horseguards Parade. Also, his portrait, by the artist Thomas Barker, was hung in the Summer Exhibition of the Royal Academy, which at that time occupied the east wing of the National Gallery, in Trafalgar Square. John Snow was the Barker family’s GP and obstetrician, and there are a considerable number of home visits listed in the Case Books. The Barkers moved quite frequently, as will be seen if the addresses that Snow visited are plotted on a map.

But John Snow’s longest hospital association was with King’s, and began in October 1848. King’s College Hospital had been opened in 1840, to provide clinical experience for the students of King’s College Medical School. King’s College, which is still in its original location in the Strand next to Somerset House, had taken over and refurbished the disused St. Clement Danes Workhouse, which was in Portugal Street, just behind the Royal College of Surgeons. This first hospital was where Snow started, but the accommodation soon proved inadequate, so between 1852 and 1860 a major building programme greatly extended and modernised it. King’s transferred to Denmark Hill in 1913, and part of the old site is now occupied by the London School of Economics.

The senior surgeon at King’s was William Fergusson, a pioneer of conservative bone and joint surgery, and of cleft palate reconstruction, whose name is familiar to anaesthetists for his mouth gag. John Snow anaesthetised for him both in the hospital and in private, on some occasions at his home. Fergusson lived at 16 George Street, which is now St. George Street and leads off Hanover Square. I found that Fergusson’s house still exists, in pretty well its original state, externally, at least. It is now the Mexican Embassy, and while it is not for an anaesthetist to give the Royal College of Surgeons more than a gentle nudge,
surely the home of Sir William Fergusson, whose contributions to operative surgery matched those of Lister, who was as much anaesthetist as surgeon anyway, should be marked by a blue plaque. See Figure 2.

Fig. 2  Sir William Fergusson’s home, 16 (St.) George Street, now the Mexican Embassy
According to Plarr’s *Lives of the Fellows of the Royal College of Surgeons*, Fergusson must have been the ideal surgeon to work with. He set a great store on punctuality, and hated wasting time. He planned his operations ahead, and worked with remarkable speed and silence until the end, applying every bandage and plaster himself. He operated on Saturdays, yet the gallery of the operating theatre was always packed with students, and it is in this environment that we have to imagine John Snow working. But Fergusson, in his private life, was quite different, very sociable, kind hearted, and easy-going. He spoke with a marked Scottish accent, and according to one biographer he enjoyed inviting his friends to dine at the Albion Tavern, in Aldersgate Street, which was noted for conviviality and the excellence of its food; and in contrast to his austerity in the operating theatre, his mode of transport was anything but. He travelled about town in his own bright yellow coach, known irreverently by his students as ‘the mustard pot.’ It may be assumed that on the days when Fergusson followed his operating list at King’s with some private cases at his home, John Snow travelled with him.

Fergusson was sufficiently distinguished to be the subject of a *Vanity Fair* cartoon, which depicts him as what today we would call the alpha male of English surgery.

**Cholera Returns**

In 1849 cholera struck again, and Snow investigated an outbreak in a row of houses called Albion Terrace, south of the river, along the Wandsworth Road. Until recently this had been little noticed by popular historians of cholera, but it was almost a preview or trailer for the Broad Street outbreak of 1854. It is very well described in the book by Sandra Hempel. Briefly, Albion Terrace was a recent development of seventeen good quality houses for middle-class professionals or successful tradesmen, far different from the usual breeding grounds for cholera that are shown in the well-known *Punch* cartoon. Starting on 28th July 1849, the residents of ten of the houses went down with cholera, and during the next ten days 24 people died. Such an outbreak affecting this section of the population was so unusual, and could not be blamed on bad smells and atmospheric pollution, that John Snow became particularly interested. Excavation revealed overflowing cesspits leaking into a fresh water conduit, and based on these findings he published his first booklet on the mode of communication of cholera in 1849, but the public health doctors were deeply unconvinced.

Albion Street is shown on a rather crude map published in the early 1830s, and Albion Terrace ran along Wandsworth Road adjacent to it. Clues to its location
are Brandon Street, and Union Grove, the curved road that joins Wandsworth Road opposite. There is no Albion Terrace on maps of South London published after about 1855, and there is much evidence both of new road building and name changing along the Wandsworth Road, right to the present day. On an 1860s map the other landmarks are still there, but Albion Street has become Milton Street, and Albion Terrace has become Milton Terrace. Following up a clue from Peter Vinten-Johansen, I visited the site, hoping to find a row of Victorian cottages. Instead, I found that the whole area had been redeveloped since the War, and Milton Street, and the adjacent terrace, had disappeared completely, being replaced not by Milton, but by Bilton House, which now stands on the original site of Albion Terrace; and I doubt whether the residents would welcome a blue plaque commemorating an outbreak of cholera.

**Expanding Horizons**

Richardson, in his biography, mentions that 1851, the year of the Great Exhibition, was a fortunate one for Dr Snow. His affairs had taken a new turn, the harassments of professional struggle were over, the world was recognising his merits, and old friends, brought to town by what Richardson called the World Fair, flocked around him. In that year of the Great Exhibition John Snow became a Licentiate of the Royal College of Physicians by examination, equivalent to today’s Membership. Had he survived another year he would almost certainly have been elected a Fellow. The College was located on Pall Mall East, adjacent to Trafalgar Square, and is now Canada House.

By 1852 Snow’s anaesthetic practice was overtaking his GP work, and was centred more in the West End, so he moved to Sackville Street, No 18, off Piccadilly. This was a substantial Georgian house, and was marked by a blue plaque, but it was demolished in the 1960s and replaced by a warehouse of no architectural merit for Austin Reed, and the plaque was not replaced. Sackville Street, being near Regent Street and the Quadrant, was a much more up-market location than Frith Street, and living there brought Snow conveniently near the places where he did his private work, and pursued his academic interests. He was within comfortable walking distance of Fergusson’s house, and nearby, at 15 Hanover Street, was the shop of Mr. Bullock, the chemist, who supplied John Snow with amylene during his unfortunate trial of that agent, and probably with chloroform also; and it appears that the original building remains.

The Medical Society of London had had its own premises in Bolt Court, off Fleet Street, but as the medical centre of gravity moved to the West End its membership fell off, so in 1850 it took a lease on 33 George Street. At about the same time it amalgamated with the Westminster Medical Society, which,
contrary to some accounts, was in a much healthier state as regards both membership, which stood at about 150 to the MSL’s 50, and also financially. Number 33 (St.) George Street today also appears to be the original building.

Sackville Street was also in comfortable walking distance from some of the places where Snow gave private anaesthetics. One was a dental practice in Hanover Square, where he worked frequently, and another was Almond’s Hotel in Clifford Street, of which there is a detailed description in the *Survey of London*.

He was very near the Thatched House Tavern in St. James’s Street, where in March 1853 he delivered the very prestigious Annual Oration to the Medical Society of London; and on 7th April 1853 he could have walked to Buckingham Palace, which was still a bit of a building site, Parliament having disputed the funds required to complete its refurbishment, when the call came that Queen Victoria had gone into labour; but the urgency of the situation probably spurred him to call a cab.

He wasn’t too far from Soho either, when cholera struck again, in the area around Broad Street in August and September of 1854. There had been a number of cases in 1853, and a catastrophic outbreak started on 31st August 1854. The story of Broad Street and the cholera outbreak that was centred around the pump seems to be well known now to the general public. As an 1854 drawing shows, Broad Street was by no means a slum, but a respectable lower-middleclass area, where a number of the 18th century houses remain today. Snow’s famous cholera map, showing the cluster of cases around the pump, is also well-known; and in his 1855 treatise on the mode of communication of cholera, he describes how he invited himself to a meeting of the Board of Guardians of St. James’s Parish on 7th September, as a result of which the handle was removed from the Broad Street pump on the following day. I assumed that the Guardians met at the parish church, St. James’s Piccadilly, which is just opposite Sackville Street. This is a beautiful Wren church, and contains memorial plaques to William Hunter and to William Bowman, who described Bowman’s capsule in the kidney, and later became an ophthalmic surgeon at King’s, for whom John Snow anaesthetised on many occasions. Both are buried in St. James’s. The church was badly damaged during World War II, but an Ordnance Survey map of 1870 shows the Vestry Hall in St. James’s Churchyard, where I assumed that the famous meeting must have taken place. However, Peter Vinten-Johansen pointed out that the people who were responsible for the street pumps weren’t the Guardians, but the Paving Commissioners, and according to notes he had made at the Westminster Archives in 1989, they didn’t meet between 30th August and 20th September; and this was the beginning of a very long on-going story that there isn’t time to
go into, but so far it has involved four whole days at the Westminster Archives Centre, fruitlessly searching the minute books of all the St. James’s Parish committees, for any mention of any sort of meeting on 7th September 1854. We don’t doubt John Snow’s story for one moment, and I did find a later minute that implied that the pump was out of action, for which I received a well-deserved pat on the back, but we just want to know when and where and with whom the famous meeting was held.

Coming towards the present day, Broad Street was renamed in 1934, and the John Snow Pub, on the corner of Broadwick and Lexington Streets, commemorates his part in the cholera story. The location of the pump is now marked by an unimpressive plaque on the wall of the John Snow pub, and there is a modern facsimile pump nearby. We don’t have an illustration of the original, but there was an advert by Fowler, the manufacturer who had the contract to maintain the street pumps in St. James’s Parish, in *The Builder*, that indicates what it was probably like.

Coming right up to date, four members of the HAS were present by invitation at a ceremony sponsored by the Royal Society of Chemistry at the John Snow Pub on 16th June 2008, the actual 150th anniversary of John Snow’s death, at which a new, much more appropriate plaque was unveiled by Alan Johnson M.P., that will be fixed to the outside wall.

As the title of this lecture series commemorates, John Snow administered chloroform to Queen Victoria during childbirth on two occasions, the second being on 14th April 1857; and later that year he was invited to Court. Richardson has a description of him in court dress, complete with sword, and Dick Ellis looked into this and gave a partial reference. Peter Vinten-Johansen very kindly followed this up for me, and found the announcement in The Times archives. Snow was presented by Sir Charles Clark, who was the Queen’s physician, and seems to have functioned as her head-hunter also. He introduced both Peter Squire, and John Snow, into the Queen’s service.

**Personal Life**

In 1856 John Snow had his very well known photograph taken, by which he is remembered. We don’t know very much about his social life, but one of his close acquaintances was Golding Bird, a contemporary at the Great Windmill Street School, who became a physician at Guy’s, and remained an active member of the Westminster Medical Society, where he and Snow would have met every week. He lived at 48 Russell Square, which in the 1980s became the first home of the Royal College of Anaesthetists. Snow was a member of several
medical societies, apart from the Westminster; he belonged to the Royal Medical and Chirurgical, which met at 53 Berners Street, and the Epidemiological Society, so he must have had a very wide circle of acquaintances. The general practitioner Peter Marshall of Greek Street was a close colleague, but the friend who seems to have been closest was, of course, his biographer, Benjamin Ward Richardson. The well-known photograph of Richardson in late middle-age is misleading, because he was only 22 when they first met in 1850, and 30 when John Snow died. From 1852 Richardson lived at 12 Hinde Street, off Manchester Square, home of Hertford House and the Wallace Collection. The house bears a blue plaque, but it commemorates the writer Rose Macaulay. There is ample room for another.

In the Spring of 1858 Richardson set up a small group, of which John Snow was an enthusiastic member, to research and develop the use of the stethoscope, and it must have been a meeting of this group that Snow attended the evening before he became ill. The following morning he suffered a stroke, and died six days later, on 16th June 1858, at the age of 45.

John Snow is buried in the Brompton Cemetery. His gravestone is near the northern entrance, and is very easily found. Next to it is an insignificant little stone, badly weathered, on which one can just make out the letters C and E. I confirmed some years ago from the Brompton burials register that this is the grave of his uncle, Charles Empson, who died in mid-June 1861 during a visit to London. John Snow’s will was proved on 8th July. His brothers William and Robert were his executors. He made provision for his housekeeper, Jane Weatherburn, his mother, who survived him by some years, his brothers and sisters, and his uncle Charles.

**John Snow - A Pioneer Veterinary Anaesthetist**

Finally, it struck me that on a special commemorative occasion such as this, the speaker might be expected to conclude by pulling a rabbit out of a hat. And where better to find a rabbit than the London Zoo? The Zoo was established in 1828, in the northern end of Regent’s Park, and anaesthesia can claim a very tenuous connection, because Sir Humphry Davy was one of the prime sponsors; and its location hasn’t changed. An 1834 drawing shows the general layout of some of the early enclosures, with the Nash Terraces and St. Paul’s in the background. One of the popular attractions, especially to children, was the bear pit. These were brown bears, well-known throughout Europe for centuries as a source of entertainment at fairs and circuses, as dancing bears.
But in the 1840s the Zoo acquired an expensive rarity, three grizzly bears, bought from a big game hunter in the United States; and it gradually became apparent that grizzly bears, so-called because of their grey hairs, were very prone to develop cataracts and become blind, which very much reduced their value for exhibition purposes; so the Zoo got an ophthalmologist, Mr. William White Cooper, who was on the staff of St. Mary’s, and later became Queen Victoria’s oculist, to look at them. How he did this it is difficult to imagine, because they are enormous. When standing erect they are about eight feet tall, and literally weigh a ton. Anyway, as a result, we can do much better than a rabbit.

We can produce - a grizzly bear – in fact two grizzly bears – and, a three-legged cheetah! Because, somehow, it has escaped the notice of all of John Snow’s biographers, that in 1850, on the 5th and 15th of November, he anaesthetised two grizzly bears, at the London Zoo, for cataract operations, and some months earlier a cheetah had been chloroformed for the amputation of a leg. (Subsequent research has shown that John Snow did not anaesthetise the cheetah.) Snow did not publicise his adventures with the grizzlies himself, and doesn’t mention them in the Case Books, but it did come to public notice.

I got on when my curiosity was roused by an editorial in the Medical Gazette of November 1850. Snow had been campaigning against a Bill introduced into the House of Lords by Lord Campbell, specifically targeting the use of chloroform by thieves. Snow claimed it was impossible to chloroform people against their will without the use of force, and if the criminal was going to use force, why bother with chloroform? The Medical Gazette’s editorialist presumed, sarcastically, ‘that there would be no more difficulty in rendering a person insensible by chloroform than was experienced in chloroformising the grizzly bears at the Zoological Gardens.’ Snow replied that ‘each bear was secured by a collar, and held by two or three men, whilst the chloroform was given to it.’

So my interest being stimulated, I contacted the Archivist at the London Zoo, and he sent me a copy of a 157 year old page that he had received, from the March 1851 number of Harper’s New Monthly Magazine, in which the cataract operations were described most graphically. ‘On the 5th of last November, the first operation of the sort was performed on one of these grizzly bears, which was blind in both eyes. As this detracted materially from his value, it was decided to endeavour to restore him to sight; and Mr. White Cooper having consented to operate, the proceedings were as follows: A strong leathern collar to which a chain was attached, was firmly buckled around the patient’s neck, and the chain having been passed round one of the bars in front of the cage, two powerful men endeavoured to pull him up, in order that a sponge containing
chloroform should be applied to his muzzle by Dr. Snow. The resistance offered by the bear was as surprising as unexpected. The utmost efforts of those men were unavailing; and, after a struggle of ten minutes, two others were called to their aid. By their united efforts, Master Bruin was at length brought up, and the sponge fairly tied round his muzzle. Meanwhile the cries and roaring of the patient were echoed in full chorus by his two brothers, who had been confined to the sleeping den, and who scratched and tore at the door to get to the assistance of their distressed relative. In a den on one side was the Cheetah, whose leg was amputated under chloroform some months ago, and who was greatly excited by the smell of the fluid and uproar.’

During his experimental work, and his lectures and public demonstrations, John Snow had, of course, anaesthetised many birds and small mammals, but his role as a pioneer veterinary anaesthetist is something not previously recognised. Unfortunately the Zoo’s archives for this period are almost non-existent, but, as we have seen, it is fully authenticated elsewhere. (Additionally, the very recent public availability of The Times archives on the internet has revealed a letter from Mr. White Cooper, in which he described the operation.)

So I hope that two grizzly bears, and a three-legged cheetah, will be a fair substitute for a rabbit.

Acknowledgements

I have received help from a number of people, notably from Peter Vinten-Johansen, the lead author of the currently definitive biography of John Snow. He first made contact with me by email about twelve years ago, and we have remained in touch ever since. He recently retired from the professorship of history at Michigan State University, and is now engaged on building up comprehensive web site for John Snow studies. Also I am most grateful to Peter Squire’s great great grand daughter, Mrs. Diana Douglas; to Dr. Terry Turk for the loan of her six volume set of Walter Thornbury’s ‘Old and New London’ 1878; to our own archivists at the AAGBI, Trish and Iris; to the very knowledgeable Dee Cook of the Society of Apothecaries, who has been very helpful; to Michael Palmer, archivist to the Zoological Society of London; and to my daughter Linda for the loan of her 1967-8 form prize, which depicted ‘The World of the Early Victorians as seen through the eyes of the Illustrated London News’.

Bibliography

I found the late Dick Ellis’s monumental transcription of John Snow’s Case Books invaluable, and used Benjamin Ward Richardson’s biographical essay on
John Snow as a guide. Other biographical information came from *Plarr’s Lives of the Fellows of the Royal College of Surgeons*. Also I made great use of the massive *Survey of London*, which now runs to about 44 volumes, especially Vol. 30, and of a number of London guide books, contemporaneous and modern, and the Godfrey reprints of early Ordnance Survey maps. Much topographical and background information was obtained from the following:

Weale’s Pictorial Handbook of London. Bohn’s Illustrated Library, 1854.

**References**

4. This is reproduced in Gloyne, S. R. *John Hunter*. Edinburgh, Livingstone, 1950, fig. 6.
12. The Times – Court Circular, Saturday, 20th June, 1857.
It is with great personal pride and pleasure that I am delivering the citation for Dr Ian McLellan on his investiture as an Honorary Member of the History of Anaesthesia Society. This has been awarded in recognition of his huge contribution to History and to the Society over many years.

Before I return to his contributions to the History of Anaesthesia I must first give some background.

I first met Ian when I was a Nottingham Anaesthetic Registrar attached to Groby Road in Leicester to learn Cardiac Anaesthesia and have kept ‘bumping in to him’ so to speak ever since. Ian was educated at Merchant Taylor’s School and then at St Bartholomew’s Hospital in London, where he qualified MBBS and LRCP, MRCS in 1968. He started anaesthetic training as a Senior House Officer in St Bartholomew’s Hospital followed by a Registrar post in The London Hospital and The London Chest Hospital, qualifying FFARCS in 1973. A Senior Registrar rotation followed at the Middlesex Hospital, Queen Mary’s Hospital for Children, Carshalton, Mount Vernon Hospital and Harefield Hospital. He was appointed Consultant Anaesthetist at the University Hospitals of Leicester in 1976 where he retired in 2003 being given Emeritus status. In Leicester he was on the development team of the New Glenfield Hospital, Specialty Co-ordinator of Thoracic Services between 1988 and 1991, Chairman of the Cardiothoracic Division between 1988 and 1990 and the Consultant in administrative charge of the Intensive Care Unit at Groby Road Hospital from 1983 to 1987. In Leicester his main interests were of course as a Consultant Cardiothoracic Anaesthetist but initially he also had a special interest in Paediatries, which he gradually relinquished as more formally trained specialists were appointed. Within the Hospital he also organised the undergraduate training in anaesthesia and was Associate Director of Clinical Studies at the new Glenfield Hospital. Continuing his interest in education he took on the role of pre-registration House Officer Educational Supervisor and also organised the courses for the FFARCS and later FRCA examination within Leicester until these were formally handed over to the University Department.
At a time when there was a divisional structure of specialties within Hospitals, he was Chairman of the Specialty of Cardiothoracic Division but became Clinical Chairman and Clinical Director of Anaesthetics in 1992. Much time was spent on the manpower issues raised by the changes in the training of junior anaesthetists, the new deal and the working time directive. Ian was also active in the development of the appraisal system in Leicester.

Finally, Ian was the President of Link up, the adult cardiac patient support at the Glenfield Hospital from 1996 to 2003. Not one to retire gracefully, his burgeoning interest in the law and medical issues has taken him as a postgraduate student to the School of Law in the University of Southampton where he is undertaking a full-time M. Phil and PhD.

Of course, this has only described Ian’s work within a Hospital environment. He was an elected Council Member of the Association of Anaesthetists from 1989 to 1993, having previously been the Association’s Linkman from Leicester. He was the Honorary Librarian of the Association from 1982 to 1998, this role being recognised by the Pask Certificate of Honour in 1997.

As one of the founders of the History of Anaesthesia Society, he was its first Honorary Secretary and then President for 2 years commencing in 2000. During his long association with the Society, he personally organised 2 meetings in Leicester but more importantly whilst Honorary Secretary, he was one of the main Committee Members for the Second International Symposium on the History of Anaesthesia held in London in 1987. Of his many presentations and publications, naturally cardiothoracic anaesthesia and intensive care have featured prominently, but he has been a distinguished and continuous author in the field of the History of Anaesthesia.

It was, of course, during his two years of Presidency that I worked most closely with Ian. He and I shared a common desire to introduce the next generation of Anaesthetists into the History Community. A bid to host the Sixth International Symposium on the History of Anaesthesia took root between myself and Jean Horton during the HAS meeting in Edinburgh but it did not start to grow until the meeting between myself and Ian at Bowood House when he, as President, presented a bench on behalf of the Society in recognition of the work of Joseph Priestly. It was there that he suggested that the Society should bid for hosting this meeting that you are now all attending.

Ian has, for 4 years, chaired the committee that has brought this meeting to you and has been a most wonderful supporter through both the good and the bad times.
Finally it is perhaps the little things that give you and insight into a person. I took my son to the 75th Anniversary meeting of Ralph Waters in Madison and it was with Ian and Isabelle McLellan that we sat during the Gala Dinner. Ian treated my then 14 year old son as an adult, conversed with him all evening, which is now a night that Jonathan will not forget and indeed still talks about, but most importantly Ian was willing to swap his beef for my son’s prawns, thereby completely rescuing the night. So Ian for that and for the contributions to the Society and to the History of Anaesthesia may I, on behalf of this AGM, thank you.
Professor Sir Keith Sykes is a graduate of Cambridge University and he started his anaesthetic career at University College Hospital, London. He went to the Massachusetts General Hospital (MGH) in Boston for a year in 1954. I doubt whether going to the birthplace of ether anaesthesia demonstrated an early interest in history, but rather a shrewd move to study what America had to offer.

I first met him at the MGH where Henry K Beecher was Professor. Keith had arrived soon after the Beecher-Todd study of anaesthetic mortality had concluded that curare was a dangerous drug that was responsible for an increased death rate. This contrasted with the British view that curare, properly used, was a turning point in the development of clinical anaesthesia. Keith has always been somewhat outspoken and it might have been regarded as a little undiplomatic for this recent arrival from Britain to go to Beecher and say ‘please Sir, I want to set up a study to prove you wrong’. But Beecher was a bigger man than this: he readily agreed, the study went ahead and launched Keith on his academic career.

Returning to England Keith went from strength to strength. He moved to the Hammersmith Hospital in 1958, then full of strongly independent people who, I suspect, were knocking sparks off each other in the process of advancing the science of anaesthesia. He held his own, indeed he excelled and in 1970 was appointed Professor of Clinical Anaesthesia in the Royal Postgraduate Medical School. His research interests have always been in the basic sciences and their application to clinical practice and he was therefore exactly the person needed at this stage in the development of our specialty.

The pinnacle of his career was when he was appointed Nuffield Professor of Anaesthetics in the University of Oxford in 1980. At the Hammersmith he had been in the happy position of being able to get on with his own researches whilst Professor Sir Gordon Robson took care of the politics and administration. In Oxford he had to do it all himself. He headed a department that had suffered setbacks, partly because the University had never really been convinced that
anaesthesia was a subject worthy of a professorial department. He and his colleagues built up the Department and he left it in 1991 in a position of high achievement and influence.

Historians remind us that history starts, if not yesterday, certainly the day before and these are the times that tend to be neglected until the people who know about them have died and we wish we had asked them more about what happened. Keith does not let this happen, he surveys and records what happened in his lifetime and to which he himself contributed in such large measure. His historical studies are conducted with all the rigour he devoted to his scientific researches and are written in an elegant style that many historians would do well to emulate.

Keith is a figure of international renown and has received many honours and prizes, including a knighthood in 1991. It is appropriate that our Society is adding to them by electing him to its Honorary Membership. We honour him and he honours us.

Reference

ADRIAN PADFIELD

Dr D Zuck
Past President of the History of Anaesthesia Society

(Citation delivered at the AGM of the HAS in York, 27th June 2008)

It is a pleasure to present Adrian Padfield for the honorary membership of the History of Anaesthesia Society; I can’t think of anyone more worthy. He fulfills more than adequately the two criteria that I think should be the requirements for this distinction: contributions to the study of the history of anaesthesia, and service to the Society.

He played a significant role in helping Tom Boulton get the Society started, and was the founding Hon. Treasurer and Membership Secretary. In 1994, at the time of the 150th anniversary of the use of nitrous oxide by Horace Wells, he was President of the Section of Anaesthesia of the RSM, and jointly with the HAS he organised and chaired a very successful and unique commemorative meeting. He contributed the article on Massey Dawkins to the New Dictionary of National Biography, and more recently he edited and produced the Henry Hill Hickman biography. He is also, of course, a past President of this Society, and has contributed a number of papers over the years. At present he is the Heritage Advisor at the AAGBI, and is responsible for organizing the History Page in Anaesthesia News.

I don’t mention his other achievements in the specialty, because they are not specifically connected with its history, but they are many.

So it is with very great pleasure that I commend Adrian Padfield for the honorary membership of the History of Anaesthesia Society.
BOOK REVIEWS


This Symposium attracted nearly two hundred delegates who were accommodated in the picturesque, 550 year-old Queens' College that sits astride the river Cam, in Cambridge, UK. The famous wooden Mathematical Bridge connects the two halves of the College and from this vantage point participants could view straw-hatted undergraduates propelling their relatives and friends down the river in the traditional flat-bottomed punts. Although the setting was perfect, the sheer volume of papers left delegates little time in which to explore the other delights of this historic university city, a disappointment to those of us with close Cambridge connections.

The bid to host the Symposium was made during the HAS Presidency of Dr Ian McLellan; it was fitting, therefore, that he should be awarded Honorary Membership of the Society during the meeting. The Organising Committee (Dr Neil Adams, Professor Douglas Bacon, Dr Bill Hamlin, Dr Jean Horton, Dr Ian McLellan and Dr John Pring) was chaired by the then President of the HAS, Dr Ian McLellan. The Scientific Programme Committee consisted of Dr Peter Morris, Dr David Wilkinson and Dr Neil Adams and the adjudicators for the John Bullough Prize were Dr Peter Morris, Professor Roger Maltby and Dr Rod Westhorpe. The meeting was organized jointly by the History of Anaesthesia Society and the Department of Anaesthesia at the West Suffolk Hospital, but it was Dr Neil Adams and his family, Dr Jean Horton, and their colleagues from Bury St Edmunds, who bore most of the burden of the organisation. There was also strong support from the Association of Anaesthetists. An admirable illustrated description of the meeting which evokes the spirit of the occasion perfectly has been published by Dr Selma Calmes in The Bulletin of Anesthesia History, Volume 24, Number 4 (see the Wood Library-Museum website http://www.woodlibrarymuseum.org/AHApdf/October %202005.pdf) and there is a copy of this report on the History of Anaesthesia Society website (<http://www.histansoc.org.uk/>).

Participants assembled on the Wednesday evening to hear a carefully researched address on the history of anaesthesia by Dr Mary Archer, Chairman of Addenbrooke’s Hospital Foundation Trust. This was followed by the Blessed Chloroform Lecture “To see ourself’s as others see us!” given by Dr David Wilkinson of St. Bartholemew’s Hospital, London, and by a memorable
Reception in the Old Hall and Old Kitchen. On Thursday morning and afternoon there were free papers in the four lecture theatres. Each session was preceded by a guest lecture: Dr Rod Westhorpe, Curator of the Geoffrey Kaye Museum in Melbourne, Australia spoke on “Geoffrey Kaye - a man of many parts” and Emeritus Professor Roger Maltby from the University of Alberta, Canada on “Notable names in anaesthesia”.

The Friday session was opened by a Guest lecture by Dr Marten van Wijhe from Groningen, The Netherlands, on “Pain and Culture through time” and followed by a series of five papers given by junior doctors competing for the John Bullough Prize. These contributions were of a very high standard, the Prizewinner being Dr Jason L. McKeown from Birmingham, Alabama who, after extensive investigations, concluded that William Halsted may well have met Carl Koller during his stay in Vienna from 1879-80. Runner-up prizes went to Dr Hugh Smith, Mayo Clinic, Rochester, Minnesota, USA who spoke on "Post-operative nausea and vomiting and the rise of anaesthesia as a surgical specialty 1846 -1946" and to Dr Matthew J Mazurek of the University of California, USA, whose paper was entitled “Chauncey Leake and the development of divinyl oxide from bench to bedside”. The morning concluded with an erudite Guest lecture by Dr Andrew Cunningham from the Department of Philosophy and the History of Science, Cambridge, entitled “Death in Venice: Morgagni and Pathology in the 18th Century”.

The Friday afternoon Guest lecture was given by Professor Douglas Bacon, Professor of Anesthesiology and the History of Medicine, Mayo Clinic, Rochester, Minnesota, USA on “The American Society of Anesthesiologists at 100 - Reflections on the History of Anesthesiology’s Oldest Surviving Organisation”. Participants were then transported by buses to the American War Cemetery at nearby Madingley, where they were able to view the Memorial Chapel and Wall and the massed graves of American Service men and women who had lost their lives during World War II. Although winds seemed to reach gale force, this proved to be a deeply moving occasion with particular resonance for our American colleagues. The buses then took us to the awesome Imperial War Museum at Duxford. There, in the shadow of a huge B32 bomber in the American Hangar, Dr Selma Harrison Calmes from the UCLA School of Medicine in Los Angeles, California gave a moving account of her father’s participation in the invasion of France as a Major in the 82nd Airborne 508 Parachute Infantry Regiment in 1944. The evening concluded appropriately with an American-themed dinner in College.
On Saturday the two Guest lectures were given by Professor Colin Suckling, of the University of Strathclyde, Scotland on “Inventor and son; recollections and reflections on the discovery of Halothane” and by Dr David Lai, from Tacoma, Washington, USA on “Pentothal Postcards: Anaesthesia advertising from Abbott Laboratories”. These lectures were again followed by free papers in four lecture theatres. The meeting closed with a vibrant Reception and Gala Dinner in Cripps Hall in the College.

Throughout the meeting there were displays of artifacts and historic equipment from the Heritage Centre of the Association of Anaesthetists of Great Britain and Ireland; the Wood Library-Museum in Park Ridge, Illinois; the Horst Stoeckel Museum in Bonn, Germany; GE Healthcare UK; Dr Alistair McKenzie, Edinburgh; and Dr Gary Enever, Newcastle.

The Editor of the Proceedings of this meeting was Dr Peter Drury, from Liverpool, who has for many years been Editor of the Proceedings of the History of Anaesthesia Society in the UK. The task of editing a book of 797 pages containing 113 papers is enormous and was not made easier by the failure of a number of authors to submit their papers in the correct format and on time. To add to these problems the Editor was struck down by severe illness for several months and there were printing delays. Happily, Dr Drury has now recovered, but the Editorial process was severely hampered and the production of the volume delayed. It is not surprising that there are a few errors and omissions in the text.

It is obviously impossible to provide a detailed review of such a volume so what follows is an attempt to indicate the scope of this work.

The contents have been divided into a number of sections. The first is a Preface including a paper by Dr Aileen Adams, Cambridge, entitled “Where is the campus?”, and a summary of Dr Selma Harrison Calmes’ presentation. This is followed by the Guest lectures already mentioned. There are then sections on various aspects of anaesthetic history, notable names in anaesthesia, significant clinical events, anaesthesia in times of war, equipment, Departments and Organisations, veterinary and regional anaesthesia, the papers given in the John Bullough prize competition, and a list of abstracts and posters. It is not surprising that the published papers vary greatly in length and quality, but many provide detailed reviews of the subject. From the Guest Lectures one would pick out David Wilkinson’s “Blessed Chloroform” lecture in which he brilliantly reviewed the place of the anaesthetist in society, Douglas Bacon’s succinct history of the American Society of Anesthesiologists, Colin Suckling’s personal reminiscences of his father’s role in the development of halothane, and Rod
Westhorpe’s characterisation of the multi-faceted Geoffrey Kaye. In the Notable Names section Dr R. Patterson discusses the post-mortem evidence relating to C.T. Jackson’s insanity and there are other contributions on John Snow, Joseph Thomas Clover, Paul Bert, Noel Gillespie and, to my great delight, Dr Stanley Sykes. In the section on Anaesthesia in times of War, Henry Connor provides some fascinating insights into the early use of anaesthesia under combat conditions while Alistair McKenzie discusses the role of women anaesthetists in the First World War. There are also two interesting, well-illustrated articles about the partisan medical services in Slovenia during the Second World War.

The section on anaesthetic apparatus contains papers on the production of oxygen from 1772-1902, the evolution of anaesthetic apparatus in the USA, pharyngeal airways, the Boyle-Davis mouth gag, the Newcastle and Amsterdam ventilators, and the Robertshaw double-lumen tube. A final recommendation is Barbara Weaver’s fascinating illustrated account of the trials and tribulations of equine anaesthesia.

In conclusion, the production of a “Proceedings” of any Congress is, at the best of times, a daunting task, and there have been delays in the publication of some other SISHA meetings. This volume was born in adversity and publication was inevitably delayed. It lacks information on those responsible for the organisation of the Congress, an introduction, and an index, and there are several errors and omissions which might have been avoided if the authors had been able to correct proofs. Nevertheless, this volume illustrates that research into the history of anaesthesia is flourishing and it provides a valuable record of the diversity of study among historians of anaesthesia at the beginning of the 21st century.

Copies of this publication are priced at £65.00 + postage and may be obtained from Dr Anne Florence whose address is shown on the HAS Website <http://www.histansoc.org.uk/>.

Keith Sykes

When he or she learns of my interest in the history of medicine, a trainee will often ask which book would be a good start to read around a subject. This question may often be difficult to answer, the subject material being spread through so many sources. Should that question now be asked about resuscitation, I would immediately point him or her in the direction of *Resuscitation Greats* or better still, immediately lend it.

From the foreword we learn that the origin of the book came from the appointment of the late Peter Baskett as Editor-in-chief of the journal *Resuscitation*. He decided to publish a series of articles about the “Resuscitation Greats”, detailing the contributions made to the practicalities and science of the subject. He notes that the qualification to be featured was to be “dead, nearly dead, or well into retirement”! From the articles, published at nearly one a month from 2000 to 2007 and set out chronologically in the book, Dr. Peter Baskett and his brother Professor Thomas Baskett have produced this work.

In total there are 82 papers written by 56 internationally recognised authors. The work is indexed. The illustrations are mainly black and white though there are a few colour portraits. Each paper is referenced.

The first short paper by Judith M Fisher sets the scene in the papyri of ancient Egypt 4000 years ago with Isis breathing into her husband’s mouth and with the Bible where God is said to have breathed life into Adam. The last paper by Douglas Chamberlain entitled “Never quite there: a tale of resuscitation” is a canter through the highlights of the subject to the present day, and then looking towards the future. In fact, two chapters earlier we also learn about Douglas Chamberlain the man, his struggles, not only with medicine but also with dyslexia.

The Table of Contents and comprehensive index both read as a “Who’s Who” of the significant characters from the History of Resuscitation, and more generally from the history of medicine. Galen, Paracelsus, Andreas Vesalius, John Hunter, Claude Bernard and John Snow all have papers devoted to them. The paper on Snow illustrates the considerable scope of each chapter. It commences with a pocket history of Snow’s career before turning to the main theme with sections on resuscitation of the stillborn and then anaesthesia.
With such a comprehensive work, it is difficult to encapsulate all the wonderful subject matter that is so meticulously reported and dissected. In the book we find Sir Edward Sharpey-Schafer’s “simple and efficient” method of performing artificial respiration, Silvester’s technique of artificial respiration and Janos Balassa on resuscitation by chest compression. This is alongside Bernard Lown and defibrillation, and Kouwenhoven, Jude and Knickerbocker and the introduction of defibrillation and chest compressions into modern resuscitation. Arthur Guedel and the oropharyngeal airway is included, as are Edgar Pask, Peter Safar and Brian Sellick.

This is a valuable addition to the literature of the History of Medicine and to be commended as both an excellent read and a major reference source of historical facts relating to the history of resuscitation and beyond.

Neil Adams