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oooOooo

We are saddened to report the death of our Society member, Dr Tom Bryson.

HISTORY OF ANAESTHESIA SOCIETY

2009 Summer Scientific Meeting, Hilton Bath City Hotel

29-30 May 2009

Organizer: Dr Patrick Magee

The Organizer would like to acknowledge the HAS Council for support throughout the planning process, his family for help in mailing and managing the desk, and the Royal United Hospital for assistance with mailing.

Proceedings of the History of Anaesthesia Society
Hon Editor: Dr Alistair McKenzie
9 Craiglockhart Avenue
Edinburgh EH14 1HN
E-mail: mckenzie_alistair@hotmail.com

The Society acknowledges with thanks the photographs taken by Dr Geoff Hall-Davies

HISTORY OF ANAESTHESIA SOCIETY

Council and Officers – September 2009

President	Prof J Anthony W Wildsmith, Dundee
President-Elect	Dr C Neil Adams, Bury St Edmunds
Honorary Secretary	Dr Anne Florence, Cheshire
Honorary Treasurer and Membership Secretary	Dr Adrian Kuipers, Shrewsbury
Honorary Editor	Dr Alistair McKenzie, Edinburgh
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	Dr Paul Goulden, Dewsbury
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	Dr Patrick Magee, Bath
	Mrs Patricia Willis, London
	Dr Christopher Woollam, Norwich
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(Llandrindod Wells 2010)	Dr Barrie Fischer, Uphampton (Worcs)
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	Dr Thomas Boulton OBE TD
	Dr Jean Horton
	Dr Ian McLellan
	Dr Adrian Padfield
	Prof Sir M Keith Sykes
	Dr David Zuck
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	Prof John Severinghaus, San Francisco
	Prof Doreen Vermeulen Cranch, Elburg

oooOooo

For more information visit the website: www.histansoc.org.uk

EDITORIAL

Blessed with glorious sunshine, the Bath meeting was an occasion to remember. Appropriately the scientific program began with an account of the first anaesthetics in Bath, presented in lively style by Dr Marjot. Next in the miscellany of papers scheduled for the morning was the harrowing story of suxamethonium murders in USA. Anaesthetic events recorded in 19th C. British regional newspapers were perused, followed by biographies of Peter Squire and James Young Simpson; the last paper in the session was a fascinating investigation into the Liston painting.

The afternoon session had three trainee papers, which were all of a high standard. Next was a full account of the Drummond Jackson libel case, an attempt to identify a wheeled stretcher found in Scotland, and a fun look at postcards with relevance to anaesthesia.

The AGM was conducted smoothly. Notably the members agreed that Council should proceed, using its discretion, to implement a range of options to dispose of the HAS Publications, which have become increasingly costly to store at the commercial depot in Reading. Members were also informed of the acceptance of two nominations: Dr Neil Adams as President-Elect and Prof Roger Maltby as an Honorary Member (Overseas) – both to be effected at the next AGM in Wales. The annual dinner was held in the magnificent Pump Room – a truly enjoyable experience.

On the Saturday morning the delegates were treated to an account of an 1847 ether vaporizer discovered by Henry Connor at the RCP London. Equally interesting accounts were given of deaths attributed to criminal use of neuro-muscular blockers at Ann Arbor, anaesthetic contributions of Joseph Lister and a celebration of the life of the late Dr Peter Baskett.

The final two papers were: the contrast between Sydenham and Wiseman in 17th C. England, and a delightful account of hydrotherapy in Bath. The organizer, Patrick Magee, was thanked for a most enjoyable meeting.

Alistair G McKenzie, Hon Editor

FUTURE EVENTS

2010 25-26 June. HAS Summer Meeting, Llandrindod Wells
Contact: Dr Adrian Kuipers (a.j.k@btinternet.com)
October: HAS Autumn Meeting, Newmarket
Contact: Dr Kenneth MacLeod (kenmacleod@doctors.org.uk)

Speakers at Bath

Dr R Marjot

Prof Sir MK Sykes

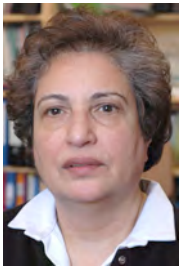
Mrs Diana Douglas

Dr D Zuck

Dr T Simpson

Dr P Featherstone

Dr T Gilkes



Dr Veera Gopakumar

Prof JAW Wildsmith

Dr I McLellan

Dr H Connor

Prof R Maltby

Dr Jean Horton

Dr J Nolan

Dr J Sill

Dr M Coupe

Dr Catherine Adam	Leven	Dr Ronald Lo	London
Dr Aileen Adams	Cambridge	Dr Kenneth Macleod	Huntingdon
Dr Neil Adams	Bury St Edmunds	Dr Patrick Magee	Bath
Dr Moyna Barton	London	Prof Roger Maltby	Canada
Dr Edward Bick	Cheltenham	Dr David McCallum	Edinburgh
Dr Colin Birt	Rochford	Dr Alistair McKenzie	Edinburgh
Dr John Blizzard	Chelmsford	Dr Colin McLaren	Wootton Bassett
Mr Anthony Clover	Shrewsbury		
Dr Henry Connor	Hereford	Dr Ian McLellan	Gillingham
Dr Ian Corall	London	Mrs Iris Millis	London
		Dr Peter Morris	HolmesChapel
Mrs Diana Douglas	Dartmouth	Dr James Mulvein	Bristol
Prof Alan Dronsfield	Derby	Dr John Murray	Kidderminster
Dr Peter Eadsforth	UK	Dr Tony Nightingale	Liverpool
Dr Christine Earlam	Lymm	Dr Louise Oduro-Dominah	W.Suffolk
Dr Peter Featherstone	Bury St Edmunds	Dr Adrian Padfield	Sheffield
Dr Ann Ferguson	Broadstairs	Dr Robert Palmer	Hants
Dr Barrie Fischer	Ombersley	Dr Yashvant Pole	Manchester
Dr Anne Florence	Frodsham	Dr John Pring	Penzance
Dr Tom Gilkes	London	Dr Miles Rucklidge	Lancaster
Dr Veera Gopakumar	Walsall	Dr John Sill	U.S.A.
Dr Miles Gough	Grimsby	Dr Ian Smith	Aberdeen
Dr Paul Goulden	Dewsbury	Prof Sir Keith Sykes	Devon
Dr Geoff Hall-Davies	Redditch	Ms Nancy Tardy	U.S.A.
Dr Bill Hamlyn	Blackburn	Dr Alistair Trench	Dunblane
Dr Helen Hannah	Chippenham	Dr Barbara Weaver	Winscombe
Dr Jean Horton	Cambridge	Prof Tony Wildsmith	Dundee
Brig. Ivan Houghton	London	Mrs Patricia Willis	London
Dr Mike Inman	Plymouth	Dr Raymond Wise	Blandford Forum
Dr D M Jackson	Swindon		
Dr Reg Johnstone	Ulverston	Dr Chris Woollam	Norwich
Dr Adrian Kuipers	Shrewsbury	Dr David Zuck	London

Guest Lecturer:
Dr Michael Coupe, Bath

THE FIRST ANAESTHETICS IN BATH

Dr R Marjot
Consultant Anaesthetist, Royal United NHS Trust, Bath

Bath is a World Heritage Site. It is a most beautiful and historical city. Inspired by a lecture delivered by Robin Weller entitled 'The first anaesthetic in Bristol'[1] this is an account of the discoveries made deep in the archives of Bath's public library, where scraps of microfilm still precariously exist of local newspapers from those early months in 1847. They lead us around the city in the footsteps of Bath's anaesthetic pioneers, those great men of science who embraced this 'blessing to mandkind'. It takes us to the doorstep of perhaps Bath's first anaesthetic specialist. His professional skills may have meant that the citizens of Bath were blessed with the wonderful benefits of anaesthesia, uninterrupted, from those early pioneering experiments to the advanced and diverse services that we provide today.

Spread of the news of ether

On the 16th October 1846, William TG Morton gave the first successful demonstration of ether anaesthesia in Boston, Massachusetts. Communications of this new dawn for surgery travelled to England on the paddle steamer *Acadia* that docked in Liverpool on the 16th December 1846. By the 21st December, the experiment had been publicly repeated under the direction of the London surgeon, Robert Liston at University College Hospital [2].

News travelled fast, and events were widely reported in the local and national press, as well as the medical literature. By the 31st December, major surgery was conducted under the effects of ether at Bristol General Hospital. William Herapath, eminent chemist, administered the ether anaesthetic via a 'very large bladder'. His detailed account and observations were again widely reported, including an article within the *Times*, under the banner heading of 'Another Surgical Operation Without Pain' [3, 4]. This was the first account of anaesthesia administered in an English city outside of the capital.

These enthusiastic reports undoubtedly came to the attention of medical men across the breadth of the nation. Bath was to be no exception.

First anaesthetic in Bath

In this city, George Nathaniel Hosking, apothecary at the United Hospital, administered ether anaesthesia on the 5th January 1847, at his residence at 1

Walcott Terrace. His letter describing what occurred was reported in the 14th January edition of the *Bath Chronicle*, which was, at that time, a weekly publication [5]. Contained within the section entitled *'Local Intelligence'* appeared the following letter.

SURGICAL OPERATION WITHOUT PAIN

To the EDITOR *of the* BATH CHRONICAL

Sir.- Most of your readers, no doubt, have heard of the device by which surgical operations are rendered painless by inhaling the vapour of ether, but as I am not aware if it has been tried in this city, I beg to acquaint you with the particulars of the following cases: - A boy, fourteen years of age, was yesterday thrown into sleep after inhaling the vapour about three minutes. He remained quite insensible for nearly three minutes. During this time I punctured his arm with a needle in several places, and violently shook him, of both of which facts, on awaking, he had no knowledge. The second case was that of a girl, to whom I administered the ether this afternoon in the presence of several persons. The inhalation occupied little more than a minute, she remained insensible upwards of three minutes, during which time I extracted a tooth from her upper jaw, and also punctured her arm. On awaking she appeared much astonished, and declared that she was not aware I had touched her. In both cases not the slightest indisposition or unpleasant feeling followed the operation. The apparatus I enlisted was that recommended by Mr. Herapath, of Bristol.

I am, Sir, your obedient servant,

1, Walcot Terrace, Bath. GEORGE N. HOSKING

January 6th 1847

The house is currently occupied as the 'Bath Centre for Psychotherapy and Counselling'.

It is interesting that Hosking used the technique described by Herapath in Bristol. Herapath's account was not published in the *Bath Chronicle* until the 7th January, two days after Hosking used the technique himself. One can only presume Hosking had received his information directly from contacts in Bristol, or from reading an account published in the *Times* on the 4th January. In 1840 the Great Western Line had opened between Bath and Bristol, a journey of only 33 minutes. By 1841 Brunel had completed the Box tunnel, linking Bath to London by 'God's Wonderful Railway'. Hence, communications between the three cites must have been relatively rapid (especially by today's standards!).

Bath was in the vanguard of cities first to use anaesthesia, (Table 1) [1-15].

Table 1: First anaesthetics administered

Place	Date	Etherist
Boston, USA	16th October 1846	WTG Morton
London, Gower St	19th December 1846	James Robinson
Dumfries	19th December 1846	William Scott
London, UCH	21st December 1846	William Squires
Paris	22nd December 1846	AJ Jorbet de Lamballe
Bristol	31st December 1846	William Herapath
Cambridge	2nd January1847	George Humphrey
Glasgow	4th January1847	JHH Lewellin
Bath	5th January1847	George N Hoskins
London, Kings College	?7th January1847	?William Fergusson
London, Guys	?7th January1847	?Charles Aston Key
Edinburgh	9th January1847	?
Liverpool	12th January1847	?
Manchester	12th January1847	Charles Strange
London, St Georges	14th January1847	?Caesar Hawkins
Middlesex Hospital	25th January 1847	John Tomes

Further reports of ether anaesthesia in January 1847

At this time, dental extractions were probably the commonest (& safest) surgical procedure to be performed. The pain already being endured outweighed the pain of any proposed surgery. However, the prospect of a painless dental extraction could only greatly enhance the popularity of a dentist and this attraction did not escape the attention of those practising in Bath. Within 11 days, James Edwards, a prominent dental practitioner in the prestigious premises of 18 Gays Street, utilised and publicly reported his experiences with anaesthesia [16].

To the Editor *of the* Bath Chronicle

Sir, - Public attention has been recently drawn to possibility of performing surgical operations without producing pain to the patient, by the previous inhalation of the vapour of sulphuric Ether. Few minor operations inspire more dread than the extraction of teeth, the fear of which delaying its execution, resulting in permanent and irremediable malformations of the mouth. Confronted by these causes, I have been induced to try the effects of ether inhalation in operations of this nature, and with your leave, which will interest

your readers, will lay before you the results of experiments I have hitherto been enabled to make.

The first was on Saturday, the 16th inst.: the patient was a lady, 21 years of age, with a canine tooth of the lower jaw protruding considerably beyond the range of the adjacent teeth. From its size and soundness, giving promise of considerable resistance to a forcible ejectment. Having inhaled the vapour in the recommended manner for about a minute, she became quite insensible, into a sound and composed sleep, in which state the tooth was extracted without exciting consciousness of pain: she almost fully recovered from the effects of the vapour, and could not upon visual inspection, be persuaded of the reality of its removal. She afterwards declared she did not suffer the least inconvenience either at the time of the operation, or in recovering from the effects of the inhalation, neither headache or other affection following discontinuation.

The next case was that of a lad of about 16 years of age, with a deeply rooted tooth in the back of the upper jaw, which it was necessary to extract. In this case the inhalation tube apparatus had been removed from the mouth before the delivered ether sufficiently obtunded, and although the required insensibility was partially produced, the patient stayed in a state of semi-consciousness throughout the whole treatment, although from the force required, the pain would otherwise have been most severe. He did not, by any muscular contraction, or otherwise, show evidence of discomfort or uneasiness during the time of operation.

In another case, from peculiarity of temperament, it was felt advisable to postpone the operation.

To the truth of these statements Dr Wilkinson, Mr ****, Mr Hunt and Mr E Boult, surgeons, Mr Tylee, chemist Bridge Street , and Mr Freeman, of the Photographic Institute, cheerfully bear testimony.

I have been thus particular in stating these cases. It is only from well authenticated facts that new discoveries as this can be judged by the public, and their merits or otherwise tested.

I am myself so satisfied with the results, that I shall advocate it where, from nervousness or timidity, a necessity arises. This is a pleasant and innocuous mode of counteracting the fear of attending an operation to which the most delicate, of either sex, are continually liable; and my attention will be directed to the best mode of administering so valuable an agent in my practice.

I am, Sir, your most obedient servant,

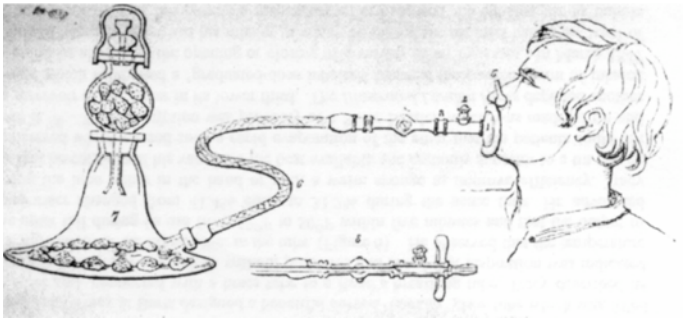
JAMES EDWARDS

Bath, Jan 19th, 1847. Surgeon Dentist, 18 Gay Street

(**** indicate where type script was undecipherable).

Edwards did not choose to adopt the bladder technique advocated in Bristol but had indeed chosen to use an 'inhalation tube apparatus'. This may well have been a Hooper Apparatus (Figure1), which had been described in detail in the 9th January edition of *The London Illustrated News* [13]. It was indeed this device that was employed by the next demonstration of ether at the United Hospital itself.

Hooper's Apparatus



***The London Illustrated News* 9th Jan 1847**

James Edwards, Bath, 16th January 1847

United Hospital, Bath, 29th January 1847

Fig. 1 Hooper's Inhaler

The United Hospital (currently occupied by the City of Bath Technical College, Figure 2) was situated centrally in Beau Street opposite the Hot Baths, which is now the site of the ultra modern Thermae Bath Spa. The Albert Wing was built in 1856 when the hospital was granted the title of the Royal United Hospital, which remains the title of this institution to this day (although the site has moved from the city centre).

The First Anaesthetics in Bath

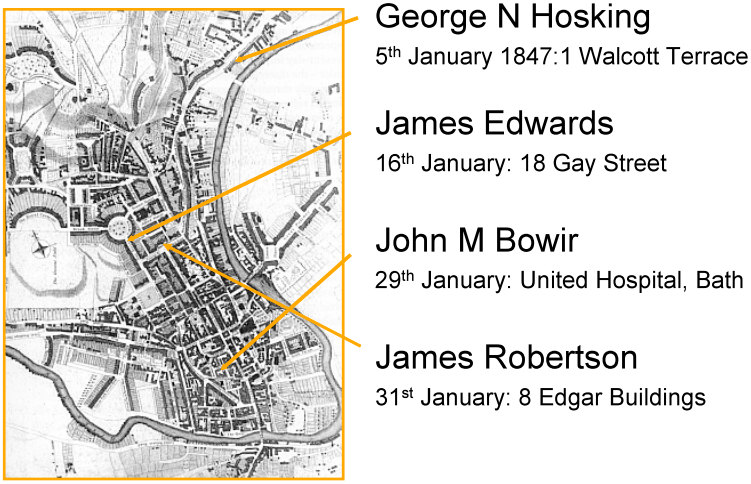


Fig. 2 Locations of the first anaesthetics administered in Bath

The first anaesthetic administered at the hospital was on the 29th January 1847 and reported by John M Bowir [17], who may have been the resident apothecary (although his status is unclear and not recorded in the Bath Directory of 1848).

To the EDITOR *of the* BATH CHRONICLE

Sir. – So much interest has naturally been raised by the reference to operations performed when the patient is in a state of insensibility, that I feel no apology in thus forwarding to you the subjoined particulars:-

Stephen Sweet, aged 16 years, who had fever and was an in-patient of this Hospital, was admitted on January 22nd inst. He was then labouring under suppuration of the femur, with numerous abscesses connected within. On account of the boy's health failing from the quantity and bad quality of the pus discharged, it was found necessary to amputate the thigh. On Thursday, at 12 o'clock, the patient was placed on the operating table, and made to inhale fumes of sulphuric ether, from an apparatus supplied by Mr Hooper, practical chemist,

of Pall-mall, London. After inhaling for the space of three minutes he became insensible and Mr Brown, the operating surgeon, then made his incision.

During the whole course of the operation the boy showed no sign of sensation, and, when completed, was not aware that anything had been done to him. It was very quickly performed, the whole time, after tying the arteries from the start of the inhalation of the ether, nor exceeding ten minutes.

This case has added another proof to the benefits of the inhalation of ether in surgical operations with its ability to deaden sensation. It is to be hoped that as a result this blessing to mankind will obtain that further recognition which it deserves.

There were present besides the regular Hospital Staff, Chas.Clarke, Mr Soden, sen, Mr Hensley, and Mr *****

I am, Sir, your obedient servant

JOHN M BOWIR, ****

United Hospital, Jan 29th, 1847.

The operating surgeon, Richard John Brown, and the witness Mr John Soden both resided in addresses in Gay Street and would have been well acquainted with the dentist James Edwards and his experiments with ether.

The final recorded demonstration took place on the 31st January, at 8 Edgar Buildings (at the top of Milsom Street), the premises of another dentist, James Robertson. He reported this account [18].

To the EDITOR *of the* BATH CHRONICLE

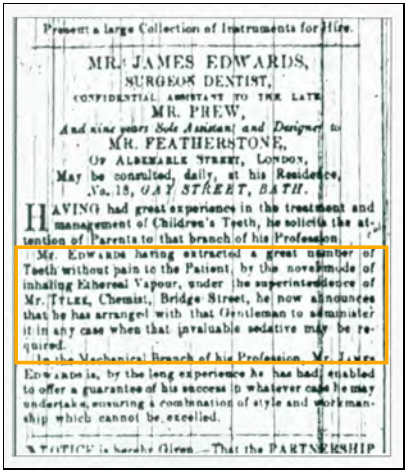
SIR: - The interest generally taken by the public of the administration of the vapour of sulphuric ether, rendering surgical operations not only easy of performance, but painless and the great importance of the subject, induces me to beg the insertion of the following successful cases.

The patient, a boy of sixteen years of age, had suffered for days from pain caused by the decay of a large and carious molar tooth. As he was considered a favourable case for the administration of the ether, I proposed the inhalation to which he readily assented. Mr Tylee, of Bridge Street kindly undertook to administer the vapour, and within three minutes the boy's hands fell powerless, his head and mouth offered no resistance to the introduction of the forceps .The tooth was immediately extracted, when the boy opened his eyes wide, and appeared as if aroused from sleep. When questioned, he answered that

he had dreamed, and that he was conscious of the removal of the tooth, but distinctly recalled that he did not suffer the slightest pain, thus proving to the satisfaction of the gentlemen present, the great value of the agent in such cases. The boy did not complain of sickness after the operation, nor did he suffer any other inconvenience.

The operation was performed in the presence of following: Mr Clark M.D., Dr Bealey, Dr Harman, Dr Spry ******* Esq., J Soden, jun., Esq., and other gentlemen.

I am, Sir, your obedient Servant,
JAMES ROBERTSON, Surgeon Dentist
8, Edgar Buildings, Feb. 1, 1847



Present a large Collection of Instruments for Sale.

MR. JAMES EDWARDS,
SURGEON DENTIST,
CONFIDENTIAL ASSISTANT TO THE LATE
MR. PREW,
And nine years Sole Assistant and Designer to
MR. FEATHERSTONE,
OF ALBEMARLE STREET, LONDON,
May be consulted, daily, at his Residence,
No. 18, *GAY STREET, BATH.*

HAVING had great experience in the treatment and management of Children's Teeth, he solicits the attention of Parents to that branch of his Profession.

Mr. EDWARDS having extracted a great number of Teeth without pain to the Patient, by the novel mode of inhaling Ethereal Vapour, under the superintendence of Mr. TYLEE, Chemist, Bridge Street, he now announces that he has arranged with that Gentleman to administer it in any case when that invaluable sedative may be required.

In the Mechanical Branch of his Profession, Mr. JAMES EDWARDS is, by the long experience he has had, enabled to offer a guarantee of his success in whatever case he may undertake, ensuring a combination of style and workmanship which cannot be excelled.

NOTICE is hereby Given.—That the PARTNERSHIP

"..Mr Edwards having extracted a great number of Teeth without pain to the Patient, by the novel mode of inhaling Ethereal Vapour under the superintendence of Mr Tylee, Chemist, Bridge Street, he now announces that he has arranged with the Gentleman to administer it in any case where that invaluable sedative may be required."

Fig. 3 An advertisement that appeared in the *Bath Chronicle* 11th, 18th & 25th February 1847

Emergence of the specialist anaesthetist

The repeated gathering of men of science & medicine to witness these experiments with ether, not only illustrate that they were taken seriously, but were recognised to be of great importance and interest. Among the audience of James Edwards's extractions in Gays Street was Mr John Palmer Tylee, a 'chemist, druggist and medical electrician'. He actually administered the anaesthesia on this occasion for James Robertson. Subsequent adverts by Edwards in the *Bath Chronicle* over the next months announced the anaesthetic services of John Tylee (Figure 3). Perhaps Tylee can be regarded as Bath's first anaesthetic specialist. The premises on Bridge Street are still recognisable as a chemist shop today, with big brass windowsills inscribed with the words 'Chemists' & 'Dispenser'. 'Tylee and Cooper' managed these premises up until 1972.

It was not uncommon in these early days for non-medically qualified gentlemen to administer anaesthesia. Some were undoubtedly good at it and others most probably were not. It was the efforts of Dr John Snow in London at this time that established the scientific principals of anaesthesia and who realised their necessity for safe and consistent administration of ether [19].

Was faith in anaesthesia maintained in Bath?

There are no surviving records for the United Hospital, beyond the hand written minutes of its Board Meetings. These, sadly, predominantly deal with matters of finance. It is therefore difficult to tell if the flame of anaesthesia was extinguished in Bath as readily as it had been in Bristol in these early months. In Bristol, as in many locations, anaesthesia was quickly abandoned as inconvenient, unreliable or unsafe [11, 20]. Perhaps the professional skills of the likes of John Palmer Tylee would mean that the citizens of Bath were blessed with the wonderful benefits of anaesthesia, uninterrupted, throughout these early days.

Acknowledgements

I am grateful to the Society of Anaesthetist of the South West for permission to reproduce this article in the Proceedings of the History of Anaesthesia Society: Summer Meeting 2009, Bath.

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THE SUCCINYLCHOLINE MURDERS

Nancy S. Tardy, R. Ph., J.D.
Hospital pharmacist and writer, Las Vegas USA

Succinylcholine has been named as the murder weapon in a number of cases that have resulted in convictions since the mid-1960s. The majority of these cases have occurred in the United States, but others have been noted in Japan and Germany.

I will discuss a few of the more noteworthy cases beginning with two anaesthesiologists convicted of murdering their wives.

Dr Carl Coppolino

Dr Carl Coppolino joined an anaesthesiology group at Riverview Hospital in Red Bank, New Jersey in 1962, while his physician-wife, Carmela, worked at nearby Hoffman La Roche Labs. In their early thirties with two young children, the Coppolinos moved into a new home in an upper class neighbourhood of Middletown, where parties and sporting events provided a ready-made social life.[1] The neighbours were friendly; in fact, one was so friendly that she became Carl's mistress after asking him to hypnotize her in an attempt to quit smoking.

Marge Farber and Carl even vacationed together in Florida and other tropical settings with their spouses' apparent approval. Marge accompanied him as a caregiver for a heart condition thought to have been self-induced by inappropriate use of digitalis in order to gain disability income. He had resigned from the anaesthesiology group for health reasons, but that did not seem to prevent him from indulging his passions.[2]

After returning from one vacation, Carl told Marge that her husband must go. And, go he did. First, Marge moved Bill Farber, a retired army officer and insurance executive, out of their bedroom. When Marge did not file for divorce, Carl told her to inject Bill with a drug that he said would kill him but couldn't be traced in the body after death. She mixed the powder that Carl gave her with water in a syringe and stabbed him in his leg. When he didn't die, Marge called Carl for help, and he supposedly gave him another injection and smothered him with a pillow. Carmela Coppolino, at the request of Marge and Carl, signed the death certificate, and Bill was buried without an autopsy.[3]

Within two years Marge and Carl had ended their love affair, and Carl moved his family to Florida to begin a new life. Shortly thereafter, he began a new

affair with Mary Gibson, a recently divorced wealthy Sarasota resident, that he met at a bridge club where he took lessons.[4] Bad investments and Carmela's inability to obtain a Florida medical license led to financial problems for Carl. Marge Farber added further stress when she sold her New Jersey home, moved to Florida and made plans to build a home next to the Coppolinos.

Trying to please three women, all in close proximity, may have been difficult for Carl, and it appears that he was looking for a way out. Within weeks of meeting Mary, Carl asked a friend to send him six vials of succinylcholine, ostensibly to use in experiments on cats. Two weeks after Carl received the vials, a seemingly healthy 32 year-old Carmela lay dead in the bedroom of their new Florida home. Carl telephoned a friend of Carmela's and asked her to sign a death certificate, indicating that Carmela had symptoms of a heart attack the previous night. Carmela's life insurance proceeds helped with some of Carl's financial problems, and marriage to Mary a few weeks later solved the remainder.

They might have lived happily ever after but for his scorned lover, Marge Farber. Marge believed that Carl had murdered Carmela, just as he had murdered her husband. She told law enforcement officials that Carl had killed two people with what he had said was "the perfect murder weapon." To gain their interest, she confessed that she had participated in her husband's murder, though she said she was "an unwilling and hypnotized love slave".[5]

Police authorities ordered the exhumations of Colonel Farber and the recently deceased Carmela Coppolino. Farber's body was in much worse shape after being buried for three years, and the body was damaged during the removal of the casket. Both bodies were turned over to the noted New York City Medical Examiner, Dr Milton Helpern, for autopsy. He was unable to find a reason for Carmela's death, so he sent samples of the brain, liver, kidneys, and stomach tissue, plus sections of both buttocks to his toxicology lab where Dr Joseph Umberger was told to test for general unknown poisons. In the event of negative findings, Umberger was asked to test specifically for succinylcholine. [6] Corroborating Marge Farber's story, Dr Helpern found that Bill Farber's cricoid cartilage had been fractured in two places leading to an official finding that he had died as a result of manual strangulation.[7]

The State of New Jersey proceeded to trial first, charging Carl with murder in the first degree in the death of Bill Farber. Though no evidence of succinylcholine or its byproducts were found in Colonel Farber's body, a fractured cricoid cartilage usually means murder. The jury listened to Marge's strange story of hypnosis, extramarital affairs, and murder by succinylcholine.

Carl took the stand in his own defense and acknowledged his affair with Marge. But he defended his actions in the medical care of her deceased husband as nothing more than an attempt to help a friend. The jury, obviously swayed by his calm testimony regarding Colonel Farber's health problems, returned a verdict of not guilty.[8]

The Florida trial was held in the small west coast town of Naples in April 1967. Many locals felt that Carl was guilty of both murders and escaped punishment in New Jersey by using sly lawyers. The trial lasted four weeks and, as expected, encompassed a large amount of medical and technical testimony that confused and bored the jury. Carl was found guilty of second-degree murder, which is loosely translated to mean murder without premeditation and, obviously, does not fit this case, since poisoning requires planning. However, in Florida all lesser offences were included in the charge of first-degree murder. [9]

Carl Coppolino was sentenced to life in prison. He exhausted all appeals and served 12 years in Florida prisons, while maintaining his innocence. In fact, he served a longer sentence for a second-degree murder charge in Florida than any other convicted felon and was finally paroled in 1979. His wife, Mary, was waiting for him.[10]

Unnamed German anaesthesiologist

A German anaesthesiologist reported that he arrived home to find his 34 year-old wife's body crumpled at the bottom of a staircase. He told investigators that she was unconscious and pale with a slow, weak pulse, which faded. He said that he had attempted CPR, tracheal intubation and bag ventilation with negative results before calling the emergency response team. The doctor presented authorities with several electrocardiogram (ECG) strips that he said he made on his wife during his resuscitation attempt. The strips showed consecutive sinus bradycardia, asystole and ventricular fibrillation with a date and time stamp on them. He mentioned that his wife's blood pressure problems might have been responsible for the accident.[11] No blood, hair, or other biological traces could be found on the stairs, and the prosecutor ordered an autopsy.

A three-centimetre laceration was found in the right occipital/parietal region, but the autopsy revealed no obvious cause of death. Nor was there evidence of acute traumatic brain injury, pre-existing diseases, fractures of bones or myocarditis.[12]

Police became suspicious that the young wife may have been murdered. First, a vial of succinylcholine was found missing from the anaesthesiologist's

emergency case. Second, the ECG strips appeared to have been faked, and, furthermore, authorities learned that a planned divorce might have created financial hardship for the husband.

An anaesthesiologist was asked to give a statement based on the autopsy findings, forensic reports and the ECG strips. He concluded, "With certainty Mrs. X did not fall down the stairs. With certainty Dr. X has not carried out resuscitation measures on his wife, neither mechanically nor with drugs. Therefore, death was caused by a deliberate withholding of oxygen. Only this can cause the death of this young healthy woman." [13]

Although succinylcholine administration was suspected in this case, no evidence of the drug or its degradation products were found in specimens by using mass spectrometry. Testimony by Dr Jurgen Peters indicated that at least part of the ECG recordings from the scene and presumed to have been recorded during CPR on the deceased were identical with the unique ventricular fibrillation pattern stored in and displayed by an ECG simulator located at the hospital of the husband. Ruling out random coincidence, this implied that the ECG tracings seized on the scene had not been recorded from the woman found dead at the base of her home staircase.[14]

Even though the cause of death could not be determined, the fake ECG strips were an essential hint of foul play. After several months of trial activity, the husband suddenly confessed to killing his wife but gave no further details and was sentenced to a long imprisonment for manslaughter.[15]

Nurse and Serial Killer, Genene Jones

In the early 1980s babies on Nurse Genene Jones' 3-11 shift in a San Antonio, Texas hospital began to sicken suddenly, and some died. Genene was often the first person to respond to an emergency Code Blue. These babies suffered all types of medical insults, including bleeding from orifices, massive urination, seizures, atypical cardiac rhythm and breathing difficulties.[16] Additional safeguards were instituted by the medical staff, yet the medical emergencies continued. Some suspected foul play, and one nurse even documented that Genene was seen in close proximity to most of the emergencies. Hospital managers could not, or did not want to, believe that someone was intentionally harming these helpless young children.[17] Rather, they decided to close the Paediatric Intensive Care Unit (PICU) and reopen it with only registered nurses, supposedly to provide a higher quality of care.[18]

Since Genene was not a registered nurse, she could not remain in PICU. She declined an offer to transfer to any other unit in the hospital, since she was not allowed to work further in any paediatric unit. Within months she was hired by a female paediatric physician graduating from the residency program at the hospital where Genene worked.[19]

Dr Kathy Holland was realizing her dream to open her own clinic, and she chose a small town about an hour from San Antonio. Though only two patients came to the clinic the first day it opened for business, one, a 15 month-old with a history of breathing difficulties became limp and stopped breathing while Genene played with her in a nearby treatment room. After being rushed to the local hospital and admitted, Chelsea was playing normally by bedtime. No explanation was made for her sudden loss of consciousness. Within the next four weeks, seven more children were rushed to the local and area hospitals, all with unexplainable respiratory collapses. The local medical community wondered what could possibly be triggering this sudden outbreak of paediatric emergencies, since they had never experienced even one in their many years of practice.

Five weeks after her first visit, Chelsea, the first medical emergency at Dr Holland's clinic, accompanied her sick little brother. She was healthy, though in need of her routine immunizations. As her mother held her, Genene gave the little girl an injection in each thigh. Chelsea suddenly collapsed and died en route to the hospital. The autopsy returned findings of an undetermined breathing problem.[20]

During one of these emergency codes at the local hospital, an anaesthesiologist noticed that the child appeared to be recovering from a drug-induced paralysis.[21] He reported this to the hospital administration, and research showed that a number of similar medical emergencies had occurred at Genene's last workplace. At this point the Texas Rangers were called in to investigate little Chelsea's death.

Dr. Holland could not understand what was happening. She checked and rechecked her work and could find no reasonable explanation for the number of suddenly ill children in her office. Almost as an afterthought one day, Genene mentioned that she had found the vial of succinylcholine reported missing the previous week in the office. Though the cap was off, the vial appeared to be full. Dr Holland had never used the drug because she was not familiar with its dose. As she looked closer, she noticed that, though the vial appeared full, the rubber stopper showed numerous punctures. She turned the vial over to the authorities, and tests showed that it had been used and refilled with saline. [22]

Now aware of Genene's history and the tampered vial of succinylcholine in Dr Holland's office, officials exhumed Chelsea's body. Tissue samples around the injection sites were excised, and samples of body fluids from the previous autopsy were taken for further examination. Dr Bo Holmstedt claimed that he could find succinylcholine in embalmed human tissue, and Chelsea's samples were sent to the Karolinska Institute in Sweden to attempt the difficult testing. Within months Texas officials were notified that succinylcholine was found in the tissue samples.[23] Questions continue to this day, twenty-five years later, whether the science behind the testing is certain and replicable enough to be admissible in a court of law to determine guilt beyond a reasonable doubt.

However, here Genene Jones was found guilty of one count of murder and seven counts of assault stemming from cases solely in this small Texas clinic.[24] If the jury did not rely totally on Dr Holmstedt's findings for the guilty verdict, then they certainly gave weight to the evidence of the tampered vial of succinylcholine and testimony of Dr Kathleen Kagen-Halley, a neuropathologist, who testified that Chelsea's brain stem scarring, found at autopsy, would have made her more sensitive to a respiratory insult. The jury exonerated Dr Holland from any wrongdoing, acknowledging that no successful criminal case could have been prosecuted without her help in supplying the tampered succinylcholine vial.

Additionally, Genene Jones was convicted in San Antonio of one case of assault that occurred in that hospital. Although Nurse Jones was thought to have killed or harmed upwards of fifty babies and children during her tenure at the hospital, the records, except for the one used for prosecution, were not available, since they had been shredded by hospital managers in an attempt to avoid liability.[25]

Genene Jones was sentenced to 159 years in the women's prison in Texas, where she remains to this day, repeatedly being denied parole. However, in 2017 she will be released, having served her complete sentence from the point of view of the state of Texas.[26]

Chaz Higgs, ICU nurse and wife-killer

The emergency call for an ambulance early one July morning in Reno, Nevada in 2006 was unique. The ambulance dispatcher could not believe the calm manner in which the male voice said that he found his wife not breathing and non-responsive. He indicated that he was an ICU nurse and had begun cardiopulmonary resuscitation (CPR), all the while giving extensive directions

to his home. Never breathing hard, nor breaking for breaths, the caller finally put down the phone and waited outside for the ambulance to arrive.[27]

Kathy Augustine was a slightly overweight 50 year-old with no major medical problems and a high elected position in Nevada state government. Resuscitated at the scene by emergency medical technicians (EMTs), she was admitted to a local hospital where her husband of three years had formerly worked. Kathy died three days later without regaining consciousness.[28]

The autopsy was inconclusive though her husband, Nurse Chaz Higgs, told local police that he thought she had suffered a heart attack, brought on by the stress of her current political campaign. Chaz might have moved on to his next love affair with a sizable inheritance from his late wife had it not been for his anger and boasting.

Though Chaz' actions during those three days of his wife's illness, including his telephone call for help, were not typical of a shocked and saddened spouse, no hint of murder surfaced until a co-worker said that he had told her "if you want to get rid of someone, you just hit 'em with a little sux, because they can't trace it post-mortem". [29] This conversation took place the day that an angry Chaz said he was going to divorce his hated wife. Kathy Augustine was admitted to the hospital the very next morning.

Responding to this possibility, physicians froze samples of fluid, blood and tissue for testing later if needed. They, also, carefully examined her body and found what was believed to be a needle puncture wound in her left buttock.[30] Though not familiar with succinylcholine, local authorities learned that the Federal Bureau of Investigation (FBI) was able to test for the drug and its byproduct, succinylmonocholine.

Police searched the Higgs' home and found the drug, etomidate, which is often packaged with succinylcholine into a Rapid Sequence Intubation Kit for emergency use in hospitals. Etomidate reduces the anxiety that occurs during the rapid onset of paralysis.[31]

The FBI test came back positive for both succinylcholine and succinylmonocholine in Kathy's urine, and a warrant was issued for Chaz Higgs' arrest on first-degree murder charges.[32]

Based on the FBI's finding of succinylcholine in Kathy's body and the insult to her brain tissue, the medical examiner changed the autopsy findings to death by

suffocation caused by succinylcholine injection without external breathing support.[33]

The FBI analyst gave no evidence of how the succinylcholine was tested for when testifying at his trial a year later. However, the jury had heard and seen examples of Chaz' anger toward his wife, his flirtations with other women and his indifference to his wife's medical condition after her collapse. Also, he had the three components required for a murder conviction-motive, means and opportunity. On June 29, 2007 Chaz was found guilty of first-degree murder and is now serving a life sentence with the possibility of parole in twenty years in a Nevada prison.

Acknowledgements

The author would like to acknowledge assistance received from Dr Ann Ferguson and Dr Roger Maltby.

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REFERENCES TO ANAESTHESIA IN 19TH CENTURY BRITISH REGIONAL NEWSPAPERS

Keith Sykes, Emeritus Professor, University of Oxford
Budleigh Salterton, Devon

At the June 2008 meeting of the History of Anaesthesia Society the author reviewed the references to anaesthesia in the *Times Digital Archive 1785 to 1985* [1]. The present paper provides a similar analysis of articles in 48 other 19th Century British Newspapers that have been selected for digitisation because they represent different political and cultural segments of British society.

In 1800, there were four main daily newspapers being published in London: *The Morning Post; The Morning Chronicle;* the *Morning Herald* and *The Times.* These were of roughly equal importance. However, with a dynamic editorial team and the introduction, in November 1814, of the Koenig Steam press capable of producing 1000 sheets per hour, *The Times* soon overtook its rivals, its circulation increasing from 5000 copies in 1815 to 40,000 by 1851.

In England, Wales, Scotland, and Ireland the provincial newspapers were well established by 1800 and were usually published weekly, but their growth was slow during the first third of the century because they were subjected to excessive taxation designed to pay off the debt incurred by the Napoleonic Wars. Thomas Wakley, Editor of *The Lancet*, was one of those who strongly opposed these taxes, and it was only when they were repealed in the 1840's that newspaper production expanded rapidly. During the first half of the century there were few professional journalists or mechanized printing presses, and most of the papers were produced by local printers and on a very small scale. Transport between cities was difficult and time-consuming so regional newspapers tended to concentrate on local news, and relied heavily on advertising revenue for their survival.

By the second half of the century there had been a significant move of the population from the rural areas into the cities, London having grown from a population of 1 million in 1800 to over 2 million by 1850. During the ensuing years, the improvement in transport and communication systems, the mechanization of printing presses, the development of professional journalists and the general prosperity all contributed to a massive expansion of the press and to the birth of many new titles.

Database search

The Devon Library Service provides a range of online reference sources. The microfiche copies of the 48 Regional 19th century newspapers could be accessed online by typing in a Devon library card number. There are a number of search options and, for the purposes of this communication, the news section of each newspaper was searched using the terms **Anaesthesia** or **Ether** or **Chloroform** or **Nitrous oxide**.

The search yielded a list of 250 articles ordered according to their date, with the oldest first. The article could then be viewed as an isolated column of text with the keywords highlighted in green, or it could be displayed in its original position on the microfiche copy of the page. The article could be saved as a .pdf file, printed, or dispatched as an email attachment. Information about the dates of publication and history of each newspaper could be accessed from each reference.

Search results

There were 250 references to anaesthesia that were published between 1824 and 1899. These were contained in 30 of the 48 titles in the database. There were 6 references to nitrous oxide, 60 to ether, 176 to chloroform and 8 to both ether and chloroform. Most of the references in the London-based papers appeared in the *Daily News, The Morning Chronicle*, *Lloyds Weekly Newspaper* and the weekly *Reynold's Newspaper* while the most frequent sources of references in the provincial papers were *Freeman's Journal and Daily Commercial Advertiser* (Dublin), the *Liverpool Mercury*, the *Glasgow Herald*, the *Birmingham Daily Post*, *The Leeds Mercury*, *The Belfast News-letter*, and the *Caledonian Mercury* (Edinburgh). There were only six articles each in *The Manchester Times* and the Cardiff-based *Western Mail*.

Nitrous oxide

Two of the references to nitrous oxide predate its clinical use. On October 15th 1824 The *Liverpool Mercury* carried an article from *The Kaleidoscope* entitled "The singular effects produced by the respiration of nitrous oxide". This refers to the experiments of Humphrey Davy and the cerebral effects of breathing the gas noted by Southey, Coleridge, Wedgewood, Lovell Edgeworth and others, and it then quotes the experience of a correspondent who had recently breathed the gas. In his final paragraph this correspondent wrote:

" During the height of what may be termed the paroxysm, my sensations somewhat resembled those I have occasionally experienced when it has been my good fortune to come in for a share of superfine wine. What particular species of the juice of the grape in its effects the most resembles this *laughing gas,* I cannot just now determine;— but if you, or any of your friends, are particularly anxious to have the point settled you have only to send me a few specimens of Superior Champaigne or Burgundy, whilst I still retain the recollection of the nitrous oxide, and I will endeavour to ascertain to which beverage it bears the nearest affinity.
……I remain, yours &c. Egerton Smith"

The second reference to nitrous oxide, entitled "Experiments on the nitrous oxide or laughing gas", appeared in *The Northern Liberator* (Newcastle-upon-Tyne) on December 15th 1838. The article described a public exhibition of the properties of the gas in the lecture theatre at St Bartholomew's Hospital on the 28th November 1834. The experiments were conducted by a Dr Elliotson (who seems likely to have been the University College Hospital Physician who was forced to resign over his support for mesmerism) and the audience consisted of "a great number of scientific men, nearly all of the present Cabinet, then in town, and….. several Foreign Ambassadors….."

Dr Elliotson first allowed some medical students to inhale the gas, with varied results. My Lord Howick then signified his wish to inhale the gas. "He took a little, which produced the most laughable effects upon his Lordship. He laughed all at one side of his mouth, and cut the most grotesque capers. But the whole company got most alarmed when they saw his Lordship take a London *Champion* newspaper out of his pocket, make it into the fashion of a merryman's cap and go and set fire to it upon his head. Remonstrance was of no use; he ran about the room with the blazing headpiece, till the cap burnt down to his own locks, which seemed to put a stop to his gambles.

Lord Palmerston next took the tube, and filled his mouth with the exhilirating air. He stood for few seconds quite speechless….and then ran towards the Turkish Ambassador, and wanted to hide his head under his wide and capacious breeches. …. The Turk did not appear to relish this manoeuvre very much for he took a quid of opium from his box and rolled it in his mouth, evidently under the influence of subdued passion".

…."Lord Melbourne was the next experimentalist. He was eyed with great interest by the whole company; especially by the female part of it…… He then began suddenly to run up and down the whole room in an excitable state offering to embrace all the ladies in it".

The Bishop of Exeter (Dr Phillpots) and Dr Pusey (of Oxford) were the next to inhale the gas, again with unpredictable results, but it was the Chancellor of the Exchequer who caused the most distress for "he took two half crowns out of his waistcoat pocket; threw them violently on the table; went up to the American Ambassador; doubled his fist in his face, and swore he would kick him to Nootka Sound". At this the company decided to take hold of the Honourable gentleman while Dr Elliotson gave him some sedative drops. These caused him to go into a collapsed state so they had to send for his carriage to take him home.

The report concludes with the antics of an Irishman, and then those of Sir Francis Burdett who was on crutches because of the gout. He "threw down his crutches and spun round like a whirling dervish, upon one leg, with preternatural activity. Happening, in the middle of his whirl, to fix his eye upon a picture of the late Mr Pitt, he suddenly fell down on his knees as if to worship it, and asked pardon for all the sins, errors, heresies, and enormities of his youth"… This was the concluding experiment and the company dispersed.

Surprisingly, there were only four other references to nitrous oxide. Two were from a dentist advertising his use of the gas in Birmingham and the other two were thinly veiled advertisements for a Mr Davies, a dentist in Dublin. The second reference to this man, dated 1871, is of interest because it refers to the revival of nitrous oxide anaesthesia for dentistry resulting from the visit of Gardner Q. Colton to Paris in 1867 and the subsequent visit of the American dentist Mr Evans to London a year later. The report notes that Mr Davies now employed Barth's Patent Economiser that reduces the quantity of gas required for each anaesthetic from 8-9 gallons to 1-2 gallons. The report also cites a zero mortality with nitrous oxide compared with a mortality of 1 in 2,723 for chloroform and 1 in 23,204 for ether. Finally there was a brief letter in *The Bristol Mercury* in 1894 asking why chloroform was still used in dentistry when nitrous oxide was available and much safer. It is interesting that there are no reports of death under nitrous oxide either in *The Times* or provincial newspapers throughout the 19th century.

Ether

The report on the first use of ether as an anaesthetic at University College Hospital on December 21st 1847 appeared in the issue of *The Lancet* dated December 26th 1846. The first reference to ether revealed by the search in *The Times* was on January 4th 1847 when William Herepath, an analytical chemist, described an operation that he had witnessed in the Bristol Royal Infirmary.

However, the first reference to anaesthesia in *The Times* (**not** picked up by the search engine) was on December 28th 1846, page 3, columns E & F (personal communication, Dr AJ Newson, Auckland, New Zealand). This is an extract from an article written by Dr John Forbes in No. XLV of *The British and Foreign Medical Journal*. In this article Dr Forbes quotes letters from John Ware and John C Warren describing the use of ether for surgical operations in Boston, Massachusetts. Dr Forbes also provides a personal description of the operations at University College Hospital, London on December 21st 1846.

The Examiner (London) and the *Hampshire Telegraph and Sussex Chronicle* carried the Herepath story on January 9th 1847, and on January 11th *The Morning Chronicle* (London) described successful ether anaesthetics at King's College Hospital and St Thomas's Hospital. These cases, and a failed attempt to anaesthetise a patient at Charing Cross Hospital were described in the *Liverpool Mercury* on January 15th. On January 20th *The Derby Mercury* described successful ether anaesthetics in Derby and Birmingham, and quoted a recent article in *The Lancet* describing the history and technique of ether anaesthesia. Successful anaesthetics were recorded on January 28th in Leeds and Sheffield, on January 30th in Liverpool and Edinburgh, and on February 10th in Aberdeen.

On March 19th*The Times* carried an extensive report of the Coroners inquest on the death during ether anaesthesia of Ann Parkinson of Spittlegate, Lincolnshire. This was followed by similar reports in the London papers: *The Morning Chronicle* and *The Examiner,* on March 20th, the *Glasgow Herald* on March 22nd and the *Caledonian Mercury* on March 25th. There followed a lively discussion in a number of papers on the possible dangers of ether, the last reference to the subject being on April 10th 1847. There were several letters about the relative safety of ether and chloroform during the rest of the century and in 1862 the *Daily News* reported that doctors in Naples, Lyon and Boston had concluded that ether was the safest drug, and questioned whether the use of chloroform was still justified. Ether finally hit the headlines again in 1890 when there were some 16 reports on the problem of ether drinking in Ireland.[1] [2]

Chloroform

Not surprisingly the *Caledonian Mercury* in Edinburgh scooped the story of Simpson's discovery of chloroform with an article on November 15th 1847 entitled "New anaesthetic agent—Ether superseded".[3] This described its administration to three patients, two operated upon by Professor Miller and one

by Dr Duncan. *The Times* reproduced this article on November 20th, and reproductions followed in Dublin and Newcastle on November 19th, Portsmouth on November 20th, Aberdeen on November 24th and Exeter on November 25th. On November 20th the *Liverpool Mercury* described the use of chloroform in 8 cases, one being a lady in childbirth. On December 7th the *Mercury* printed a paper given by David Waldie in Liverpool on November 29th 1847. In this paper Waldie, who had suggested its use to Simpson, described the properties and use of the drug.

The inquest on Hannah Greener, the first person to die under chloroform, was reported in *The Times* on February 3rd 1948, and this report was reproduced by newspapers in Portsmouth, Preston, Glasgow and Liverpool over the next few days.

From then until the end of the century there were regular reports of deaths occurring during the inhalation of chloroform both in *The Times* and in various regional newspapers. While some of the deaths occurred while the drug was being inhaled for the self-treatment of pain or asthma, and others were due to suicide or recreational use, the majority resulted from the use of chloroform for surgical procedures. There were 23 reports of deaths due to chloroform anaesthesia in *The Times* from 1848 to 1900, but the Regional newspapers carried 62 reports of deaths during anaesthesia during the same period, nearly treble those recorded by *The Times.* While most of these reports described deaths in the paper's local area, some deaths were recorded by a newspaper in another region.

One of the most interesting reports was published in the London *Daily News* of 5th July 1848. It describes the inquest on Walter S. Badger, aged 23, who died under the influence of chloroform administered to him by Mr Robinson, Surgeon dentist of Gower Street, on Friday 30th June 1848. (It was James Robinson who was persuaded by the American physician, Francis Boott, to administer the first UK ether anaesthetic for the removal of a tooth on December 19th 1847). The Coroner was Mr Thomas Wakley, Editor of the Lancet, and the inquest was held in the Apollo Tavern in Tottenham Court Road on Saturday 1st July and attracted a large audience of medical men. The report stated that after a protracted hearing the jury concluded "that the deceased died under the influence of chloroform acting on a diseased heart and enlarged liver". However, on July 11th the *Daily News* carried a further story concerning this inquest. It stated that it had received a letter from Mr Robinson claiming that their report was erroneous and that chloroform had not been implicated in the verdict. The paper went on to explain that it had not been possible to cover the inquest in the usual way because Mr Wakley had not provided sufficient notice

of the inquest to enable them to send a reporter, and it then accused Mr Wakley of attempting to deny the press access to the most important inquests by holding them at short notice and in private homes so that he could secure the copyright for the Lancet which he owned. Mr Wakley does not appear to have rebutted these charges.

In addition to the reports of deaths, there were a number of articles discussing the safety of chloroform, and in 1870 a physician called Charles Kidd, writing from Sackville Street in London, claimed that he had given 10,000 chloroform anaesthetics without a death! There were also descriptions of the use of chloroform anaesthesia in veterinary practice, in the treatment of cholera and hydrophobia, and for the removal of bees from a hive!

Life in the 19th Century

Whilst these references to anaesthesia provide an illuminating commentary on the practice of anaesthesia throughout the 19th century, one cannot help reading some of the stories that appear in contiguous columns of the newspaper. For example in 1838 the description of the nitrous oxide larks at St Barts was followed by an article entitled "Lord Durham's pie". It appears that Lord Durham was planning to give his friends a Christmas Pie to celebrate his safe arrival from the "Far West". The contents were to include "12 Solon geese which his Lordship had shot on the banks of the St Lawrence, a large calf's tongue with the guts and gizzards of 12 water hens; a sheep's liver with all the biliary appendages; reindeer tongues from the Emperor of Russia; two bottle nose whale tabs, from Mr Hutt of Hull; four curious *Canadian sea-gulls;*.... and a fine sucking pig of the Turton breed..... The whole weight of the pie will be about a ton and a half". There is then a detailed description of the pie crust and the various decorations and inscriptions to be placed on it. The article concludes that "the remains of the pie, after the Durham banquet, are to be served up as a dessert at the Hull dinner to be given in honour of his lordship". Since there was no further reference to the consumption of this pie one wonders who perpetrated the hoax?

But there was also more serious news: in 1852 one of the anaesthesia articles was followed by a poignant report listing the names of the vessels in Dublin waiting to take starving emigrants to the USA after the great famine. Later there was a description of the wreck of one of the vessels off the New England coast.

Many papers carried a "Miscellany" section packed full of information on a wide range of topics. For example in *The Leeds Mercury* on June 24th 1848 it was noted that there was marked increase in the number of unemployed in

Glasgow; that the Messrs Rothschild had lost upwards of 8 million pounds because of the recent continental revolutions; that the late Princess Sophia, daughter of George 111 had received nearly a million pounds in public money during her lifetime; that in May 1848 there had been less than ¾ of an inch of rain compared with 5 and ¼ inches the previous year; that Berlin has suffered a heatwave followed by a hailstorm that had broken more glass than had the revolution; that the Liverpool steamer and Furness Railway had brought their correspondent 7 hours distant from Liverpool whereas in previous years it had taken 36 hours to complete the journey; and finally, that in 1766 the Duchess of Charteris had beaten her husband in a foot race of 200 yards for a prize of 200 guineas, the Duchess having been allowed to secure her petticoats above the knees of her drawers!

Obviously, it has only been possible to provide a brief outline of the way in which Regional newspapers have viewed the development of our speciality throughout the second half of the 19th century. Not surprisingly, *The Times* carried more reports and correspondence concerning the relative safety of ether and chloroform than the regional newspapers, and it also carried more reports of anaesthetic practice in other countries, while the latter carried more reports of the inquests on chloroform fatalities occurring in their locality. There must have been many deaths that were not reported, but from a perusal of the ones that were, one cannot help wondering why chloroform continued to be such a popular agent well into the 20th century.

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PETER SQUIRE, AN EMINENT VICTORIAN PHARMACIST

Diana Douglas, Dartmouth

I am the great, great granddaughter of Peter Squire (Figure 1), who played a significant part in the early days of general anaesthetics and until two years ago I knew very little about Peter and his rather eccentric family.

Early life

Peter Squire was born in 1798 and was the third son of a corn merchant from Biggleswade in Bedfordshire[1]. Having left Apsley Guise School at the age of 14, Peter continued his education as an apprentice with a chemist and druggist in Peterborough. It was at this time that he began to study botany, by collecting wild flowers and plants whilst walking to work. The hours of an apprentice were long and arduous, from 7 am until late in the evening, so he could only study his specimens when he had finished work. His bible and reference book was Sir John Hill's Herbal, which showed him pictures of the plants which he could find in the ditches and hedgerows around Peterborough. These studies laid the foundation of his botanical skills, which afterwards made him such a terrifying examiner at the Pharmaceutical Society " to those candidates for pharmaceutical honours who had never been able to see the use of botany" to quote from his obituary. Peter obviously did well in his work, as he caught the attention of John Baker, the Master Warden of the Apothecaries, who obtained further apprenticeships with two houses in London, where Peter learned about the quality of drugs in pharmacy. In his mid 20's Peter moved on to become a partner in the firm of Alexander Garden who was in partnership with the well known Frederick Accum, whose interest in chemistry probably encouraged Peter Squire to attend chemistry lectures given by Faraday and Brande at the Royal Institution. After 8 years with the Garden family, Peter finished his education by working with a French pharmacist in the Rue de la Paix in Paris. He was either an opportunist or had some good connections, as this post was obtained for him by the physician to the French Embassy [2].

Business – appointment to the Queen

About 1831, when Peter was 33 years old, he went into business on his own. He bought a shop from another pharmacist in Oxford Street and eventually rebuilt and enlarged the premises in the 1870's. The building still stands more or less as he built it, at 413 Oxford Street, on the corner with Duke Street (Figure 2). His fame spread, and Dr. John Clark, who was physician to the Princess Victoria and her mother The Duchess of Kent, came into the shop incognito on

Fig. 1 Peter Squire – a Daguerreotype 1842

Fig. 2 Architect's painting of the premises built for Peter Squire (1870) at what is now 413 Oxford Street, London

several occasions to examine his preparations. Clark eventually approached Peter and, having assured himself that Peter was "of good moral character", offered him the position of chemist and druggist to the heir to the throne and her mother. This was the first time that a man who was not an apothecary was considered for this position based on Clark's stated assumption that "a man who had devoted himself to the study of drugs and pharmacy must be better qualified to select and dispense them than one whose education had been chiefly concerned with the art of prescribing them". In 1837 the Princess became Queen and Peter was made Chemist and Druggist in Ordinary to the Queen's Medical Establishment [3] and, after the royal wedding, to Prince Albert – see Figure 3. In the Royal Pharmaceutical Society of Great Britain there is a small green book which lists all the prescriptions that Squire made up for the Queen from June 1837 to November 19th 1844. It is a fascinating book, written in Peter Squire's own hand, and it not only lists all the prescriptions and their ingredients, but gives the dosage and the time of day that the medicine had to be taken. It seems that the Queen was being prescribed about four or five different preparations a week, mostly for her nerves and digestive system! [4]


P. Squire
You are hereby appointed
Chemist & Druggist
to His Royal Highness Prince Albert
Given under my hand and Seal
at Buckingham Palace
this Seventh day of August 1840
Groom of the Stole

Fig. 3 A Royal Warrant for the Appointment as Chemist in Ordinary to Prince Albert, 7th August 1840

Experiments

It was from his shop in Oxford Street that Peter did some of his most important work by experimenting with the extraction of plant material in order to obtain purer compounds, and he introduced for the first time a set of true extracts, characterised by the peculiar smell and colour of the plants they represented. As the shop was busy he did his experiments in his laboratory in the evenings, and would often still be working until the early hours of the morning. It seems that it was common practice to try out the extracts on his friends, some of whom were doctors. He doesn't seem to have killed anyone and some of the comments of his friends were very favourable [5]. He clearly had a great deal of energy as he also became an astronomer of some note. It is not clear when he had time for his family!

Medicine chests

Peter Squire was responsible for fitting out several medicine chests for the Queen and Prince Albert. One of these is at Osborne House and some of the bottles are still nearly full of the original contents, including a bottle, well stoppered, of Meconate of Morphine. A chest fitted out by Squire, which probably belonged to Prince Albert, was acquired by the Thackray Museum in Leeds in the 1990's, having been sold by the estate of Miss Hilda Squire, who was the spinster daughter of Edward Squire, a great nephew of Peter's. The sale of the medicine chest caused some gossip as it held a bottle containing arsenic, which led the press to speculate that Prince Albert had not actually died of typhoid. One of Peter's notebooks contains a list of prescriptions for the prince from 1840 until 1862; a great many of which were for toothache [6]. My own family also have a small medicine chest which was made for the Queen out of oak from Peter's estate. I don't know if she ever used it!

Herb garden

As Peter Squire became more successful he needed somewhere to grow his herbs. Basmead, near St. Neots, is a medieval manor house and farm which was bought by Peter from the estate of his late brother John, whose assets had been placed into the hands of a "committee" as he had been certified as being a lunatic. The Squire family had to go to the Attorney General in order to stop John's brother in law from selling the manor and farm and pocketing the proceeds. In 1845, while of sound mind, John paid £10,700 for the house, farm and about 400 acres, equivalent today of roughly £833,000 using the retail price index, or nearly £8 million, when compared to the increase in average earnings since then: but Peter paid £9,400 in 1851. This may have been a piece of canny

wheeling and dealing or the price of land had dropped significantly in six years. Bedford County Archives have the sale details of the manor and also Peter's pencil drawings for the alterations to the house and some of the accounts for the work [7]. The property is still farmed by Peter Squire's great great great nephew Richard Squire and his father Peter.

Coronation oil

One of the duties of the Chemist to the Royal Household was to make the Coronation Oil, which the family duly did until the firm was taken over by Savory and Moore in the 1950's. They held the formula for preparing the anointing oil for the coronations of four monarchs. It contained oils of orange, roses, cinnamon, musk and ambergris [8]. When the present Queen came to the throne there was some consternation, as the only batch of oil which the authorities knew about had been stored in the Westminster Abbey Deanery, which had been bombed in 1941. Luckily my great aunt Mabel had a sample in a Channel No 5 bottle which sat on a table in the hall of her house. The contents of the bottle were sent off to be analysed, and so when the Queen was anointed at her Coronation, perhaps there was a little of the Channel No 5 perfume mixed into the formula!! Mabel was very cross that she only received a signed photograph of the Queen – she had expected a seat in the Abbey at least – if not a personal audience!!

Squire's extract - cannabis

Peter Squire continued to build up his business and to make his name as a pharmacist. His work on plant extracts paid off, and his preparations were medically successful on the whole. One of his most successful preparations was Squire's Extract. Dr. William O'Shaughnessy, a professor of chemistry at the Medical College of Calcutta, had carried out some studies of the effects of cannabis on animals in pain. In 1843 he reported on his studies and suddenly his medical colleagues in England were clamouring for him to supply them with cannabis for their own medical practices. The previous year O'Shaughnessy had returned to England with a large supply of cannabis which he turned over to Peter Squire to convert into a form suitable for medical use. This preparation became known as Squire's Extract, and it launched Peter and his sons into prominence as the main and most reliable supplier of cannabis extract in England and, in fact, in Europe. The preparation contained camphor, cochineal, fennel seeds, spirit of aniseed, tincture of snake root and of course cannabis [9]. It was prescribed for various ailments – from loss of appetite and migraines to involuntary twitching and excessive coughing, and it was particularly useful in relieving pain in childbirth. Dr. John Grigor, a pioneer in the obstetrical use of

cannabis wrote of the medication "it is capable of bringing the labour to a happy conclusion considerably within a half of the time that would otherwise have been required, thus saving protracted suffering to the patient and the time of the practitioner." [10, 11]

Influence on British pharmacy

Peter Squire's impact on pharmacy was immense. He was a founder member of the council of the Royal Pharmaceutical Society, serving for 27 years, was President three times, and on the examining board for many years. In 1862 he assisted with the Freedom of Jury Service Bill, which among other things made provision for the exemption of pharmaceutical chemists from jury service. In 1864 he headed the pharmaceutical representatives on the General Medical Council's committee on standardising prescriptions from the three centres of pharmacy in London, Dublin and Edinburgh. This resulted in the British Pharmacopoeia being published. Up until that time a prescription written in London and being made up, say in Dublin, 12 hours later, might have three times the strength of a drug than was originally intended. At the same time he published his own Companion to the British Pharmacopoeia, which later was taken over by his son, my great grandfather, Peter Wyatt Squire. This went through 19 editions. Peter Squire also published specialist pharmacopoeias for the London hospitals and comparisons with pharmacopoeias abroad [12].

Squire's ether inhaler

Peter Squire's involvement in the first operation under ether in this country has always caused some controversy. He was approached by his nephew William Squire, a medical student, who, accompanied by Robert Liston the surgeon, visited Squire's premises on Saturday 19th December 1846. Liston had an operation to perform on the following Monday and he particularly wanted to try to anaesthetise the patient with ether. Peter was asked to make an apparatus for delivering the ether vapour, which he duly did, having tried it out on the lad in the shop with some effect! The operation took place successfully on Monday December 21st 1846 [13]. Robert Liston died the following year, and in his will he left his rifle to Peter. Liston had a hatred of cats and he carried the rifle around with him with the sole purpose of killing every cat he saw. Peter was an excellent shot and used the gun to shoot rabbits with great accuracy [14].

Further achievements before his death

Squire worked in many diverse ways with doctors doing experiments on blood and resuscitation techniques. But probably his most bizarre assignment was

assisting Alexander Nasmyth in his experiments into the structure of teeth by injecting a solution of iron and following it with a solution of ferro cyanide of potassium. Peter succeeded in taking out some deep coloured stains of iron from "four fine medallions of Carrara marble" found in Windsor Park, without damaging the texture of the stone, a feat thought to be impossible according to contemporary references [15]. He had an interest in many new innovations, among these was electric light. For the peace celebrations after the first Boer War in 1881, a beam of light was shone down the length of Oxford Street. The electric motor for this show was provided by Peter's battery, which he adapted for the purpose [16].

Peter Squire's achievements were numerous. He was a founder member of the Royal College of Chemistry and of the Royal Botanic Gardens in Regent Park. He was a fellow of the Linnaenan Society and a member of the Royal Institution. More interestingly, in 1860 he was a member of the International Congress held in London under the presidency of Prince Albert, when it was arranged that the metrical system should be used in international communications. Peter died in April 1884, aged 86 (see Figure 4) at his home in York Gate, London. A few months before his death he presented a paper to the International Pharmacopoeia Congress [17]. As a pharmacist he may have been unique in having laudatory editorials published in the medical journals after his death.

Family life

We don't know very much about Peter Squire's personal life. He married Mary Jane Balmanno from Scotland and they had five children – four boys and one girl, Fanny who never married. She is buried with her parents and two brothers in Kensal Green Cemetery. Alexander Balmanno Squire, Peter's second son, became a well known dermatologist, publishing books on psoriasis and a manual of diseases of the skin. He was a pioneer of the use of photography in dermatology [18]. The fourth son, Alfred joined his father and older brother in the firm [19]. Peter's third son, Peter Wyatt Squire was my great grandfather. He was born in 1847, in the family house in Hanover Square the year after the ether operation and educated at Kings College School, Wimbledon. He joined the family business in 1867, which then became Squire and Son. Peter Wyatt was created Chemist in Ordinary to the Royal Household, along with his father. When his father retired in 1877, he became the sole holder of the royal appointment, and when Edward VII came to the throne; the appointment was gazetted again on April 20th 1901 [20]. He was knighted for his services. The family home was at 40 Avenue Road, St. John's Wood, but he also had a house, The Ryepeck, on the river Thames at Shepperton (Figure 5). Peter Wyatt

Fig. 4 Peter Squire – obituary in *Chemist and Druggist* 15th April 1884

Fig. 5 Peter Wyatt Squire, his wife Mabel and daughters Mabel (left) and Phyllis (right). C. 1900

married Mabel Bremner, who was always known as Jum, short for Jumbo, as she was rather large. She required her guests to accompany her for a swim in the Thames every day between May and September. The Ryepeck had quite a large garden, a boat house, two tennis courts and a nine hole golf course and everyone was expected to take exercise. The British punting championships were held at the Ryepeck and the grass tennis courts were mown by a mower pulled by a horse with leather shoes on so that the surface of the courts should be preserved. Any bachelor who stayed with the Squires was housed in the water tower, which had accommodation on the ground floor, and they had to walk across the lawn for their ablutions in the morning. Into this rather eccentric household were born two girls. Mabel who became a well known tennis player and won a bronze medal in the 1912 Olympic Games and my grandmother Phyllis, who, with her husband, James Johnson, were world champion pair skaters in 1904 and 1908. She won silver medals in two Olympic Game and played squash well enough to win the British Squash championships, one year against the men. Her husband died of consumption between the wars and she took herself off to Brazil to live where she found herself another husband!

William Squire

Turning briefly to William Squire, he was born in Silsoe in Bedfordshire in 1825 and was the son of William Peppercorn Squire the elder brother of Peter Squire. He was a medical student at University College Hospital, where he won several medals and prizes. Three years after assisting Robert Liston with his operation, William qualified as a doctor and served as a house surgeon at UCL. He interested himself in the regular taking of a patient's temperature, which resulted in his work in making the first short stemmed thermometer. He is best known for his work on epidemiology and he published books and papers on preventative medicine and temperature variations in children [21]. His daughter, Rose, having been educated at home, became a lecturer in health and hygiene in 1893. In 1895 she became a lady inspector of factories and in 1906 she was a special investigator to the royal commission on the poor laws. Rose received the OBE in 1918 and in 1920 she became the first woman to hold an administrative post in the Home Office. Sadly most of the records from the Squire's pharmacy business were lost when the Squire's family house was bombed during the war [22]. However Rose's niece, Hilda carried on the medical work for her family. She qualified under the Sanitary Inspectors Examination Board and became a hospital almoner of note specialising in neurological illnesses such as epilepsy. After a very distinguished career she died unmarried in 1991 [23].

Conclusion

Peter Squire was a man of high principles, ambitious and somewhat parsimonious or thrifty. He is reported to have published his own books, bought the paper himself, used his own printer and book binder, advertised his books and also sold them himself [24]. He undoubtedly possessed a highly acquisitive nature – was a larger than life character and was, in my rather biased view, among the many great Victorian scientists of the 19th century. Perhaps he is the one who should have been knighted instead of his son!?

Acknowledgements

I would like to thank the following people for their help with my research. Dr. David Zuck for his huge knowledge and enthusiasm. Briony Hudson and her staff at the Royal Pharmaceutical Society of Great Britain. Dee Cook, Archivist at the Worshipful Company of Apothecaries. The staff in the Rare Manuscripts Department of the Wellcome Foundation Library. Trish Willis and Iris Mills at the Association of Anaesthetists of Great Britain and Ireland. Michael Hunter, Archivist at Osborne House, Cowes, Isle of Wight. Jim Garretts, Senior Curator of The Thackray Museum in Leeds. All the staff in the archive department of the Bedford County Library. Nancy Tardy of Las Vegas and Chris Bidmead for their help in interpreting some of Peter Squire's prescriptions and David Pott for his help with the genealogy and research.

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WHO ADMINISTERED THE ETHER AT UNIVERSITY COLLEGE HOSPITAL ON 21ST DECEMBER 1846? THE MYSTERY OF THE DESTROYED PAINTING

Dr D Zuck, Past President HAS, London

The case notes of Frederick Churchill, who received the first general anaesthetic administered at University College Hospital, on Monday 21st December 1846, for the amputation of his leg, do not record who administered the ether. It is not disputed that the ether inhaler was put together by Peter Squire, and in two accounts of the events of that day published by Peter's nephew William Squire in 1888 and 1896, he claims that he, William, was the etherizer. This claim, supported by Liston's assistant, William Cadge, has generally been accepted. My interest was aroused when Mrs. Diana Douglas, Peter Squire's great great grand daughter, told me that there was correspondence in the Wellcome Library that disputed this account. She also introduced me to the story of the destroyed painting. Enquiry revealed that correspondence about the destroyed painting still existed, and the file was made available to me by the Curator of Iconography, William Schupbach, to whom I am most grateful.

Liston painting commissioned

The idea of founding a Historical Medical Museum to house his growing collection of artefacts was first made public by Henry Wellcome in 1904. Wellcome appointed C.J.S. Thompson to be its curator. Planning and building, at the enormous cost for those days of twenty million pounds, took some eight years, and the museum opened, at 54A Wigmore Street, in 1913. Thompson was an unusual and interesting character. He had trained as a chemist and pharmacist, and had worked himself into the position that nowadays would be called Wellcome's Personal Assistant, or P. A. He liaised all over the world with agents and dealers in medical and anthropological artefacts, books and manuscripts, and supervised the cataloguing and organization of Wellcome's ever-growing collection. But he was also the author of some forty books on such arcane subjects as magic, witchcraft, astrology, poisoning, mythology and folklore. Many were reprinted during the 1970s, and can be found advertised on the Web.

In 1910 Wellcome asked Thompson to arrange for a number of historical tableaux to be painted to ornament the walls of the Museum. These would depict seminal events, mainly in the history of medicine, but in history, philosophy and religion also, and a well-known artist who specialised in the painting of such scenes, Ernest Board, was commissioned. Ernest Board (1877-

1934) was born in Worcester, received his early education in Bristol, and studied at the Royal College of Art and the Royal Academy Schools. He started to exhibit at the Royal Academy in 1901. He had painted such tableaux as the departure of John and Sebastian Cabot from Bristol on their voyage of discovery, which is in the Bristol Art Gallery, and the arrival of Edward 4th and his Queen at Reading Abbey in 1464, now in Reading Town Hall. His career flourished, and he eventually retired to the village of Farley Green, Surrey, south east of Guildford, where one of his religious paintings can be seen in the local Barn Church.

The first surviving letter from Thompson to Board is dated 1st March 1909. It refers to a painting of an abdominal operation that is to be copied from an old engraving. Board is instructed to '…introduce in it all the local colour possible. I should have all the assistants holding their noses as depicted … We must also have the cut in the abdomen shown exactly as in the woodcut … it will not do to play about with facts. I should make the background an ordinary oak-panelled room …' Board produced several art-works, all of which were satisfactory.

Then Wellcome decided that he wanted a representation of the scene in the operating theatre at University College Hospital, London, on 21st December 1846, when the first ether anaesthetic was administered for a 'capital' operation in England. Wellcome wrote personally to University College, and in a reply dated 15th June 1910 the Dean of the Medical School, Dr. Batty Shaw, offered help with the painting. He had a picture of Squire's ether apparatus, 'and further reference to the subject from Dr. Dudley Buxton.' He believed the medical school still had the original operating table, and there might be a picture of the old operating theatre. (The hospital had been rebuilt in its present cruciform design at the beginning of the 20th century; it re-opened in 1905).

Thompson set about borrowing portraits or photographs of the people Wellcome wanted to feature in the painting. On 29 September 1910 he wrote to Dr. Edward Squire CB, at 8 Harley Street, asking for the loan of a portrait of his father, Dr. William Squire, 'who was present on that occasion …' and was lent a photograph taken in 1845. Board submitted a preliminary sketch, and in a three-page letter dated 4th October 1910 Thompson detailed the many alterations he required. The operation was amputation of the thigh, so Liston should be standing, not sitting, and holding a large amputation knife in his hand. The mask should not be on the patient's face, as he would already be under the anaesthetic. ' The moment which you should take for illustration in the picture is that in which Liston is just about to commence the operation, with the knife in his hand, and addresses those present, saying, "Gentlemen, I am now going to try a Yankee dodge for making men insensible." Squire, the anaesthetist, then

said “He is ready now, sir.” Liston’s knife flashes in the air, and the operation is over in 26 seconds.’ The ether apparatus should be on a table on the left side of the head, ‘you have it on the right,’ and the patient’s face should be flushed, not pale. Thompson supplied portraits of Liston, Reynolds, the young Lister, the two Squires, Sir John Erichson (sic), Mr. Cadge, ‘who was acting as Liston’s assistant, and others.’ The grouping of the students was good, but ‘you must not make them too modern. Liston would not be wearing an apron, neither would Squire. They did not wear them those days when operating, but you might have Liston without his coat.’ He sent two prints and details about the operating table, which was of ‘plain deal,’ with slits for straps to secure the patient; and he continued, ‘I also enclose a portrait of Peter Squire, the chemist who administered the ether on this occasion, and a portrait also of his cousin Dr William Squire, who would be among those around the table.’ With three errors in that one sentence alone, it is ironic that he continued, ‘It is most important for me to have the picture absolutely correct in every detail, as it will be sure to be criticised professionally, as great interest is being shown in it.’ However, the uncritical inclusion of people who were not known to have been present shows that this was not intended to be a factual representation, but a celebratory tableau, of the sort in which Board specialised. An example of such a tableau is the painting by Raphael called ‘The School of Athens,’ in which philosophers who lived a millennium apart are depicted, for the glory of philosophy. Wellcome wanted to celebrate the contribution of some of the notables who had given lustre to University College Hospital, whether there was any evidence that they were present or not.

Board submitted a revised sketch, which on 13th October Thompson considered a great improvement, ‘and with a little modification will do very well.’ The operation was of such interest that all those present ‘should be leaning forward and showing intense interest.’ Letters dated 14th, 15th and 19th October 1910 indicate that Wellcome was so impressed with the importance of the painting that he wanted to ‘make a bigger thing of it,’ to enlarge it to 6 feet by 4 feet 6 inches. Board had agreed to supply a painting 4 feet by 3 feet for £20; for the enlarged work Thompson offered £25. On 14th October 1910 Board replied that he was glad that the last sketch was satisfactory. He continued, ‘ The latter part of your letter is certainly surprising! Surely you cannot be serious in offering me £25 for a painting 6 ft × 4 ft or 4 ft 6 in. There must be a mistake! It pans out at not much more than labourer’s pay …’ The painting Thompson suggests would be three times as large in area, and contain much more detail, with many portrait figures. ‘ Instead of Mr. Welcome (sic) expecting me to do my work cheaper than I’ve done it before, I should rather have expected him to have increased my rate of payment, as I now get double as much for my work generally as when I started doing ‘medicals’.

Thompson replied three days later that 'I am treating these pictures as a regular thing, not as a single commission, which can go on for a considerable time, and if you look at them in that light I think you will find that I am not attempting to depreciate their value.' However, in view of Board's objections, he was prepared to stick to the original agreement. Two letters in early November relate to the people to be depicted, and the clothes they might have been wearing, after which there is no further correspondence until January 1912. In the meantime Board's situation had changed considerably. He had been commissioned to complete a set of murals started by the eminent American artist Edwin Abbey, resident in London, who had become ill with cancer, for the Pennsylvania State Capitol in Harrisburg, and to supply a number of large tableaux for the lobby of the House of Lords. As a result he was extremely busy. He had moved into Abbey's studio in Chelsea, taken lodgings locally, and was in his own studio in Belsize Park, Hampstead, only at weekends. Nevertheless he managed to complete and deliver the Liston painting in October 1911.

Alterations to the painting

However, after keeping it for three months Thompson wrote on 29th January 1912, ' I am sending per bearer Liston's operation picture for the few alterations I want making in it. In the first place I am told that Liston should be wearing an apron with bib the kind I am sending you herewith … The folded handkerchief should be laid over the patient's nose, not held down. The floor should be sprinkled with sawdust, the table screwed to the floor by angle irons.' He was having a watercolour painted by a surgeon of what the diseased leg should look like, for Board to copy. From this it would appear that Thompson had had the painting for sufficient time for it to have been seen by someone in a position to advise on the surgical aspects. Also, as will become evident, it had been photographed.

Evidently Board was so busy that he took some eight months to make the alterations to the painting, for it was not until 14th October 1912 that he wrote, ' The ether operation picture is just about done, and if you can send your man for it tomorrow (Tuesday) it will be ready for him. The alterations have given me far more trouble than I anticipated, and my charge for this is £7.' Thompson replied on 17th October, ' Thanks for the operation picture … I think it is much improved by the alterations, and am glad you have been able to do it so well. I enclose a cheque for £7 …' There the correspondence ends. I did not realise the significance of these final letters, coupled with the ready payment of the substantial additional fee, until much later than I should have done.

Reproduction of the original painting

What the painting shows, or showed, is a patient on a rather primitive operating table, two men at the head of it, a surgeon wielding a long knife just about to operate, an assistant, a number of onlookers, and a Squire's ether inhaler. It was reproduced in books, Douglas Guthrie's *A History of Medicine*, and Harold Ellis's *History of Surgery*, and in a variety of historical and promotional publications; and between the two World Wars, because the study of the history of anaesthesia was virtually non-existent, it became accepted as a true depiction of the event in the operating theatre at UCH on 21st December 1846. But for reasons that will become obvious, it could never have been displayed in the form in which it was so widely reproduced.

Mistakes by Underwood, resulting from the painting

The present Wellcome Building in Euston Road was erected during the early 1930s. Henry Wellcome died in 1936, and a Board of Trustees was set up to oversee the running of the Museum and Library. In 1946, to celebrate the centenary of general anaesthesia, the Wellcome Museum mounted a special exhibition, and the British Medical Journal invited the Director of the Museum, E. Ashworth Underwood, to write an introductory paper.[1] Underwood's career had been in public health, but he had also built up a reputation as a medical historian, being especially active in the History section of the Royal Society of Medicine. In 1945 he was appointed Director of the Wellcome Museum and Library. The fact that he was the son-in-law of the highly respected Charles Singer, the only professor of the history of medicine in the United Kingdom, evidently had not been a disadvantage.

Underwood's paper, not entirely accurately, surveyed the history of attempts to relieve the pain of surgical operations, culminating in the use of ether by Morton, and told how the news was passed by Jacob Bigelow of Harvard to Francis Boott in London, and from Boott to Robert Liston. He continued that on Monday December 21st Liston ' wrote to Boott the historic letter (Liston, 1847)[2] in which he said that he had that day carried out two operations under ether, one being a case of amputation of the thigh, and the other evulsion of both sides of the great toe nail. Joseph Lister was present at these operations. The anaesthetic was given by Peter Squire, who improvised an inhaler for the occasion (Forbes, 1847).' [3]

Examination of the two references cited by Underwood shows that they do not mention either Joseph Lister or Peter Squire, and from subsequent events it becomes obvious that what Underwood had done was merely describe what was

shown on the painting, without first researching its accuracy. For a historian in his position this is astonishing, and to his undoubted chagrin, as subsequent correspondence shows, several anomalies must have been pointed out to him. In particular, the claim that William Squire was the etheriser, not Peter, was pursued vigorously by William's grand daughter, Hilda Squire.

Accuracy of the painting challenged – order for its destruction

The following year one of the Wellcome Trustees, the very distinguished Professor T.R. Elliott FRS, who held the chair of clinical pharmacology at University College, challenged the accuracy of the painting in general, and Dr. F.N.L. Poynter was asked to examine it. Poynter was the Wellcome Librarian at the time, and later succeeded Underwood as Director. I could not find Poynter's report, which may have been verbal, so what happened next has had to be reconstructed from correspondence between Underwood,[4] Poynter, and various people who wrote asking for permission to reproduce the painting.

Underwood's correspondence suggests that he had become quite paranoid about the painting. Replying on August 14th 1952 to a request from Ciba Laboratories for permission to photograph and reproduce the original painting 'The First Use of Ether in Britain,' he replied that were problems. The painting had been ' reproduced by Guthrie, who said that the original is in University College Hospital, London, but theirs may be a copy. If so, please do not use it.' He would inspect it; and he continued that ' The picture in this Museum was executed on commission many years ago by a not very outstanding artist. It is purely imaginative, and it contains quite a number of obvious mistakes. For these reasons the Trustees of the Museum some years ago ordered that the picture should be destroyed.' He had no hesitation in agreeing with the action taken. The picture was painted 80 years after the event and was of no historical value or importance.

He wrote to Ciba again a week later. He had seen the so-called painting at University College Hospital. It was in fact a photograph of the Wellcome painting, presented to UCH Medical School by the Wellcome Museum. He was very critical of Guthrie, who did not 'observe the established courtesies,' when reproducing the picture. Underwood wrote also to the Secretary of the Medical School, Major General Birks, asking that it should not be reproduced in future; and to the Picture Post Library which, without his authorization, had supplied a copy for inclusion in a book. He secured an assurance that the negative and all prints would be destroyed.

The continuing capacity for the painting to make mischief was revealed in 1959 by a letter to the Radio Times from Dr. T.D. Whittet, Chief Pharmacist at University College Hospital, who was a distinguished pharmaceutical historian. He had watched with interest the BBC television programme 'They Made History,' about the first operation under anaesthesia in Europe, which took place in University College Hospital in 1846, and wished to challenge one point. ' … it was stated that Peter Squire, the pharmacist, was not present, having no stomach for it. In the key to a picture made of the operation in University College Hospital Medical School, Peter Squire is definitely shown as being present. In fact, although most accounts agree that William Squire administered the anaesthetic, in this picture Peter Squire is shown holding the mask to the patient's face, whilst William Squire is standing behind.' A hand-written note by Underwood dated April 4th 1959 records that he had spoken to Whittet, who said that the painting had not been in the Common Room for a long time; he had written from memory, and he agreed to remove the picture from an article he was preparing for the Pharmaceutical Journal. Underwood also spoke to Major General Birks, who was very annoyed that Whittet had not consulted him before sending his letter.

The main reason for destroying the painting was revealed in a letter from Poynter to Own (sic) Wangensteen, the distinguished American surgeon and historian of surgery, dated 6th June 1973. When checking it his investigation had centred round the presence of Joseph Lister. At the time of the operation Lister had only just completed his undergraduate course in Arts, and since he did not begin his preliminary studies in medicine until the Fall of 1848 he was not even a medical student in December 1846. So ' it would be most unlikely that he would be invited to witness an operation in the hospital, or, if invited, given such a prominent place close to the table. This improbability was reinforced by the fact that in late December the young Lister, recovering from an attack of smallpox and a "nervous breakdown" had gone to Ireland to convalesce.' Furthermore, ' As you say, Spencer Wells also was abroad in Malta, and would not have been present.' Elliott had ordered the painting to be destroyed, and it was. The photograph that used to hang in the Common Room was removed when the painting was discredited.

A record of the altered painting

Fortunately for posterity, a very accurate record, or recording, of the painting still exists. When I approached the Wellcome Archivists for a slide I was given a 4.6 Mb version on a CD. I have to thank the Wellcome people, who have been most generous with their help, and have waived their reproduction fee.

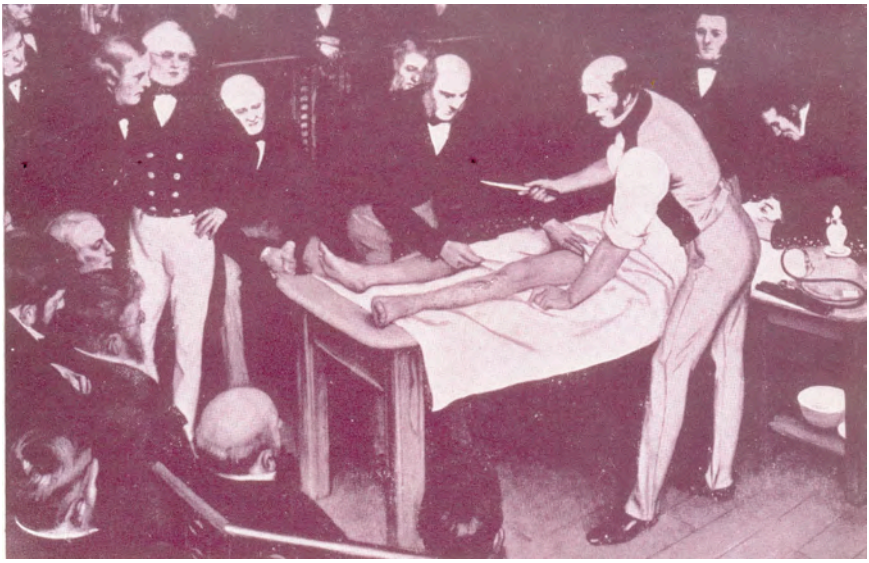

Fig. 1 The original, much reproduced version (from D. Guthrie, *A History of Medicine*)

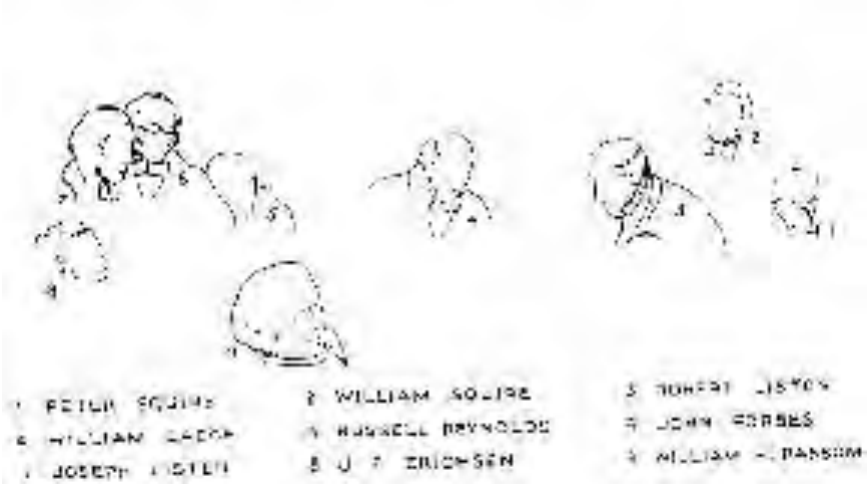

Fig. 2 The key to the dramatis personae – UCL Art Collections

Analysis of the original painting

Figure 1 shows the disputed painting. What is wrong with it? Let us start at the head end of the table, with the ether inhaler. We know from Squire himself that this is not the apparatus that was used. In the published account of his talk at a meeting of the Pharmaceutical Society on January 1847 it is depicted more basically, as the lower vessel of a Nooth apparatus. [5] The version in the painting, which is the familiar one, is a later elaboration. Then there are the two elegantly dressed young men at the head of the table, Peter and William Squire according to the key – see Figure 2. In all his subsequent writings about the event Peter never claimed that he was even present, let alone that he administered the ether; in fact he studiously appears to have avoided the question. William, on the other hand, did claim to be the etherizer in both his papers,[6] and described in some detail Liston's preparatory experiments to ensure the success of the administration. William's claim was backed up by Liston's first assistant, William Cadge, who in the *British Medical Journal* of October 17th 1896 wrote: '… as to the main incident of the amputation of the thigh, the scene was too startling and dramatic ever to be erased from my recollection. … Mr. Squire, the well-known chemist of Oxford Street, prepared the apparatus, and Mr. (now Dr.) William Squire administered the ether.' So there we have it.

As regards Liston, he would most likely have been facing up the table, but the composition of the painting requires him to be shown as he is. William Cadge was born in 1822, and would have been 24 in 1846, not the old man who was depicted from the likeness that Thompson had borrowed. Next is Russell Reynolds, eventually Sir Russell, born in 1828, who would have been eighteen. On the official key to the painting the next person is listed as John Forbes, who undoubtedly was there, but the man in a naval uniform, from comparison with his other portraits, can only be Thomas Spencer Wells, who undoubtedly was not. There is indisputable evidence that he was stationed in Malta at the time. My guess is that the person described as Reynolds was actually meant to be John Forbes. Forbes had started off as a naval surgeon, and like his old school friend James Clark, after demobilisation had qualified M.D. in Edinburgh. When Clark became Queen Victoria's physician he helped Forbes into a similar appointment with Prince Albert. By 1846 Forbes had founded and was editing a very valuable journal, *The British and Foreign Medical Review*. Forbes wrote the account of the operation which was cited by Underwood, unfortunately omitting to record who had administered the ether, and who had been in the theatre.

Next comes the young Joseph Lister. Poynter's comments have already been described, although Barbara Duncum, whose book was ready for publication in time for the centenary, so antedating Poynter's enquiry, said he was there, and appears to have believed that he was already ' notable.' [7] Probably Lister was present, because all Lister's biographers date his illness to a year later, so Poynter may have been mistaken and the painting was destroyed for the wrong reason; but in any event the clinical students would never have allowed him to get into such a prominent position. Lastly, the distinguished surgeon and teacher John Erichsen, and the distinguished physician William Henry Ransom, could both have been present, though there is no evidence for either. Erichsen was born in 1818, and Ransom in 1823. One person not depicted is Joseph Clover; according to Barbara Duncum, he was present.

Finally, we come to the biggest bloomer of all. In December 1946, to celebrate the centenary of this operation, University College Hospital published, in the form of a booklet, the case notes of Frederick Churchill, and from them it is seen that the diseased leg was the right; so the painting shows Liston operating on the wrong leg!

The altered painting revealed

But even that is not the end of the mystery. I had been working from the reproduction in Guthrie, and when I received the CD from the Wellcome I discovered that the painting that was destroyed was substantially different from the generally known and widely reproduced one. Figure 3 shows the virtually unknown version supplied to me by the Wellcome Library, and it is the only one they have. It was obviously produced by over-painting the central part of the original in accordance with Thompson's instructions, for which extra work Board was paid the additional £7, almost a third as much as the original cost. So the much reproduced painting existed for only three months before it was drastically altered, during which time a photograph was made and presented to UCH Medical School, and we need to be grateful to Guthrie for preserving it! All subsequent reproductions were made from that photograph, or from each another. But how was it possible that no one, not even Poynter, noticed that the painting that was destroyed was so much different from the version that had been so widely reproduced? When I raised the question, no one at the Wellcome knew that two versions of the painting had ever existed. To put it politely, they were very surprised to hear that the painting that Poynter inspected and condemned was not the version in Guthrie, which, like the celebrated Norwegian Blue, had ceased to exist; it was an ex-painting.

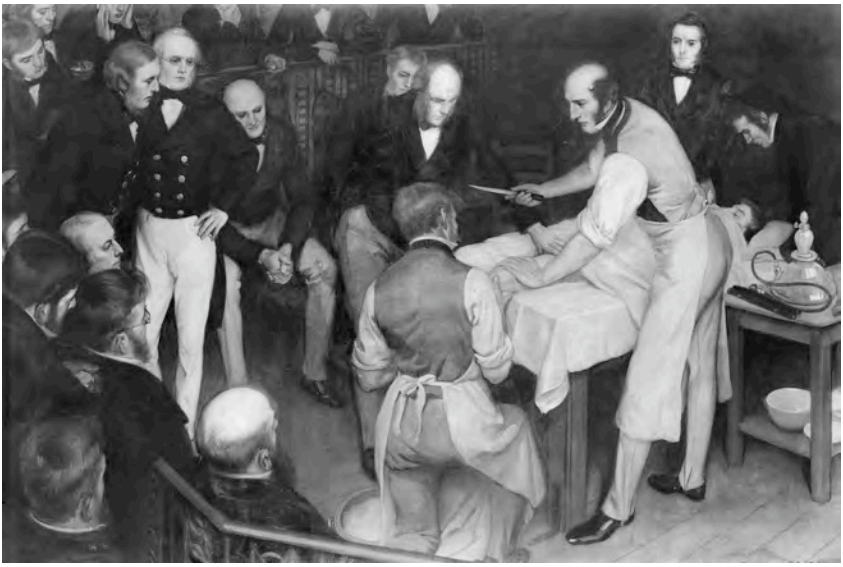

Fig. 3 The painting that was destroyed (Wellcome Library, London)

Should the painting have been destroyed?

When I first heard about it my reaction was of dismay. It was a sort of historic document, however inaccurate, a piece of art, the product of a man's craft. But as I came to learn more about the way it had created uncertainty about the history of the event my feelings changed. Like the docudramas and Hollywood blockbusters that are accepted as fact by later generations, it had distorted the truth, and misled at least one distinguished medical historian, and one very distinguished historian of pharmacy. While this paper was in preparation a deliberately inaccurate film about the attempted assassination of Queen Victoria was released which may well be cited by future generations as confirmation that Prince Albert was shot while trying to protect her. I now think that the painting should have been preserved, with a health warning, as an example of the damage that such productions can cause, and that it is the people who deliberately distort history who should be destroyed. For me the most horrifying aspect of George Orwell's *1984* was not Big Brother, the Thought Police, or Room 101, but Winston Smith's job. He was employed to continually rewrite history, to falsify the present, and destroy all evidence of the past.

Conclusion

So finally, who did administer the ether? I have been reassured that I shan't lose any friends, when I say that my vote goes to William.

Acknowledgements

I am grateful to Diana Douglas for starting me on the trail; to William Schupbach and Rachael Cross of the Wellcome Trust; and to Dr. Andrea Fredericksen, Curator, Art Collections, University College, London.

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MY FAMOUS FORBEAR

Dr T Simpson
Consultant Anaesthetist, Royal United Hospital Bath

There was reportedly a crowd of up to 80 000 lining the streets of Edinburgh watching a procession of 2000 people as it left 52 Queen's street, the home of Sir James Young Simpson on the day of his burial on May 13th 1870[1]. A man born into relative poverty 59 years earlier died as a celebrity and left an estate worth more than £54 000 (a modern day multi-millionaire).

James Simpson was born on the 7th June 1811 at his father's bakery in Bathgate a town in-between Glasgow and Edinburgh. He was the seventh son and there has been a long held tradition in Scotland that a seventh son was special and would bring good luck to a family.

His elder brother Thomas had four children and his grandson was another Thomas Simpson (1864-1921) – see Figure 1. It was this man who came South as a Horse trader and something of a black sheep. However over a twenty year period he built up a large farming business in Buckinghamshire and on his death passed this onto his two sons George and William Simpson. William Simpson was my Grandfather.

Fig. 1 Thomas Simpson 1846-1921 (My Great Grandfather)

Early life of James Simpson

James Simpson's mother died when he was 9 years old and his elder sister Mary took over the running of the family until his father died in 1830. James attended the local school in Bathgate and at the age of 14 went to further his education at Edinburgh University. It was common practice for the older siblings in a Scottish family to support a bright younger brother, and so James was the only member of his family to receive a University education.

He walked the 18 miles to Edinburgh and lodged with John Reid a school friend and a Mr McArthur who was a mature student who had been a teacher in Bathgate both of whom were enrolled to study medicine. James Simpson then enrolled in classes on Latin, Greek, Mathematics and Moral Philosophy, but being inspired by his flatmates after two years he changed courses and in 1827 enrolled as a medical student. It was during his undergraduate studies that he was regularly exposed to the horrors of watching operations performed on conscious patients with no form of pain relief[2]. Simpson was so upset that he almost gave up medicine and went to study law. He did not, although these experiences were to be a major motivation when in his later life he strove to develop the use of anaesthesia in surgical and obstetric practice.

Simpson could not complete his MD until he was 21; he applied for the job as a Parish surgeon in a small village on the Clyde but was unsuccessful: "If chosen I would probably have been working there still". He ended up working as an assistant with two local practitioners Dr Dawson and Dr Girdwood. In 1831 he was awarded his MD having prepared and presented his thesis "Death from Inflammation" in Latin.

He was about to leave for Liverpool having been offered a job as a ship's surgeon when Professor Thomson the Professor of Pathology and Military Surgery offered him a post as his assistant, having read and been greatly impressed by his MD thesis; his annual salary was £50. Thomson then suggested that Simpson should take an interest in midwifery as there were vacancies in the speciality and so he attended the lectures of Professor Hamilton, Professor of Midwifery[3].

A European tour was considered an essential part of training for a rising specialist and so once again funded by his long suffering elder brothers he departed in 1835. He visited hospitals in London, Paris, Liege, Brussels, Antwerp, and Ghent. He returned home by way of Oxford, Birmingham and Liverpool, where he visited Walter Grindlay, a cousin of his father. At this visit he met the daughter, Jessie Grindlay, who was later to become his wife.

In 1839 Professor Hamilton resigned from the chair of Midwifery, which was the first of its kind in Great Britain, having been established in 1726. Simpson was only 28 but did already have 5 years experience and had published widely in the field. His election campaign was fought with great vigour if not with the total political correctness as judged by modern standards. He openly canvassed anyone with influence on the voting committee and spent £500 on his campaign more than he had earned in his entire professional career to date.

Simpson was criticised for being too young and inexperienced and for coming from a rural background. The main problem he had however was that he was not married. It has been described in historical textbooks as an almost callous act on his part marrying only in the interests of his promotion. As already stated Simpson met his future wife Jessie Grindlay in 1835 and was in regular contact with her in the intervening period and the content of his letters to her are amusing and deeply endearing suggesting a caring relationship had already developed prior to their engagement[4]. However it is hard to deny that the timing of their marriage was brought forward and that they were engaged for only a month. Having been married in Liverpool on December 26th, 1839 they returned to Edinburgh where Simpson continued canvassing and his new wife was immediately put to work cataloguing and putting together a portfolio of teaching material. During 1839 the darker side of Simpson's character emerged when he directly challenged a colleague, Dr Lewins, of writing a critical article in *The Observer*.[5] Allegedly tempers soared and the preliminaries of a duel were being attended to when friends made them both see sense. There were four other candidates for the Chair, the main rival being Dr Evory Kennedy from Dublin. The result of the election was announced on 4th February 1840 and Simpson was appointed over Kennedy by 17 votes to 16. He wrote home with the news "*I was elected professor today by a majority of one. Hurrah!*". After his appointment he and Jessie were finally able to go on their honeymoon.

Following his election as Professor his practise and reputation increased and the Simpson household was increasingly filled with visiting doctors and private patients. He wrote and lectured prolifically and was one of the first to advocate the use of the uterine sound, the speculum and bimanual pelvic examination [6] in the diagnosis of gynaecological conditions. He developed his own variety of delivery forceps which are still in limited use, as well as the "air tractor" a forerunner of the ventouse forceps used today [7]. He was also responsible for advocating hysterectomy in the treatment of uterine cancer a condition that had previously been treated by cautery alone. He greatly increased the role of the doctor in the process of managing labour.

Simpson and anaesthesia

Simpson heard about the activities of the Boston dentist William Morton and his success with Ether from his next door neighbour Professor James Miller who had been written to by his colleague Robert Liston the Scottish born Professor of Surgery at the University of London. Liston had performed an operation to amputate a leg on a patient who had been given ether on December 21st. Miller either dropped in or discussed his news with Simpson or he heard it via his students as Miller had read Liston's letter to his class at the Infirmary. Simpson was quickly aware of the significance of this event and was due to go to London for his appointment as one of Her Majesty's Physicians for Scotland and stay with Liston. On his return Simpson persuaded his colleagues at the Infirmary to use ether, and on January 9th 1847 James Duncan used ether in an operation to amputate the leg of a young man who had been injured in a railway accident.[8]

Being an obstetrician it was not surprising that Simpson wanted to use ether in his obstetric practice as soon as possible. On January 19th 1847 he gave ether to a lady who required a complicated delivery because of her deformed pelvis. Although the infant died as expected the mother did well and felt no pain during the operation and this was the first time ether had been given to a labouring mother. On the same day Simpson received the letter confirming his appointment as Queen's Physician in Scotland. The next day he wrote to his brother "*flattery from the Queen is not common flattery but I am far less interested in it than having delivered a woman this week with sulphuric ether. I can think of naught else"*. [9] He published his first experiences in the February issue of the *Monthly Journal of Medical Science*, followed in the March issue by "Notes on the inhalation of Sulphuric Ether in the Practice of Midwifery", the two articles then being printed as a pamphlet.[10]

Simpson was unhappy with ether, he found it had a "*disagreeable and very persistent smell*", a "*tendency to irritation of the bronchi during its first inspirations*".[11] It was volatile and flammable as well as requiring large quantities that were difficult to transport in Edinburgh houses and tenement closes. So despite robustly defending the use of Ether and publishing much literature regarding its safety he continuously sought for a new anaesthetic agent that would be more effective and manageable.

Simpson and Chloroform

Simpson discussed the problem with druggists and University colleagues such as Robert Christison (1797-1858) the Professor of Pharmacology and William Gregory (1803-1858) the Professor of Chemistry.[12] They recommended and he

experimented with inhalation of chloride of hydrocarbon, nitrate of ethyle, benzine, and even vapour of iodoform.[13]

Chloroform was discovered independently by Justus von Liebig in Germany, Eugene Souberaine in France and Samuel Guthrie in the USA at about the same time in 1831. In 1834 Professor Jean-Baptiste André Dumas investigated the action of chlorine on alcohol, purified the product, determined its vapour density, and concluded its formula was C_2HCl_3. Dumas named the substance chloroform.

Having survived his early experiments Simpson was visited by an old friend and medical school contemporary Dr David Waldie. Waldie had abandoned medical practice to become Chemist to Liverpool Apothecaries Hall and in this role had come into contact with "chloric ether" (a solution of chloroform in alcohol). He was also aware of early attempts to prepare chloroform such as that by the chemist Dr Jacob Bell who had prepared impure chloric ether containing mostly alcohol. Holmes Coote a surgeon at St Bartholomew's Hospital had used Bells solution in the summer of 1847 not surprisingly without success. Waldie had found a method of producing pure chloroform from chloric ether by washing out extraneous matter in order to obtain pure chloroform which was then dissolved in a measured volume of spirit, thus making a solution of uniform strength and quality. Waldie suggested trying pure chloroform, he promised Simpson that on his return to Liverpool he would send him some. Waldie did not send Simpson any chloroform due to a fire occurring in his laboratory in Liverpool. Having heard nothing from him Simpson approached local chemists Duncan and Flockhart and described Waldie's method of purification, they then prepared him some chloroform.

The next part of the chloroform story is medical history and there are variations of the events of the evening November 4th 1847, but all are in general agreement. Simpson's inhalational experiments had usually taken place before supper and on this occasion his two assistants Dr George Keith and Dr James Mathews Duncan joined him. A description of the events that then followed is described by Simpson in a letter to Dr Glover "*In searching for another object among some loose paper after coming home very late one night my hand chanced to fall upon it and I poured some of the fluid into tumblers before my assistants, Dr Keith and Dr Duncan and myself. Before sitting down to supper we all inhaled the fluid and were all* '*under the mahogany*' *in a trice to my wife's consternation and alarm"*.[14] The scenes were witnessed by Mrs Jessie Simpson, her sister Wilhelmina Grindlay, and her brother in law, Captain Petrie RN and his daughter Agnes who later in the evening also inhaled chloroform.

On regaining consciousness Simpson immediately realised that this substance was what he had been looking for and wasted no time in making the news known to his surgical colleagues. Simpson told Professor Miller when he next called in; Miller had taken to checking, in the morning, if his friend had survived his various nocturnal inhalational experiments.

The activities of November 4th had exhausted the supply of chloroform so Simpson had to wait for Duncan and Flockhart to make some more. When the new supply arrived he wasted no time and gave the first chloroform anaesthetic on November 8th 1847 to a Mrs Jane Carstairs, a lady in labour, who had lost her first child in a difficult labour and had delivered a dead baby by "Perforation of the head". She received chloroform and was delivered and then woke up and had to be persuaded the baby was hers. Another recipient (possibly second) was Mr JD Morrison [15] who wrote a letter to Simpson agreeing to free him from any responsibility if mishap were to befall him. It is interesting to note that Simpson was due to give an anaesthetic to one of Professor Miller's patients on the 8th November but was unavailable. The operation went ahead and the patient died soon after the first incision. It is impossible to estimate the effect this might have had on the subsequent popularity of chloroform if it had been used. On November 12th Simpson did administer chloroform to three patients who were successfully operated on – the first and second by Miller, the third by Duncan.
He carried on with great enthusiasm and by the and on November 20th had a published report in *The Lancet*.[16]

It was a staggering achievement to get from initial discovery of chloroform properties to publication of fifty cases in the leading journal of the time in under a month in an age where there were none of our modern day communication networks and travel from London to Edinburgh was by coach and horses and took 2 days. For a modern day comparison sevoflurane took about 25 years to become established in clinical practice having been initially discovered in 1975.[17]

Simpson strove to publicise and popularise the use of chloroform; he made much of alleged opposition from the church but the reality may be that these have been greatly overstated.[18] His zeal and strength of character undoubtedly overcame many of the objections but there was a London-Edinburgh divide on the safest method of administration with Simpson preferring the philosophy that anyone could give or receive chloroform and that it was best administered via a handkerchief and that only the respiration need be monitored. John Snow of London was far more conservative and insisted on specialist equipment and believed that specialists were required. Simpson refused to accept that there

were any deaths from chloroform and said that they were all due only to poor technique. The argument raged on for fifty years until Levy's demonstration in 1911 that chloroform can produce ventricular fibrillation and hepatic failure. In fact Levy's studies were carried out on cats and it would seem most likely that the majority of deaths due to chloroform anaesthesia in the 19th century were due to cardiac arrest caused by frank overdose with hypoxia and hypercarbia due to poor technique (as predicted by Simpson) rather than any specific effects from chloroform itself. After these publications in 1912/13 chloroform usage fell away but it was not completely abandoned. In 1947 chloroform was still being used by 94% of Scottish GPs in their Obstetric practice and 80% of Specialists in Hospitals. [19]

Simpson after Chloroform

Simpson will always be remembered for his role in developing the use of chloroform but he had many other achievements in his life. He was a pioneer in the study of cross infection in hospitals, which he called "Hospitalism".[20] His own statistics showed that 1 in 53 women died post-partum in the Edinburgh Royal Maternity Hospital (the majority from puerperal fever), compared with 1 in 270 in the community. He attributed the differences to the cramped and dirty conditions found in hospitals of his day. He conducted a further study over 10 years, which showed that the mortality in major hospitals was greater than in smaller units. He became involved in the design of hospitals and was responsible for improving the ventilation and increasing the space between patients. He urged his surgical colleagues to clean their instruments and hands thoroughly between cases (not standard practice at the time). Simpson wrote at length about wound infections and also of surgical techniques to decrease their incidence such as using platinum wire to close wounds. He advocated the use of metal pins placed through the skin to compress bleeding tissues; the pins should then be removed a day later leaving a clean wound with no foreign body in it to act as a focus for infection. He introduced the principles of isolation of infected patients, work that was to be continued and developed by a fellow Edinburgh trainee Joseph Lister who in 1867 introduced the concept of antiseptic technique.

His hectic lifestyle eventually took its toll. In February of 1870 he became ill with angina and by April knew he would not recover and amended his will and stated "*Well, I have done some work. I wish I had been busier*". He died at home on May 6th 1870. The cause of death was given as dilation and fatty degeneration of the heart. Jessie Simpson declined the offer of burial in Westminster Abbey and he was laid to rest in Warriston Cemetery with his children.

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SLEEP AND HIS BROTHER DEATH: A HISTORY OF DEATH AUDIT IN THE UK

Dr Louise Oduro-Dominah
ST2 in Anaesthetics, West Suffolk

Introduction

Today more than ever the medical profession is under scrutiny from the public and from governing bodies to ensure that the service we provide is of the highest quality. There is particularly a need for us continually strive to improve patient care especially in cases where someone has died.
Auditing of deaths under anaesthetic occurs at both local and national level. Although it would appear that this is a modern day phenomenon, the process has in fact been occurring since the first anaesthetic was given over 150 years ago. In this paper I hope to show how the evolution of this practice.

The first deaths

It is well known that the first demonstration of ether anaesthetic was given on the 16th October 1846 by William Morton in Boston and that James Simpson popularised chloroform as an anaesthetic from November of the following year. Not long after these memorable dates the reports of the first deaths caused by these drugs started to be reported in the local and medical press.

Thomas Herbert who died on Valentines Day 1847 was the first victim. He had an ether anaesthetic for the removal of bladder stone and unfortunately died two days later. His death was reported in the Provincial Medical Journal by the surgeon who undertook the operation a Mr Roger Nunn. In his article he cites ether as contributing to the death and calls for other practitioners to report their own experiences.
"I trust that the publication of this unsuccessful case may lead to the publicity of many others which have occurred so that the profession may not be led away by the erroneous supposition that the prevention of pain is so vital a desideratum in operative surgery." [1]

The next case reported by J Willott Eastment appeared in the London Medical Gazette in 1847. He documents the gruesome demise of 11 year old Albinus Burfitt who on the 23rd February 1847 became entangled in mill machinery. He underwent an ether anaesthetic for the amputation of his left leg and regrettably died three hours later. Dr Eastment begins his report by saying –

"It is pleasing to our self-esteem and perhaps advantageous to our reputation, to report successful cases: it may be quite the reverse with those which are unfavourable, yet I hold it is our duty to report them, when, as at present, they involve a very important question an when adverse symptoms may prove a valuable beacon to direct our judgements to a safer and better course in the future." [2]

Ann Parkinson was the third recorded anaesthetic death. She died on 11th March 1847 two days after an ether anaesthetic for the removal of a tumour from her left thigh. A coroner's inquest concluded that her death was due to ether. The report of her death and subsequent investigation initially appeared in the Lincolnshire Chronicle on the 19th March 1847. The inquests controversial conclusion appeared in the Times, the Provincial Medical Journal and the Lancet sparking a great deal of debate amongst medical community.

Alexis Montigny was probably the first death from a purely anaesthetic cause. He died 10th July 1847 during an ether anaesthetic for the removal of a left breast tumour. It took nearly a year for the report of his demise to be reported. The authors of the article submitted it in the hope of "*the lesson learned in the present can be useful in the future."* [3]

Hannah Greener's death is the most famous as it is credited with being the first to have occurred under chloroform anaesthesia. Having survived an ether anaesthetic the previous year she died on the 28th January 1848 during a chloroform anaesthetic to have her toenail removed. As with Ann Parkinson there was an inquest into her death in which several expert witnesses were requested to testify. Her death caused great debate in the press and divided the medical community on the cause of her death and the safety of painless surgery. *"An instance having occurred in which the application of chloroform has ended fatally,, it is highly desirable to arrive at a correct knowledge of the cause of this unfortunate result, as well that a repetition of it may if possible be avoided, as for the satisfaction of scientific knowledge."* [4]

The first reviews

Hannahs death encouraged the medical community to start publishing other cases of anaesthetic mortality, which appeared in both the medical and lay press as case reports and case series.

The most prolific interpreter of these deaths was Dr John Snow. He published a great deal about the actions of chloroform and its safe use. Between 19th May 1848 and the 16th December 1851 he published 18 papers in the *London Medical*

Gazette entitled "On narcotism by the inhalation of vapours". The initial purpose of these papers was to study chloroforms effects by undertaking experiments on animals. However the later papers also examine the cases of those who died, attempting to infer the cause of death from his experiments.

By 1849 he had compiled the first case series entitled *"*On the fatal cases of inhalation of chloroform" published in the *Edinburgh Medical and Surgical Journal* which closely examines the first six recorded anaesthetic fatalities.

This was followed in 1852 by a case series in the *London Medical Gazette* of the first 20 deaths "On the cause and prevention of death from chloroform", and in 1858 by his book *On Chloroform and Other Anaesthetics* published posthumously in the October with a chapter devoted to the first fifty deaths.

Snow was not alone in compiling case series. In 1857 T Holmes published a paper in the *British Medical Journal* picking up from where Snow had finished in 1852. He produced a table examining cases 26 through 50 looking at demographic and anaesthetic information. In his conclusion he comments on how well deaths under anaesthetic are reported.

"That the reported mortality in the British Islands has been less than six per annum, that a great number of these cases occurred in private practice; and that, as many of them were disclosed by means of coroners' inquests, it seems probable that we do really hear of most of the fatal cases which occur in the United Kingdom." [5]

Dr Robert Glover also published a case series of the first 21 deaths in his 5 part "Report on Anaesthesia and Anaesthetic Agents" published in *The Lancet* in 1858.

Committees and Commissions

Throughout his work Snow was adamant that an inhaled concentration of no more than 4% chloroform be administered in order to ensure safety. Above this concentration he showed in his experiments that cardiac arrest could occur before respiratory arrest. This had been previously noted by Francis Sibson in his paper in the *London Medical Gazette* 1848. Despite calling for an inquiry his concerns about the safety of chloroform were initially ignored.
"The late deaths from chloroform, occurring nearly at the same time in different public institutions, have naturally attracted considerable attention; and they

seem to call for some inquiry, whether means may not be adopted to prevent such accidents, or, at all events, render them of more rare occurrence."[6]

However it soon became evident that a large number of deaths were appearing in the medical press and thus a series of investigations into death under anaesthesia began. The first few concentrated solely on the safety chloroform.

1. 1864 The Royal Medico-Chiurugical Society Chloroform Committee which looked at 123 deaths under chloroform concluding that chloroform should be mixed with another agent.

2. 1877 The Glasgow Committee on Anaesthetics concluding that chloroform was more dangerous than ether.
3. 1888 The First Hyderabad Commission appointed by the Nizam at the request of Surgeon Major Edward Lawrie.
4. 1889 The Second Hyderabad Commission. Repeated by Thomas Brunton at Lawrie's request which came to the same conclusion i.e. that chloroform was safe. [7]

Following these investigations which were largely discounted by the profession, the Section of Therapeutics of the British Medical Association formed a Committee on Anaesthetics in 1891. Led by Dr George Eastes its aim was:
"To investigate the clinical evidence with regard to the effects of anaesthetics upon the human subject, and especially the relative safety of the various anaesthetics, the best methods of administering them, and the best methods of restoring a patient in case of threatened death" [8]

Specially designed books were sent out to hospitals and private institutions throughout 1892. The report was presented in 1901. In all 25,920 cases were recorded with 43 different types of anaesthetic and 29 deaths which were deemed to have occurred solely due to the anaesthetic. Of the 35 conclusions the overall one states:
"From the evidence before the Subcommittee they are convinced that by far the most important factor in the safe administration of anaesthetics is the experience which has been acquired by the administrator. In many cases the anaesthetisation completely transcends the operation in gravity and importance, and to ensure success, particularly in these cases, it is absolutely essential that an anaesthetist of large experience should conduct the administration." [8]

Charles William Krohne

After the Committee on Anaesthetics the next significant collection of anaesthetic mortality was compiled by a gentleman named Charles William Krohne who was a Prussian born in 1823. He moved to England and along with his half brother Henry Frederick Sesemann set up business manufacturing surgical equipment. He had a special interest in anaesthetics, especially their safe delivery, and as well as being a part time anaesthetist on Harley Street he also constructed a variety of inhalers. For reasons that are still not apparent using his contacts with the press he compiled a hand written record of all the deaths occurring under anaesthetic between 1903-1904 noting patient, anaesthetic and surgical information. Although the document was never published the level of work involved is comparable to the work done today by NCEPOD.

A Royal Inquiry

Nearly a decade after the Eastes report it was noted that anaesthetic mortality was still increasing. To this end in 1908 the Coroners Committee appointed a panel to investigate the question of deaths resulting from the administration of anaesthetics. The findings of report were presented to parliament in 1910 by the command of His Majesty Edward VII. This was the first inquiry which examined deaths occurring under both general and regional anaesthetics. In the opening statements it is noted that:

"There is an increasing number of deaths under anaesthetics, and that in the opinion of experts a certain number of these deaths are due to preventable causes." [9]

This is the first report where it is suggested that anaesthetists should come under regulation by the law, and that anaesthetics should be a compulsory part of medical education.

"Although a man cannot sell a glass of beer to another without a licence, he may drug that other person to his heart's content, without hindrance from the law. Apart from any criminalintent, a bone-setter, or a beauty doctor, or a quack of any kind is as much at liberty to administer an anaesthetic to his patient for the purpose of an operation as a qualified anaesthetist." [9]

"The General Medical Council have recommended that all medical students before qualifying should be trained in the administration of anaesthetics, and all medical schools and examining bodies are, we understand, now acting on this recommendation. We think an adequate course of training in anaesthetics should be compulsory." [9]

The main recommendations of the paper were as follows:
Every death under anaesthetic should be reported to the coroner.
No general respirable anaesthetic should be administered by any person who is not a registered medical or dental practioner.
Practical and theoretical instruction into the administration of anaesthetics should be an essential part of the medical curriculum.
A small standing scientific Committee on Anaesthetics should be instituted under the authority of the Home Office.[9]
Unfortunately most of these recommendations were not acted upon.

1910 Onwards

In the 30 years following the inquiry there was a decline in death reporting. Whilst there was no official collection, data being published by individuals demonstrated that the number of deaths was rising each year. Examining three papers published between 1913 and 1939 it is evident that the profession felt that the responsibility for collating data should be fielded to a permanent medical body.

The first paper by Dr A. L. Flemming entitled "A Review of Inquests concerning Deaths during Anaesthesia, 1910-1913" was presented at the Royal Society of Medicine. This paper looked at all the deaths reported in the lay press for the time period totalling 700.

"The first point which attracts our attention is the number of fatalities occurring, with melancholy regularity in different parts of the country. A perusal of the evidence as reported in connexion with these 700 cases can leave no doubt in one's mind as to the avoidability of a large majority of the fatalities." [10]

"It seems a great pity that we cannot devise some method by means of which we might obtain full and accurate accounts of all instances where an anaesthetic either kills, helps to kill, or threatens to kill. One naturally wonders whether this Section could not do something in the direction of inducing anaesthetists to report their difficult cases so that we might have the advantage of their experiences."[10]

The second paper by William Sykes appeared in the *British Journal of Anaesthesia* in 1933 examining 316,327 anaesthetics across four hospitals with 198 deaths. He makes several recommendations in the article. Firstly he

proposed questionnaire that should be attached to every patients' notes undergoing an anaesthetic, and secondly he notes that as there was a reporting system in place for patients having radium therapy, the AAGBI which had been formed the previous year, should be able to implement a similar system for anaesthetics.

"If the newly formed Association of Anaesthetists were to undertake such an investigation, they would be placing a powerful weapon in the hands of any of their members who have reforms to suggest. The need for improvements will always exist, but it may be extremely
difficult to introduce them in the absence of documentary evidence of their necessity" [11]

Sykes later published a book entitled "Essays on the First Hundred Years of Anaesthesia" in which he dedicates a whole chapter to anaesthetic mortality.

The final paper written by Ronald Jarman was presented to the RSM in 1939. He collected a large amount of data but felt unable to present it in a statistical fashion. His comments closely mirror that of the others.

"There is hardly an anaesthetist who has not in the forefront of his mind the possibility that a death may occur during the administration of an anaesthetic. Yet one finds that up to the present moment there is not an anaesthetic body that has ever attempted to record anaesthetic deaths in such a way that the causes may be discovered and consequently classified." [12]

"It is hoped that in future all hospitals will produce a complete registrar's report which can be referred to by those people who are following on in anaesthesia so that they may learn and form conclusions."[12]

NCEPOD

In 1949 the AAGBI heeded Sykes requests from sixteen years previously. In that year they distributed reply-paid questionnaires to encourage people to report anaesthetic deaths. In total they received 1000 responses and the formal report of their study was published in 1956. The summary of the report hoped that reporting would become "*more frequent and accurate*"[13]. In 1964 eight years after the initial report the reports of a further 600 deaths were analysed and published.[14]

This was landmark work and finally allowed a proper classification of the causes of death. Although the information was long awaited by the profession the next formal report wasn't published until 1982 when Lunn and Mushin published their study looking at anaesthetic mortality. Later that same year

CEPOD was initiated reporting on the whole perioperative experience. In 1988 CEPOD received government funding and became NCEPOD with their first report appearing in 1990.

Conclusion

This paper has been a brief overview of over 150 years of deaths that have occurred under anaesthetics. It can be seen that the reporting of death has occurred since the first death. Although throughout the years anaesthetists have strived to keep an accurate record of the number of deaths they were frequently lacking a denominator to put the data into context. The comparison of mortality with a denominator occurred with the publication of the first CEPOD report which has formed the framework of our practice today.

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DOWN, BUT NOT NECESSARILY OUT: THE HISTORY OF DEPTH OF ANAESTHESIA MONITORING

Dr Peter Featherstone, Speciality Registrar
Department of Anaesthesia, West Suffolk Hospital, Bury St Edmunds

Introduction

Whilst the assessment of anaesthetic depth is considered fundamental to the practice of anaesthesia, the concept has proven difficult to define and even harder to measure. The history of depth monitoring is intrinsically linked to the evolution of modern anaesthesia and has borne witness to astute clinical observations, semantic debates, an evolving understanding of anaesthetic awareness and an as yet unfinished search for an objective measure.

From Bigelow to Snow – the first clinical indices of depth of anaesthesia

The history of depth monitoring can be traced at least as far back as Wednesday 18th November 1846 when Henry Bigelow published one of the first reports of the events of 16th October as well as descriptions of 'insensibility produced by inhalation' in subsequent patients undergoing operations at Massachusetts General Hospital.[1] Whilst Bigelow monitored several clinical parameters in these individuals, he felt unable to classify such symptoms, noting considerable inter-patient variability. It appears Bigelow was not alone in facing such difficulties, and his paper makes reference to one Dr Ogston, who had also 'attempted in vain to group together and classify the states of respiration, pulse and pupil.'

By January 1847 these problems had found to be surmountable and Francis Plomley of the Kent Ophthalmic Institution is probably the first to describe a formal staging system of ether anaesthesia.[2] This was based upon observations during three successive operations, as well as personal inhalation of the vapour 'on several occasions'. Plomley described the first stage as a pleasurable feeling of half intoxication, the second one of 'extreme pleasure' and the third, one of profound intoxication in which 'the individual is completely lost to pain and to external impressions'. The results of surgery performed in the second stage were noted to be 'unsatisfactory' and the third the only one suitable for operative interventions.

By March 1847 others had followed suit. In England, James Robinson concluded that eye signs represented the principle index of successful anaesthesia,[3] whilst in France, Monsieur Longet described etherisation of 'the

cerebral lobes and that of the annular protuberance'[4] and Monsieur Flourens described the regular and successive loss of nervous power in dogs under the influence of ether.[4]

In October 1847, aged just 34 and having administered fewer than eighty anaesthetics at St Georges and University College Hospitals, John Snow published his description of five stages or degrees of ether narcotism.[4] Snow clarified the arbitrary nature of his classification and included two assertions which represent the very crux of depth of anaesthesia monitoring – the first that 'the point requiring most skill and care in the administration of vapour is undoubtedly to determine when it has been carried far enough'; the second that 'the question may be asked whether the medical man can always determine in what degree of etherisation the patient is...I am not sure that he always can, by the mere observation of the patient.'

1847 onwards

Over the next seventy years there was a gradual refinement in these early staging systems. Snow was to publish again in 1858,[5] and textbooks appeared from authors such as Hewitt, Boyle and Buxton.[6-8] By the early 1900s it had been established that inhalational anaesthesia with a single agent was less than optimal.[9] The introduction of preliminary medications, sedative drugs and additional inhalational agents provided significant improvements and for the first time the third stage of anaesthesia could be subdivided and descriptions of 'planes' appeared in the literature.[9] However, there existed little consensus amongst authors and this situation would not be rectified until 1920 with the publication of Guedel's seminal staging of ether anaesthesia.[10]

Importantly, all these early staging systems highlighted the detrimental physiological consequences of deep inhalational anaesthesia and much time was spent employing methods to avoid the need for these deeper planes. Whilst the combination of light anaesthesia and peripheral or central nervous blockade was used with 'strikingly good results',[11] in 1942 a drug was first utilised in anaesthetic practice which would change the face of the speciality forever – curare.[12]

Curare and the evolving awareness of 'anaesthetic awareness'

By 1945 both British and American anaesthetists were accruing experience with curare.[13] Importantly however, the use of muscle relaxants obviated seven of Guedel's signs of anaesthesia, leaving anaesthetists with almost no objective

evidence as to their patients' level of consciousness; a 1945 *Lancet* editorial noted 'care must be taken to deaden sensation and ensure unconsciousness, or the worst imaginings of the novelist may come true, for the patient can give no sign if the general anaesthetic is ineffective'.[14]

By 1950 these 'imaginings' had become a reality, and Dr EH Winterbottom of Liverpool can be credited with the first report of awareness under anaesthesia with concomitant muscle relaxation.[15] The patient involved was an 'intelligent' 46 year old woman who underwent an uncomplicated subtotal pancreatectomy. During a routine bedside visit on the third post-operative day the patient reported waking in theatre with the most excruciating pain in her abdomen but 'unable to move, cry out or otherwise indicate her suffering.' She recalled hearing the doctors talking about the gall-bladder and small intestine before going to sleep again and waking in the recovery ward. Whilst Winterbotom stated he 'should perhaps be a little more generous with the thiopentone' if faced with a similar case, he showed in print at least, no apparent empathy for the suffering of the patient, and this muted response was largely mirrored by the wider anaesthetic community.

Fortunately the thought troubled some, and in 1951, William Mushin, Professor of Anaesthesia at the Welsh National School of Medicine publically highlighted the existence of the 'grave problem which confronts us in these days of relaxants'[11] and stated that he was inclined to believe that awareness occurred more commonly than was thought. Citing a case in his own department in which a middle-aged patient undergoing a pneumonectomy recalled being called a 'tough old bird', Mushin suggested that patients should receive doses of anaesthetic agents which were known to be adequate to ensure unconsciousness even in the most resistant patients. Such an assertion was however at odds with the current anaesthetic vogue – that of the 'Liverpool technique' of balanced anaesthesia which advocated very light anaesthesia with full muscle relaxation.[16] Its originators, Gray and Rees denied the need for additional "smelly" inhalational anaesthetic agents,[17] an assertion strengthened by research in their own department demonstrating that hypocarbia secondary to pulmonary hyperventilation during periods of controlled respiration appeared to reduce the amount anaesthetic required.[18]

Not all however subscribed to this methodology and by late 1959 (some eight years since Mushin's editorial on awareness), some began publically questioning the minimalistic nature of the Liverpool technique. An editorial in the *British Medical Journal* wrote 'the time may come, if it is not now, when anaesthetists must decide whether the risk (perhaps not so small as imagined) of the patient being conscious during surgery does not outweigh the risk (perhaps

not so great as imagined) of using such well-known anaesthetics as ether, trichloroethylene and halothane.'[19]

Investigating awareness

In 1960, Ruth Hutchinson of the Anaesthetic Department, Welsh National School of Medicine published the first study assessing the incidence of anaesthetic awareness.[20] Hutchinson made post-operative visits to 656 patients who had received apparently adequate general anaesthesia for routine general, gynaecological or neurosurgery procedures and found the incidence of awareness to be 2.78% in patients receiving large doses of long-acting muscle relaxants, intermittent positive pressure ventilation and maintenance with nitrous oxide in oxygen, and zero percent in spontaneously breathing patients maintained with nitrous oxide, oxygen and halothane. She also provided the first real evidence that such experiences may prove psychologically harmful to victims and noted that knowledge of such a case may induce 'disproportionate anxiety' in other patients on the surgical ward.

It now seemed appropriate to make more scientific studies of awareness and in 1965 Bernard Levinson of Johannesburg, South Africa was amongst the first to publish.[21] Levinson described the results of a study in which ten volunteers who could be hypnotised were exposed to a suggestion of a crisis whilst anaesthetised. Four weeks later the patients were interviewed and whilst all could remember entering the anaesthetic room, none could recall anything of the operation. Startlingly however, when hypnotised, four of the ten patients were able to repeat the words spoken during the simulated crisis almost *verbatim* and another four remembered hearing somebody talking and displayed marked anxiety.

The fact that the brain may be capable of memory formation and information processing under apparently adequate anaesthesia was of considerable interest and these results sparked a chain of further studies investigating the phenomenon of 'unconscious perception'.[22] Three studies were published demonstrating significant reductions in post-operative pain and length of stay when anaesthetised patients were played tapes containing positive auditory suggestions[23-25] and two studies demonstrated improvements in the number of correct responses to general knowledge questions[26] and word recognition tests[27] when patients were primed with specific lists of answers whilst anaesthetised.

Redefining 'anaesthesia' as applied to depth monitoring

At the same time anaesthetists were first beginning to recognise and investigate awareness, some were questioning the semantic and conceptual nature of 'anaesthesia' itself, and more pertinently, the relevance of 'depth'.

The term anaesthesia, meaning absence of feeling or sensation, had been suggested by Oliver Wendell Holmes in a private letter to William Morton dated 21st November 1846 as a single term to apply to the newly described state.[28] Over the course of the next 150 years others were to attach additional meanings to the term, leading to much confusion as to what precisely constituted the state of general anaesthesia. A typical early example is provided by Boyle, who in 1911 defined the condition as one with which there existed four components: unconsciousness, insensibility to pain, diminished reflex action and absence of movement of the voluntary muscles.[7]

In 1957 Philip Woodbridge of Greenfield Massachusetts, suggested that anaesthesia could be broken down into several combined components which he called 'nervous depression' of sensory, motor, reflex and mental systems and suggested an alternative word was required to describe this multifaceted state.[29] He volunteered the Greek word *νοθρεια*, meaning torpor, and advocated restriction of the word *anaesthesia* to its 'proper meaning' of sensory block alone. Whilst Woodbridge utilised the term extensively throughout his manuscript, the concept failed to make an impact and Woodbridge was destined to remain the world's only *Nothrologist.*

In 1960, Cecil Gray chose to air his views on this subject in a paper in the *Irish Journal of Medical Science.*[30] In what was without doubt a landmark publication, Gray rationalised the concept of depth of anaesthesia and demolished many of the signs put forward as indicators of 'planes' or 'stages'. Gray felt that the clinical signs elicited in anaesthetised patients should be taught from the 'rational' view point of their physiological and pharmacological significance and also argued that patients who were "narcotic" i.e. unconscious could not be aware of pain, though they might demonstrate a variety of intrinsic reflex responses in response to surgical stimulation. Interestingly there appears to have been no contemporary reaction to this paper and it remains a mystery why the then Chair of Anaesthesia at the University of Liverpool and editor of the *British Journal of Anaesthesia* would choose to publish such revolutionary views in a relatively small journal. Furthermore, the race to define the phenomenon of anaesthesia was to lose momentum after 1960, regaining speed only in the mid-1980s when a series of letters rekindled the debate.[31-33] During this period Pinsker, Kissin and Prys-Roberts presented views almost identical to

those first proposed by Gray over twenty years previously but failed to acknowledge his paper in the *Irish Journal of Medical Science*.

Modern measures of depth of anaesthesia

Irrespective of such semantic debate, the search for an objective marker of anaesthetic depth snowballed once it became apparent that muscle relaxants were to become an integral feature of modern anaesthetic technique. A discussion of the evolution of every measure is beyond the scope of this essay, and has been ably covered in a series of recent review articles.[34-38] Indices trialled over the past fifty years include those based on specific physiological and haemodynamic parameters, real-time volatile agent monitoring linked to the concept of minimum alveolar concentration (MAC), the electroencephalogram (EEG), visual, auditory and somatosensory evoked potentials, entropy, spontaneous electromyography, oesophageal contractility, heart rate variability, pupillary reflexes and skin conductivity.[36] Combinations of these variables have been studied using discriminant analysis, multivariate logistic regression and artificial neural networks.[36]

Brain function monitoring

A huge amount of effort has been invested in research and development of monitoring modalities capable of detecting the level of 'brain functioning' during anaesthesia. However, whilst significant advances have been made in basic neurophysiology over the past four decades, understanding of human consciousness remains incomplete, thereby adding a level of complexity and uncertainty to these measures.

As early as 1937 Gibbs, Gibbs and Lennox[39] suggested that raw data from the electroencephalogram (EEG) might be of use in determining the level of consciousness in anaesthetised patients, and whilst it was utilised by a number of anaesthetists in the early 1950s it became clear quite rapidly that raw EEG data required expert interpretation and correlated poorly with Guedel's signs of anaesthesia.[36] There then evolved two broad modalities of depth monitoring based on surface recordings of brain electrical activity - processed derivatives of the EEG and sensory evoked potentials.[37] Whilst the latter were deemed clinical untenable until their recent rediscovery, monitors based on processed derivatives of the EEG were studied extensively. The first was the Cerebral Function Monitor (CFM) developed in 1975 by Prior and Maynard.[37] which was capable of demonstrating gross cerebral ischemia but failed to demonstrate reliable and reproducible changes with standard concentrations of volatile anaesthetic agents. Further processed derivatives were proposed over the course

of the next fifteen years and eventually a monitor developed by the commercial company Aspect Medical Systems Inc. came to the fore - Bispectral Index.[36]

Bispectral index

Bispectral index (BIS) quantifies the phase relationships among the underlying sine wave components of the EEG and a mathematical algorithm uses the power and frequency information obtained to assign a single numerical value between zero and 100 to the probability of unconsciousness.[36] BIS became commercially available in North America in 1993 and in Europe in 1996; in recent years most of the objective research concerning depth of anaesthesia and almost all of that concerning awareness has been performed using this modality. [38]

Studies have suggested that BIS significantly reduces the amount of general anaesthetic administered, speeds up recovery at the end of the operative procedure and reduces patient stay in the post-anaesthetic recovery unit.[38] Furthermore a series of large randomised control trials, evaluating in excess of 30,000 patients have provided evidence that BIS can reduce the incidence of anaesthetic awareness in high risk patients by up to 82%.[40]

With such striking results it may at first seem perplexing that BIS is not more widely employed in our current anaesthetic practice. The reasons for this are multifactorial: Firstly from a technical perspective, BIS cannot be used with every anaesthetic agent - ketamine for example causes intrinsic excitability in the EEG.[36] Secondly a number of the 'advantages' flaunted are relatively immaterial – BIS has been shown to reduce the time patients spend in the recovery unit by an average of only 4 minutes, and thirdly but perhaps most importantly are issues of expenditure; conservative estimates state that the routine use of BIS in most patients undergoing anaesthesia would add about £30 million to UK health care costs.[37] The American Society of Anaesthesiologists, Association of Anaesthetists of Great Britain and Ireland and the Royal College of Anaesthetists have all concluded that brain function monitoring is not routinely indicated for patients undergoing general anaesthesia and advice that the decision to use a such monitoring should be made on a case by case basis by the individual anaesthetist for selected high risk patients.

Factors driving the development of objective depth monitoring

It is also important to consider the factors which have driven the development of this technology, and these are firmly rooted in our social culture. Over the past forty years medicine has become increasingly litigious, and doctors increasingly defensive in their daily practice. Awareness accounted for 7% of all untoward

anaesthetic-related events reported to the Medical Defence Union between 1970 and 1982, but 12.2% of cases between 1989 and 1990.[41] Data from the US Closed-claims project shows a similarly increasing trend year on year.[42] In the UK the high levels of compensation paid have lead to allegations that excessive monitoring represents a development in 'defensive medicine' designed to protect the practitioner rather than help the patient.[41]

In addition, the world's media and a multitude of high profile internet-based campaigns have ensured that the general public are now better informed about the risks of anaesthetic awareness and potential for financial compensation. There is also evidence that the concept has made its way into the wider social psyche, forming the theme of the 2007 Hollywood blockbuster '*Awake*'.

Conclusions

October 16th 2009 will be the 153rd anniversary of the birth of modern anaesthesia and during this time depth of anaesthesia monitoring has made a crucial contribution to the evolution of the specialty. Sadly awareness represents a significant and increasing liability burden for practising anaesthetists and it is not inconceivable that the use of brain function monitoring may one day become mandatory, for this reason alone. It remains as true in 2009 as 1846 that whilst we can ensure our patients are down, they may not necessarily be out.

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EARLY PAEDIATRIC ANAESTHESIA AT GREAT ORMOND STREET HOSPITAL

Dr T G Gilkes
Anaesthetic Registrar at Barts and The London School of Anaesthesia
(Great Ormond Street Hospital, 2007-2008)

Great Ormond Street Hospital was founded in 1852, nearly six years after the discovery of surgical anaesthesia and at a time when the welfare of children was becoming a greater priority in Victorian England.

Records for 1894

I analysed the earliest surviving anaesthetic records from the Great Ormond Street archives dating from the year 1894. Within the limits of these historical records, the techniques and practices are compared and contrasted with current modern anaesthetic practice.

The records were in the form of a large leather bound theatre logbook recording the date of the operation, the age of the patient, the operation performed, the name of the surgeon, the anaesthetic agent(s) administered and the name of the anaesthetist.

Demographic data

From these records I was able to establish that 783 patients underwent surgery over a period of almost one year, between the 9th January 1894 and the 4th December 1894. Forty-one of the entries were illegible and the patient's age was documented in only 692 of the cases. The mean average age of the patients was 4.59 years, the youngest was aged three days old and the oldest was 14 years old. By comparison, in the year 2007, 14,609 cases were performed at Great Ormond Street Hospital with a higher average patient age of 5.70 years despite the modern incidence of premature neonates undergoing surgery.

Anaesthetic agents

The commonest anaesthetic agent in use was chloroform, administered singly in almost two-thirds of the cases (502 cases; 64%). A combination of chloroform and ether was utilised in nearly one quarter of all cases (175 cases; 22%). The 'ACE' mixture, a combination of alcohol, chloroform and ether featured solely in 60 cases (8%). Other combinations in use were chloroform followed by ACE mixture in 16 cases, ACE followed by ether in eight cases and ACE followed by

chloroform in six cases. Stand-alone ether was used in only 13 of the 783 cases. Two anaesthetics were unrecorded and ethyl chloride was used only once. These findings demonstrate that in 1894 anaesthetic agents were being used in combinations so that the beneficial qualities of each agent could be harnessed at different stages of the anaesthetic. This is a strategy still employed in modern anaesthesia today.

As early as 1849, Dr. John Snow condemned the idea of combining chloroform and ether in his paper *On narcotism by the inhalation of vapours.* [1] This was due to the large difference in vapour pressure between both compounds: "I have tried them together, but the result is a combination of the undesirable qualities of both, without any compensating advantage".

Around 1860 George Harley developed the ACE mixture composed of alcohol, chloroform and ether mixed in the ratio of 1:2:3. In 1864 the report of the Royal Medical Chirurgical Society (now the Royal Society of Medicine) was published.[2] A Chloroform Committee had been created to investigate anaesthetics other than pure chloroform which was deemed to be associated with an increasing number of deaths and pure ether which was deemed too slow in effect. Their recommendations included combinations of chloroform and ether as well as the ACE mixture. Thus, many anaesthetists began to use chloroform for induction and then switched to ether for maintenance. With the commendation of the committee, the ACE mixture also became popular.

Technique

In the Great Ormond Street records from 1894 there is no mention of the technique used to administer the anaesthetic. It is probable that the open drop method was most commonly used, as this was a common technique at the time[3] and was used well into the twentieth century. The open method could be utilised for the administration of ether, chloroform and ethyl chloride.[4]

Clover's portable regulating ether inhaler would likely have been used to administer anaesthetic agents at Great Ormond Street Hospital and this is supported by the existence of an example in the hospital museum. Clover first described this simple draw-over apparatus in 1877. It consisted of a globular body, which could be rotated on an internal tube to allow variable inspiratory airflow over a volatile anaesthetic. Only when cyanosis appeared, was the facemask lifted for a breath or two of air. This apparatus could also function with the ACE mixture.

The anaesthetists

From the records it is apparent that the operating surgeons were also practicing anaesthesia. Analysis of the records from Great Ormond Street Hospital reveals

that some surgeons were more inclined than others to show a bent towards anaesthesia. Mr. Marshall, for example, performed 448 of the anaesthetics and only 76 of the operations out of the total of 783 cases. Mr. Byles, on the other hand, performed 121 of the surgeries and only 40 of the anaesthetics. Figure 1 charts the caseload of the most prominent medics at Great Ormond Street in 1894.

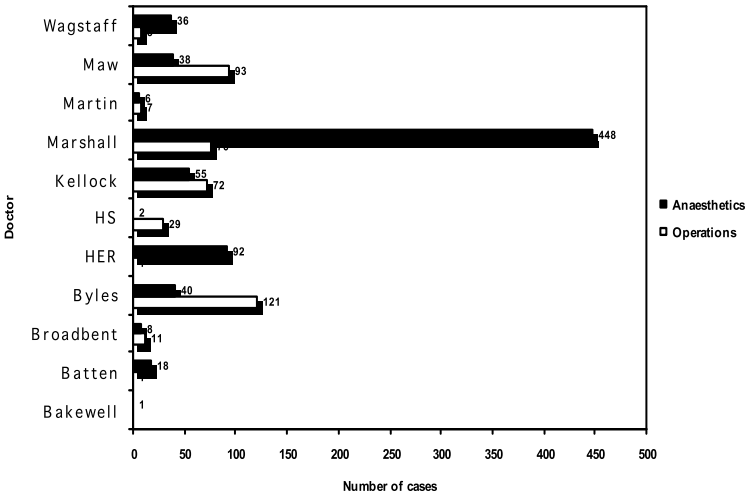

Fig. 1 Caseload of Surgeons/Anaesthetists at Great Ormond Street Hospital in 1894

Robert Turle Bakewell performed only one anaesthetic in the analysed period. Interestingly he was employed as the first full time anaesthetist in the following year, 1895, forty-nine years after the first recognised ether anaesthetic. Bakewell was born on the 8th of January 1867 in Hampstead and died, aged 65, on December the 30th 1932. He earned his medical degree from University College Hospital in 1892 and this same year, the hospital staff record book shows that he was appointed house surgeon to Great Ormond Street Hospital outpatients department. The staff book records that he resigned from his anaesthetic position in 1907.

The Post Office trade directory of 1899 records his occupation as a chloroformist of 57 Wimpole Street, London. The New Year Honours list documents that he was awarded an OBE on the 7th December 1920. Bakewell's

career at Great Ormond Street was not blemish free, however. The following is an extract from the Medical Committee meeting minute book on the 2nd December 1896:
"Letter from Mr. Owen read, regarding a complaint against the anaesthetist and Dr. Bakewell appeared before the committee and expressed his regret that he was absent from his duties without having arranged for the attendance of a substitute.".
The only other entry in the minute books regarding Bakewell was from 2nd March 1898:
"Dr. Bakewell requests that a gas and ether apparatus be purchased at a cost of, say, £10."
His relative lack of appearance in the minutes may infer a lack of influence or power that an early anaesthetist might hold. This is further suggested by a hospital committee meeting held on 4th December 1895 manned purely by senior surgical staff which demonstrates that even though a full time anaesthetist was employed by the hospital at this time, he was not involved in the decision making processes, even when these concerned anaesthesia:
"Mr. Batten brought forward the question of the anaesthetics given in the outpatients department. It was resolved that the resident medical superintendent should approve of any qualified clerk suggested for the purpose of giving anaesthetics."

Attempt to secure an anaesthetic service

A solution to a lack of anaesthetic cover was sought in the subcommittee of senior surgeons meeting on 1st December 1897:
"Difficulty finding anaesthetists to help in outpatients on two afternoons with increasing numbers. In the meanwhile the medical superintendent was requested to do his best to tide the committee over the difficulty."

Unexplained absences and a lack of anaesthetic cover may have been exacerbated by low pay awarded to anaesthetists. A copy of the *'Rules for The Anaesthetists'* found sandwiched between the leaves of a hospital medical committee minutes book from 1901 reads as follows:
"He shall be appointed for one year, but his tenure of office shall be terminable by three months' notice on either side. He shall be eligible, upon the recommendation of the Medical Committee, for re-election.
He shall not reside in the Hospital, but shall attend on such days and at such hours as shall be specified by the time Tables of the Hospital.
At the close of each year of office it shall be competent for the Committee of Management to award him a gratuity not exceeding £15 15s. for his services."

Poor pay and conditions for anaesthetists

This honorary salary for a non-resident anaesthetist was equivalent in today's terms to £1,274 using the Retail Price Index or £6,794 using average earnings comparison. Private work would therefore have been a necessity and this position may have been used to gain experience and establish a reputation.

An excerpt from an article[5] honouring the career of Dudley Buxton (1855-1931), one of Bakewell's peers, who dedicated his career to anaesthesia at a similar time, sums up the difficulties of gaining training and of making a living as an early anaesthetist:
"(Anaesthetics) occupied a position of the most minor importance. There were few specialists practicing as anaesthetists who were attached to hospitals; there was no systematic teaching by way of lectures or demonstrations although a little perfunctory instruction was given to the students as they stood by the side of the anaesthetist while he administered the anaesthetic. Little importance was usually attached to the function of the anaesthetist, and his remuneration usually consisted of the odd shillings out of the guineas which constituted the fee of the Surgeon. Frequently a hundred guinea fee went to the surgeon and he handed two guineas to the assistant commonly a house surgeon, who administered the chloroform or ether. There were certain specialists who were justly held in high repute, Joseph Clover, Woodhouse Braine, Hewlett Bailey, and Joseph Mills, but even these with the exception of Clover did not experiment, write, or give any systematic teaching. ….. Such as it was systematic instruction was relegated to a House officer at the various teaching schools."

Analysis of the operations in 1894

Many of the operations performed at Great Ormond Street in 1894 were for infective processes, including 138 cases of surgery on abscesses and 254 operations for the treatment of tuberculosis, which was rife in London's slums. These procedures ranged from scraping of Lupus Vulgaris, a skin manifestation of tuberculosis (3 cases) to rib resection (40 cases), the most invasive operation designed to reduce the volume of the thoracic cavity. There were 19 cases of scraping or excision of glands, 21 cases of erasion or scraping of joints including the hip and ankle, 17 hip excisions, 5 knee excisions and 23 cases of sequestrectomy where a detached piece of necrotic bone that would often migrate to a wound or abscess was extracted. Other diseases featured, which are now thankfully rare in the developed world, included bladder stones, rickets and one case of cancrum oris, known nowadays as noma, where it still occurs in Africa. There were three cases of supra-pubic lithotomy which had to be diagnosed by sounding of the bladder (11 cases) using a metal urethral probe.

X-ray was, of course, unavailable and this was not discovered until the following year by Wilhelm Roentgen. Four cases of surgery for Ectopia Vesicae or ectopic bladder were present. There were eighteen procedures in total for the treatment of rickets; two cases of bending rickety knees, 12 cases of straightening knees and four cases of 'wrenching foot'.

Anaesthetic risk: children compared with adults

Administering an anaesthetic in the nineteenth century was a risky pursuit, the mortality from chloroform anaesthesia was 1 in 2,873 whereas mortality associated with ether was lower at 1 in 23,204 cases, as shown by Dr John Morgan when he united British and American data in 1872.[6] These figures are supported by the findings of *The Lancet* Commission's 1893 investigation into the subject of administration of chloroform and other anaesthetics which concluded that death under chloroform anaesthesia was 8.7 times more likely than death under ether anaesthesia although chloroform was administered over 6 times more often than ether.[7]

Hence, it may seem surprising that chloroform was accounting for almost two thirds of the anaesthetics given at Great Ormond Street in 1894. In his posthumously published book[8], John Snow reviews all of the cases of chloroform related deaths in the world literature. Out of a total of 50 cases, only three were under the age of 15 and none were under the age of five years; there was one death of a patient aged greater than 65 years:
"It follows, therefore, that so far as is known, there has been a complete immunity from death by chloroform at both extremes of life".

The obvious popularity of chloroform in paediatric anaesthesia at Great Ormond Street Hospital in 1894 and it's ongoing use well into the 20th century may have been due to the fact that the fatal adverse effect of ventricular fibrillation in light planes of chloroform anaesthesia were very rare in the paediatric population.

Comparison of anaesthetic mortality in 1893 with now

The records from Great Ormond Street Hospital hold no mention of adverse outcomes. In *The Lancet's'* Commission of 1893, figures from Great Ormond Street do not feature in any of the tabulations and yet they are mentioned in the paper as one of the hospitals to be surveyed. What the figures do show is 144 chloroform deaths and 17 ether deaths across all of the London hospitals at the time.. The only paediatric hospital to provide figures was North-Eastern Hospital for Sick Children, Hackney Road, where 3135 chloroform and 7 ether anaesthetics were performed without any reported untoward cases.

Today the risk of death in the UK during anaesthesia is approximately 1:100,000 in healthy patients undergoing non-emergency surgery.[9] The risk of death in the United States due solely to anaesthesia is found to be between 1:200,000 and 1:300,000.[10] In outpatient surgery the risk of death is even lower at 1:400,000.[11]

Both anaesthetists and patients are fortunate today in benefiting from modern technologies, techniques and agents applied in anaesthesia. I do not think that the anaesthetists in 1894, 115 years ago, could possibly have envisaged or imagined the techniques, drugs and equipment at our disposal today. Have we now reached the pinnacle of practice? Perhaps it is arrogant and presumptuous to think so and I anticipate that there will be many more advances in the coming years.

Acknowledgement

I would like to acknowledge the able help given to me by Mr Nicholas Baldwin, Archivist at Great Ormond Street Hospital, without whom this project would not have been possible.

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STANLEY L DRUMMOND-JACKSON: PIONEER OF INTRAVENOUS ANAESTHESIA IN DENTISTRY

Dr Veera Gopakumar, Associate Specialist in Anaesthesia, Manor Hospital, Walsall
Miss Ashish Gopakumar, Specialist Registrar in Restorative Dentistry, Liverpool University Dental Hospital.

In the early 1900s dental anaesthesia was only inhalational with mainly nitrous oxide on one hand and ether, ethyl chloride and chloroform on the other. Induction was at times stormy and prolonged and recovery was delayed. [1] The synthesis of barbiturates, especially intravenous hexobarbitone (1931), thiopentone (1932) and methohexitone (1959) opened new avenues for dental anaesthesia. Modern anaesthesia owes a lot to early pioneers many of them being dentists and Drummond-Jackson was among them.[1]

Early career

Stanley Lithgow Drummond- Jackson (DJ to his friends and colleagues) was born in Gosforth, Northumberland in 1909. He was the son of a dentist and was educated at Barnard Castle School and subsequently at Edinburgh University Dental School where he graduated with an LDS in 1931.[2] He started dental practice in Huddersfield and was fortunate to find a Guy – Ross machine and also a trained assistant at that practice [3].

Introduction of IV hexobarbitone

Fortunately for DJ one of his patients was the representative of Bayer for Northern England and was able to obtain Evipan (hexobarbitone).[3] When DJ used intravenous anaesthesia he was convinced that this technique would successfully overcome fear and pain in dentistry. [4] In the next seven years, DJ recorded over 8000 cases using intravenous hexobarbitone. He reported his work as early as 1935 in the Dental Cosmos.[5]

World War II and book on dental practice

In 1939, DJ married Ruth Julia Graves, daughter of John George Graves, a wealthy Sheffield businessman and philanthropist who donated the Graves Art Gallery, Graves Park and many other properties to the city.[6] In the same year he moved his practice to Harley Street and commuted weekly to his home in Sheffield. This period of married bliss was short lived as World War II broke out and the young DJ enlisted in the Royal Army Dental Corps.[6]

He served with the 51st Highland Division as an anaesthetist in a field ambulance unit. [6] After being evacuated at Dunkirk, he was injured in a parachute jump exercise and discharged from active service in 1945. A disappointed Captain Drummond-Jackson returned to find his surgery at Harley Street damaged in the bombing. He then moved his practice to 53 Wimpole Street. Unable to find any guidance on practice management, he did his own research and published his first book on Dental Practice Management in 1948.[5]

Book on IV anaesthesia and training films

He gained a good reputation for his skills and expertise both in intravenous anaesthesia and dentistry. His patients came from all walks of life but mostly of high social standing, one of them being the Antarctic explorer Sir Vivian Fuchs who received a large number of anaesthetics and later gave evidence on DJs behalf. DJ was well ahead of his times and published his major work 'Intravenous Anaesthesia in Dentistry' in 1952.[34] In 1955, he set up a study group with like minded dentists and anaesthetist who met at 53 Wimpole Street.[6] Dr. Henry Mandiwall, consultant oral surgeon and also a professional film maker, recorded DJ in a series of training films on venepuncture and intravenous techniques. The excellent quality of the demonstration films prompted the British Medical Association and American Dental Association to adopt them in their training courses.[6]

S.A.A.D.

In 1957, DJ and his group of enthusiasts formalised the group and formed the Society for the Advancement of Anaesthesia in Dentistry (SAAD). The organisation became involved in clinical anaesthesia in the UK and gave new momentum to the teaching of intravenous anaesthesia.[3,6] In 1959, the first teaching course took place at 53 Wimpole Street. These courses became very popular and dentists from as far as Australia, New Zealand and United States of America attended. Some anaesthetists and dentists disapproved of the SAAD teaching of intravenous methohexitone, and regarded members as ignorant. However, despite all opposition SAAD grew and by 1967 its membership had increased to 2000. [6 7]

Goldman report on deaths under dental anaesthesia

Early in 1958, Dr. Victor Goldman's report in the *British Dental Journal* of 'Deaths Under Anaesthesia in the Dental Surgery' [8] sparked a lot of controversy and media attention. Dr. Goldman, a staunch inhalational dental anaesthetist was biased against intravenous anaesthesia. His report triggered a wave of claims

and counterclaims published in the *British Dental Journal* by supporters and opponents to the intravenous anaesthesia technique.[9]

Ministry of Health investigation of dental anaesthesia

The focus on intravenous dental anaesthesia alarmed the establishment and a Joint Subcommittee was appointed to investigate the safety of dental anaesthesia. It was chaired by Mr. Rodney Swiss (General Dental Council) and the members included Professor William Mushin. Their report in 1967 raised concerns regarding the practice of intravenous anaesthesia in the dental surgery by single operator anaesthetists.[10] The committee recommended the presence of a second person, preferably an anaesthetist, during intravenous anaesthesia, but no such restriction was placed on the inhalation technique. Through campaigning by DJ and SAAD members, the report was unanimously rejected by the British Dental Association (BDA) at their annual meeting.

Birmingham study

To give a scientific platform to the same report, Professor Robinson's group from Birmingham did a trial with intravenous anaesthesia on thirty patients. Their results were reported in a paper "Physiological responses to Intermittent Methohexitone for Conservative Dentistry" in the *British Medical Journal* (*BMJ*) in May 1969, along with an editorial in the same issue. [11] [12] The technique of intravenous methohexitone anaesthesia promoted by DJ was condemned in both articles. His claims regarding the benefits of his technique being only chemical hypnosis, preserving laryngeal reflexes with no respiratory or cardiovascular adverse effects were questioned.[1] It was also widely reported in the lay press. DJ was ridiculed and his technique considered dangerous.[10] [11]

Libel action by Drummond-Jackson

DJ asked the *British Medical Journal* to withdraw their statements in both articles or face charges of libel. The editor of the *BMJ*, Dr. Martin Ware, refused and DJ sued the authors of the article and the *BMJ* for libel that same year. DJ hoped to establish that his technique was not followed to the letter and the experiments bordered on the dangerous by altering the intermittent methohexitone technique. Secondly, the article made false claims and inferences which tarnished his reputation. Thirdly, none of the investigations were reliable and DJ declared their results were fabricated.[13] [14]

The law, however moves very slowly and it was only in June 1972 that the case came to the Court of Appeal after Lord Denning had ruled in DJs favour that

there was a case for libel defeating the appeal of the defendants that there was no cause for libel.[15 16 17 18 19] DJ, from the very outset set out to prove that there were numerous discrepancies in the defendants' research and their results were flawed..[20 21 22] This made their conclusions condemning intravenous methohexitone anaesthesia malicious, engineered to conform to the belief that his methods were bordering on dangerous and life-threatening. For 38 days the plaintiffs team including Sir Robert Macintosh and other well established anaesthetists and dentists gave evidence but to no avail.[23 24 25] Due to complicated medical aspects even the judge, Lord Ackner, couldn't see how or when it would end.[26]

The Birmingham research articles results were exposed by the evidence in court as being adjusted.[10] In January 1971, however, Professor Thornton's research on the same subject involving 600 anaesthetics in a robust study corroborated their results.[30 31] On the second day of the trial the defendants were allowed to use Professor Thornton's records. His evidence could have been decisive in favour of the defence and, if he had known, DJ would not have resorted to the legal route to redress his grievance.

In October 1972, what was then the longest and most expensive libel case in British legal history, ended in a settlement.[27 28 29] Both parties compromised: DJ accepted the research was genuine and without malice, and conceded the *BMJ*'s right to publish research, while the defendants recognised DJ as a skilled dental surgeon of integrity. The insurance paid the legal fees for the defendants but DJ lost his savings.[6]

Unfortunately the libel action deepened the distrust between the two factions which continued despite the support of many reputable anaesthetists who were members of SAAD. It took SAAD almost a decade to heal the rift. [6]

Honours and death

DJ was a tireless worker for the independence of dentists and the promotion of the SAAD organisation for education of dentists. His desire to make dentistry more pleasant, without pain and fear was his mission in life.[4 5 6] His passion for relieving pain and fear in the dental chair became the motto of SAAD: "Dolore, Vincto Timore Victo" which translates loosely as "Abolish pain to conquer fear.

He was honoured by Fellowships of international bodies and was in demand for lectures worldwide. In 1968 he was awarded the prestigious Heidbrink prize by the American Dental Society of Anesthesiology.[5 6] See Figure 1.

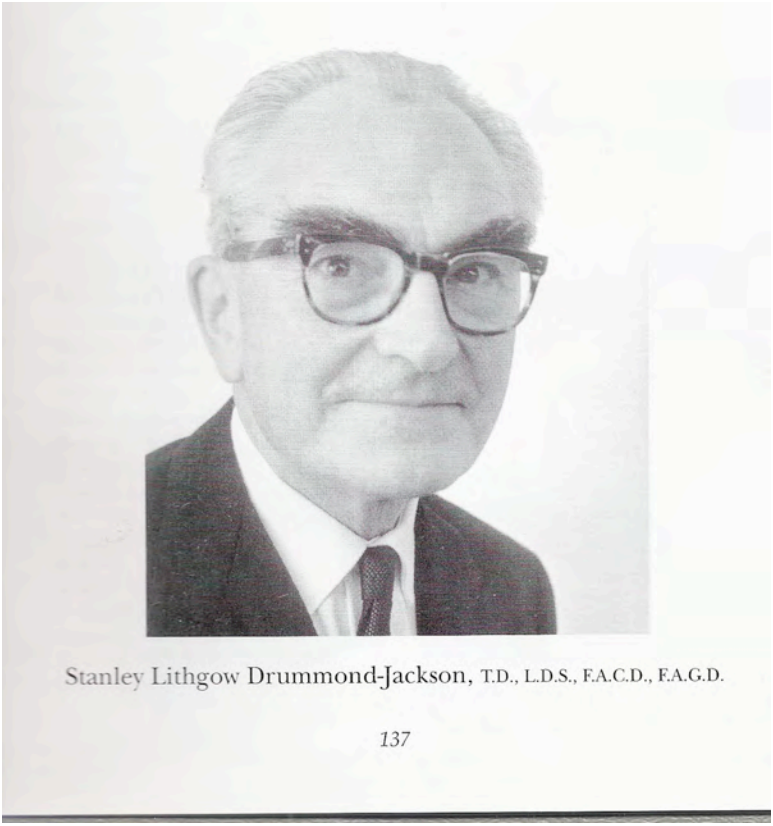

Fig. 1 Photograph reproduced with permission of SAAD

He died in December 1975 aged 66 unexpectedly of a myocardial infarction. Tributes poured from all over the world.[4] *The Times* also printed a glowing obituary.[32] The *BMJ* still embarrassed by the libel case never forgave DJ and printed a small one paragraph obituary.[33]

DJ was a fearless fighter for his cause. He fought for better undergraduate teaching in dental anaesthesia. He fought for independence of dentists. He fought for his convictions and took on the establishment. Peter Sykes aptly summarised DJ`s life: 'I was ever a fighter, so – one fight more, the best and last'- Robert Browning. [6]

Acknowledgements

Mr. Derek Debuse, Dr. Ian Brett, Dr. Douglas Pike and Ms. Fiona Wraith, (SAAD), Melanie Parker and Helen Nield, (British Dental Association), Iris Millis (AAGBI), Dr. Adrian Padfield (information on Prof Thornton), Miss Smita Bhowmik, LLM (information on Law Reports), Lothian Health Services Archives (Records of Dental Training), City of Westminster Archives (genealogical advice), BMA Library (original *BMJ*s), Dr. Chris Newson (preparation of manuscript) and as always Dr. David Zuck for his encouragement.

Note on the training films

During research for this paper we discovered that the Welcome Library has a collection of DJs archive material. However it had not been catalogued and we are pleased that SAAD has given a donation and the library has started with videos of the films of DJ made by Dr. Henry Mandiwall which are now available on line.

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CAN ANYONE HELP FINALLY IDENTIFY THIS STRETCHER TROLLEY?

Prof J A W Wildsmith, President HAS, Dundee

Early in 2009, the members of the Medical Museum Committee at Ninewells Hospital, Dundee were asked by St Andrew's First Aid (SAFA) if we could help identify the stretcher trolley, shown in Figure 1, that had been 'found' on a skip in Kirkcaldy. On the wooden end-plate of the trolley, the words *St Andrew's Ambulance Association* (the original, 1882, name of the organization - see www.firstaid.org.uk) can be seen quite clearly. The members of the committee (including me) were unable to help at all, but I was sure that this Society would, among its membership, have someone able to do much better! Dr John Blizzard thought that he might be able to help and a few weeks later a letter arrived, forwarded from Dr Chris Batten, enclosing the picture shown in Figure 2. This is from an undated Scottish Ambulance Brigade brochure thought to have been published in the late 1990s. Unfortunately, there is no reference to the original source of the picture, and the Brigade has told me that the brochure's author died several years ago so it is impossible to pursue the source through that route.

Fig. 1

Fig. 2

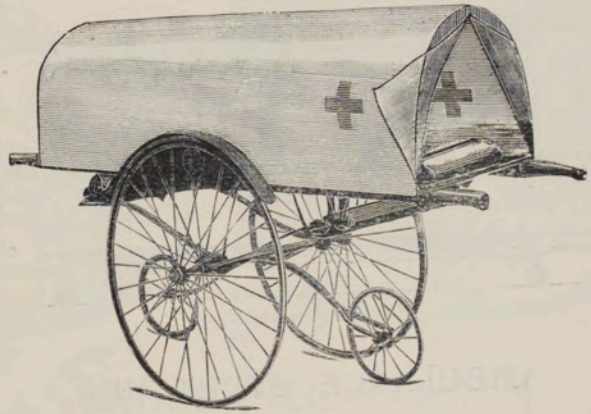
A search through all pre-1914 publications of the Association held in the National Library of Scotland did not produce an exact match, but among the end plates of Dr George Beatson's *Ambulance hand-book: On the principles of first aid to the injured* from 1891 is the advertisement shown in Figure 3. The chassis is very much the same as in the other pictures, but the remnants of the stretcher support seen in Figure 1 are closer to Figure 2 than 3. The same advertisement appears unchanged in the 1894, 1904 and 1914 editions of the hand-book, but the foundling trolley must pre-date 1904 because the Association mutated into a Corps in that year and the word Association is very clear on it.

It seems very likely that it is a variant of the same stretcher trolley, its form having evolved, but with the same picture being used in the advertisements, perhaps to save on engraving costs. However, it would be very nice to 'close the loop' completely and identify the source of Figure 2 and see what information was published with the picture. Any ideas, please?

Acknowledgement

Thanks to Dr John Blizzard, Dr Chris Batten, and the staff of St Andrew's First Aid, Scottish Ambulance Brigade NHS Trust and the National Library of Scotland.

AMBULANCE APPLIANCES.



AMBULANCE WHEELED LITTER

Fitted with Stretcher and Awning, completely sheltering the patient; hung on Armstrong's Patent Springs, and running on wheels with India-rubber tyres.

These Litters are very suitable for Public Works, and for Towns and Villages having no Hospital. They are arranged to go into a Railway van, enabling seriously injured persons to be carried to Hospital by rail with as little jolting as possible.

Price, £10 10s.

Fig. 3

POSTCARDS AND ANAESTHETIC ROLES OUTSIDE THE OPERATING THEATRE *

Dr I McLellan
Postgraduate Student, School of Law, University of Southampton

At a previous meeting I have shown that old postcards of operating theatres can illustrate historical anaesthetic apparatus and techniques. This paper illustrates the roles of anaesthetists outside the operating theatre also using postcards.

These roles relate to teaching, research, management, service and hospital development as well as other areas such as intensive care and pain management.

Projected copies of the cards will be used to discuss these roles and thus this paper is largely visual.

* Abstract only

A VERY RARE ETHER VAPORIZER DESIGNED BY JOHN SNOW

Dr H Connor, Retired Consultant Physician, Hereford
Dr D Zuck, Retired Consultant Anaesthetist, London

Summary

An ether vaporizer designed by John Snow and owned by the Royal College of Physicians of London has been identified as the 'Mark II' model which he described on 12 March 1847. The facemask is a prototype of the design which he published in September 1847, and can be dated to between mid-May and mid-June 1847. The case contains a unique and previously undescribed thermo-etherometer. This is a thermometer which incorporates Snow's table showing the amount of ether taken up by 100 cubic inches of air at different temperatures.

At a time when the design of other anaesthetic vaporizers was based on empirical trial and error, this rare instrument is an important exemplar of Snow's uniquely scientific approach to the practice of anaesthesia. Its provenance is unknown but it appears to have been owned by Sir Benjamin Ward Richardson and may have been given to him by Snow's executors.

Design of ether inhalers by John Snow

John Snow first witnessed general anaesthesia by the inhalation of ether on 28 December 1846 in the Gower Street surgery and home of the London dentist James Robinson.[1] During the early weeks of 1847 the medical journals carried numerous reports of operations performed under ether, but the success rates were very variable and many attempts ended in failure.[2 3] Only Snow appears to have understood the reason for these inconsistent results; namely, that the process of vaporisation was temperature dependent and that, because vaporisation itself caused a drop in temperature, it was necessary to provide some means of maintaining an appropriate temperature if the proportion of ether vapour in the inspired air was to be maintained. Vinten-Johansen *et al* have explained how Snow would already have been familiar with the relationship between ether vapour and temperature because of experiments which he had conducted with ether as a 'diapnetic' to promote respiration in 1843.[4] By January 16 1847, just three weeks after the first etherization in London, Snow had also realised that it was essential both to know and to be able to regulate the concentration of ether vapour which was inhaled by the patient and that there must be no obstruction to respiration. He quickly appreciated that these

conditions were not provided by the vaporizers which had been described up to that time. Most of the early vaporizers were modifications of existing and readily available chemical apparatuses. All were made of glass, which is a poor conductor of heat, and most contained sponges soaked in ether, which constituted an obstruction to free inspiration. Snow explained these basic scientific principles, illustrated by a table relating vaporization of ether to temperature, to the members of the Westminster Medical Society on January 16 1847, and informed them that he was having an instrument made which would overcome the problems of existing inhalers. The instrument would be made of metal, a good conductor of heat, and would contain no sponges. [5]

In the event Snow was to describe a series of ether vaporisers. Each one embodied the same scientific principles which he had so quickly identified as essential for consistently successful etherization. However, in the light of practical experience, he made several modifications to the initial design. Some of the modifications were to correct technical problems and others were to simplify the use of the apparatus in clinical practice. The evolution of the design will be easier to understand once the vaporizer owned by the Royal College of Physicians [RCP] has been described. When examining the apparatus we gave particular attention to both the appearance and the dimensions of the instrument, in the hope that these would indicate the date of construction.

Description of the RCP Vaporizer

All measurements were made using an electronic digital calliper. The body of the vaporizer (Figure 1) consists of a black, japanned metal container, cylindrical in shape, 113 mm (4.4 in) in diameter and 60 mm (2.4 in) in height. Its base is constructed separately and, although slightly "sprung" at one edge, there is some slight rusting which prevents the removal of the base from the body without the use of unacceptable force. In the centre is a screw-tapped orifice to receive the breathing tube. At the circumference is an opening of internal diameter 13.8mm (0.54 in), protected by a gilt metal screw cap, through which a liquid could be introduced. Also on the circumference, and at 90º from the aforementioned opening, is an air inlet of internal diameter 17 mm (0.67 in). This is a hollow tube, also protected by a gilt metal screw cap, which descends vertically down the outside of the chamber and then coils around the full circumference of the chamber before rising vertically to enter at the top of the chamber. On the side of the body is a brass plaque inscribed "Ferguson/21Giltspur St/London".

The breathing tube is connected to the body by a screw-tapped brass connector which is 30 mm (1.2 in) in length and of 14.6 mm (0.57 in) internal diameter. Incorporated into the connector is a brass 2-way (quadrant) tap, the positioning

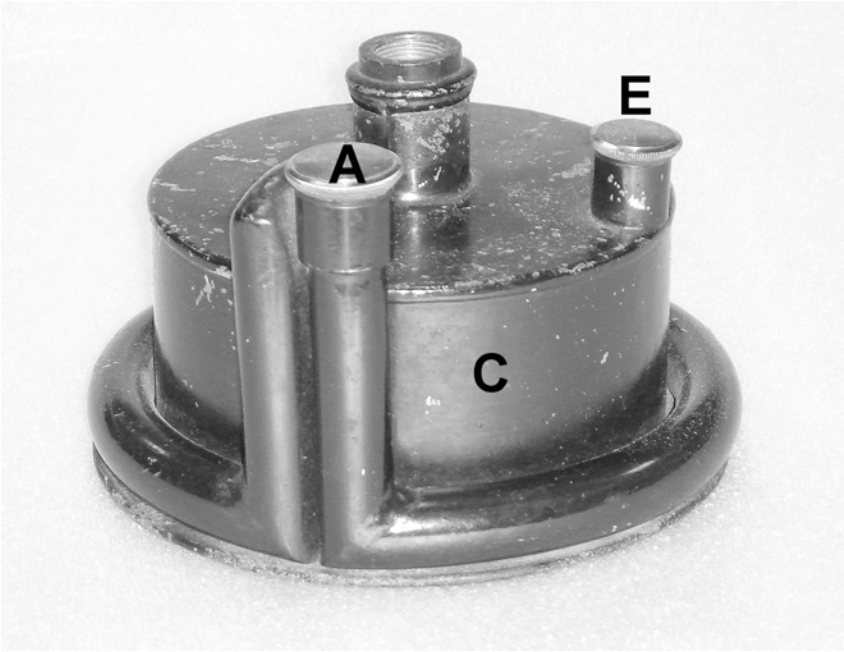


Fig. 1 Vaporizer Chamber. A = Air Inlet C = Chamber E = Ether port.
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of which would allow a variable amount of air to be mixed with the inhaled vapour. The breathing tube is fixed proximally to the brass connector and distally to a valve assembly, which is itself then connected to a face mask (Figure 2). The tube appears to be made of rubber and is closely covered with a fabric of either silk or cotton which is woven in a pattern of gold and royal blue. Internally the tube is stiffened by a closely coiled spiral of narrow wire. The tube is 835 mm (33 in) in length and has an internal diameter of 19.6 mm (0.77 in). The valve assembly is made of ebony and originally contained two small wooden (possibly cedar) balls, one of which is now loose in the carrying case. It is 16.1 mm (0.64 in or approximately ⅝ in) in diameter (see Figure 2).

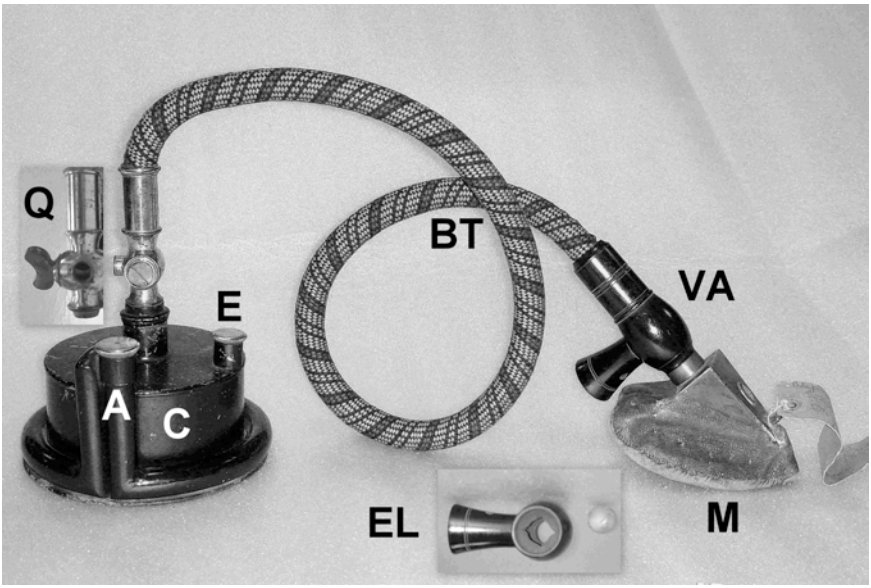

Fig. 2 Vaporizer Set. A, C, E as Figure 1. BT = Breathing Tube, EL = Expiratory Limb with Ball Valve, M = Mask, Q = Quadrant valve, VA = Valve Assembly. © Royal College of Physicians of London

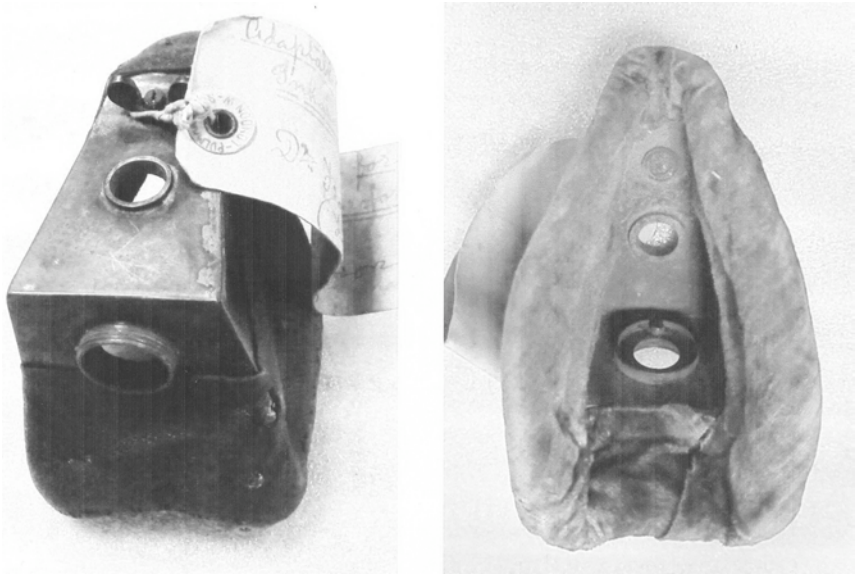

Fig. 3 Facemask. Exterior & Interior Views. © Royal College of Physicians of London

To the facemask is attached a luggage label on which is written “Adaptable mouthpiece for the inhalation of chloroform/By/Dr. Francis Sibson (The Late)”. The facemask approximates in shape to that of a truncated pyramid, open on the side which is applied to the face (Figure 3). It is 107 mm (4.2 in) long and 51.4 mm (2.0 in) wide at its base. The front plate is made of brass or plated copper covered on its outer side by soft glove leather. The rear part, which fits to the face, appears to be made of a malleable metal, probably lead. The metal appears to be covered by some soft padding which, in turn, is covered by a soft material which may be silk or possibly velveteen and which is rather crudely stitched to the underlying padding. On the front plate of the mask are two apertures. The internal diameter of the lower aperture, which connects with the valve assembly, is 17 mm (0.67 in) and that of the upper aperture is 11 mm (0.4 in). On the internal circumference of the lower aperture is a small stud or pommel. The upper aperture appears originally to have been covered by a moveable flap. This was fixed by a wing nut, which remains in place above the orifice - see Figure 3.

With the vaporizer is a carrying case, made of a hardwood which may be mahogany. It is 250 mm (9.8 in) long, 140 mm (5.5 in) high and 175 mm (6.9 in) deep. It is lined internally with dark red velvet and has compartments for the vaporizer, a rectangular glass-stoppered bottle and a thermometer (Figure 4). A circular label on the inside of the lid is inscribed “Ferguson/Surgeon’s Instrument Maker to St. Bartholomew’s Hospital/21 Giltspur Street, Smithfield, London.” On the outside of the box the initials “BWR” have been scratched on the brass base plate between the handle swivels. The words “Property of the Royal College of Physicians of London” are written on a tie label attached to the handle. On a stick-on label on the top of the box is written “Chloroform inhaler used by Dr. John Snow on Queen Victoria” and, in a different hand, “at birth of Princess Beatrice.” On a torn scrap of paper inside the box is written “Box of chloroform inhaler used by Dr. John Snow when attending...Victoria...” and, in the same different hand as on the label, “...Beatrice”. The thermometer is of the mercury-in-glass type and is inscribed at the top “Thermo-etherometer/after/Dr. Snow’s Table”. On the left hand side of the column is a temperature scale extending from 30-125 $^{\circ}$F. On the right hand side is a scale labelled “Cubic inches of Vapour of Ether that 100 Cubic Inches of Air will take up”. This scale extends from 34 to 476 corresponding to 38 $^{\circ}$F and 90 $^{\circ}$F respectively - see Figure 5. Written in ink on the back of the instrument are the words “Sir Benjamin W Richardson/25Manchester Square/London W”.

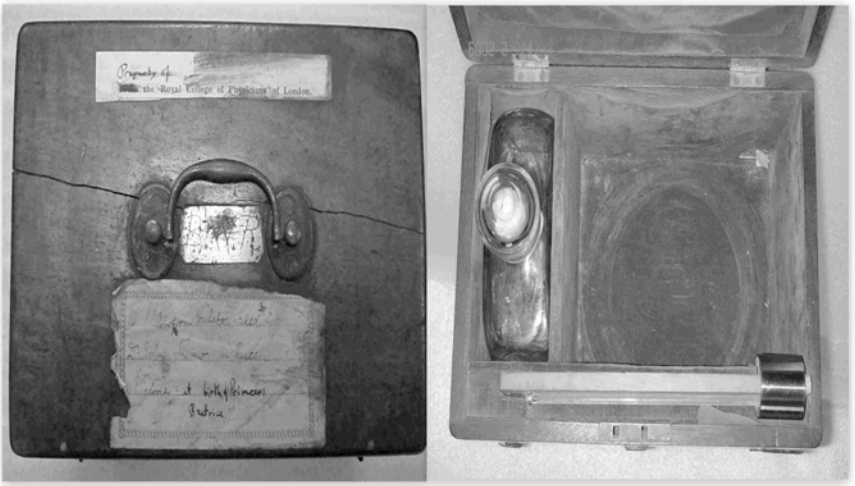

Fig. 4 Carrying Case. Exterior and Interior Views showing glass-stoppered bottle and thermo-etherometer in their compartments.
© Royal College of Physicians of London

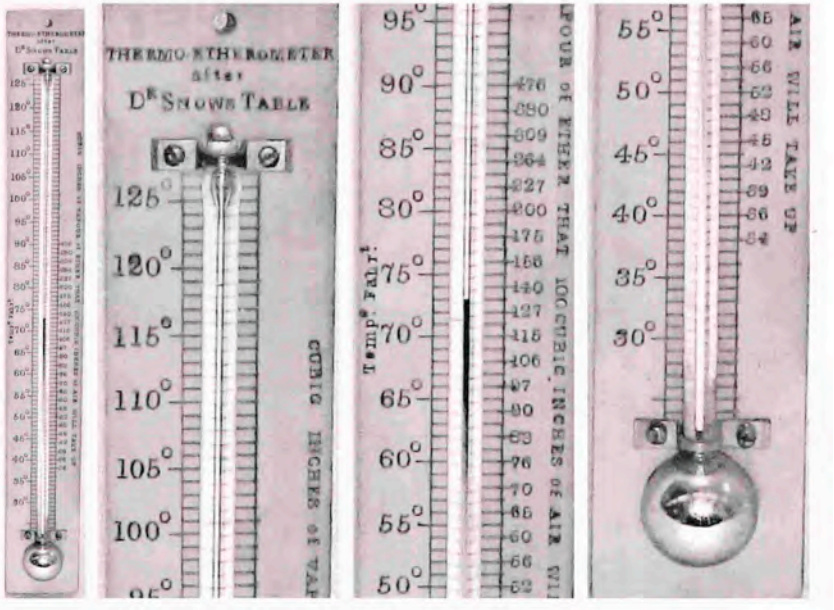

Fig. 5 Thermo-etherometer. Shown complete and as three enlarged segments. © Royal College of Physicians of London

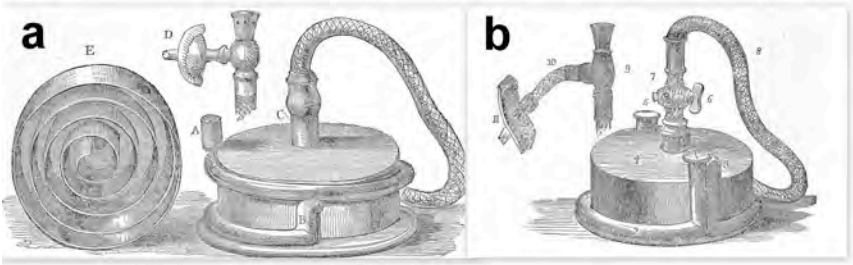

Fig. 6 a. Mark I, and b. Mark II Vaporizers from Snow's original publications [6 11]

Discussion

Snow demonstrated his first vaporizer to members of the Westminster Medical Society on January 23 1847, having already used it successfully in one case. The desired temperature was maintained constant by placing the vaporizer in a basin of water [6] – see Figure 6a. Richard Ellis described four types, or Marks as he termed them, in the evolution of Snow's ether vaporizers. The published abstract of his presentation to the History of Anaesthesia Society on this subject did not describe the criteria on which his classification was based,[7] but examination of his papers held by the Wellcome Institute for the History of Medicine shows that it was determined principally by the appearances of the chamber of the vaporiser. [8] In the first version, classified by Ellis as Mark I, the chamber was 2 inches deep, there was no separate aperture for filling the chamber with ether and the air inlet warming tube spiralled downwards around the outside of the chamber,[6] presumably because, at this time, Snow thought that the air must be warmed as thoroughly as possible before it entered the chamber.

Snow quickly realised that he had no convenient way of adjusting the concentration of the vapour, so by February 4 he had arranged with his instrument maker, Ferguson, to include a 'quadrant' or 2-way tap between the inhaler and the breathing tube. [9] With the tap fully open to the atmosphere only room air would be inhaled. When the tap was fully closed to the atmosphere only air saturated with ether vapour at the set temperature would be inhaled. With the tap in intermediate positions the proportion of ether vapour to air could easily be adjusted. The administrator could, therefore, begin the process of etherisation with the patient breathing only air and then, by gradually turning the tap, he could introduce an increasing proportion of ether vapour. By March 11 Snow had replaced the original breathing tube, which was $\frac{5}{8}^{th}$ inch in internal diameter, with one of wider bore, ¾ inch in diameter, having found that the former could sometimes impede inspiration in an adult. [10] He also made changes to the chamber of the vaporizer. A separate aperture was provided for filling the chamber with ether and the air inlet tube, instead of spiralling down around the circumference of the chamber, now descended vertically and then encircled the lowest part of the wall of the chamber.

With these modifications Snow had arrived at the design which he described in detail in a paper published on March 12 [11] (Figure 6b) and which Vinten-Johansen and Zuck have shown was submitted between March 4 and 10.[12] Ellis designated this model as the Mark II. [7] The instrument now in the possession of the RCP is very similar to this second design but differs from it in two respects. Firstly the aperture for filling the chamber with ether and the air inlet are separated by 90º in the RCP vaporizer whereas in the illustration in Snow's

paper (see Figure 6b) they are diametrically opposite each other. Secondly the illustration in the paper shows a mouth piece coming off the side arm of the valve assembly whereas the RCP vaporizer has a facemask in direct line with the valve assembly, the expiratory limb of which is now the side arm.

Snow had originally used a valve assembly and mouth piece which had been designed by Samuel Tracy[13] who, by February 1, had modified his original design in an attempt to compress the nostrils. [14] Like Snow's vaporizers this mouthpiece was made by Ferguson, which would have enabled Snow to keep the whole manufacturing process within the same firm. Snow asked for one change to Tracy's modified mouth piece, substituting common rubber for vulcanised rubber because "the latter frequently, if not always, contains sulphuret of arsenic." [11] One of Snow's earliest research projects had concerned the use of arsenic as a preservative in the bodies dissected by medical students so he had first-hand experience of its toxicity. [15] Because Tracy's mouth piece did not include the nostrils these had to be compressed or occluded with a nose clip. This was not entirely satisfactory because, as Snow subsequently explained, "some of the adult patients, after they lost their consciousness, made such strong instinctive efforts to breathe by the nostrils, that the air was forced through the lachrymal ducts..." [16] On April 3 Snow was still using a mouth piece [17] but by May 3 he had adopted Sibson's face mask. [18] However, Sibson's mask[19] was cumbersome and by June 17 Snow had designed his own facemask. He incorporated two swing (or flap) valves into the facemask itself, in place of the ball valves in Tracy's valve assembly. The expiratory valve was also made to turn on a pivot so as to allow admission of atmospheric air, thereby rendering the 2-way tap unnecessary. [20] This would have had the practical advantage that the proportion of ether vapour to air could now be controlled by the same hand which was holding the mask on the face rather than by the other hand which would have had to stretch to the 2-way tap on the vaporizer which was up to three feet away at the end of the breathing tube. There are two possible reasons for Snow's decision to change from ball valves to flap valves. Firstly, moisture in the exhaled breath might have caused the wooden balls to stick and, secondly, the flap valve was less cumbersome. For this second reason Snow had already introduced "flat" valves in place of spherical ones on a small portable inhaler which he described very briefly to the West-minster Medical Society on April 3 [17] and which Ellis designated as Mark III. [7]

The mask which Snow had introduced by June 17 and which contained two flap valves [20] was probably very similar if not identical to that which he described in detail in his monograph on ether and which incorporated both an inspiratory and an expiratory valve. [16] Sibson had used flap valves in his design but, like Tracy's ball valves, they were contained in a separate valve assembly between the mask and the breathing tube. They also required a lever and a spring for

their action and the position of the valve assembly had to be adjusted depending on the position of the patient. [19] Little is known about the 'flat' valves which Snow used in conjunction with the Mark III vaporizer. They must still have been incorporated in a separate valve assembly because this vaporizer antedated the introduction of Snow's mask and the inspiratory valve had to be "balanced with a weight". [17] In Snow's innovative facemask design the valves were not only incorporated within the mask but they closed of their own accord, without the use of counterbalancing weights, and whatever the position of the patient. [16] The mask attached to the RCP vaporizer is very similar to that described in Snow's monograph. [16] The expiratory valve is missing from the RCP facemask but its position is shown by the wing nut which held it in place (see Figure 3). The inspiratory valve, which is also missing, would have been fixed to the small stud which is located on the inside of the lower aperture, as shown in Figure 3. The attachment is shown in one of Snow's masks which is owned by the Science Museum (catalogue number A625284) and in which the inspiratory valve has survived *in situ* (Figure 7). The inspiratory valve in this mask appears to be made of latex rubber while the expiratory valve, shown beside the mask in Figure 7, is metal. It is not known if these valves are original. Snow probably experimented with different materials for the valves. They had to be heavy enough to fall back over the aperture but the inspiratory valve had to be light enough to have been lifted by a weak inspiration. Snow settled on vulcanized rubber in his published description. [16] At first sight this seems a surprising choice in the light of Snow's comments about the choice of vulcanised rubber for Tracy's mouth piece, but perhaps he considered that the surface area of the valves was too small to pose any risk of arsenic poisoning.

The crude stitching by which the silk or velveteen is attached to the Royal College mask suggests that this was a home-made prototype. If so the stitching may even have been the work of Snow himself, indicating that he did not seek the help of his landlady's daughter who, according to the census returns, was a skilled needlewoman. That the ball valve assembly is still associated with this mask could also indicate that the mask was a prototype because it would have allowed Snow to have used one or other of the ball valves in the assembly while he was experimenting with different materials for each of the flap valves.

The "thermo-etherometer", which fits snugly into its own slot in the carrying case, does not appear to have been previously described. When Snow first published on the relationship between temperature and the amount of ether vapour in air on 23 January 1847, he expressed the relationship as the proportions of ether vapour and of air in 100 cubic inches at various temperatures. [21] Thus at 70 ºF the ether occupied 49.4 and the air 50.6 cubic inches. However, in a paper published on March 12, he used a different format

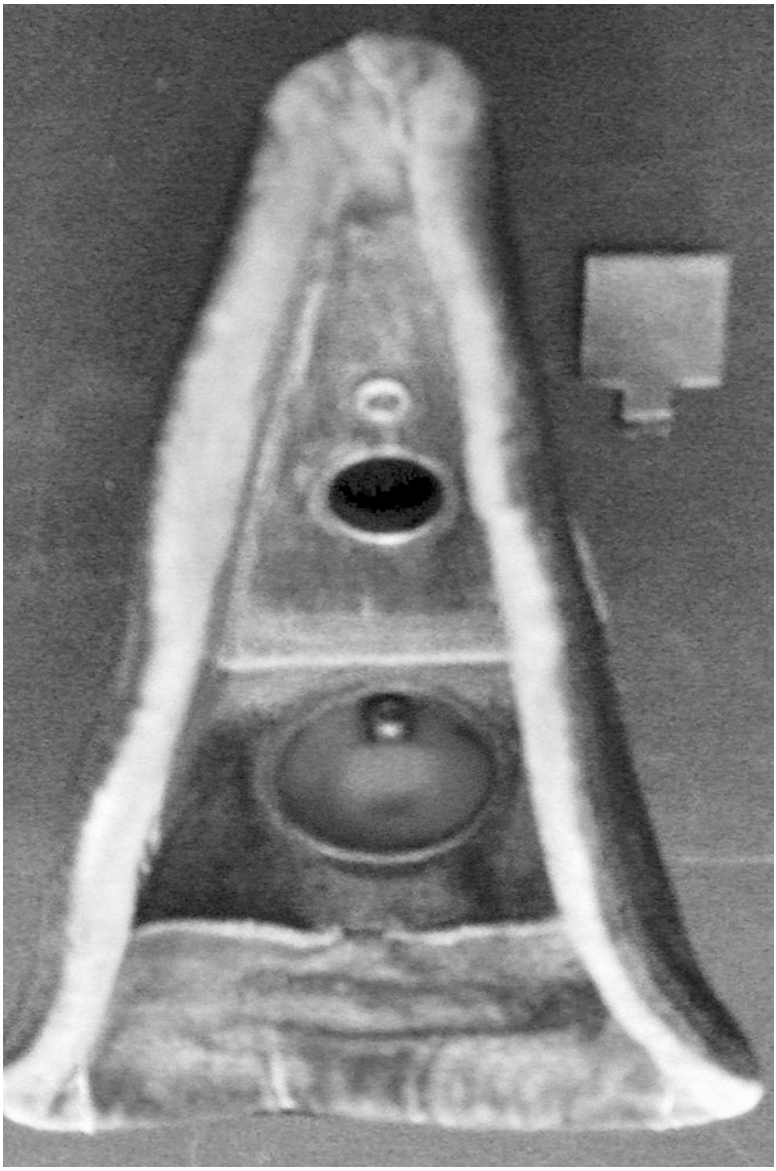

Fig. 7 A Snow Facemask owned by the Science Museum (A625284). Reproduced by permission of the Science Museum, London.

in a table which showed the amount of washed ether (the preparation most often used in etherisation) that 100 cubic inches of air would take up at different temperatures. Thus, at 70 ºF, 100 cubic inches of air would take up 115 cubic inches of vapour, equivalent to 127 minims of ether. Snow tactfully suggested that this format was "more apparent to those unaccustomed for a long period to arithmetical calculations" [11] and it was this format which was used on the thermo-etherometer which probably therefore dates from March or later.

As far as we know the only other surviving example of an original Snow ether vaporizer of any Mark is that purchased by the Wood Library-Museum [WL-M] of the American Society of Anaesthesiologists for £540 from a London dealer in antique medical instruments in 1979, although it was not until 1992 that its identity was recognised. [22] Calverley described the chamber as "about 5 inches in diameter and 2½ inches deep." The breathing tube is shorter and narrower than that of the RCP instrument being 28 inches long and ⅝ inch internal diameter. We are most grateful to Dr George Bause, Honorary Curator of the Wood Library-Museum, for providing us with accurate measurements and multiple photographs of the vaporizer. These suggest that it is virtually identical with the RCP instrument except that it is fitted with a glass mouthpiece which is very similar to one of those supplied with Gilbertson's vaporizer, as described in April 1847. [23] Its carrying case is almost identical with the one owned by the RCP but the thermometer and glass bottle are missing (personal communication, George Bause, Honorary Curator, Wood Library-Museum, 22/08/2008).

Snow stated that the vaporizer chamber in what Ellis termed the Mark I design was 2 inches deep, [6] but gave no equivalent figure in his description of the Mark II. [11] The chamber depth of the RCP and WL-M instruments, both of which conform most closely to the Mark II design, is 2½ inches. The reason for the change is not clear. Later in 1847 Snow wrote that he had experimented with several different depths, initially 2 inches, later 1 inch and finally 1¼ inches. [16] The last figure referred to what has come to be regarded as Snow's definitive ether vaporizer which he described in September 1847 [16] and which Ellis designated as the Mark IV. [7] Whether the other depths given by Snow referred to preliminary designs of this definitive vaporizer or to the earlier Marks is not clear. Ellis described the Mark II chamber as being only 1½ inches deep but gave no reference to support this figure [8] and we have been unable to find evidence for it in any of Snow's publications.

The antecedents of the WL-M vaporizer are unknown, (personal communication, George Bause, Honorary Curator, Wood Library-Museum, 22/08/2008) and the provenance of the RCP instrument is uncertain because the College has no record of it in its accessions register. No reliance can be placed

on the labels attached to the carrying case, because it is not a chloroform but an ether vaporizer and because on both occasions when Snow administered chloroform to Queen Victoria he used a handkerchief and not a vaporizer. [24] The label attached to the facemask is also misleading because, as discussed later, it is definitely not a Sibson mask. There is, however, presumptive evidence that the carrying case and thermo-etherometer (and therefore also, in all probability, the other items) were at one time owned by Sir Benjamin Ward Richardson (1828-1896), whose initials have been scratched on the handle plate of the case, and whose name and address have been written in ink on the back of the thermo-etherometer. Comparison with a known example of Richardson's handwriting [25] confirms that the writing on the thermo-etherometer is indeed that of Richardson himself. Moreover, in 1884, Richardson recorded that he had in his possession "an ether inhaler, with thermometer and reservoir invented by Snow, in 1846". [26] Richardson must have mistaken the year, writing 1846 which would have been impossibly early, instead of 1847, but he is clearly referring to an early ether vaporizer and, in all probability, the one now owned by the RCP. Richardson was Snow's friend and biographer. After Snow's death in 1858 his case books passed into Richardson's possession and remained in his family until presented to the RCP by Richardson's daughter, Mrs. George Martin on 8 February 1938. [27] It is possible that the case books were given to the College because it already possessed the vaporizer, or it may be that the vaporizer was given after the books but that the gift was not recorded. It was certainly in the possession of the College by 1946 because it and the thermo-etherometer were loaned in that year to the Wellcome Institute for an exhibition to mark the centenary of anaesthesia. [28] Richardson would certainly have considered the Royal College of Physicians to be an appropriate home for Snow's case books and vaporizer. Not only was Richardson an eminent and active fellow of the College [29] but he also thought of Snow as a physician and described him as such. [30] Snow had proceeded MD (London) in 1844 and had passed the licentiateship examination of the Royal College of Physicians in 1850. [24] Had he lived just one year longer he would, as a distinguished licentiate, have been eligible for election to the fellowship of the College under the new regulations which were introduced in 1859. [31] The Richardson connection is, at best, presumptive evidence that the apparatus had originally been owned by John Snow, but this presumption is greatly strengthened by the facemask. Snow acknowledged Sibson as the originator of the concept of a mask which encompassed both mouth and nostrils. [32] The RCP mask, however, is very different from the funnel-shaped design which was described by Sibson [19] and, despite the label attributing it to Sibson, it is very definitely a prototype of Snow's design. We can only speculate about who might have added the misleading labels. It would not have been Richardson, who would have known that the vaporizer was for use with ether and not chloroform and that Snow had

used a handkerchief to administer chloroform to Queen Victoria. It is perhaps possible that one of Richardson's children might have added the labels on the basis of some mis-remembered story. There was certainly much confusion in the 1890s about the origins of Snow's mask. Buxton, who thought that Snow had done little more than incorporate valves into Sibson's mask, had been told by Richardson's son that Sibson's mask was itself a modification of a mask which had been designed by Benjamin Ward Richardson. [33] Benjamin Ward Richardson himself gave a faulty recollection of the true sequence of events in his autobiography. Writing some fifty years after the events he described how he had made a "double-valved inhaler" with a leather mask. He showed this to Snow who made some alterations, one of which was to increase the bore of the breathing tube. According to Richardson it was Sibson who then substituted lead for the leather in the mask and "the change gave rise to the Sibson Inhaler with Snow's tube." [34] In fact Snow had already published the design of his facemask before he and Richardson had first met. Whatever the reasons for the incorrect labels it is surprising that the correct identification and description of the vaporizer in the 1946 exhibition catalogue did not result in comment on these inaccuracies.

The chambers of both the RCP and WL-M vaporizers incorporate a two-way tap, and they conform most closely to the instrument which Snow described on March 12 [11] and which was designated by Ellis [7] as Mark II, the only major difference being that the apertures in the top of the chamber are separated by 90º in the surviving examples and by 180º in the illustration in the paper. There are, however, significant differences in the breathing circuits, valves and mouthpieces. Ellis, who almost certainly derived his classification solely from Snow's published papers, assigned specific modifications in the circuits, valves and mouthpieces to each Mark, [8] but it is evident from the surviving examples that no such clear-cut distinctions can be made. It is of course possible that a purchaser might replace a mouthpiece with another of his own preference, but the WL-M apparatus is fitted with the narrower breathing tube and it is highly unlikely that an owner would have replaced the newer, wider tube with the older, obsolete one, even assuming that he had access to one. In the early months of 1847 all aspects of Snow's vaporizers appear to have been in a continual state of flux and each of these early versions, whether an illustration in a paper or a surviving example, should be seen as the transient manifestation of an evolutionary process rather than as a definitive version or 'Mark'.

The rapidity of the changes in design poses both difficulties and opportunities for the accurate dating of Snow's ether vaporizers. Both the WL-M and the RCP vaporizers include the two-way tap, and must therefore date from the time of its introduction on February 4 or later. The WL-M apparatus has the narrow bore

breathing tube and, assuming that this is original, should be no later than March 11, when the wider bore tubing was introduced. Its carrying case includes a space for a thermometer which is no longer present. If it had been a thermo-etherometer, as is present in the case owned by the RCP, then the case and its original contents are unlikely to have been sold much before the date on which Snow's paper containing the revised format of his temperature table had been submitted to *The Lancet* which, as previously noted, was between 4-10 March. The WL-M vaporizer may therefore have been constructed during the first eleven days of March 1847, before the design had appeared in print on March 12.

The dating of the RCP apparatus is more problematical. It is fitted with the wider bore tubing, which should indicate a date of March 11 or later. However if, as seems likely, this was indeed Snow's own instrument, and if it was the one which he was using to develop his facemask, it could also have been the one which he used to experiment with breathing tubes of different sizes. If so, the tube which is now with the vaporizer could be a replacement for an earlier, narrower tube.

We have no indication of the cost of Snow's vaporizers, but economic considerations would suggest that he was unlikely to have had a new model made simply to test relatively minor alterations in design. It seems probable that the production of vaporizers, like those owned by the RCP and the WL-M, which had chambers and two-way taps in conformance with Ellis's Mark II designation, would have ceased when Snow introduced what has come to be regarded as his definitive vaporizer. As previously noted, this instrument, which Ellis designated as Mark IV, [7] was first described by Snow in the monograph which he published in September 1847. [16] In this work Snow stated that he had used this vaporizer, which was incorporated within its own rectangular water bath, "for the last three months" which would imply that it was first used by him in late June or early July. It is certainly likely to have been after June 10th because a description of an anaesthetic given by Snow on that date included the words "...the inhaler being placed in water..." [20] which would not have been applicable if he had been using the definitive inhaler which was incorporated within its own water bath. How promptly Snow and Ferguson might have put the definitive inhaler on sale is not known, but it was probably soon after Snow had satisfied himself of its effectiveness and its advantages. The period during which the 'Mark II' vaporizer might have been manufactured was, therefore, probably only from early March until late June. This short time may explain the extreme rarity of known surviving examples. Indeed, it is remarkable that any should have survived at all. So far as we are aware, there is only one surviving original example (owned by the Association of Anaesthetists of Great Britain

and Ireland) of Snow's chloroform vaporizer and yet this instrument must have been produced in much larger numbers than any of the ether vaporizers.

An estimate can also be made of the period during which Snow was designing his facemask. It cannot have begun before May 3, when he first started using Sibson's mask [18] and it had been completed by June 17, when he used a mask of his own design at St. George's Hospital. [20] In a lecture delivered on May 12 and published on May 29 he wrote that he had found Sibson's mask to "answer completely". [11] However he also referred to spherical valves made of cedar wood, which suggests that he did not have complete confidence in Sibson's valve assembly and was still using Tracy's at this time. He made no mention of any re-design of his own vaporizer, but he probably would have started work on this project between mid-May and early June and he was using it in clinical practice by June 17. The unique RCP prototype can therefore be dated to between mid-May and mid-June.

The RCP and WL-M instruments, taken in conjunction with Snow's published papers, contribute to our understanding of the continuous and evolving process of Snow's vaporizer designs in what Vinten-Johansen and Zuck [12] have termed his *annus mirabilis.* The papers alone provide discreet snapshots, frozen in time, but the actual instruments add a dynamic dimension. Thus, we see the replacement of the mouth piece by a facemask, the tubing of increased diameter, and the process by which Tracy's valve assembly was replaced by the incorporation of valves into the facemask. We also see the incorporation of a 2-way or quadrant tap and its later replacement by a modification to the expiratory valve on the facemask and, although we do not know the precise chronology, Snow tells us in his 1847 monograph that he experimented with chambers of different depths. [16] All of these changes contributed to a continuously evolving design which culminated in his definitive Mark IV vaporizer.

Unless further evidence comes to light the definitive provenance of both the RCP and the WL-M vaporizers seems destined to remain an enigma but, in the development of anaesthesia in particular and of modern medical practice in general, they will always represent a major milestone in the triumph of scientific enquiry and evaluation over empirical trial and error.

Acknowledgements

The authors are extremely grateful to the President and Council of the Royal College of Physicians of London and to Bridget Telfer and Peter Basham in the College's Heritage Department for providing access to the vaporizer and to

other materials; to Mrs Elizabeth Ellis and to Richard Aspin, Amanda Engineer and Ross MacFarlane in the Wellcome Library for the History and Understanding of Medicine for access to the Ellis papers and to material relating to the loan of the vaporizer in 1946; and to Dr. George Bause for information and photographs of the vaporizer owned by the Wood Library-Museum and for his enthusiastic support.

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MYSTERIOUS DEATHS AT ANN ARBOR VETERANS' ADMINISTRATION HOSPITAL IN 1975

Prof J. Roger Maltby
Jasper, Alberta, Canada

I first read of an epidemic of mysterious deaths in the Veterans' Administration (VA) Hospital in Ann Arbor, Michigan, USA during the summer of 1975 in an article in *Time* magazine (March 1976).[1] Two years later John Dundee, professor of anaesthetics in Belfast, reviewed a book[2] that described the epidemic and subsequent investigation that led to the trial of two of the hospital's intensive care unit (ICU) nurses.[3] Two years later, in 1980, Dundee and I met at the American Society of Anesthesiologists annual meeting. He was aware of my interest in criminal use of anaesthetic drugs[4] and told me that the anaesthetist who recognized that someone was poisoning patients was Anne Hill whom he had trained in Belfast and that she was at the meeting. He introduced me to her and she accepted my invitation to visit Calgary, Alberta to describe her experience to the Calgary Anaesthetists' Society. Much of this paper is based on her personal involvement in suspecting what was going on and then demonstrating its cause.[5]

Ann Arbor Veterans' Administration Hospital

The 450-bed VA Hospital was affiliated with the nearby University of Michigan Hospital and provided specialist rotations for residents (SHO/registrar) and medical students. Most of its consulting physicians and surgeons were seconded from the University Hospital. The anaesthesia department had two staff anesthesiologists (consultants), two residents, and four certified registered nurse anesthetists (CRNA). During Monday to Friday day shifts five or six operating theatres were in use and one member of the department carried a cardiopulmonary arrest beeper. Out-of-hours anaesthesia call was taken from home by either a CRNA or an anaesthesia resident for surgical emergencies only; arrest codes were managed by two in-hospital surgery and internal medicine residents.

Anne Hill obtained her FFARCS in 1971 and was appointed to the Department of Anesthesia at University of Michigan Hospital in Ann Arbor in 1973, seconded to the VA Hospital as Chief of Anesthesia. She introduced weekly morbidity and mortality conferences as well as daily informal discussion over coffee. She reviewed patient records that did not have a documented post-anaesthetic visit and discussed the reason with the responsible anaesthetist. At the beginning of 1975 postoperative visits reached 92 per cent.

Most of the suspicious arrests occurred on evening and night shifts so the fact that anaesthetists were not on call for out-of-hours arrest codes may explain why Anne Hill was unaware of increasing numbers until the last week of July. It was only then that a series of events initially puzzled her, then led to an annoying suspicion that something was wrong, and finally convinced her that something absolutely dreadful was occurring.

Unexplained postoperative arrests

On Friday 25th July Anne Hill anaesthetized a 68-year-old man with bronchogenic carcinoma for a right lower lobectomy. He had a history of three previous myocardial infarctions; ECG showed an old MI with normal sinus rhythm. Anaesthesia was induced at 07:45 a.m., and surgery was completed uneventfully at 1.30 p.m.. She reversed the relaxant, extubated his trachea and performed intercostal blocks before transferring him to the recovery room. She saw him in ICU at 6 p.m. − pain-free, coughing in response to command and taking deep breaths − before she went home. On Monday, 28th July she was told that he had arrested at 1.30 p.m. on Saturday but was quickly intubated and resuscitated. She went to see the patient and he was stable. The surgical resident told her that on Saturday morning at 8 a.m. he was so well that, when ICU telephoned to say he had arrested, he replied, "It's impossible; you've given me the wrong name." The patient's chart showed nothing to account for the arrest. A few days later the surgical resident remembered that the nurses reported that he "shook all over" just before he arrested. She wondered if suxamethonium (succinylcholine) could have been given by mistake, or if some other drug could be labelled, for example, penicillin but in fact be suxamethonium. She went back to the patient's chart to see if an antibiotic or any other drug had been given or ordered shortly before he arrested. There was no record of any drug having been given.

A second suspicious arrest occurred on Tuesday 29 July, three days after the first. She had anaesthetized the 60-year-old man for radical cystectomy on 19 July. After two days in ICU, he was discharged to the ward, still with an intravenous line for antibiotic therapy. On the tenth postoperative day he suddenly arrested. She immediately thought of pulmonary embolus, went to see him and found that he had been extubated 12 h after the arrest and was now sitting up in bed, "bright-eyed and bushy-tailed", with normal blood gases – obviously not a massive pulmonary embolus. The nursing aide who was first at the arrest said the man was blue, not breathing and he could not feel a heart beat or pulse. He thumped on the man's chest and, when the cardiac arrest team came arrived, the ECG showed normal sinus rhythm. The surgical resident said it was a respiratory arrest but he had not been on the scene. Had it been a burst

of ventricular tachycardia or fibrillation or a respiratory arrest? Why had he recovered so quickly?

Three other patients whom she had anaesthetized in the last week of July had postoperative arrests. A 52-year-old man, ASA IV with a history of a cerebrovascular accident three months earlier and an old myocardial infarction, had a 12-hour resection of an abdominal aortic aneurysm and femoropopliteal bypass. He was ventilated in ICU and arrested three days later. An 87-year-old man with an old myocardial infarction had an uneventful anterior sigmoid resection. He was breathing well in the recovery room postoperatively and was transferred to ICU. Four hours later he arrested and was successfully resuscitated. There was strong evidence that he had had a myocardial infarction. A 42-year-old man had a long history of epilepsy, multiple myocardial infarctions, recent triple coronary artery bypass, left lower lobe infiltrates and a recent acute myocardial infarction. He survived an uneventful 4-hour debridement of his left leg, and was awake when he was transferred to ICU. Ten hours later he arrested and was successfully resuscitated. None of these arrests really surprised or worried her; they were not unexpected and were compatible with the patients' general condition. The two arrests that did worry her were the pneumonectomy patient who shook and the radical cystectomy patient; they were unexpected and were not compatible with the patients' general condition.

Next she heard rumours among nurses and residents that there had been a lot of arrests over the first weekend in August. She asked for this concern to be brought up at the clinical executive board meeting that she was unable to attend. The acting chief of staff reported that Anne Hill was examining patient files for clues to determine what was causing these arrests − perhaps suxamethonium was wrongly labelled, drugs were dispensed incorrectly, or even that IV fluids were contaminated during manufacture. He said that the department of medicine was already looking at this problem and suggested that one of their doctors review records with her. The bizarre idea that inadequate air conditioning was a possible cause of respiratory failure was discussed. When she read the minutes she began to think that maybe she was going crazy. She continued to look at the chart of any patient she heard had arrested, trying to get a clue to the problem of shaking. She could not find a single chart with evidence of a medication being given just before the arrest.

On Monday 11th August a 43-year-old man presented with massive haematemesis. After resuscitation his surgery and anaesthesia were uncomplicated and he was transferred to ICU. Next morning, she helped him out of bed to sit in the chair and he felt very good. He arrested at 6 pm and was resuscitated. His chart revealed nothing. The only information she learned later

was that, as he arrested, he clutched at his throat. She knew that something terrible was happening but did not know what it was.

That same evening the on-call medical and surgical residents who covered the double shift 4 pm to 8 am were called to a total of eight arrest codes and one suicide. The first four who were in ICU (including Anne Hill's patient) were all resuscitated. Then two men in the same surgical ward on a different floor arrested. The first had undergone hip surgery; he could not be resuscitated. The second was a healthy 40-year-old carpenter with a broken elbow who was easily resuscitated. Two more codes occurred during the night. All the patients had IV infusions running and each resident independently began to wonder if the IV solutions were contaminated, but if so there should have been problems throughout the hospital on all shifts. Then each began to wonder if it was something more sinister.

On Wednesday 13th August Anne Hill wrote to the VA acting chief of staff, requesting an inquiry into these unexplained arrests. She suggested a panel to talk to the nurses and physicians who had been on the spot and might give valuable information that would reveal an answer if there was one. The only common factor she could see was that they mostly occurred at night and had IV fluids running. She recommended beginning the inquiry the next day and provided the names of ten patients whose arrests should be studied.

She left the memo on the acting chief of staff's desk and went to the University Hospital to talk to her chairman. He said told her, "Anne, sometimes to get things going one has to put things in writing. I think you were right." The next morning the VA acting chief of staff came to her office and talked about everything except the memo. As he left she said to him, "I have looked at every chart I can find and I have seen nothing written as being charted and the only thing that I can think is someone is giving it and not charting it." She said later that it was almost as if someone else was speaking and she felt strange at the way he looked at her. He had told the chief of medicine that she was getting paranoid and perhaps they should get a psychiatrist to see her, or maybe give her a vacation, but a psychiatrist would be easier. She ignored the advice.

Friday 15th August

Anne Hill was in her office at 4.40 p.m. with two medical students, deriving the shunt equation, when she heard someone using the telephone in her outer office. There was an arrest code in ICU. She ran to ICU with the two students. A surgical resident, who had already intubated and ventilated the patient, asked for a stethoscope and she threw hers to him. As she watched, a nurse called her to

the adjoining coronary care unit (CCU) where a second patient had arrested. She ventilated him by mask, sprayed his throat with 4 per cent lignocaine, and intubated him. The acting chief of surgery and the chief of medicine happened to be in the unit checking on the bed situation for discharge and new admissions. The surgeon, knowing of her first patient who shook before his arrest code, commented to her that "neither of these patients shook". She responded that she was going to get a peripheral nerve stimulator. When she inserted needles and stimulated the first patient, she was horror-struck to see an obvious non-depolarizing block with marked fade and very marked post-tetanic facilitation. She left those needles in situ, went to the second patient and found exactly the same picture.

Then she realized that they were into something bigger and more unusual than she had ever coped with and that documentation was very important. She sent one of the medical students to pharmacy to get unopened bottles of neostigmine and atropine. She repeated the nerve stimulation with witnesses. Fade and post-tetanic facilitation were obvious, and she asked each patient to “lift your head off the bed, open your eyes, squeeze my fingers”. Then she made sure the witnesses checked the unopened bottles and checked the atropine and neostigmine dosage before she administered it to the first patient. Reversal was obvious. She went to the second patient and the result was precisely the same. She was then asked to check a third patient in the adjoining CCU who had arrested and been resuscitated while she was intubating the second patient. He had no twitch, but a marked post-tetanic facilitation so she waited for 20 minutes before reversing the relaxant. She then ordered all IV bottles and tubing to be taken down, labelled and locked up immediately. Her description of what happened next was that, “All hell broke loose in the hospital. People were running from everywhere.”

Around 6 p.m., she felt shaken up and was acting automatically. She went to her office to think because it was a long time since she had studied forensic medicine. She knew she had to do things carefully. Urine samples were needed but she knew she should not draw them. She asked the resident to draw urine samples from the first and third patients. She made him sign that he had handed them to her, and she signed that she had received them. They were hand-carried to the University Hospital laboratory for analysis. She suspected pancuronium as it was the most frequently used relaxant in ICU.

Paralysing doses of the neuromuscular blocker had been administered to three patients in ICU/CCU within 15 minutes. The close proximity of time and place made it likely that the guilty person (or persons) witnessed the proof. It was late evening when she finished writing her notes and prepared to go home. Her

husband was out of town. She asked for a guard to escort her to her car but the guards were guarding all the specimens! She ran to her car, expecting a sharp stick from behind but it did not come. Her contribution in the dramatic events was complete and the epidemic of unexplained arrests ceased.

Investigation

The Federal Bureau of Investigation (FBI) was called in that evening. Three days later it assembled a team of physicians from Veterans' Administration, the Epidemic Intelligence Service of the Center for Disease Control in Atlanta, and the University of Michigan Medical School to review hospital records and charts of all patients who died from or survived a cardiopulmonary arrest from 1st July through 15th August 1975 and for the same period in 1974.[6] The team identified 51 arrests in 35 patients, some of whom had arrested more than once. Forty-three occurred on the 4 p.m. to midnight shift, most but not all in ICU/CCU (Table 1).[6] Level of suspicion in each case was designated high (unexpected, not compatible with clinical status), moderate (unexpected but compatible with clinical status) or no suspicion (not unexpected, compatible with clinical status). Eighteen of the 20 highly suspicious arrests were assessed as primarily respiratory; 70 per cent of these survived compared with 32 per cent in arrests during the same period of 1974. A team from Food and Drug Administration (FDA) that examined the medication and IV solution records and dispensary system found no important differences in over 100 variables between high and low suspicion groups. All of the victims had IV lines and the drug must been given by bolus injection to be effective, not mixed and diluted in the IV solutions.

There was no apparent motive for the poisonings. Potential suspects included nurses, medical students, doctors, and other hospital employees - especially those in ICU/CCU. The University of Michigan Hospital laboratory identified pancuronium in the 15th August ICU/CCU urine specimens within three days.[3] Earlier victims who survived had metabolized and excreted any possible evidence of the drug, and some of those who died had been cremated. Four bodies were later exhumed and pancuronium was identified in two of them. The FBI painstakingly correlated employee work records with the time of each arrest and narrowed the list of suspects to two Filipino nurses, both of whom were on duty when most, but not all, of the respiratory arrests occurred. The two nurses agreed but pointed out that, when an arrest occurred, it was their duty to assist at resuscitation. Their colleagues supported them. Even when some of the surviving patients were hypnotised by a New York psychiatrist to help recall for the FBI, none had a clear recollection of a nurse making an injection into the IV

Table 1. Cardiopulmonary arrests variables [6]

	Epidemic total	High suspicion	1974 control
	(n = 51)	(n = 20)	n = 28
Time			
Midnight - 8 am	5	0	8
8 am - 4 pm	3	1	10
4 pm - midnight	43	19	10
Place			
Intensive care unit	32	15	11
Other	19	5	17
Level of suspicion			
High	20	20	0
Moderate	9	0	0
Low	22	0	28
Primary type of arrest			
Respiratory	25	18	5
Cardiac	10	0	12
Both or data n/a	16	2	11
Mortality			
Deaths	18	6 (30%)	19 (68%)
Survivals	33	14 (70%)	8 (32%)

Modified from: Stross JK, Shasby DM, Harlan WR. An epidemic of mysterious cardiopulmonary arrests. *NEJM* 1976; **295**: 1107-10

tubing immediately before they became unable to breathe.[7] The two nurses were indicted by a grand jury in June 1976 on five charges of first degree murder and ten of poisoning with intent to injure.

The prosecution struggled to build its case in US District Court in Detroit. The evidence was entirely circumstantial and local press reports made it seem increasingly unlikely that they would ever be convicted.[8] Midway through the

13-week trial the judge threw out the murder indictment against one nurse, although he let most poisoning charges stand. After deliberating 93 hours over the course of 15 days, the jury found each of the nurses guilty of three poisoning charges and conspiracy, but acquitted one of the murder counts against her. The nurses' lawyers launched an immediate appeal. Several months later the conviction was overturned on the grounds that the verdict was against the weight of the evidence and the conduct of the prosecution was prejudicial. Although a new trial was ordered, it was never held and both nurses returned to nursing, one in Ann Arbor and one in Detroit.

Discussion

Serial health care killers are uncommon but are not as rare as most people believe. Details appear more often in the mass media, books, or forensic science journals than in widely-read medical journals. Yorker *et al* conducted a LexisNexis® search and published summaries of 90 cases in 20 countries between 1970 and 2006.[9] Furbee presented a smaller number of detailed case reports with a useful discussion of patterns, methods and personalities.[10] Retrospective studies of clusters or "epidemics" of unexplained cardiopulmonary arrests describe the investigative techniques used, with recommendations for regular proactive documentation to detect abnormal cardiopulmonary arrest and death rates. [11-13]

The 1975 pancuronium murders in Ann Arbor were among the first high profile serial killings by health care workers and stimulated the reinvestigation of the possible curare murders in New Jersey. [14-15] They were followed within a decade by: the unsolved digoxin poisonings in the cardiac unit of Toronto's Hospital for Sick Children in Canada; [16] the conviction of Texas licensed vocational nurse Genene Jones who killed between 11 and 46 infants and children with injections of heparin in a paediatric ICU and later suxamethonium in a clinic; [17 18] and the English nurse Beverley Allitt's poisoning of children at Grantham and Kesteven Hospital. [19 20] To most people the possibility of health care professionals' deliberately harming or killing patients was, and still is, unthinkable. Doctors persist in trying to find a medical explanation while institutions go into denial and are reluctant to document or investigate suspicions or inform the police.

The average number of Ann Arbor cardiopulmonary arrests from July 1974 through June 1975 was six per month. This rose to 24 in July 1975 and soared to 27 in the first two weeks of August. [6] Whether "regular documentation" of these numbers would have been sufficiently up-to-date to alert senior staff and

administrators earlier than Anne Hill's suspicions is debatable. Nineteen of the 20 highly suspicious arrests occurred when only the on-call medical and surgical residents were scheduled to be in the hospital. When that quiet or hectic shift was over, several days passed before their next on-call that might be just the opposite. The death rate did not increase dramatically, because patients whose respiratory arrests were treated promptly, were successfully resuscitated. What was remarkable was Anne Hill's hard work, persistence and courage in seeking a cause for her two patients' medically inexplicable arrests. She examined at least ten patients' charts in detail and others to a limited extent. When correlation with medical explanations or innocent medication errors was impossible, she appears to have agreed with Sherlock Holmes that, "when you have eliminated the impossible, whatever remains, however improbable, must be the truth".[21] The occurrence of ICU arrests during her late Friday afternoon tutorial on 15th August enabled her to be present and to demonstrate unequivocally, with a nerve stimulator and simple physical signs, the presence in all three patients of a nondepolarising neuromuscular blocking drug that had not been prescribed, and reversal of its effects with neostigmine. The poisonings ceased but who perpetrated them remains a mystery.

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JOSEPH, LORD LISTER (1827-1912) AND HIS CONTRIBUTIONS TO ANAESTHETICS

Dr Jean Horton. Cambridge
Past President, History of Anaesthesia Society
Emeritus Consultant Anaesthetist, Addenbrooke's Hospital, Cambridge

Introduction

I have always been interested in the life of Joseph Lister, Lord Lister (1827-1912). I was aware of him from a very early age and knew that he was a very famous surgeon. This was because we always had a print of him aged 75 on the dining room mantelpiece in our house in Weymouth (Figure 1). This is a print by Swaine of a portrait by Hugh Riviere. Also, my father, Robert Lister Horton was named Lister after Lord Lister and was always known as Lister Horton, but that is another story.

It is well known that Lister introduced antisepsis and aseptic techniques, which revolutionised surgical practice in the latter part of the nineteenth century but how many people are aware of his contributions to anaesthetics?

I did not realise that Lister had taken so much interest in anaesthetics until I bought a copy of Sir Rickman Godlee's book " Six Papers by Lord Lister", which includes his seminal paper "On Anaesthetics". Sir Rickman Godlee (1849-1925) was Lister's nephew, and biographer.[1 10]

This paper "On Anaesthetics" originally appeared in Holmes 'System of Surgery', first published in 1861 and revised in 1871 and 1883, and was one of those multiple author textbooks that were becoming increasingly popular and at the time was one of the most important of its kind in the United Kingdom. Lister also wrote the article on "Amputation" and was the only contributor not from London. [2 3]

I should have known about this article because certainly the following anaesthetists did know and have published comments on it. Joseph Clover,[4] K. Bryn Thomas,[5] Geoffrey Organe,[6] Stanley Sykes,[7] and David Zuck,[8] Barbara Duncum also discussed Lister's work in her book, ' The Development of Inhalation Anaesthesia'.[9]

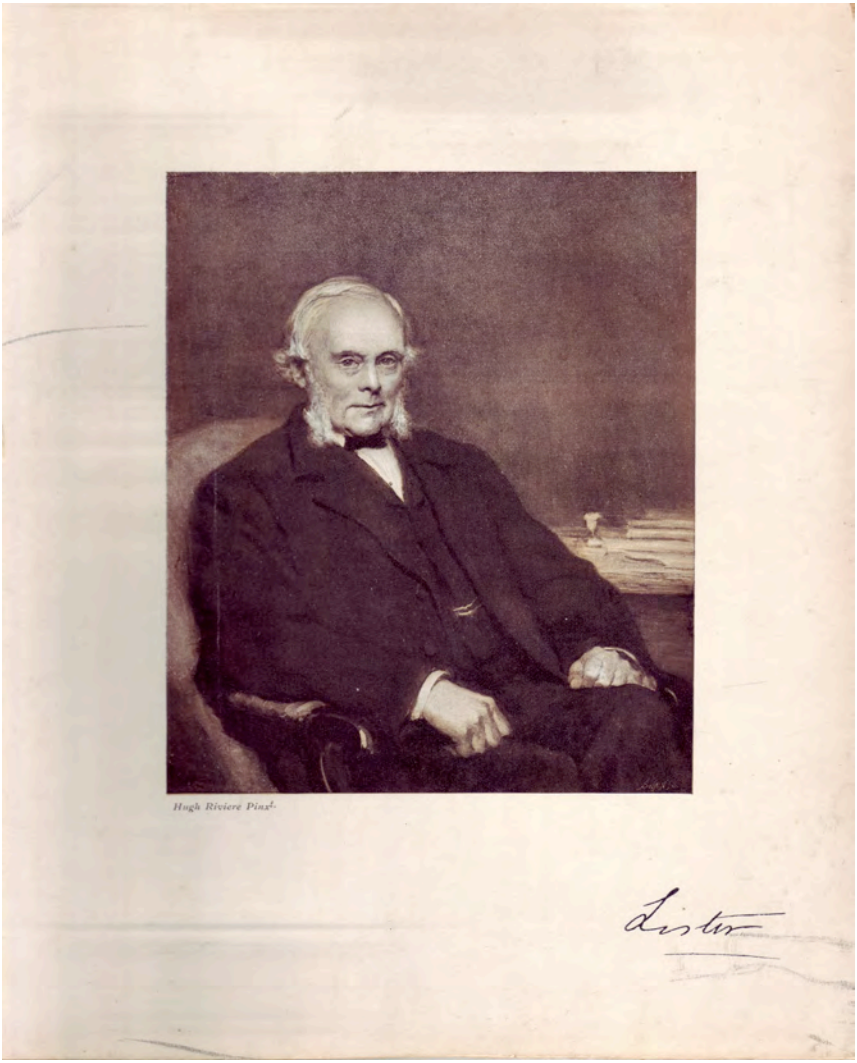

Fig. 1

Why was Lister interested in anaesthetics?

To have a better understanding of Lister's interest in anaesthetics we need to look at his background, life and career as they are significant for appreciating why he was interested and knew so much about anaesthetics and its history.[10-12]

Also it is important to understand the state of medicine and surgery in the 19th century. This can be no better explained than in the introduction to the 'The Collected Papers of Joseph, Baron Lister' prepared by a committee but the following words in the introduction bear the stamp of Rickman Godlee. [13]

"Those unacquainted with the position of surgery and the conditions prevalent in surgical wards in the middle of the 19th Century may not understand the difficulty and complexity of the problems presented to Lister and other surgeons. The operations undertaken then were very different from those of today (i.e.1909) and were often limited to saving life.

These operations were amputations for injury and disease, excision of tuberculous joints, amputation of the breast, removal of tumours, operations on jaw and tongue, skull trephining, strangulated hernia, urinary tract operations, and some plastic surgery, e.g. hare lip."

Although the introduction of anaesthesia had relieved the pain of surgery and many more operations could be performed, the big killer was still sepsis until Lister introduced his ideas on antisepsis.

In the same context consideration needs to be given to the general practice of medicine and surgery in the United Kingdom at least until the end of the Second World War and the advent of The National Health Service, with special emphasis on practice in remote areas.

The background and career of Joseph Lister [10 11 12]

Lister had always said he wanted to study medicine and be a surgeon, but his father, Joseph Jackson Lister, from a Quaker family, a wealthy wine merchant, and amateur microscopist, who introduced achromatic lenses and was elected a Fellow of the Royal Society (FRS) in 1832, persuaded the young Lister to first study for an arts degree and so in 1844 he enrolled in the Arts Faculty of University College London (UCL). As a Quaker and not a member of the Church of England he was unable to go to Oxford or Cambridge.

While he was still a student in the Arts Faculty he was present at the administration of the first ether anaesthetic in England on 21st December 1846, and this he confirmed in 1896 in Liverpool in his Presidential address to the

British Association for the Advancement of Science.[14] He was not a medical student in 1846 but Robert Liston had advertised the operation the day before and Lister shared lodgings with an Edward Palmer, who was a medical student, and seemed to have been a big influence in Lister's life. Palmer knew that something spectacular was about to take place and probably encouraged Lister to attend Liston's lectures. Liston would not have objected because he was also an FRS and probably knew Joseph Jackson Lister. Did this episode influence Lister's interest in anaesthetics?

Lister graduated BA in 1847, and after an attack of smallpox and a nervous breakdown commenced medical studies in 1848, at UCL and then University College Hospital. His father's influence had encouraged him to have an enquiring mind and he was familiar with the microscope. Encouraged while still a medical student to do research by his Professors at UCL, (William Sharpey, Professor of Physiology, Thomas Graham, Professor of Chemistry and Thomas Wharton Jones, Professor of Ophthalmology) he published two papers, based on his experiments "Observations on the contractile tissue of the iris", "Observations on the muscular tissue of the skin". This was no ordinary medical student !

As was the custom of the time, in 1851-1852 while still a medical student he was Physician's Assistant (House Physician) to Dr Walter Hayley Walshe (1812-1892) and then House Surgeon to Sir John Erichsen (1818-1896).

He qualified to practice medicine in 1852 as MRCS and FRCS and also graduated Bachelor of Medicine (MB) of London University. He had no particular plans and did not need to go out and earn a living as he was supported by his father and so William Sharpey, who was an Edinburgh graduate and friend of James Syme (1799-1870), the Edinburgh surgeon, encouraged Lister to go to see Syme and spend a month in Edinburgh and then go to surgical centres in Europe. He went to Edinburgh and initially stayed not for a month but for seven years, and admired the work of Syme. Also Syme was so impressed by the abilities of this young Quaker that he offered him the post of supernumerary clerk and then House Surgeon in Edinburgh Royal Infirmary (RIE). He was then 26 and older than the other residents who called him the 'Chief'. (I find it strange that this Englishman and English graduate should have been a resident at the RIE).

However, while he was in Edinburgh, both at the RIE and Minto House, Syme's private Hospital in Chambers Street, he would have seen the use of chloroform using the Scottish technique originally introduced by Sir James Young Simpson (1811-1870) and Lister obviously liked what he saw.

In 1855 he reported each week to *The Lancet*, sometimes with his own notes, Syme's complete series of lectures on Clinical Surgery at the University of Edinburgh, 22 lectures in all, delivered during the Winter Session of 1854-1855. Lecture no 3 is "Chloroform" in which Syme briefly describes the Edinburgh or Scottish Technique of administering chloroform, and also the method of relieving respiratory obstruction by pulling the tongue forward with artery forceps. Was this Syme's idea or Lister's? [15]

Following the untimely death in 1854 in the Crimea from cholera of the surgeon RJ Mackenzie, Lister took the opportunity to take over his lectures to medical students on the "Principles and Practice of Surgery", and so hired a lecture room at 4 High School Yards, near the Royal Infirmary. Lister's lecture series would certainly have included one on anaesthetics.

He was elected Assistant Surgeon to the Royal Infirmary in 1856 and had further opportunities to study and teach the administration of chloroform and remained in Edinburgh until 1860 when he was appointed Regius Professor of Clinical Surgery to the University of Glasgow.

Professor of clinical surgery, Glasgow 1860-1869

It was when he was in Glasgow that he did his original epoch making work on antisepsis. But significant for this presentation was that in 1860 he was invited by Timothy Holmes to contribute the article "On Anaesthetics" for his book "A System of Surgery", which was first published in 1861, a second edition in 1871 and the third in 1883. It has always seemed strange that Holmes did not invite JT Clover to contribute the article on anaesthetics. The other article by Lister in this textbook was on "Amputation". [2]

In the first part of the article "On Anaeshetics" he gives an account of the history of anaesthesia, then deals with the physiological and pathological principles necessary for safe anaesthesia and concludes with detailed instructions for the administration of chloroform based on the technique used in Scotland.

Although Lister's rules for the safe administration of chloroform using the Scottish technique, appear at the end of the article I put them here for a better understanding of his views on anaesthetics.

Lister's rules for the safe administration of chloroform from 1861 edition

"A drachm (3.5ml) or two of liquid chloroform having been sprinkled upon the middle of a folded towel, hold it near the face, taking care that free

space is afforded for the access of air beneath its edges, till the eyelids cease to move when the conjunctiva is touched with the finger. Meanwhile watch the breathing carefully, and if at any time it should become obstructed or strongly stertorous, suspend the administration and draw the tip of the tongue firmly forwards till the tendency to obstruction has disappeared."

He then stated *"These simple instructions may be acted upon by any intelligent medical man. The notion that extensive experience is required for the administration of chloroform is quite erroneous, and does great harm by weakening the confidence of the profession in this valuable agent."*

Every problem that faced him Lister investigated with experiments at his home, assisted by his wife Agnes, the daughter of James Syme. He knew John Snow believed that if more than a certain percentage of chloroform was inhaled then the heart would stop before respiration, and that when chloroform was administered from a folded cloth the concentration was 9.5%. Lister thought that this was a fallacious argument, so conducted his own experiment and showed that the chloroform concentration was only 4.5%, much of which dissipated into the surrounding air.

He also investigated stertorous breathing by inspecting his own larynx using a small oblique long-handled speculum and a common mirror reflecting bright sunlight, and showed that the stertor and obstruction was caused by vibration of the mucous membrane above the apices of the arytenoid cartilages and was cured by drawing out the tongue.

Professor of Clinical Surgery, Edinburgh 1869-1877

In 1869 following the death of James Syme, Lister was appointed to the Chair of Clinical Surgery in Edinburgh, and became known as the leading surgeon in Scotland. The second edition of Holmes's "System of Surgery" was published in 1871 and Lister commented that nine years had passed since he wrote the first article and the main doctrines had been confirmed.[3] Chloroform was safe when administered according to the rules laid down in the first article. He reaffirmed that *"The pulse is entirely disregarded, but vigilant attention is kept upon the respiration" "The appointment of a special chloroform-giver to a hospital is not only entirely unnecessary, but has the great disadvantage of investing the administration of chloroform with an air of needless mystery, and withholding from students the opportunity of being trained in an important duty which they may be called on to discharge on commencing practice".*

The 1871 Edition of "On anaesthetics" prompted an article in the *BMJ* of 8 July 1871 by Joseph Clover[4] on "Chloroform Accidents" in which he criticised Lister on five counts for maintaining that :-

1. In deaths from chloroform the breathing fails before the circulation.

2. The chief danger arises from laryngeal obstruction.
3. The chief duty of the administrator is to watch for laryngeal obstruction, and draw out the tongue with forceps when it occurs.
4. It is useless to watch the pulse.
5. Chloroform may be given as safely by means of a towel as by any apparatus.
   In his article Clover notes that he always watched the pulse as well as the breathing.

In the *British Medical Journal* of 29th July 1871 Lister replied, defending his technique, known as the Scottish Technique, in terms that today would probably give rise to litigation. *e.g. "He promulgates a mischievous doctrine. A pernicious piece of advice"*.[16]

The pulling forward of the tongue was then further supported by Professor McLeod of Glasgow in1876 as David Zuck pointed out in his presentation on "Props, tongue forceps and mouth gags" at the History of Anaesthesia Society meeting in Malvern 2006.[8,17]

Professor of Surgery, King's College Hospital, London 1877-1892

In 1877 aged 50 Lister was invited to replace the late Sir William Fergusson as Professor of Clinical Surgery at King's College Hospital London (KCH), and so left Edinburgh and remained at KCH until he retired from active surgical work in 1892. In 1883 while he was at KCH, a third edition of Holmes's "System of Surgery" was published with Lister updating his article "On Anaesthetics", and making the following comments, which showed that he was fully aware of developments in anaesthesia.
Twelve years had passed since the second edition and 22 years since the first. He noted that because of supposed greater safety that ether had superseded chloroform in the practice of many British surgeons. He mentions the inhaler introduced by Dr Ormsby of Dublin and modified by the late Dr Clover, but commented that this produced partial asphyxia combined with rebreathing.

He continued to instruct the students to never touch the pulse so that their attention was not distracted from the respiration.

He noted that Junker's inhaler acted admirably in experienced hands, but the bellows was irksome and such a special apparatus not always available, and liable to break down. He now seemed to prefer a smaller framed Skinner's mask using coarse linen instead of flannel. He mentions the use of nitrous oxide for induction followed by maintenance with ether. Lister was also aware of the use of preoperative morphine and of the dangers of preoperative dehydration which he overcame by giving a cup of tea or beef tea two hours before operations.[3]

Some of the criticisms of Lister and anaesthetics

Stanley Sykes in Part 3 (Edited by Richard Ellis) of his *Essays on the first hundred years of anaesthesia* denounces Lister in 15 pages, calling the article in Holmes "*inept, futile, ill-informed and bigoted*".[7]

Geoffrey Organe in the Lister Centenary Number of the British Journal of Surgery 1967 wrote that Lister's teaching died hard and was to hold back the progress of anaesthesia in Scotland until comparatively recently.[6]

Conclusions

SO WHAT WAS LISTER'S LEGACY TO ANAESTHESIA?

1. He was the first person to do fundamental research on respiratory obstruction.

2. I can do no better than quote from Hamilton Russell's 'Reminiscences of the Chief'.[18]
"He sent out into practice an army of first-rate administrators whom he had himself taught to give chloroform confidently and safely".

My personal conclusion is that it is interesting that up until the end of World War II, the favoured technique of admnistering ether and chloroform was to use an open mask and not apparatus or inhalers.

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THE LIFE OF DR PETER BASKETT *

Dr J Nolan
Consultant Anaesthetist, Royal United Hospital Bath

Peter John Firth Baskett, Past President of the Society of Anaesthetists of the South Western region (SASWR) and one of the world's leading figures in cardiopulmonary resuscitation, died on 18th April 2008. In the early 1970s he developed advanced training for the ambulance personnel, who were amongst the first paramedics in Europe. Peter was also responsible for introducing Entonox into the ambulance service in the United Kingdom. Along with John Zorab, Peter established the Intensive Care Unit at Frenchay hospital, Bristol in 1967.

Peter was a founder member and later, Chairman (1981-85), of the British Association for Immediate Care Schemes (BASICS). He was also a founder member of a committee that in 1981 evolved from BASICS – the Community Resuscitation Advisory Committee (CRAC). In 1984, this committee became the Resuscitation Council (UK) – the first Resuscitation Council in Europe. Five years later, Peter was one of the founding members of the European Resuscitation Council (ERC) and was elected Chairman (1989-94). Over 100 publications attest to his knowledge of CPR and airway management. He was Editor-in-Chief of the journal *Resuscitation* from 1997 until his death. During his 'retirement', Peter personally introduced the European Advanced Life Support (ALS) course into 22 countries.

Peter was elected to the Association of Anaesthetists of Great Britain and Ireland (AAGBI) Council in 1976 and held several positions until eventually becoming President in 1990. Peter was Chief Medical Officer to Castle Combe motor racing circuit from 1968 until the late 90s. He continued to attend motor sport events as a doctor until he became ill in 2007.

* Abstract only

A PHYSICIAN FIGHTS A SURGEON *

Dr J C Sill
Anesthesiology, Mayo Clinic, Rochester, USA

It was a cold February morning in Revolutionary 1645 when Thomas Sydenham, then a 19 year old medical student serving as a coronet, rode with the Parliamentary cavalry to drive a Royalist occupying force from Weymouth. Within the city, 20 year old barber-surgeon Richard Wiseman tended to the Royalist wounded. Sydenham and Wiseman would ultimately become two of England's greatest 17th century physicians – Sydenham as "England's Hippocrates" and Wiseman as a pioneer of surgery. Historical fate determined that they would fight again – at Worcester in 1653, one of the final battles of the civil war. By now Sydenham was an officer in Cromwell's New Model Army and Wiseman a leading surgeon with Charles II's soon to be defeated forces.

Why did they fight? The answer lies in the dialectical moment of the English Revolution. Wiseman, perhaps due to noble birth, perhaps due to favours shown to the College of Surgeons by Charles I, fought for the crown. In contrast, Sydenham, a man of Cromwell's "middling sort", fought for liberty. Concepts of democracy and social equality prevalent in the Leveler influenced Parliamentary army were undoubtedly the birthplace of Sydenham's future ideas concerning society, health, epidemiology and universal healthcare.

Following the Revolution, Sydenham and Wiseman's empirical, open minded methods and insights provided evolutionary steps on the road to modern medicine. The radical Sydenham achieved this success despite the new conservatism while Wiseman, a Royalist, prospered both financially and scientifically following Charles II's restoration and became the country's Principal Surgeon.

* Abstract only

GUEST LECTURE – ABSTRACT

THE HISTORY OF HYDROTHERAPY IN BATH

Dr Michael Coupe
Consultant Anaesthetist, Royal United Hospital Bath

Water has played a vital part in the life of Bath since the Celtic times, through the Roman occupation and into the period of Saxon rule. It played a pivotal role in Bath's Georgian renaissance and its influence can still be felt in Bath today, in sites such as the Thermae Bath Spa, and in the Pump Room, where the Society's dinner was held. As an anaesthetist who is also a practitioner in pain medicine, I am aware of the benefits that patients still obtain from water treatment, and I am delighted to be invited to give a talk on the history and uses of hydrotherapy in Bath, a city that has water at its heart more than any other in Britain.

POSTER FROM THE LONDON MEETING (31 October 2008)

JOHN SNOW AND THE MEDICAL READING SOCIETY OF BRISTOL

John Powell, Consultant Emeritus, Southmead Hospital, Bristol

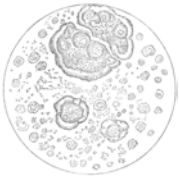
Introduction

The Medical Reading Society of Bristol (MRS) was founded by 11 Bristol doctors in March 1807 "for the purpose of promoting medical knowledge and friendly intercourse among its members, and purchasing medical books"[1]. It soon elected a 12th member and has never had more than 12 members at any one time. With few exceptions it has met monthly since its foundation. Members of the society interacted with John Snow in the fields of both cholera and anaesthesia.

Cholera

In August 1849 Snow published his pamphlet *On the Mode of Communication of Cholera*[2]. In September William Budd, "Bristol's most physician"[3], published *Malignant Cholera, its mode of propagation and prevention*[4]. Both men agreed that cholera was a waterborne disease, but Budd thought it could also be transmitted by inhalation and that a fungus was the causative organism. Publication of the work had been timed to coincide with the report of microscopical studies by his colleague Joseph Swayne[5]. Budd was not a member of the MRS at this time (member of 1855 -1869), but Swayne was (member 1845 – 1858). In October Swayne was present at a lecture on cholera at the Westminster Medical Society[6]. In discussion afterwards Swayne again put forward the Bristol view that a fungus was the causative organism.

William Budd
1811 – 1876



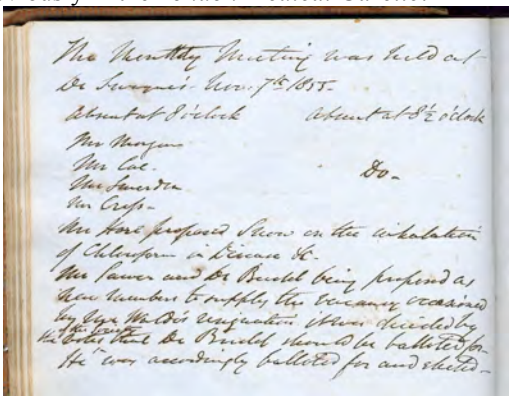
their "fungus"
(soon refuted)

Joseph Swayne
1816 - 1895

Between 1832 and 1856 the MRS bought 13 pamphlets/books on cholera[7], the last of which, proposed by Budd , was John Simon's *Reports on the Last Two Cholera epidemics in London, as affected by the consumption of the impure water*[8]. However Simon did not acknowledge John Snow's painstaking studies during the 1854/5 epidemic, of which his own work was corroboration and an extension. At a meeting of the Bristol Medical Association in Birmingham in August 1856 Budd strongly supported the motion of regret at this omission, once more giving Snow due recognition for his "admirable, long prior and entirely original researches"[9].

Anaesthesia

The Society bought two pamphlets on anaesthesia by Snow. However in November 1856 *'Snow on the inhalation of chloroform in disease, etc'* was proposed but was not purchased. Presumably this referred to the second collection, parts 8-16, of *On Narcotism by the inhalation of vapours* that had been published previously in the *London Medical Gazette*.



The monthly meeting was held at Dr Swayne's November 7th, 1855.
Absent at 8 o'clock. Mr Morgan, Mr Coe, Mr Smerdon and Mr Cross. Absent at 81/2 o'clock ditto Mr Hore proposed Snow on the inhalation of Chloroform in Disease, etc. Mr Sawer and Dr Budd being proposed as new members to supply the vacancy occasioned by Mr Waldo's resignation, it was decided by the votes of the Society that Dr Budd should be balloted for .
He was accordingly balloted for and elected.

Pamphlets on anaesthesia purchased by the Medical Reading Society 1847-1856

Purchased	Title	Proposer
1847 Oct	**Snow J**. *On the Inhalation of the Vapour of Ether in Surgical Operations.* London: Churchill, 1847.	Mr **Morgan**
1848 Mar	Curling TB *The Advantages of Ether and Chloroform in Operative Surgery*, London: Highley, 1848.	Mr **Morgan**
Oct	Simpson JY. *Answer to religious objections to the use of chloroform in midwifery.* Edinburgh: Sutherland & Knox, 1847.	Dr **Swayne**
Oct	Protheroe Smith *Scriptural authority for the mitigation of the pains of labour, by chloroform and other anaesthetic agents*. London: Highley, 1848.	Dr **Swayne**
A Oct	Merriman S. *Arguments against the indiscriminate use of Chloroform in Midwifery*. London: Churchill, 1848.	Dr **Swayne**
1855	Murphy EW. *Chloroform: its properties and safety in childbirth*. London: Wilson and Maberley, 1855.	Dr **Swayne**
1858	**Snow J**. *On Chloroform and other Anaesthetics,* ed. Richardson BW. London: Churchill, 1858.	Dr **Budd**

So by March 1848 William Morgan, surgeon to the Bristol Royal Infirmary (member of MRS 1825 - 1878) had access to two very positive papers about anaesthesia, including one by Snow, that he himself had proposed. Yet the first anaesthetic at the infirmary was not given until August 1850, in contrast to the Bristol Gen Hospital where anaesthesia was enthusiastically received[10-12].

In April 1857 Snow reported a death under amylene* anaesthesia[13]. Augustin Prichard (member of MRS 1844 - 1885) in his presidential address to the Bristol and Bath branch of the British Medical Association[14] was scathing in his criticism of amylene and, by implication at least, of Snow. Snow defended both himself and amylene strongly at this time[15], though he stopped using it later that year after a second death. He finished his riposte to Prichard with this sentence:

> *I doubt whether the style of sarcastic reprimand, if not exhortation, which he has employed, will be calculated to encourage other laborious attempt to advance the science and practice of medicine.*

In February 1858 a death under chloroform anaesthesia occurred at the Bristol Royal Infirmary[16]. Prichard reported this in the *British Medical Journal (BMJ)*. Snow commented the following week, and a series of letters took place in the pages of the *BMJ* between Prichard and Snow. Snow reminded Prichard that a death had also occurred in Bristol in 1854, and said that if chloroform was a problem why not go back to using ether? Prichard reminded Snow that he too had had a death with chloroform. In his final acrimonious letter he wrote:

> *I venture to prophesy that anaesthetics will more and more fall into disuse and will ultimately be had recourse to only for the most severe or protracted operations.*

William Morgan
1809 - ?

John Snow
1813 – 1858

Augustin Prichard
1819 – 1898

During his final illness Snow was attended by William Budd's older a brother, George.

*C_5H_{10} not $C_{10}H_{10}$ as Snow stated[17].

References

A full list of references, many with annotation and direct link to source, can be found at
www.johnpowell.net/jsmrs/index.html, as can the text and pictures above.
Comments/questions to John Powell at john@johnpowell.net.
The MRS website is at www.medicalreading.org.uk.