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THE HISTORY OF ANAESTHESIA SOCIETY PROCEEDINGS

Volume 32

2003 Summer Scientific Meeting, Assembly Rooms, Ludlow

13th & 14th June 2003

Contents of Volume 32

HISTORY OF ANAESTHESIA SOCIETY

2003 Summer Scientific Meeting, Assembly Rooms, Ludlow

Organiser
Dr Adrian Kuipers, Shrewsbury

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HISTORY OF ANAESTHESIA SOCIETY

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Editorial

Anyone making a list of suitable places to hold a meeting of the Society would surely place Ludlow at or very near the top, because of its association with Hickman. In any case it has been described as one of the finest market towns in the country. Thanks to Adrian Kuipers, formerly a consultant anaesthetist at Shrewsbury who lives in Shropshire, this became a reality in June 2003 and it was a varied and interesting meeting. There were two talks on local history, and an opportunity to visit the Ludlow museum which has a Hickman section. Outings were arranged to Bromfield church, where he is buried, and Tenbury Wells where he died. At the end of the meeting there was a guided walk round Ludlow (for those with energy left).

Appropriately, since it was Hickman's chosen anaesthetic agent, there was a paper on the history of carbon dioxide in anaesthesia. Otherwise there was no particular theme, and subjects varied from analgesia in ancient Greece to 19th century features such as the French gauge, Startin's inhaler and criminal use of chloroform. From our own era we heard about history of anaesthesia in Hong Kong, cyclopropane, and the evolution of rapid sequence induction. There was a surprise to discover that a member of the Mayo family acted as an anaesthetic assistant before reaching his majority, and that a dummy had been constructed so that Professor Pask need not be thrown into the river Tyne (as he had previously been into a swimming pool).

Our warmest thanks are due to Adrian Kuipers, Marion Kuipers, and Gillian Padmore for their organisation of a successful meeting.

We owe an apology to Drs Essex-Lopresti, Fairer, Ferguson, Flanagan, Florence and Mrs Garner, whose names were omitted from the list of those attending the Sheffield meeting in November 2005.

PMED

FUTURE EVENTS

2004 7 April – Poynter Lecture at the Wellcome Building, Euston Road, London.
Jenny Uglow: *Medicine and the Lunar Society.*

2-3 July
HAS Summer Meeting, Grange-over-Sands, Cumbria
Contact: Dr Miles Rucklidge. Email: Miles@ohfi.freeserve.co.uk

13 November
HAS Autumn Meeting, Liverpool
Contact: Dr Peter Drury. Email: pmedrury@aol.com
or: Dr Anne Florence Email: gasflo@btinternet.com

2005 March
Joint Meeting with the Section of Anaesthetics, Royal Society of Medicine.
To be confirmed

14-16 September
Sixth International Symposium on the History of Anaesthesia, Cambridge

Speakers at Ludlow

Dr H Connor

Dr J Poll

Dr Z Lett

Dr N Adams

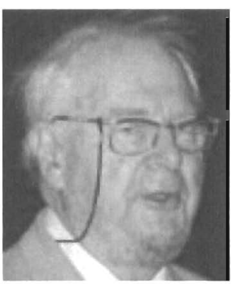
Dr G Kalantzis

Dr O Warner

Dr R Flannagan

Dr G Enever

Dr D Byer



Prof. R Bodman

Dr Megan Jones

Mr D Lloyd

Meeting of the History of Anaesthesia Society
Ludlow, 13 – 14 June 2003

Participants

Dr C Adam	Leven
Dr C N Adams	Bury St Edmunds
Dr A K Adams	Cambridge
Dr E Armitage	Hassocks
Dr A M Barr	Reading
Dr M Barton	London
Dr J A Bennett	Alveston
Dr F E Bennetts	Wokingham
Dr R C Birt	Rochford
Dr J Blizzard	Chelmsford
Prof R I Bodman	Cork
Dr T B Boulton	Reading
Dr E Bradshaw	London
Dr D Byer	Rochester, Minnesota
Dr J Chamberlain-Webber	Brighton
Dr J Clover	Shrewsbury
Dr A Clover	Shrewsbury
Dr H Connor	Hereford
Dr P M Drury	Liverpool
Dr G Enever	Newcastle
Dr A Ferguson	Broadstairs
Dr R Flanagan	London
Dr A M Florence	Liverpool
Mrs S Garner	Leicester
Dr M Gough	Grimsby
Prof T C Gray	Liverpool
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Dr G Hamlin	Blackburn
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Dr M Harcup	Malvern
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Dr J M Horton	Cambridge
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Dr D D C Howat	London
Dr M Inman	Plymouth
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Dr R Johnstone	Kidderminster
Dr M Jones	Bury St Edmunds
Dr G Jones	Edinburgh
Dr G Kalantzis	Bristol
Dr A Kuipers	Shrewsbury
Dr R Laishley	London
Sir Alan Leslie	London
Dr Z Lett	Hong Kong
Mr D Lloyd	Ludlow
Dr K McLeod	Huntingdon
Dr C A B McLaren	Wotton Bassett
Dr I McLellan	Leicester
Dr L Mendonca	Potters Bar
Dr P Morris	Leicester
Dr J Mulvein	Bristol
Dr A O'Callaghan	London
Dr A Padfield	Sheffield
Dr J Parker	Colchester
Dr Y Pole	Manchester
Dr J Poll	The Hague
Dr J Pring	Penzance
Mr F Pyke	London
Dr N Rose	Ledbury
Dr E Rouse	Colwyn Bay
Dr M Rucklidge	Lancaster
Dr G Rushman	Thame
Dr J Shah	Birmingham
Dr B Smith	Birmingham
Dr T Smith	Reading
Dr U Smith	Birmingham
Dr J Stevens	London
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Dr O Warner	Oxford
Dr D White	Beaconsfield
Dr D Wilkinson	London
Dr T M Young	Altrincham
Dr D Zuck	London

THE EARLY HISTORY OF ANAESTHESIA IN HEREFORD

Dr H Connor
Consultant Physician, County Hospital, Hereford

The arrival of the news in Hereford

It is likely that the first news that doctors in Hereford would have received of the early anaesthetics in London and of the earlier events in Boston would have been when they read the London *Times* on 28 December 1846.[1] The London papers reached Hereford on the day of publication, coming by rail to Gloucester and then by coach to Hereford. Some of the newspapers would have been destined for private individuals, some for the subscription coffee rooms in hotels, and others for local inns, in some of which it was the custom at this time to employ a newsreader.[2] Only two days earlier the *Hereford Times* had carried a report from a northern newspaper describing the successful use of mesmerism for a dental extraction, but the editors of both the *Hereford Times* and the *Hereford Journal* may have been sceptical of the news about etherisation, because neither carried the story until after reports had been published in the medical journals.[3]

The first anaesthetics in Hereford

Etherisation had been used in many smaller towns before it was employed in Hereford and a letter to the *Hereford Times*, written on 25 January 1847, asked 'if any steps are being taken at the Hereford Infirmary to promote by far the most important improvement of modern times in operative surgery?'.[4] In fact, the first operation under ether had already been performed on 25 January when a 3-4 lb tumour was removed from the back of a 60 year old woman.[5,6] The operation lasted fifteen minutes, during which time: 'the woman continued free from suffering, neither uttering a groan nor making any complaint, although the operation must have been extremely painful.[5] The surgeon was Thomas Cam, who was the fourth generation of his family to practise in the city and also an ardent liberal, an alderman for thirty years and a mayor on two occasions.[7]

The second major operation under ether, on 27 January, was a transfemoral amputation in a 13 year old boy who had chronic disease of the knee joint. The limb was amputated in three quarters of a minute and the lad awoke while the arteries were being tied but felt no pain. The report tells us that nearly all the medical gentleman of the City were present.[8] The surgeon was Charles Lingen[9] who, sixteen years later, was to feature in a case which achieved national coverage as one of the earliest instances of litigation brought against a doctor by a former patient.[10] The proceedings, although unsuccessful, were very protracted and the anguish caused to Lingen probably contributed to his resignation from the Infirmary in 1864, although the published reason for his resignation was the increase in his private practice.[11]

Joseph Levason, one of Hereford's two surgeon-dentists, was using ether for dental extractions before the end of January 1847 and was advertising this service in the local press from early February.[12] On 27 January Levason attended the County Gaol, at the request of its Medical Officer, Dr Henry Graves Bull, to extract a prisoner's tooth. The ether was administered using an inhaler designed by Bull,[13] who was later to be appointed as physician to the Infirmary and who, even by the standards of Victorian doctors, was a very considerable polymath.[14] In the early etherisations at the Infirmary, the ether had been given using a simple bladder.[15] As elsewhere, this technique was not always successful,[16] and on 13 February the *Hereford Times* carried a letter asking:

> 'May not the imperfect action of ether, in those cases where success was incomplete, have been occasioned by the absence of proper scientific apparatus? Surely the medical staff of our Infirmary have the power of at once ordering so important an instrument without waiting for any special authority.'[17]

(Some things have not changed in the last century and a half!) The first reported use of an inhaler in the Infirmary was not until two months later, when an inhaler designed by the Infirmary's dispenser, Mr Glegg Bullock, was used for an amputation by Mr Cam.[18]

Etherisation was soon being used elsewhere in the County - on 8 February in Leominster where the ether was prepared and administered by a local chemist,[19] in Kington on 26 February using Startin's apparatus,[20] and in Weobley on 6 March using Mr Tracey's apparatus to amputate the fingers of a 15 year old boy whose hand had been trapped in a straw crushing machine.[21]

Local effects of the first death attributed to ether

As elsewhere, the advent of surgical etherisation led to a massive increase in the number of operations,[22] but a note of caution was introduced after reports of the first death attributed to ether on 19 March 1847.[23] The *Hereford Times*, which was strongly in favour of anaesthesia, omitted all mention of the death of Ann Parkinson of Grantham, but the *Hereford Journal*, which took a more neutral line, carried a detailed report of the inquest and post-mortem findings.[24] One immediate effect was that the weekly advertisements of the surgeon-dentist, Joseph Levason, no longer made any reference to the availability of ether in his practice. Whether Levason continued to use ether is not recorded, but certainly he never referred to it again in his advertisements. In the report of the first use of ether in Hereford after the death of Ann Parkinson, it is specifically mentioned that the ether was administered at the patient's request.[25] The operation, which lasted one minute, was for the amputation of a leg, and it would appear that, at this time, the medical staff were only using ether if requested to do so by the patient.

Chloroform

Simpson's first report on the use of chloroform in November 1847 was described by both of the Hereford newspapers, and it was also mentioned that, by the time of their reports, it had already been used in Cheltenham and Birmingham.[26] The earliest reported use of chloroform in Herefordshire was in the market town of Kington in January 1848 when a veterinary surgeon removed a tumour from the horse of one of the medical surgeons.[27] The first documented human use was in late March 1848, two months after the first death attributed to chloroform,[28] (an event which was not reported at the time by either of the Hereford newspapers, though they did refer to it some months later[29]) the patient being a farm labourer who required amputation of both hands which had been trapped in a chaff-cutting machine.[30]

Local anaesthesia

The Hereford newspapers made no mention of local anaesthesia, but it may well have been used in the city in 1866 because in September of that year a local surgeon, Dr Henry Vevers, addressed the Herefordshire Medical Association on 'Dr Richardson's method of inducing local anaesthesia'.[31] This is the first recorded instance of a postgraduate medical lecture in Hereford, and it was probably based on the paper published by Dr Benjamin Ward Richardson seven months earlier.[32]

Discussion

Surgeons in Hereford appear to have been relatively cautious about introducing both ether and chloroform, delaying the use of both agents until after reports from many places outside London. After the introduction of ether there, as elsewhere, the numbers of operations increased. Administration using a bladder was often unsuccessful and some practitioners designed their own inhalers. The description of the patient during the first etherisation, for an operation which lasted fifteen minutes, suggests that she was only lightly anaesthetised and was possibly even awake but insensible to pain. However, during early amputations under ether, the patients appear to have been fully but only briefly anaesthetised and the surgeons did not alter their usual practice of amputating the limb as rapidly as possible. Public interest in anaesthesia is reflected in the number of reports in local newspapers which, in Hereford, were on a par with reports on cholera and Chartism, and greater than the numbers of reports on railway accidents.[33] Public demand for dental anaesthesia was evident from the advertisements of a local dentist, but news of the first death attributed to anaesthesia clearly introduced a sense of caution. Anaesthesia was also used in veterinary practice.

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oooOooo

100 YEARS AGO

Hospitals and the state: The Liverpool Medical Club have passed a resolution 'that all public hospitals should be taken over by the state'. Why should the resolution stop here? Why not all medical attendance? Free education may or may not have been a mistake. There is at least quite as much, and probably a good deal more, to be said in favour of free medical attendance than ever has been said in favour of free education.
Keary JH. Correspondence. *British Medical Journal* 1903: **1**:943.

Postgraduate Instruction in Anaesthetics: As far as we are aware there are no special arrangements at the hospitals for instruction in anaesthetics, except in the case of the West London Hospital, Hammersmith. Some hospital anaesthetists make arrangements with qualified practitioners whereby the latter can receive instruction in anaesthetics. The fees can be ascertained by writing to the anaesthetists.
Letters, Notes and Answers. *British Medical Journal* 1903; **1**:452-453.

THE FRENCH CATHETER SIZE - OUR UROLOGICAL HERITAGE

Dr J S Pöll

Consultant Anaesthetist
Medical Centre Haaglanden, The Hague, Netherlands

Introduction

Anaesthesia has become applied pharmacology, physiology, anatomy and chemistry. Nevertheless there is a vast amount of craftwork in the speciality. Anaesthetists do not want to be called the plumbers of medicine or supradiaphragmatic urologists, but introducing tubes and vascular catheters is their stock in trade. With access devices as needles, catheters, cannulas and tubes the anaesthetist is able to control central nervous system, ventilation and circulation under every circumstance. The diameters of these access devices reveal roots in older, pre-anaesthetic times. On labels of anaesthetic utensils several different units of size are used: the gauge, inch, centimetre, Charrière and French Size.

Origin

The French Size is the same as the Charrière Size. It is named after Joseph-Frédéric-Benoît Charrière, instrument maker in Paris. He was born on 19 March 1803 in Switzerland into a cutler's family, but moved to Paris in 1816 to become instrument maker.[1-2] Most 19th century instrument makers (Luer, Weiss) were originally cutlers.[3] Charrière made his gauge, a 30-hole mould with increments of one third of a millimetre, in the 1830s as an appropriate range of sizes for his urological dilating bougies.[4] Until then most instruments came from Great Britain, for example from the Weiss Company in London. Weiss used the English Size with increments of half a millimetre.[5]

Design

An original specimen of the Charrière Gauge is held in the Science Museum in London. It is in perfect condition with no corrosion or other damage observable (Figure 1). Each hole has two numbers: on top the Charrière Size and below it the diameter in mm.

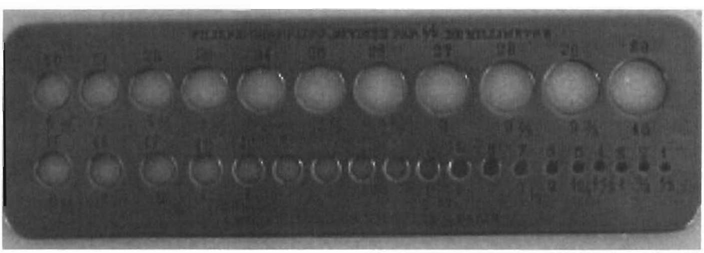

Figure 1
Filière Charrière, divisée par 1/3 de millimètre
A filière is a draw bench, used for wiredrawing or gauging.
Bottom inscription: *9, rue de l'École de Médicine* à *Paris*

Measurements make clear that the holes are not multiples of 1/3 mm. All holes are a bit (0.2-0.3 mm) wider then expected on the idea that 1 Charrière is one third of a millimetre (actually this would be impossible because 1/3 is not an exact number but a recurring fraction). The hole corresponding with Charrière 24, expected to be 8 mm, is 8.3 mm, and so on (Table 1). Probably Charrière designed his size as a 'go, no go gauge'.[6] The smallest hole through which a bougie passes is the Charrière Size of that bougie. One must realize that passing a bougie of 9 mm through a hole that is also exact 9 mm is difficult and could lead to mistakes.

Charrière Size	Expected (mm)	Measured (mm)
24	8	8.3
25	$8^1/_3$	8.58
26	$8^2/_3$	8.93
27	9	9.25
28	$9^1/_3$	9.5
29	$9^2/_3$	9.93
30	10	10.28

Table 1. Expected and measured diameter of Charrière Sizes

Internationalisation

Sir Henry Thompson, Surgeon-Extraordinary to His Majesty the King of the Belgians and Professor of Clinical Surgery at University College Hospital in London, published his clinical lectures on diseases of the urinary organs.[7] Urology in those days consisted of dilatation of the urethra to let stones pass or to treat strictures and stenosis. Dilatation was done by introducing bougies of increasing diameter. For dilatation Thompson recommended the French Size (as he called the Charrière Size), with increments of ⅓ mm, in preference to the English Size with increments of ½ mm. The French Size was more gradual, which meant less irritation. With typical French elegance Charrière considered increments of one third of a millimetre to be more convenient and comfortable for the patient. According to the catalogues of instrument makers around 1900 it became the leading size for urological catheters and instruments. Allen & Hanburys Ltd in London and Georg Tiemann in New York used the French Size.[8-9]

The Rüsch Factory in Waiblingen, Germany, originally a rubber catheter company later a leading endotracheal tube manufacturer, also used the French Size.[10] According to a gauge from 1895, kept in the Rüsch storage, the German Size was the same as the French Size (Figure 2).

Figure 2
Gauge from Rüsch factory, dated 1895.
Outer row: *Deutsch und Französisch,* inner row: *Englisch.*

Significance for the history of anaesthesia

Besides the use in urology, catheters became the universal sterile tubing in the hospital and were used to establish new invasive techniques. Some early endotracheal tubes used for tracheal insufflation around 1910 were urethral catheters.[11] The first continuous regional techniques were established with ureteral catheters.[12] Fogarty used in 1963 a ureteral catheter for his first embolectomy catheter.[13] The continued existence of the French Size in anaesthetic access devices such as endotracheal and endobronchial tubes, intravenous catheters, central venous catheters and some epidural and spinal catheters makes it likely that their prototypes were urological catheters. Direct access to the central nervous system, ventilation and circulation marks an important, if not decisive, step in the evolution of the anaesthetic speciality. The French Size, inherited from urology, runs through it like a thread.

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oooOooo

From Overseas

In America there exist professional anaesthetists. This specialty is being praised in Germany. I cannot think of anything more dull.
Attributed to August Bier (1861-1949) - German Professor of Surgery.

The greatest discoveries of surgery are anaesthesia, asepsis and roentgenology - and none was made by a surgeon.
Martin H Fischer. 1879-1962 - US physician and writer
First published in *Fischerisms:* Howard Fabing and Ray Marr 1944.

These were submitted by Anne Florence who is reviewing *The Oxford Dictionary of Medical Quotations* for the British Journal of Anaesthesia. There could be more where these came from.

ANAESTHESIA AND INTENSIVE CARE IN HONG KONG
From rags to riches

Dr Z Lett
Formerly Senior Consultant Anaesthetist
Government Medical and Health Services, Hong Kong

Introduction

There is a fair amount of evidence that in Hong Kong the development of Anaesthesia[1-5] and Intensive Care[6] has been on course. The author was able to say recently 'Anaesthesia in Hong Kong has come a long way from humble beginnings, has stood the test of time and is being catapulted into the 21st century'. A similar assessment appeared in a book review by Saunders: 'Hong Kong has become a net exporter of anaesthetic knowledge'.[7]

Earlier Reports

In contrast the late Dr George Thomas, who graduated in 1912 from the Hong Kong College of Medicine is on record as saying 'Anaesthesia at that time was regarded so lightly (I would say even contemptuously) that anyone, even a medical student, would not only be allowed but actually encouraged to give anaesthesia'. Chloroform and ether were the routine anaesthetics. Morphine and atropine were administered hypodermically beforehand. Warmed ether was a refinement.[8] Dr Thomas, though not an anaesthetist himself, helped to establish the Society of Anaesthetists of Hong Kong.

Later Dr HPL Ozorio, who was a graduate of Hong Kong Medical Faculty just before the 2nd World War (and an inventor, raconteur, musician and expert on cricket and tropical fish), wrote that practicing anaesthesia during the period 1945-1954 was like 'a lonely voice crying in the wilderness'.[9] Another pertinent comment on the prevailing standards at the time was that of Prof G B Ong, who stated 'the standards and methods of anaesthesia were generally unsatisfactory and in need of improvement'.[10] The author has tried to recognise the events and personalities which led to the present more favourable position. It is not possible, in the space available, to enumerate all who deserve credit, and our gratitude, for this achievement.

Anaesthesia as a separate specialty

In 1953 the Government of Hong Kong approved the new post of Specialist in Anaesthesia (since it was then a British Crown Colony it also needed the blessing of HM Colonial Office). Advertisements were placed at first locally, and later in international professional journals, including the *British Medical Journal* and the *Lancet*. The author, who was working at the time in the Sheffield Region, was offered the appointment of First Specialist (Anaesthesia). The appointment embraced all relevant surgical work for the Department of Surgery, University of Hong Kong, including the teaching of medical students. There was initially no Department of Anaesthesia, the Department of Surgery serving as a temporary home until much later.[6]

The Society of Anaesthetists of Hong Kong (SAHK)

Following his arrival in Hong Kong in 1954 the author, in close association with Dr Ozorio embarked on the formation of a Professional Society of Anaesthetists. As there was a paucity of doctors engaged in anaesthesia at the time, a number of surgeons and other non-anaesthetists helped with the process of founding the Society. The inaugural meeting was held on the evening of 17 June 1954. The aims of the SAHK were proposed and voted in at the first meeting. They were (and remain as objectives):

i) to promote continued interest in the art and science of anaesthesia;
ii) to create and maintain favourable conditions for training of anaesthetists in this area;
iii) to hold clinical meetings, lectures, film shows, discussions, conferences, and symposia with special emphasis on anaesthetic and allied questions;
iv) to educate indirectly the public of Hong Kong in a strictly ethical and professional manner on the importance of this branch of Medicine; to dispel present superstitions and wrong impressions that may prove detrimental to the advance of the science of anaesthesia, and therefore detrimental to the safety and well-being of the patients.

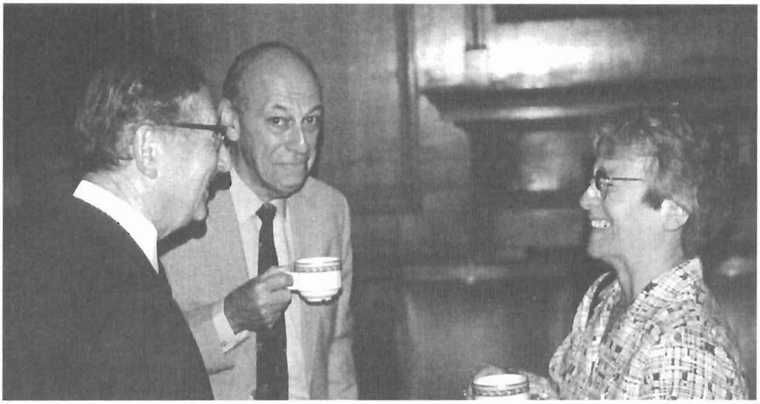
After these aims and objectives were voted on and approved, the author spoke on 'Present views on the physiology and pharmacology of the neuro-muscular junction and some possibilities of neuro-muscular block'.[11] Editors of *Anaesthesia* were always sensitive to the needs of our fledgling SAHK. The activities and proceedings were reported in the overseas section. The SAHK was admitted to full membership of the World Federation Societies of Anesthesiologists (WFSA) in the same year as the latter was established (1954), which boosted the Society's standing and helped to call the attention of doctors in Hong Kong to anaesthesia.

Visitors[12]

Being reportedly at the 'Crossroads of the world', members of the SAHK enjoyed and benefited from distinguished personalities who visited Hong Kong over the years, some more than once.[4-6] They came from UK, USA, Canada, Australia, New Zealand, Europe and Africa. Space does not permit them all to be named here, but I wish to thank them for the significant part they played in our development by giving lectures, and just by their very presence. They were Deans and other senior officers from the various Colleges and Faculties especially Australia, England and Ireland.

Examinations

Until 1969, candidates from Hong Kong wishing to sit for their Fellowship examination would need to travel abroad. In the early days it would be to the UK; later they would go to Singapore, Kuala Lumpur or Australia. From 25 September 1969 it became possible, after negotiations with the FAANZCS, to have the Australasian examination include Hong Kong also in their itinerary. This removed the need for paid leave of absence (replacements were not generally available), and the payment of travelling and subsistence allowances - usually a lengthy and uncertain procedure.



Dr Lett with Professor John Nunn and Dr Jean Horton

Hong Kong Society of Critical Care Medicine

This was established in May 1983, with the author as Chairman. It was soon affiliated to the Western Pacific Association of Societies of Critical Care Medicine (WPACCM). It targeted all those engaged in looking after patients needing Intensive or Critical Care, i.e. doctors, nurses, ambulance and immediate care personnel (provided in Hong Kong by the Fire Services Department and St John's Ambulance). Amongst its aims was monitoring various response times (time to arrival of ambulance, time of transport to hospital, time from arrival to triage); once the variables were known improvements could be looked for.[6] Another aim was to impress on all the importance of early CPR and to run practical courses to that effect. The functions of the Society included lectures, seminars, workshops and training videos.

Academic Departments of Anaesthesia

The first Department of Anaesthesia was established in 1983 within the Medical Faculty of the Chinese University, itself dating from 1979. The first Head was Andrew Thornton from the University of Sheffield, assisted by Cindy Aun and Jean Horton, with other staff from Asia, Australia, the UK and Hong Kong. The Prince of Wales Hospital was the first to place Intensive Care under Anaesthetic management. The report from this Department about the establishment of an ITU makes interesting reading.[13] The second Head, Prof.T E Oh, is well remembered for his numerous publications.

The department covered most fields of surgical anaesthesia, as well as Intensive Care, and Pain therapy. It was, however the anaesthesia service of the Queen Mary Hospital (on Hong Kong island) that cared for obstetric patients at the Tsan Yuk Maternity Hospital on Hong Kong island. This hospital celebrated its Golden Jubilee in 1972, and a booklet was produced which included a chapter on anaesthesia.[14]

The Hong Kong College of Anaesthetists (HKCA)

There is no doubt that the establishment of this college in 1982[6] helped the anaesthetic community to progress towards the millennium. The prime mover was the Society of Anaesthetists of Hong Kong, who formed from amongst senior members the Board of Studies of Anaesthesia and Intensive Care, with Prof.Thornton as Chairman. The HKCA was incorporated in September 1989 as a company limited by guarantee and with a charitable status under its Memoranda and Articles of Association. The first President was Dr M T Moles, Reader in Anaesthesia in the Facio-Maxillary Department of the Dental Faculty in the University of Hong Kong. Work leading to the registration and recognition of the College was considerably facilitated by the efforts of Colonel (later Brigadier) I T Houghton, who has both medical and legal qualifications.

It might be appropriate to quote from the Editorial in the *Gazette* of the College regarding the intentions and functions of the College:

> 'Our College will be judged by anesthesiologists around the world by the standards we set and how we achieve them. During the current year the Board of Education has formulated the curriculum for the examinations for the Diploma of Fellow of the HKCA. The Board of Examination has set out the examination requirements and the regulations for the assessment of trainees. Guidelines for the safe practice of anaesthesia and standards required for accreditation have been set up by the appropriate Boards and Committees. It can be said that the standards our College has set are achievable and are parallel with those of other prominent Colleges of Anesthesiologists in the world'.[15]

It would be only fair to comment how much our Sister Colleges have contributed. The RCA, the ANZCA and the FARCS in Ireland have given staunch and invaluable support. The HKCA is very grateful and enjoys reciprocity.

Local Medical Staff

When the author arrived in Hong Kong in 1954 to take up his duties, there was a shortage of medical doctors, particularly anaesthetists. Hospitals where surgery was being done were a) Government, run by the Medical Department; b) those run by voluntary organisations (such as the Tung Wah Group); c) Private, run by boards of Governors such as the Yong Wo and d) Forces: in Hong Kong in those days there was a Military Hospital run by the RAMC and a Naval Hospital.

To be permitted to practice medicine in Hong Kong, a practitioner had to be licensed in Hong Kong and on the Hong Kong Medical Register. Doctors in the Forces were registered in the UK or other Commonwealth countries. The Hong Kong registration system at that time recognised all UK and most Commonwealth medical registration. Although only registered medical practitioners were employed on a permanent basis, whenever there was a shortage and necessary posts could not be filled, a useful loophole allowed those who were employed by the Government as medical or assistant medical officers to be designated as 'deemed to be registered'. These were mainly Chinese mainland graduates, or from Taiwan and the Philippines. Because of marked shortages in the anaesthetic service, many of these were posted to anaesthesia and played a vital part in providing a service, and this should be duly acknowledged. This situation, although not strictly desirable, did not really abate until the output of both Medical Schools caught up with the demands of the service.

Conclusion

There are many outstanding individuals, too many to mention here, to whom the improved anaesthetic situation in Hong Kong is indebted. Perhaps the saga will continue.

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STARTIN'S PNEUMATIC INHALER

Dr D A Walmsley, Chelmsford
and Dr D Zuck, Past President HAS

Introduction

This apparatus was seen by one of the authors (DAW) in a private collection. During discussion it rang a faint bell in the memory of the other, who later discovered that about eight years earlier he had copied a drawing of it into a notebook with the intention of following it up and had promptly forgotten about it! Once the identity of the inventor was established it was not difficult to put the rest of the story together. The strange thing is that although Startin's appears to have been the first ether inhaler to be manufactured and mass-produced commercially and was described in the medical literature of the time, it is not mentioned in any of the histories of anaesthesia, not even by Barbara Duncum.

James Startin

James Startin was born in Moseley, Birmingham, in 1806, the son of John Startin, a merchant and banker. Showing an early interest in medicine, he enrolled at St Bartholomew's, and took the general practitioner qualification LAC (Licentiate of the Apothecaries Company) in November 1827, and MRCS Edinburgh in February 1828.[1] Returning to Birmingham, he worked as resident medical officer at the Birmingham General Hospital. He married, travelled abroad, and studied dermatology in Paris and Montpellier. Returning to London, he set up in general practice at 3 Finsbury Place South, the location favoured by fashionable doctors before they moved west to Harley Street during the 1850s. In 1841 he established the London Infirmary for the Cure of Diseases of the Skin, first at the adjacent 84 London Wall,[2] then in a large house, 25 New Bridge Street, Blackfriars. He was fortunate to attract substantial financial assistance from the wealthy philanthropist Samuel Gurney. By 1851 the Infirmary had become the Hospital for Diseases of the Skin. It continued to function until the National Health Service refused to take it over in 1948. Startin became a Fellow of the Royal College of Surgeons in 1852.

His description of a new kind of inhaler was the first of his communications. Also in 1846 he delivered a course of lectures on diseases of the skin. The following year he published an innovative paper on the use of glycerine in the treatment of skin conditions. In 1849 he moved to a much more fashionable address, 3 Saville Row. Other publications were on the use of an elastic spiral bandage for the treatment of varicose veins and on skin diseases in artisans. Another innovation was a tubular needle for the suturing of deep wounds and fistulae, which was highly praised by Simpson and Spencer Wells. Startin's interests were wide. He was a Fellow of the Society of Arts, of the Antiquarian Society, of the Royal Medical and Chirurgical Society, of the Medical Society of London, and of the Statistical Society, at the last three of which he may well have met John Snow on numerous occasions.

James Startin died on 22 December 1872, aged 66. He is buried in the Brompton Cemetery. His obituarists described his clinical approach as eminently practical, relying on great experience and memory. His consulting room was always crowded, and his prescriptions were so complex that it is said that 'neither he nor anyone else knew which ingredient was effective'. Personally he was sociable, genial and kind-hearted.[3]

The Pneumatic Inspirator

On 29 May 1846 James Startin submitted a proposal for a new kind of inhaler to the Society of Arts. This proposal is preserved in the archives of the (now Royal) Society of Arts. It is hand-written, and runs to four and a half foolscap pages. It describes a valved facemask, originally designed to allow a patient to be wholly immersed in a fume bath in which the whole of the skin would be exposed to the vapour of sulphur, iodine, mercury, or other substances unfit for respiration. This small instrument he called the 'Pneumatic Inspirator.' Reducing it to a portable, simple, inexpensive and efficient form had been accomplished by the use of a comparatively recent invention, Hancock's Vulcanised Indian Rubber, an elastic substance uninfluenced by ordinary temperatures or moisture.[4] He inserted a diagram to assist with the description. (Figure 1)

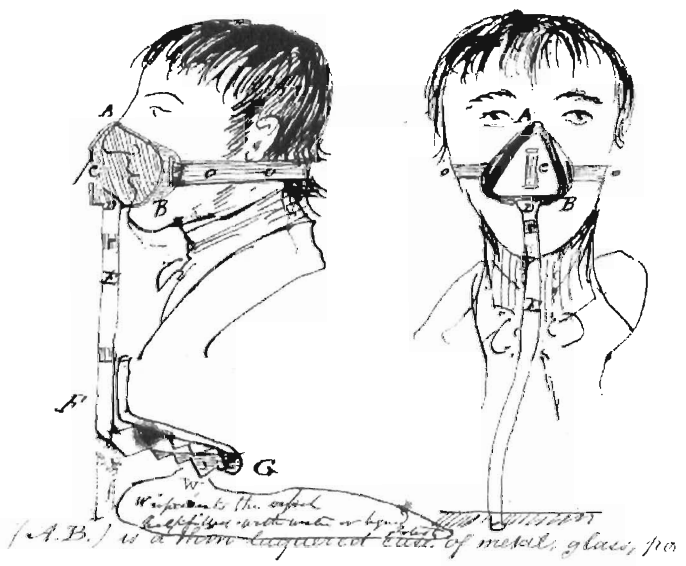

Figure 1

The face mask was a thin lacquered case which might be constructed of metal, glass, porcelain, wood, leather or gutta percha. It was about 1¼ inches deep, 2¼ inches long and 2¼ inches broad at the base, so as to cover the mouth and nostrils. It was retained in place by an elastic band. The 'case' was provided with two valves opening in opposite directions, and made of Vulcanised Indian Rubber or of light metal. Consideration of the design led him to believe that the instrument would be of value in other situations where a person was exposed to breathing impure or contaminated air. For use in factories where noxious dust or vapours were generated, a flexible tube of variable length would connect the inlet of the mask to a wooden shaft that brought fresh air in from the outside. Alternatively it could be connected to a vessel containing a fluid, an acid or alkaline solution, through which the inhaled air must pass, and which would abort, neutralise or extract the noxious particles. With slight modification the instrument could be made suitable for the inhaling of any vapour, gas or medicinal substance, and even for a diving apparatus, replacing the helmet currently in use. He envisaged it being used also where the wearer was moving about in a sudden emergency (as in a house on fire) or a foul well. In effect he had designed the snorkel.

Startin's proposal was read at the Society of Arts on 3 June 1846:

> 'The Candidate was in attendance and exhibited his apparatus to the Committee. He explained how it could be used by divers by the addition of an air bag, by means of which they would be able to remain under water for a minute or two at a time, fix chains to sunken objects etc; and also its applicability to the administration of Sulphuric Ether and other medicated vapours. He stated in reply to questions from the Committee that it could be used in the exploration of mines, as an apparatus for breathing the Nitrous Oxyde and other gases, and also heated air.
>
> The Candidate then withdrew, and the Committee resolved that the apparatus appeared simple and effective, and gave it its approbation.'

The production model

The definitive apparatus was described in the *Medical Times* of 30 January 1847,[5] and was on the market immediately afterwards. It was illustrated also in a review article in the *Edinburgh Medical and Surgical Journal*.[6] It was manufactured by Joseph Walters and Company, 82 London Wall, the design being registered on 20 January. It was supplied in a cardboard box. A description, a diagram, and instructions for use, were pasted inside the lid. (Figure 2)

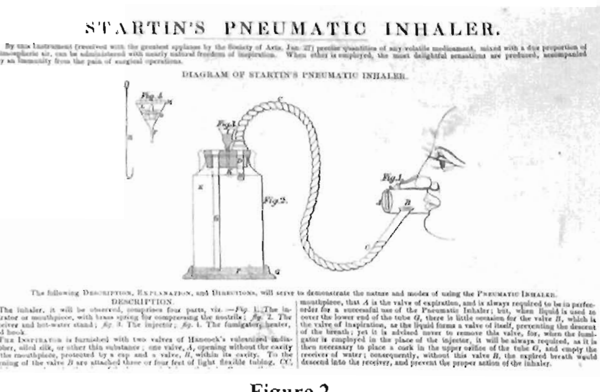

Figure 2

These are identical with the paper published in the *Medical Times*. It was now called Startin's Pneumatic Inhaler, and it was claimed that:

> 'By this instrument (received with the greatest applause by the Society of Arts, Jan. 27) precise quantities of any volatile medicament, mixed with a due proportion of

atmospheric air, can be administered with nearly natural freedom of inspiration.[7] When ether is employed, the most delightful sensations are produced, accompanied by an immunity from the pain of surgical operations.'

'As the name indicates, the concept had changed. Whereas, because of its original purpose the emphasis had been on the facemask, it was now on the vaporizer. The applicability of the apparatus to the newly introduced procedure of general anaesthesia had been quickly recognised. The novel idea of an oro-nasal mask had been dropped in favour of a combined mouthpiece and nose clip, but the two valves had been retained. The mouthpiece was connected to the 'receiver' or vaporizing chamber, by three or four feet of light, flexible tubing 'which must at least be the size of the human windpipe'. The vaporizing chamber was a glass vessel of sufficient capacity to contain a single inspiration. It was closed by a bung with three perforations through which passed the air inlet and outlet tubes, and the injector. The injector consisted of an inverted metal cone with a small stopcock near the injector tube. The top was covered by a very thin flexible metal disc, sensitive to changes in atmospheric pressure: 'so as to inject into the receiver, at each vacuum created by inhalation, a jet of ether or other liquid, which is formed into vapour by the hot water.'

The principle was that the inhaler contained sufficient air for one inhalation, and the injector or the fumigator, controlled by the administrator through a stopcock, allowed a graduated quantity of volatile agent to be inspired. For anaesthetic use the stand should contain very hot water, and alcohol-free ether of specific gravity 0.750 should be used. Startin described the technique of induction, allowing the patient to become habituated to the nose-clip and mouthpiece, which he called 'the inspirator', before gradually introducing the ether vapour. He expected insensibility after five or, at the most ten minutes, after which the alternation of three breaths of pure air with three from the inhaler should be sufficient to maintain the desired state.

Discussion

Virtually all the very early ether inhalers, John Snow's apart, were modifications of existing pieces of chemical apparatus. Startin, similarly, opportunistically adapted a very good idea designed for a quite different purpose. His original 'inspirator' featured a valved breathing circuit, an oro-nasal facemask, and a head harness. With its many possible applications its ingenuity speaks for itself. Mention of sulphuric ether and nitrous oxide before 19 December 1846 is intriguing, but unexplained.

In the production model, which was on the market some two months before Snow's, Startin elaborated the specification of the circuit, stipulating that the breathing tube should be at least the diameter of the human windpipe. A criticism of many of the early inhalers was that the bore of the tubing was too narrow, and while John Snow is generally credited with pointing out the need for it to be at least as wide as the trachea, Startin obviously had the same idea, and earlier. Whereas Snow, by controlling the temperature of the water bath in which his vaporizing chamber was immersed, intended only to set an upper limit to the strength of ether vapour, Startin, by virtue of his injector, ambitiously aimed to control the concentration of every breath. However the technology available to him was not adequate for the requirement. His injector must have had the problem of pressure equalisation and would have functioned more as a dropper, but he thought of the idea first. It was the best part of a century before another apparatus appeared, the Goldman Vinesthene vaporizer, that incorporated the drip principle. Abandoning the oro-nasal facemask, possibly because of production problems, was a mistake, but Startin's was better designed and nearer to present day models than the one subsequently produced by Sibson and adopted by Snow. Joseph Walters appears in the London Post Office Directories at 82 London Wall from 1845 to 1848. He is described as a surgical instrument and truss maker. Startin probably chose him because of the proximity to his own establishment.

The Society of Arts

The Society of Arts was an unlikely forum for the introduction of a piece of anaesthetic apparatus, but a very suitable one for the original version of Startin's inhaler. It had been founded in 1754 by William Shipley, a drawing teacher and inventor, to create a fund to support improvements in the liberal arts, sciences, and manufactures, its revenue to be raised by subscription. It was the second of England's national scientific societies, being preceded only by the Royal Society, so with its emphasis on the practical application of science, its influence became very considerable. Stephen Hales was a founder member and its first vice-president.[8] Early members included Benjamin Franklin, William Hogarth, and Samuel Johnson. In 1758 it began to confer awards for improvements in agriculture, chemistry, manufactures, trade, and the polite (fine) arts. Prince Albert became president in 1843, and the Society was the moving force behind the Great Exhibition of 1851. It fostered the establishment of the City and Guilds Institute and the Royal College of Music. A number of other learned and specialist scientific societies originated from it. It initiated the London blue plaques, and in 1870 began to campaign for the nationalisation of the railways. In 1908 Edward VII granted permission for use of the title 'Royal'. In 1948 it came up with the idea for the Festival of Britain of 1951. It continues to be an extremely active and influential organization.[9]

(See also the Royal Society of Arts web site, http://www.rsa.org.uk/rsa/history.asp).

Conclusion

The absence of any mention of Startin's inhaler in any of the standard comprehensive histories of anaesthesia is difficult to explain, because apart from the presentation to the Society of Arts, which might not have been noticed, it was also described in the widely read *Medical Times*, and mentioned in other reports. In spite of differences between the diagram and the actual models, such as the absence of the expiratory valve that should be on the mouthpiece, it appears that it did work. At King's College Hospital in February 1847, after failing to induce anaesthesia with Hooper's apparatus for excision of the scapula and half of the clavicle of a man aged 33 (the patient breathing most industriously but the only effect being slight excitement): 'Startin's Inhaler was then tried, and the result was most striking. In a few minutes a quiet slumber was induced, when the surgeon proceeded with the necessary incisions'. The operation took about fifteen minutes, during most of which the patient was unconscious of suffering.[10] Presumably Hooper's apparatus failed because the ether was too cold, and there was no external source of heat. Startin's inhaler would have been an even more efficient vaporizer than Snow's because a very small quantity of ether was being vaporized at each breath by very hot water.

Examples of Startin's inhaler seem to be very rare. We know of only two, the other being in the store of the Science Museum, South Kensington (catalogue number A196023, Collection of Anaesthesia). There are differences between them. That on loan to the Science Museum is part of the Wellcome Collection. It is numbered 169, its stand and cap are of gilt metal, and the noseclip is integral with the mouthpiece. (Figure 3) The one in private hands, numbered 1507, is closed by a stopper of lignum vitae with a brass surround, the metal parts are steel, painted a mottled green, and the noseclip is separate. The apparatus in the Science Museum is in mint condition, and the breathing tube, coiled up for perhaps 150 years, remains flexible, and quite without cracks or other signs of age. It has the appearance of a presentation or demonstration model. If the serial numbers indicate how many were made, it is surprising that there are not more of these inhalers about.

Figure 3
Startin's Inhaler
(Courtesy of the Trustees of The Science Museum)

Acknowledgements

We are grateful to Dr Gloria C Clifton, Curator of Navigational Instruments, Greenwich Observatory and Alan Humphries of the Thackray Museum, Leeds, for information about Joseph Walters; to Chris Denvir and Nicola Gray, archivists, the Royal Society of Arts, and to the Society for permission to reproduce the entries from its records; to Dr E T Mathews for information about the early hospitals in Birmingham; and to David Thomas and the Trustees of the Science Museum, to whom the copyright of the photographs of the apparatus in their care has been assigned, for permission to reproduce them.

An account of the Inhaler by the present authors appeared in *Anaesthesia.*[11]

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In the absence of the Speakers this paper was read by Neil Adams

THE USE OF ANALGESICS AND HYPNOTICS IN THE ANCIENT GREEK AND BYZANTINE ERA

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Introduction

An indissoluble relation between humans and nature has existed since the prehistoric period. People were obtaining not only their food from nature, but also the necessary herbal substances for curing their wounds and diseases. In order to keep up to date, humans had to summon up all their observations regarding the therapeutic properties of plants. In the course of time, their knowledge was enhanced and enriched as many traders and travellers introduced new plants from different lands. Thus, phytotherapy became an indispensable aid of medical art for all the ancient civilisations. Ancient Greek doctors discovered numerous herbs with healing properties and they carried the torch of learning to the Byzantine doctors through the ancient Greek texts.

Ancient Greece and the Roman Empire

The knowledge of herbal therapy was not the same in different areas of the world. Moreover, the absence of classification of the different plant species was a compounding factor for better understanding and subsequent therapeutic use of plants. Hippocrates (460-370 BC) was the first to focus his interest on the healing properties of plants. In *Corpus Hippocraticum* 236 different plants are listed and their properties are mentioned, but they are not described very thoroughly.[1] Aristotle (384-322 BC) attempted a similar recording in his book '*On Plants*'. At the same time Theophrastus (372-287 BC) laid the foundations of modern botany with his book '*Historia Plantarum*'.[2]

During that period of time, collecting herbs for a lot of people was not just a procedure but a ritual. They were processing the roots of the plants, though they were not herbalists. However, later on they developed into pharmacists. The most famous among them was Krateus (120-63 BC) who was serving Mithridata, the King of Black Sea.[1]

Dioscorides (1st century AD) is considered as the founder of pharmacology and the father of botany.[3] He collected a great deal of botanical information during the expeditions of the Roman legions where he was employed as a physician, and he recorded his observations in the memorable book '*De material medica*'. He intended to correct all the previous mistakes of the naturists who dealt with that issue. In his book more than 1,000 formulae of animal, plant or mineral origin are mentioned, as well as 4,740 medical applications of them. Dioscorides' work was thorough and became irreplaceable during the following sixteen centuries; even nowadays a significant number of those herbs are still mentioned in pharmacopoeias.

Byzantine physicians

In the Byzantine era people held botanic physicians in high esteem and many of them were influenced by Dioscorides. In the 4th century Oribasius (325-425 AD) wrote a book which actually borrowed several chapters from the three books that Dioscorides had written.[4-8]

Aetius of Amidena[9] (6th century) was an expert in toxicology and he dealt in his books with many plants and antidotes. His contemporary Alexander of Tralles[10] wrote ten books; among them the well-known '*Therapeutics*' which deals with herbal medicine.

Paul of Aegina (7th century)[11] was an eminent Byzantine doctor who described herbal, animal and mineral medicines, adopting an alphabetical classification in his book '*De medicina*' similar to the classification that Dioscorides and Galen (2nd century) had already introduced.

Many Byzantine physicians wrote several books attempting to improve the classification of plants and formulae, but they did not manage to avoid repeating Dioscorides' classification. Briefly, we can mention Ioannis Aktouarios (13-14th century) with the book '*On the composition of drugs*', Vassos Kassianos (6-7th century) who wrote the book '*Agronomics*' and Theophanes Chrysovalantes (10th century) who is the author of the book '*Synopsis of medical art*'.[12]

Analgesics

All the above mentioned medical books include a great variety of herbs and formulae that had been used as analgesics in many diseases. Nevertheless, every plant could have several properties apart from these analgesic functions and could be administered as expectorants, anti-inflammatory agents, diuretics, antidotes etc. In order to present the analgesic properties of the plants we have classified them according to the type of illness that they had been used to treat.[13,14]

Headaches

Ancient Greek and Byzantine physicians distinguished between acute headaches (transient pain and headaches not accompanied with fever) and chronic headaches.

Acute headaches

The most frequently used medicines were the ethereal oils of rose (*rosa gallica var. centifolia*), the farming of which was rife in ancient Greece, and they were applied to the temporal region. This preparation is mentioned in the book '*Medical Synopsis*' written by Leo in the Byzantine period.[15]

More complicated preparations were poultices made from the bark of *solanium nigrum*.[3] In this case the plant was boiled until a sticky material was formed which was later applied to the temple.

Chronic headaches

In case of chronic headaches, physicians boiled the plant extracts with vinegar, which was then sprinkled on the forehead or the temple of the patient. The most commonly used plants were *portulacea oleracea* and *amomum sublatum*.. The latter was an aromatic herb from India which had a hypnotic action as well. Another plant, which had been used quite often, was *pimpinella anisum* that had narcotic features when it was administered in high doses.

Aetius of Amidena[9] suggested spreading a cold, pinkish pulp made of dill and camomile on the forehead in cases of headache accompanied by fever. On the other hand, in cases of chronic headache he advised doctors to prescribe an essential oil combined with mint and ivy, a mixture frequently mentioned in the texts of Paul of Aegina[11] and Oribasius.[7,8] Finally, Alexander of Tralles, in his book '*On headaches*', emphatically discouraged the administration of both *mandragora officinara* and hemlock.[10]

Otalgias

In otalgias most of the physicians preferred the infusion of different oils mixed with certain herbal extracts like *aloe, crocus sativus, balanites aegyptiaca* (a plant from Africa) and *hyoscyamus niger*. The pharmacological action of *hyoscyamus niger* was clarified many centuries later by Brandes, who discovered the alkaloids hyoscyamine and hyoscine. Moreover, some physicians recommended the topical infusion of *cannabis sativa* in the ear canal.

Abdominal pain

Patients suffering from gastric pain were administered maternal milk or a concoction of mint and vinegar.[9] Others recommended the oral administration of *ficus sycomous* or *artemisia apsithium* which is the most important constituent of the alcoholic beverage absinth.

Gynaecological pain

A regular medication for pain caused by gynaecological diseases was the oil produced from *amygdalus communis*, which was considered the best painkiller in case of uterine diseases. Moreover, *aristolochia pallida* was a plant used during the puerperium; its name originates from the Greek words aristos + lochia (best for the puerperium).

Lumbar pain

Lower back pain was a very common disease requiring analgesia during the ancient Greek and Byzantine era. Aetius characteristically mentioned that: 'back pain is a symptom of a severe illness'. Treatment of backache included linseed poultice or concoction of *vicia faba* and *capparis rupestris.*

Hypnotics

Hypnotics did not constitute a different group of drugs since most of them appeared to have more pharmacological features. They were administered per os (juices), by smelling ethereal oils or by spreading over the temples. The essence of using hypnotics was to sedate the patient in order to fall asleep and perform a surgical operation. The most frequently used plants were *papaver somniferum*, *withania somnifera*, *mandragora officinarum* and *conium maculatum.*

According to the Byzantine botanists, there are two kinds of *papaver somniferum* (poppy): i) *papaver* and ii) *papaver nigrum rhoeas.*[2,3] Nowadays, we know that this plant contains morphine (20%), codeine (2.5%), papaverine (2.5%), thebaine (2%), narceine and hydrocotarnine.[16] *Papaver somniferum* was known since the Minoan period (1380-1110 BC) because several idolatrous statuettes related to the plant had been discovered. The extract from the plant's leaves was boiled, and then it was either administered orally or it was applied topically on the forehead and the temporal regions of the patient in order to cause sedation. It is worth mentioning that many physicians, like Dioscorides, disagreed with the use of *papaver* as an analgesic in case of pain in the ear or the eye.

The bark of the root of *withania somnifera* had soporific action, but it had a shorter duration compared with *papaver*. *Mandragora officinarum* is one of the most poisonous plants and contains hyoscyamine, atropine and scopolamine. Botanists distinguished between the male (white) and the female (black) *mandrogora*.. The therapeutic juice was prepared from the root and had a hypnotic action.

A plant known worldwide was *conium maculatum* or *divaricatum* which contains the alkaloid coneine. It has a toxic effect and causes neuromuscular paralysis with the respiratory muscles being affected. It was administered in small doses in order to achieve analgesia and sedation. The most dramatic case of hemlock administration in the ancient Greek history is the execution of the famous philosopher Socrates in 399 BC.

Also, we should mention that the fish *torpedo mamorata* caused numbness when it was in contact with the patient's skin.[3] The Roman physician Scribonius Largus (1st century) gives valuable information about the use of that fish in medicine. *Torpedo mamorata* is a fish in the Mediterranean Sea and it is depicted in several ancient Greek ceramics and Roman mosaics. Furthermore, in Plato's work '*Menon*', Socrates is likened to that fish because he could 'anaesthetize' his interlocutors the same way that the fish could soothe the pain and sedate the patients.[17] Finally, another fish with hypnotic features is *malopterus electricus*, which can be found in the Nile and is depicted on several frescos in an Egyptian vault (3rd century BC).[18]

Conclusion

Knowledge about the therapeutic application of herbs was preserved and enriched in the Ancient Greek and Byzantine era. The various applications of plant extracts give evidence of a high level of scientific knowledge, which is further proven by the fact that the physicians, who carried on their legacy, documented those significant achievements in their books. Further evidence of this arises from the fact that most medical schools of Western Europe, from the late Middle Ages until the dawn of the 18th century, based their teachings of pharmacodynamics and pharmacotherapy on the work done in the ancient Greek and Byzantine era.[19]

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Surgeons and anaesthetists: Mr RT Richmond read a paper entitled Surgeons and Anaesthetists. He considered that the choice of anaesthetic should always be left to the anaesthetist, and the utmost confidence ought to be placed with the anaesthetist by the surgeon. Southern Branch of British Medical Association: South Wiltshire District. *British Medical Journal* 1903; **1**:257.

Ether drinking in Russia: The habit of ether drinking is extremely prevalent in some parts of Russia as of East Prussia .... an idea of the extent to which the habit prevails may be gathered from a report given in the Russian newspapers of a recent accident which occurred at a place called Trossno. Ether is drunk by farmers on festive occasions, when it seems to be consumed in pailfuls. A farmer celebrating his son's wedding, in the fullness of his hospitality, got in two pails of ether. During the process of decanting the ether into bottles a violent explosion took place, by which six children were killed and one adult was dangerously injured, and 14 others were more or less severely injured.
Annotation. *British Medical Journal* 1903; **1**:28.

RAPID SEQUENCE INDUCTION: HISTORY AND EVOLUTION.

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Introduction

Pulmonary aspiration of gastric contents during anaesthesia has always struck fear into the heart of anaesthetists. The first report of death from aspiration of food was in 1853[1] during chloroform anaesthesia. Since that time and throughout the 1900s, there was a steady flow of reports citing this complication of anaesthesia as frequent and often avoidable. In 2002, all anaesthetists are familiar with the technique of rapid sequence induction (RSI) where preoxygenation is followed by rapid intravenous induction of anaesthesia, cricoid pressure, paralysis and the insertion of an endotracheal tube. Although other anaesthetic techniques are available that reduce the risk of pulmonary aspiration in the high-risk patient, RSI has enjoyed widespread popularity. However, the technique of RSI has developed slowly through an accumulation of ideas. It has taken the last century to achieve this evolution and was only made possible by the discovery and design of, amongst other things, endotracheal intubation equipment and intravenous anaesthetic drugs that caused rapid loss of consciousness. The recognition for specialist training in anaesthesia has had much to offer to the refinement of ideas and further research in this area. With the advent of neuromuscular blockade and the description of cricoid pressure application, the road was clear to develop the technique that we have today. But there are still further refinements and potential improvements in question. This article outlines the history of the development of RSI. The author has deliberately omitted discussions concerning antacid prophylaxis and gastric emptying because RSI is designed specifically as a protective rather than a prophylactic technique.

Recognising the risk of aspiration

In 1891, the Section of Therapeutics of the British Medical Association formed a committee to investigate the effects of anaesthetics on humans, safety, techniques of administration and resuscitation.[2] 25,920 case reports were gathered and in 1901 Eastes[3] reported the analysis. The committee had met more than 300 times and amongst the 35 conclusions was one stating that: the phenomena retching and vomiting were frequently associated with complications and doubtless bore a causal relationship to them. A decade later in 1910, an enquiry into the question of deaths resulting from the administration of anaesthetics was presented to Parliament by the command of Edward VII.[4] In this article, the leading London-based anaesthetist, Frederic Hewitt, concluded that over the 40 years between 1866 and 1905 there had been a steady increase in the number of fatal accidents during the administration of anaesthetics. One of the many recommendations of this committee was that no general anaesthetic should be administered by any person who was not a registered medical or dental practitioner.

Thus, it was during this period that anaesthesia evolved to become a specialist subject[5] and many of the advances in the specialty were made as a consequence. It was also clear that at the start of the 20th century, pulmonary aspiration had been identified as a complication of general anaesthesia.

Aspiration risk factors throughout the 1900s

It was not until the mid 1900s that attention was paid to the subject of food and fluid intake before surgery.

In 1946 Mendelson described 66 cases who developed pulmonary aspiration syndromes out of 44,016 pregnancies. Of these, there were 2 deaths. In his paper, after a series of ingenious animal experiments, he was able to show that a picture of either obstructive or asthmatic respiratory distress developed following aspiration of gastric contents and this depended on whether it was either solid or acidic liquid or both that had been aspirated. He concluded that both types of aspiration were preventable. He suggested that starvation in labour should be mandatory, and that gastric lavage and alkalinisation prior to the administration of general anaesthesia should be routine.[6]

After 1960 a delay of five to six hours was commonly recommended for all patients undergoing general anaesthesia but it was felt that this was unreliable in emergency cases. The factors that delayed gastric emptying were also increasingly understood. Trauma, sepsis, drug effects, bowel obstruction, gastro-oesophageal pathology and pregnancy were all known to be potentially hazardous when combined with the administration of anaesthesia.[7] Thus, advice focused on the role of gastric intake control, aspiration and lavage prior to surgery in the high-risk cases.

The next 40 years saw the addition of antacid regimes. This article will not deal with their development. However, in 1993 a prospective French National Survey described the anaesthetic complications occurring in 200,000 cases for all types of procedures. The results showed that aspiration of gastric contents was detected in 1:7400 patients and that aspiration was responsible for the death of a patient in 1:33000 anaesthetics. Results from surveys in other countries, together with editorials and reviews all emphasise repeatedly that prophylaxis by aspiration of gastric contents remains an important way to reduce anaesthetic related mortality.[7]

Tracheal intubation

It was not widely appreciated until the 1940s that tracheal intubation during general anaesthesia was an effective way of reducing pulmonary aspiration.[8] Alfred Kirstein of Berlin is thought to have designed the first direct vision laryngoscope in 1895, when his colleague reported that a patient's trachea had accidentally been intubated during an oesophagoscopy. Aware of the clinical potential of this observation, he promptly fabricated a hand-held instrument, which consisted of a blade and a handle. By 1913, the American anesthetists Janeway and Dorrance, had also designed a cuffed endotracheal tube to be used with the laryngoscope, but it failed to capture wide attention. This may have been because there was lack of a sufficient market when in 1913 there were fewer than 100 anaesthetists active in the United States.

Two of the most distinguished pioneers of endotracheal intubation were the self-trained British anaesthetists, Sir Ivan Magill and his friend, Stanley Rowbotham. In 1919, after the First World War, they worked together as general medical officers with an interest in anaesthesia at the Facial and Jaw injuries unit at The Queen's Hospital, Sidcup. There, they created several modifications of the insufflation technique. These included blind nasal intubation (at which Magill proved to be a master), and the introduction of the single lumen, red rubber endotracheal tube in 1920.[9]

Until 1940 it was widely thought that laryngoscopes were cumbersome, ill-designed to protect the patient's teeth and offered only limited exposure of the larynx. Because muscle relaxants were not yet available, these problems were even more pronounced. For many years, ENT surgeons were routinely called to the operating room in some hospitals for every elective or emergency intubation while the anaesthetist confined his or her attention to the administration of anaesthetic gases. In 1943, Professor (later Sir) Robert Macintosh of the Nuffield Department of Anaesthetics at Oxford introduced a curved laryngoscope, which is named after him and still used today. It is said that he and his chief laboratory technician, Richard Salt, designed the laryngoscope during one morning's ENT operating list at the Radcliffe Infirmary.

The development of both the endotracheal tube and the custom-built Macintosh laryngoscope paved the way to make endotracheal intubation more popular. In doing so, it was appreciated that it was one of the principal defences against pulmonary aspiration and allowed the evolution of RSI to proceed. The depressant effects of anaesthesia on the protective airway reflexes had long been recognised and thus the need for as brief a period as possible before insertion of an endotracheal tube. It must be remembered that before paralysis was available, intubation was only possible during the deeper planes of anaesthesia, and events such as vomiting or passive regurgitation could occur during this danger period. Implicit in this is the importance of factors that could cause intubation to take longer than usual, so increasing the risk for the patient.

However, signs of potentially difficult intubation tracheal intubation were not consistently appreciated as factors to be considered when identifying the risk of aspiration for a patient until the last decade of the 20th century.[8]

Intravenous induction of anaesthesia and paralysis

Up to the 1930s, anaesthetists had a constant predicament about what depth of anaesthesia to maintain during surgery. In the lighter planes, the protective airway reflexes were potentially maintained but the patient's airway and response to surgery were troublesome. At deeper levels of anaesthesia, there was increased risk of passive regurgitation and aspiration. With the exception of cyclopropane, rapid loss of consciousness combined with muscle relaxation could not be achieved with inhalation agents. But rapid loss of consciousness was not thought desirable, because although the slow and often stormy induction of anaesthesia with volatile agents (usually ether) was sometimes interrupted by attempted or actual vomiting, the laryngeal reflexes were understood to be mostly active during this period, and therefore were known to protect against aspiration.

Thiopentone was brought into clinical use in the mid 1930s. Although it produced a much more desirable induction for the patient, anaesthetists were still very concerned about its use in the high aspiration risk patient because of the loss of airway control, possible apnoea and the loss of protective laryngeal reflexes. For them it seemed, incredibly, that slow and suffocating induction of anaesthesia was safe and desirable. Also, after induction, deeper levels of anaesthesia were still necessary for surgery, especially if endotracheal intubation was envisaged. For this reason, and because of its detrimental affect on the cardiovascular system, particularly in the ill patient, thiopentone usage for the emergency patient did not gain wide acceptance during this period. It was not until the era of muscle relaxation that it gained popularity.

In 1935 Harold King isolated the first pure curare alkaloid, tubocurare.[10] This made its clinical investigation possible. In 1941 supplies of chondrodendron tomentosum vines became available together with large quantities of crude curare from Ecuador, through the efforts of the explorer and adventurer Richard Gill. In 1942, Griffith and Johnson in Montreal used the drug for the first time as a skeletal muscle relaxant in anaesthesia.[11] In 1948 Cecil Gray declared that because of the discovery of muscle relaxants 'anaesthesia had been revolutionised by removing for all time the need for deep anaesthesia'.[12] It still seems incredible that this group of drugs, developed from the arrow poisons of the South American Indians, would become widely used to paralyse patients during anaesthesia.

The search for synthetic muscle relaxants with superior properties had begun and led to work by Barlow and Ing on the methonium compounds in this same year.[13] In 1949 suxamethonium was synthesised and was introduced into anaesthetic practice in 1951.[14]

The 1950s revolution

And so it was, that by 1951 all of the key drugs used for a modern day RSI had been discovered. There was a greater understanding of gastric and oesophageal physiology during this decade, especially of the lower oesophageal sphincter. This increased the reliance upon positioning during induction.[15-18]

In 1950 the Association of Anaesthetists of Great Britain and Ireland set up a committee to investigate deaths associated with anaesthesia. They studied 43 deaths resulting from regurgitation and aspiration. Inexperience was implicated in many of the reports. Morton and Wylie[19] sat on this committee and although they did not discuss specific cases they offered a paper limited to the particular aspects of this problem. Most text books of the period failed to deal with this issue. By 1956 they had collected 1000 deaths due to anaesthesia of which 110 were from aspiration of gastric contents. These often occurred induction, especially when muscle relaxants were used. They concluded from this that for the inexperienced an inhalational induction with ether was the safest method. For the more expert, the smooth and pleasant induction with thiopentone and relaxant with 20° foot down tilt (to avoid passive regurgitation) could be attempted. They were very cautious with this second technique and stated that it should on no account be attempted by the learner anaesthetist.[20] They also introduced the concept of preoxygenation, although it was not formally discussed.

Three positions were now favoured for induction. These were foot down, sitting or left lateral positions. Hamer-Hodges et al published a case series of 1500 patients giving support to the combination of foot-down tilt with thiopentone and suxamathonium induction.[21] However, in the 1950s research on lower oesophageal sphincter (LOS) function, backed up by careful thought, provided a platform that allowed RSI to evolve. O'Mullane showed that LOS competence was not affected by the actions of local anaesthetics, ganglion blocking agents or muscle relaxants. He was able to conclude that the LOS was therefore a valve.[15] Marchand went further when he found that the cardia was even competent in the cadaver![16]

But regurgitation was still clinically evident. There appeared to be two situations when oesophageal reflux might happen. Dornhorst showed that glottic obstruction during spontaneous respiration produced high negative pressures within the oesophagus which encouraged reflux.[17] Dinnick investigated with barium meals obstetric patients who had regurgitated, and showed that this was due to incompetence at the cardia.[18]

But the most comprehensive paper on the subject was offered by Snow and Nunn. They used the data from O'Mullane[15] where he found, even in gastric distension, that gastric pressures did not exceed 18 cms H_2O. They calculated, after making various assumptions, that the larynx was 19 cms H_2O above the cardia if the patient was in a 40° foot down position. They used gallamine paralysis which avoided the increase in abdominal pressure that occurred with suxamethonium. Of the 606 emergency patients anaesthetised in this way, only one clinically irrelevant regurgitation occurred.[22]

However, all these techniques were to be eventually replaced by an alternative strategy to posture. In 1961 Sellick described the use of pressure on the cricoid cartilage to occlude the oesophagus against the cervical vertebrae.[23] Patients could therefore be induced in the supine position with the application of cricoid pressure. This minimised the cardiovascular changes that occurred in the foot-down position and optimised access to the airway. By the 1980s reliance was primarily on the supine posture with cricoid pressure.[8] Subsequent to 1980 choices for induction of anaesthesia in the emergency patient with a full stomach were RSI, awake intubation or regional anaesthesia.

Preoxygenation

The concept of preoxygenation became widespread after the introduction of intravenous induction agents. In 1951 Morton and Wylie suggested that: 'the inhalation of oxygen for a few minutes prior to induction with all agents other than nitrous oxide may be a wise precaution'.[19] In 1955 Hamilton and Eastwood[24] demonstrated that denitrogenation was 95% complete within 2-3 minutes if a subject was breathing at a normal tidal volume. This led to the recommendation that preoxygenation should last for 3-5 minutes before RSI of anaesthesia. Thereafter, several studies demonstrated that patients are optimally oxygenated after 3 minutes of normal tidal volume breathing.[25,26]

Further studies have tried to achieve more rapid and sustained oxygenation by using deeper breaths over shorter periods of time. Both the '4 deep breaths over 30 seconds' (4DB/30 sec), and the '8 deep breaths over 60 seconds' (8DB/60 sec) methods have achieved equal or longer periods before desaturation compared to the traditional 3 minute tidal breathing.[27] Whatever the final outcome of this continuing research, preoxygenation before RSI has become standard practice.

Cricoid pressure

In 1961 Sellick published a paper called 'Cricoid pressure to control regurgitation of stomach contents during induction of anaesthesia'.[23] He was concerned about the widespread use of the barbiturate/muscle-relaxant/rapid intubation technique in the sitting position that had become popular following the recommendations of Morton and Wylie in 1951.[19] This position predisposed to cardiovascular collapse in the seriously ill and in addition, if active vomiting did occur during induction, it facilitated the entry of stomach contents into the lungs. Sellick suggested that his technique prevented regurgitation during induction before an endotracheal tube was inserted, and that it also prevented inflation of the stomach during intermittent positive pressure ventilation.

This latter use was first documented in 1774 and concerned the recovery of persons 'drowned and seemingly dead'. William Cullen wrote about experiments carried out by Dr Monro[28] and this article makes fascinating reading: 'To persons of little knowledge in anatomy, it is to be observed, that the pressure should be only on the cricoid cartilage, by which the gullet may be straitened, while the passage (of air) through the larynx is not interrupted'.

Sellick's manoeuvre was not practiced widely in the UK until the late 1960s. For the next 20 years, there was very little refinement made to the original description of the application of cricoid pressure. However, there are now indications that cricoid pressure can be far from harmless and in some circumstances can be responsible for airway obstruction, difficult tracheal intubation, pulmonary aspiration and, rarely, oesophageal rupture. Vanner and colleagues have done much to answer some of the fundamental questions concerning cricoid pressure[29] in the last decade. The timing and force of application has now been quantified. The Magill neck position (sniffing the air) has been vindicated and altering the pressure to achieve better laryngoscope views has been shown to be effective.[30] Recognition of the need for training anaesthetic assistants has also evolved.

Conclusion

RSI is a technique where a series of separate advanced manoeuvres and complex pharmacokinetic and pharmacodynamic effects are combined to reduce the potential risk of regurgitation and aspiration during induction of anaesthesia. There is only circumstantial evidence to indicate that it has been responsible for lowering the rate of pulmonary aspiration and much of its evolutionary history, like so many other aspects of medicine, is based on best practise. It is a technique that is widely used and is one of the only 'standard' inductions that anaesthetists practise. It has revolutionised our approach to the patient with high risk of pulmonary aspiration. However, a recent UK survey that looked at anaesthetic practice for RSI in obstetrics suggested that there is still variation in the timing and application of cricoid pressure, and the choice and dose of drugs used together with their timing of administration.[31] There are still many questions concerning RSI that remain unanswered and there is potential for further refinements. The quest for better pharmacocdynamics and kinetics remains and the continuing use of suxamethonium is in question. It has come along way in the last 100 years; what will happen in the next?

Acknowledgement

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Originally the College (of medicine; Pennsylvania Hospital, Philadelphia 1765) offered both the BM and MD, the latter requiring additional course work and a thesis. When it became apparent that few men returned for this degree, the baccalaureate degree was discontinued and graduates received an MD degree (p17).

The first medical schools....were associated with colleges: Philadelphia, New York, Harvard, Maryland and Yale. While the original plan called for two degrees, an MB that would be followed seven years later by an MD, this did not happen. Within a few years the MB was discarded and the MD became the degree earned, unfortunately with less education required than the original MB. (p23)

Submitted by Adrian Padfield , also from a book review, this time for the J Med Biog; The Renaissance of American Medicine by Alan C Mermann MD.

CHLOROFORM - MURDER OR SUICIDE
Sir Thomas Stevenson and his role in the trial of Adelaide Bartlett

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The Trial of Adelaide Bartlett

In 1886 Adelaide Bartlett was tried at the Old Bailey before Mr Justice Wills for murdering her husband Thomas Edwin Bartlett (1844-1886) with chloroform. The Attorney General Sir Charles Russell QC (1832-1900) led for the Crown. Edward Clarke QC (1841-1913) * led for the defence. (Figure 1)

Figure 1
Edward Clarke QC cross-examines Mr E Bartlett snr
(Mansell Collection)

A sensation in its day, the case remains one of the most intriguing of 19th century murder mysteries and raised many questions that are still relevant today. Although chemical analysis can prove exposure to a particular poison, and in some cases quantitative measurements can indicate likely toxic effects, proving the means by which a poison was administered and whether the poison had a causal effect on outcome is often an entirely different matter.

*** Clarke had an illustrious career, becoming MP in turn for Southwark, Plymouth and the City of London, Solicitor General 1886-92, and a Privy Counsellor (1908), although he never became a judge. He was Counsel for Oscar Wilde in the disastrous Queensbury libel case that led to Wilde's criminal trials for gross indecency. Clarke again represented him, generously waiving his fees.**

Adelaide and Edwin

Adelaide de la Tremoille had married Edwin in 1875 when she was 19. He was a prosperous South London grocer, but according to Adelaide's later reports had no interest in sex. Their reported one act of unprotected intercourse led to a still-birth. Within a year of their marriage she was said to have begun an affair with her brother-in-law. In 1885 Edwin and Adelaide moved to Merton Abbey, near Wimbledon, and became friends with George Dyson (b.1858), a Wesleyan minister. Edwin approved of Adelaide's close friendship with Dyson, and even made a will leaving everything to Adelaide with Dyson as executor and made its clear that he expected him to ensure that Adelaide was provided for if he died.

The Bartletts moved to 85 Claverton Street, Pimlico SW in October 1885. Edwin encouraged Dyson to see as much as possible of Adelaide, even buying him a season ticket from Putney to Waterloo to make it easier for him to visit her, ostensibly to instruct her in academic subjects, although their maid later testified to finding the couple sitting on the floor together. Within weeks Edwin became ill. He died on the 1st January 1886. The autopsy was performed by Dr T H Green of Charing Cross Hospital and four other doctors within a day or so of the death. They suggested the presence of a large amount of chloroform in his stomach. Dr Thomas Stevenson of Guy's Hospital, Home Office analyst, found 11¼ grains [727 mg, 0.5 ml] of chloroform in the stomach contents.

Murder or suicide?

Adelaide was charged with murder, and Dyson was charged with being an accessory before the fact as he had admitted at the inquest to obtaining chloroform for Adelaide. However, the case against Dyson was withdrawn before trial. This was probably a ploy by the prosecution to enable Dyson to give evidence. Adelaide herself was not allowed to testify in her own defence (this was not allowed until the Criminal Evidence Act of 1898 gave the accused the choice of testifying or not), although she had given evidence at the inquest.

It was shown in court that Dyson had bought bottles of chloroform from various chemists (Dyson had said he wanted it for use as a cleaning fluid) on Adelaide's behalf. Adelaide had admitted to using it, sprinkled on a handkerchief, to help Edwin sleep during his supposed terminal illness. That Edwin was poisoned with chloroform seems clear, but the defence suggested that he had drunk it to commit suicide. Ingestion as an anodyne was also a possibility. In the event, as there was no evidence to show how the poison had been taken, a 'not guilty' verdict was returned.

Was it murder?

After the verdict was delivered, Sir James Paget PRS (1814-1899),* is said to have remarked, 'Now that it is all over, she should tell us, in the interest of science, how she did it?'. The prosecution had suggested that Adelaide had chloroformed Edwin in his sleep, an extremely difficult thing to do, and had then trickled chloroform down his throat. The lower end of the oesophagus and the stomach showed clear signs of irritation, but there was no indication of irritation in the mouth or/throat. If Edwin had drunk chloroform quickly whilst conscious and whilst sitting up then this might explain the lack of irritation in the mouth or throat, although

*** Noted surgeon and histologist of St Bartholomew's Hospital (Paget's Disease) and friend of Verchow.**

if this was the case then it is possible that he would have vomited. However, there was no sign of vomit in the mouth or lungs. If chloroform had been poured down his throat while unconscious, some might have got into his lungs, but again there was no sign of irritation in the lungs.

Sir Thomas Stevenson and toxicology at Guy's

Dr (later Sir Thomas) Stevenson (1838-1908), the principal expert witness at Adelaide's trial, was an outstanding analyst and jurist – a pivotal figure in analytical chemistry and in forensic toxicology (Figure 2). His laboratory became a training ground that eventually yielded Sir Frederick Gowland Hopkins (1861-1947) PRS, first Professor of Biochemistry at Cambridge, and now widely acknowledged as the 'father' of modern biochemistry.

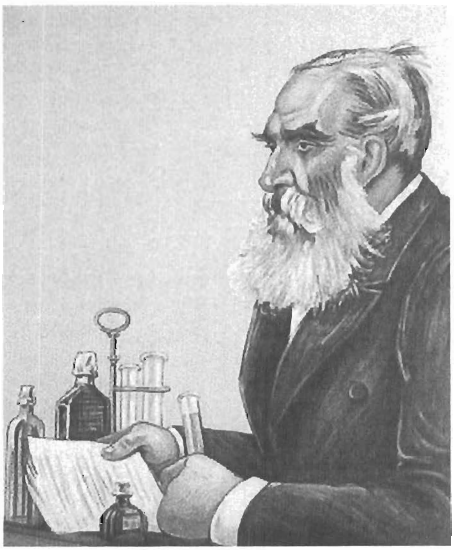


Figure 2
Sir Thomas Stevenson (1838-1908)
***Vanity Fair* 30 November 1899 by WAG (A G Wetherby)**

Guy's Hospital had opened in 1726. Thomas Guy (1645?-1724), a London bookseller, was an active governor of St Thomas' Hospital from 1704. Having made a fortune as a result of speculation in South Sea stock, he built (£18,793) and endowed (£200,000) a new hospital for incurables and lunatics, the largest single charitable donation made up to that time (he also left money to other charitable causes). The new hospital was designed to take patients refused treatment at St Thomas's, hence the emphasis was on materia medica and medical treatment rather than anatomy and surgery, which remained at St Thomas's. This was to contribute significantly to the development of scientific medicine in Britain, and established a tradition of chemistry at Guy's that lasted into the 20th century[1,2] Goodwill between the two hospitals crumbled in 1825, resulting in Sir Astley Cooper's transfer to Guy's and the formation of an independent medical school. Chemistry developed on three fronts: medical, forensic, and hygienic, resulting in some major discoveries. Among these were the first descriptions of alcaptonuria, paroxysmal haemoglobinuria, and the composition of kidney stones. Richard Bright FRS (1789-1858) discovered protein in urine, the diagnostic characteristic of Bright's disease of the kidneys, Alexander John Gaspard Marcet FRS (1770-1822) was the first to identify bicarbonate as the major blood buffer and John Bostock FRS (1773-1846) gave the first complete account of hay fever.

The appointment of Alfred Swaine Taylor FRS (1806-1880) as the first Professor of Medical Jurisprudence (1834-77) brought emphasis to the chemical analysis of human tissues and fluids and the clinical effects of poisons such as cyanide and strychnine. Not only did his writings become standard works on the subject, especially as regards presentation of evidence - updates remained in print for over 100 years[3] - but the relative rigours of his analytical laboratory (he was himself not a great analyst) were continued by Stevenson. Stevenson hailed from Rainton in Yorkshire, but had trained at Guy's (MB, 1863; MD, 1864). He was lecturer in chemistry and forensic medicine(1871-1908)and analyst and senior analyst to the Home Office (1872-1908).

He became in turn President of the Institute of Chemistry and of the Society of Public Analysts. He was an expert witness in all the leading criminal poisoning cases from 1881 (Lamson – aconitine, 1882; Maybrick - arsenic, 1889; Cream - strychnine, 1892; Horsford - strychnine, 1898; Bell - antimony, 1899; Chapman/Klosowski - antimony, 1903; Devereux - morphine, 1905; Brinkley - hydrocyanic acid, 1907) and was knighted in 1904.[4]

Stevenson had recruited Fred Hopkins in 1883 and he remained his assistant until 1888, when he enrolled in the medical school at Guy's. Later he became the first lecturer on the chemical and nutritional aspects of hygiene at Guy's. Given a lectureship at Cambridge in 1898 at a salary of £200 a year, he added to his income by supervising undergraduates and giving tutorials, and undertaking forensic toxicology case work for the Home Office for a few years after Stevenson's death. Subsequently Hopkins worked on proteins, studied xanthines and haem pigments, and helped Sir Archibald Garrod FRS (1857-1936) develop his concept of inborn errors of metabolism. His most famous work was in discovering the existence vitamins, for which he shared the Nobel Prize for Physiology and Medicine in 1929.[5] *

On Stevenson's death the mantle of Senior Home Office Analyst passed to (Sir) William Henry Willcox (1870-1941) at St Mary's Hospital. Willcox worked with Sir Bernard Henry Spilsbury (1877-1947) on many notable poisoning cases including those of Crippen (1910) and Seddon (1912). Toxicology at Guy's did not recover from the loss of Stevenson's protégées Wade and Hopkins until the eminent pathologist Professor Sir Keith Simpson (1907-1985) re-established an analytical laboratory to assist in his forensic work.

The other major influence, albeit indirect, was Professor Francis Edward Camps (1905-1972). His contact with Roy Goulding (1916-) whilst Camps was a general practitioner in Essex

*** In 1921 Hopkins isolated a substance that he named glutathione (GSH) and which he showed is widely distributed in the cells of plants and animals. Later he identified it as glutamylcysteinylglycine. GSH we now know is important in the metabolic detoxification of phosgene, a reactive intermediate formed by the oxidative metabolism of chloroform. By analogy with paracetamol, it is likely that depletion of hepatic GSH after chloroform exposure leads in some instances to oxidative damage to hepatic macromolecules, hence the development of liver necrosis manifest in its later stages as jaundice possibly leading to liver failure (Pohl et al 1981)[6]**

during World War 2 was a major influence in Goulding's decision to take up medicine. Goulding, with Simpson's help, was instrumental in founding the National Poisons Information Service (1963), and the Poisons Reference Service Laboratory (later the Poisons Unit, now the Medical Toxicology Unit) (1967) at Guy's, and spontaneous adverse drug reaction reporting (the 'yellow card' system) (1964), amongst other initiatives.[7]

Sir Thomas Stevenson and the Bartlett trial

Much has been written about the Bartlett trial in recent years.[8-10] A major source has been the trial transcript published soon after the trial and edited by junior counsel for the defence assisted by Edward Clarke himself,[11] but there are other contemporary records,[12] articles, etc.[13-15] It has not been generally remarked on that Edwin had had a canine tooth removed on the day he died and was given a 'very large quantity' of nitrous oxide - he is said to recovered from its effects exceptionally rapidly,[15] but will clearly have had a very sore mouth. He had had four teeth extracted only ten days before without anaesthetic and his gum was still badly infected. Given that the effects of nitrous oxide may take hours to wear off completely,[16] it seems possible that Edwin may have suffered a degree of mental confusion, compounded by pain, which inadvertently led him to overdose on chloroform. No-one at the time seems to have considered the possible complicating effects of nitrous oxide; indeed, its use appears to have been made public only after the trial had ended.

Whatever the true cause of Edwin's demise, it is clear that the domestic arrangements in the Bartlett household were unusual to say the least, and thus there were a number of points that favoured suicide or, failing that, accident as the reason chloroform had been ingested, as discussed above. On the other hand there was some circumstantial evidence to suggest that Adelaide herself had planned and executed the whole episode. On balance, from the records available, the jury's verdict was probably correct in the circumstances, although as they stated 'grave suspicion is attached to the accused'.

Stevenson's evidence was the key as to showing why Edwin Bartlett died and the careful analytical work he and his assistants Fred Hopkins and/or John Wade performed, together with Stevenson's experience of presenting scientific evidence in court, may well have saved Adelaide's life. Unusually in the history of analytical science, Stevenson's laboratory notebooks survive in the Gordon Museum at Guy's, now part of King's College London. These give a day-by-day account of his work for HM Coroners and the police over some 30 years. The notebooks are quarto and written in Stevenson's own hand, not always easy to read, each one numbered on alternate pages and indexed by Stevenson himself. Records of analytical work are initialled on every page. His first book for 1886 is devoted to the Bartlett case (Tables 1 and 2, Figure 3). It is clear that Stevenson was fully involved at an early stage of the investigation and was given copies of the statements of the principal witnesses, including that of Adelaide herself. Many of the early pages have a vertical pencil line drawn through them, perhaps done by Stevenson himself once he had prepared his report to the Coroner.

Unfortunately there are no references to the analytical methods used, only records of specimens received, analyses carried out, statements of witnesses, and copies of reports to Coroner and Treasury Counsel. There is also a record of experiments on rabbits carried out in response to questions raised at the committal hearing and reported at the trial. It is hoped to

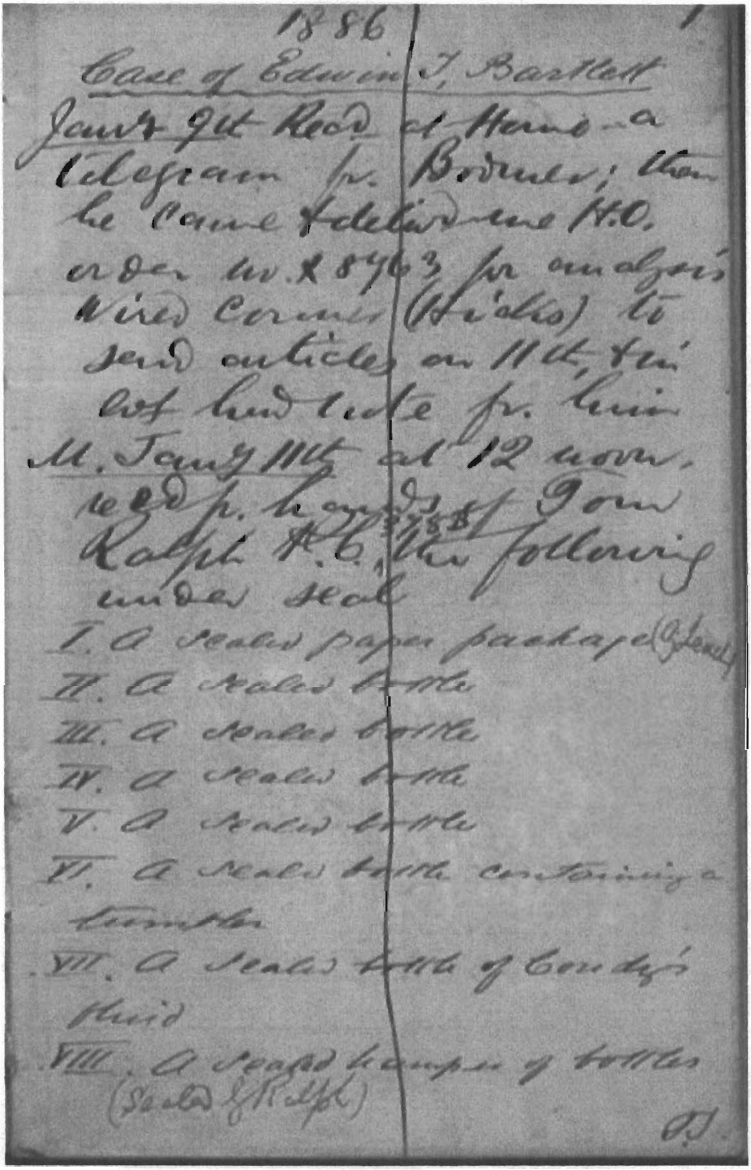
Index	Page *	Notes
Case of Edwin T Bartlett	1	Instructions from the Home Office for the analysis; catalogue of samples received; notes of analysis performed
History of case	11	
Analysis of jaw and tongue	29	
Statement of Adelaide Bartlett	34	As given to Dr Leach on 4 January
Report to Coroner	37*	Fair copy of Stevenson's report
Depositions before Coroner	54*	This not in Counsel's proof
Extract from Counsel's proof	57*	
Notes on chloroform poisoning	60	
Case of Bartlett	79	His own record of some of the evidence given at the committal hearing
Fatal cases of chloroform poisoning	83	Literature references to published work
Experiments on rabbits with chloroform 25 March 1886	85	Performed to see if chloroform was detectable in the stomach after administration by inhalation
Further proof of evidence sent 7 Apr 1886	87*	Gives details of the experiments on rabbits
Case of Bartlett	88	His own record of some of the evidence given at the trial at the Old Bailey
Post-mortem notes	89	Record of the post-mortem examination read in court
Personal diary of events	90-91	Possibly used to draw up his fee note?

Table 1.
Sir Thomas Stevenson's Bartlett Casebook

* See Table 2 for full text

Page	Text
54-	I cannot say exactly how much chloroform had been taken. but from the quantity I found I should say it was more than one ounce. The taste of chloroform is hot and fiery. A person taking chloroform would not easily mistake it for chloral. One fluid ounce of chloroform has destroyed an adult. I have known persons to have swallowed oil of vitriol by mistake. If a fatal dose of chloroform has been taken, it has been known to destroy life in from one hour to twenty-four hours. Sometimes the chloroform produces sickness & then the patient usually recovers. At other times it produces insensibility & then death. The insensibility is usually produced within the hour, sometimes more rapidly. Brandy does act as a solvent of chloroform but it would take two or three wine glasses of brandy to dissolve one ounce of chloroform. I may say that I did find a trace of alcohol in the stomach, but whether anything deceased had taken in the way of wine, or from it being contained in the chloroform, I am unable to state, as chloroform always has about 1 per cent of alcohol added to make it keep. If the chloroform had been taken in a large amount of brandy I should have expected to have found more traces of alcohol. The bottle in which I found the Condy's fluid I handed to Inspector Marshall.
57-	I am of the opinion that the appearances in the stomach, coupled with the quantity of chloroform found in the contents of the stomach, and also its presence in the fluid from the intestines point to the administration of a fatal dose of chloroform, in the liquid form, by the mouth. There is no evidence available in the articles submitted to me to show whether the administration by the mouth had been preceded by the use of chloroform by inhalation. Chloroform is a poison, which may kill when it is swallowed in excess; when it is inhaled in excess; or manifestly by both methods of administration. About three-quarters of a fluid ounce of chloroform, swallowed, has destroyed the life of an adult; a teaspoonful has killed a child, aged four years; & I have known a teaspoonful produce severe symptoms in an adult. Death has resulted in an hour from the swallowing of chloroform. It is a hot fiery liquid, of pungent odour and could not be swallowed without producing an immediate powerful sensation of burning in the mouth and throat. Persons may be chloroformed by inhalation whilst asleep. If the person be not too far gone liquids placed far back in the mouth are swallowed, i.e. the act of swallowing is excited. But when very greatly under the influence of inhaled chloroform, liquids placed at the back of the throat do not excite the act of swallowing. A person under the influence of chloroform administered by the mouth is insensible; and this insensibility may supervene quickly, i.e. in a few minutes. The sealed wrappers I have referred to, & all the medicines I have referred to, were produced by me at the adjourned inquest on February 4th, & were left in the custody of the officer of the court. Tom Ralph.
87	Since the magisterial hearing I have experimented upon rabbits with chloroform, to clear up points suggested in cross examination. A rabbit was caused to inhale chloroform till it was dead. It was then opened immediately. The blood and intestinal organs smelled of chloroform. The stomach was removed quickly, and the contents examined for chloroform. None was detected. This experiment shows that when chloroform is inhaled in fatal excess, there is no sensible secretion or excretion on chloroform into the stomach. One fourth of a fluid ounce (a desertspoonful) of chloroform was introduced into the stomach of a rabbit by means of a tube. In 10 minutes the animal could not stand; and in about half an hour it was insensible, and remained so. In three hours it was in a dying condition, but the blood was still circulating. The throat was cut, and the blood which flowed was analysed and found to contain chloroform. This experiment proves that chloroform when taken into the stomach passes into the blood. On post-mortem examination there was found to be recent acute extensive inflammation of the stomach and the mucus membrane was abraided - probably commencing ulceration.

Table 2
Extracts from Sir Thomas Stevenson's Casebook 1886



1886 1

Case of Edwin T. Bartlett

Jany 9th Recd at Home a telegram fr. Broderer; then he came & delivered me H.O. order No. X 8763 for analysis. Wired Coroner (Hicks) to send articles on 11th, & got had note fr. him

M. Jany 11th at 12 noon recd fr. hands of Tom Ralph P.C. 378B the following under seal

I. A sealed paper package (sealed)

II. A sealed bottle

III. A sealed bottle

IV. A sealed bottle

V. A sealed bottle

VI. A sealed bottle containing a tumbler

VII. A sealed bottle of Condy's fluid

VIII. A sealed hamper of bottles (Sealed by Ralph)

T.S.

Figure 3
Sir Thomas Stevenson's Bartlett Casebook (page 1)

Page	Text
1	Jan 9th - Received at Home a telegram from Bodmer; then he came and delivered the HO order no X8963 for analysis. Wired Coroner (Hicks) to send articles on 11th ...[4]
37-	On January 11th last I received from the hands of Tom Ralph PC 375B the following articles all sealed with unbroken seals:- A paper package sealed with plain seal, and marked re. Ed. T. Bartlett deceased, W Ralphe 17 Charlewood Place. Contents Jaw entire, Parts of tongue etc.; it contained the lower jaw of an adult, with the tongue and adjacent soft parts. A glass jar, sealed 'J.G.D.' containing a very thick semi-fluid mass, measuring one-fourth of a pint, and presumably the contents of the small bowels. A glass jar or bottle, sealed 'J.G.D.' and containing a human stomach which had been cut open A glass bottle, sealed 'J.G.D.' and labelled as 'mango relish'. A (4 oz) glass bottle containing a tablespoonful of thick semi-fluid matter, presumably the contents of the stomach, having a strong and peculiar odour. A glass jar, sealed 'J.G.D.', containing a fluid, a broken tumbler, and a 1½ ounce medicine bottle. A brandy bottle, sealed 'J.G.D.' containing a fluid. A hamper, sealed, containing 36 bottles and other vessels, to each of which I shall assign a distinguishing letter or letters. On the 16th January I received from the hands of the same person, a further sealed package, containing three vessels, to which I have assigned distinguishing numbers. I have duly examined & analysed the articles contained in these packages and vessels with the following results:- The lower jaw was diseased, and contained four teeth only, viz. on the right, the canine tooth, & one molar, & on the left the two bicuspids. From the half of the jaw & the whole of the soft parts, I extracted traces of copper and lead – in the aggregate 1-80th grain of the two metals. I am unable to assert with certainty that mercury is present or absent; the quantity of material was too small to admit of its detection in the presence of lead and copper. The contents of the intestines contained mango relish. I extracted also a trace of chloroform, 3-10ths of a grain, and no other poison. The stomach had apparently been acted upon by some irritant during life, and shortly before death. The mango relish was free from poisons. The tablespoonful of stomach fluid was faintly acid. It contained mango relish. The peculiar odour was distinctly that of chloroform. I ascertained that the fluid contained 11¼ grains of chloroform, or nearly five per cent. There was no prussic acid, morphine, or other poison present besides chloroform. The vessel containing the fluid with the broken tumbler, contained partly decomposed Condy's fluid[5], and was free from chloroform and chlorides, i.e. the products of the decomposition of chloroform. It contained a small quantity of sulphate of magnesium. The brandy bottle contained Condy's fluid, and no poison. It was free from sulphate of magnesium. I am of opinion that the quantity of chloroform met with in the visceral articles submitted to me, points to the administration of a fatal dose of chloroform; and the post-mortem appearances met with, more especially those in the stomach and the heart, are such as would be met with in poisoning by liquid chloroform. [For this paragraph in Counsels' proof, vide p 57] The vessels in the sealed hamper, and those delivered to me on the 16th January contained various medicaments including nux vomica, opium, chloral hydrate and chloroform, but all in ordinary medical and non-poisonous doses. The only medicines containing chloroform or chloral hydrate - from which latter chloroform is obtained by a simple chemical process - were:- X^1, X^2, X^3, which contained the residues of a mixture prescribed 'by A Leach', prescription no. 38557 containing chloroform - minute quantities only, quite insufficient to account for the chloroform found in the body of the deceased.

Table 3
Further extracts from Sir Thomas Stevenson's Casebook 1886

undertake a full study of the Bartlett notebook and the other notebooks in due course.

Acknowledgements

We thank Mr Bill Edwards (Curator, Gordon Museum), Dr Roy Goulding, and Dr David Zuck for kind assistance; Dr David Watts, late Reader in Biochemistry, United Medical and Dental Schools of Guy's and St Thomas' Hospitals, for information on the history of biochemistry at Guy's; and Linda Stratmann for her detailed comments on the Bartlett case.

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Abstract

'THE PROFESSOR NEEDS A DUMMY'
The story of Seaworthy Sierra Sam

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Professor Edgar Pask is famous for his Second World War exploits.[1] He is remembered as the limp figure seen adrift in a pool, testing life-jackets for the RAF. His researches saved the lives of many airmen, and left Pask with a lifelong interest in marine safety and rescue.

After ten years as head of the Department of Anaesthesia in Newcastle, Pask came back to the subject of research into life-jackets; with his poor health and seniority, it was inappropriate to throw the Professor into the Tyne, and so a substitute was sought. Eventually, an American company was found that made anthropomorphic test dummies for the USAAF. They built a dummy for Pask, 'Seaworthy Sierra Sam'. He was unique, and made to simulate an unconscious person exactly, as well as being waterproof.

Sam was brought back to Newcastle, and used in a number of experiments.[2] He remained a 'member' of the Department for more than ten years after the death of Pask in 1966. He was finally sold to a marine institute in Hamburg in 1978.

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Abstract

ANESTHETIC ADMINISTRATION BY A JUVENILE
Stories from a Medical Family

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Charles H Mayo (1865-1939) administered an anesthetic at a young age. The Mayo family often retold the anesthesia story. According to C H Mayo:

> 'I began my work in anesthesia at the age of eight or nine years. I remember a physician whom father (William W Mayo 1819-1911) used to call in to give anesthesia. One time a patient with a large ovarian tumor was going to be operated on. They never used to operate for an ovarian tumor in those days until it weighed 80 or 100 pounds. On this occasion the physician was giving the anesthetic, and Dr Will, who was [four years] older, was called in to help across the table from father, and I was sitting disconsolately on the doorstep. The door opened and the physician came out on the lawn, giving a good exhibition of seasickness. I was called in to give the chloroform. Father told me when to stop and when to start'.[1]

Other accounts place the age of Charles H Mayo at twelve,[2,3] seventeen,[4] or eighteen[5] years.

William J Mayo (1877 or 1878) provided two descriptions:

> 'I am sure I cannot add anything to what Dr Charlie has said. I remember the instance of which he speaks and can see him in my mind's eye, a small boy of twelve in knee pants standing on a chair and dropping the chloroform on.'[2]

> 'When I was sixteen (1877 or 1878) I was my father's first assistant, and Charlie handled the sponges behind me. Dr Mosse was giving the anesthetic – this was out at the Voltz place - as father got the incision big enough for digging into the tumor, Dr Mosse fainted away, and Charlie stood on a box and administered ACE - from that time he was the anesthetist.'[3]

The Rochester *Post* carried the following item:

> 'Last Wednesday (January 3, 1883) Dr W W Mayo, assisted by Drs J E Bowers, F R Mosse and W J Mayo, removed from the person of Miss Anna Voltz, of Marion, an ovarian tumor weighing twenty-eight pounds. The operation was entirely successful and there is every reasonable prospect of the complete recovery of the patient.'[4]

W W Mayo reported:

> 'Ovarian Tumor Operation - Recovery. Miss T Voltz, age 19, Marion, Minn. Consulted me in the fall of 1882 regarding an abdominal enlargement - an operation advised and refused, as she was but little inconvenienced. In October 1883, still refusing an operation, she was tapped. The tumor now rapidly refilled and on January 3rd (Thursday, 1884) the patient and friends consenting, assisted by Drs J E Bowers, W J

Mayo and D M Berkman, I operated, removing a multilocular cyst weighing thirty-two pounds. The patient made an uninterrupted recovery without medication, and in about one month married and within the year was delivered of a fine child - Anesthetic: chloroform; no antiseptics.'[5]

Attempts to resolve the variations in dating of the event have been interesting. A consideration of the Volz (Voltz) family suggests the patient described by W W Mayo was Anna Volz. Anna Volz married her stepbrother Justus Frank Volz on 2 March 1883. Their son Frank J Volz was born 17 January 1884. These dates fit the rapid recovery described by W W Mayo. According to the *Post* the procedure occurred on 3 January 1883. Charles H Mayo was seventeen years old at that time.

Finally the story provides an interesting illustration of the father as medical mentor to his young sons. As W J Mayo said:

'He used to take us to National meetings, even when we were small boys. I never knew I had any choice except to be a doctor. As we went around with him he was very careful to see that we saw everything.'[3]

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THE STORY OF CYCLOPROPANE AT HILLINGDON HOSPITAL

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Cork, Ireland

Introduction

I first saw cyclopropane used in 1942. I was a dresser on Professor Rendle Short's firm at the Royal Infirmary in Bristol. Ronald Belsey, a graduate of St Thomas' Hospital, newly arrived from the United States where he had graduated in the new speciality of Thoracic Surgery, was established temporarily in a convalescent home in Weston-super-Mare. The Professor was anxious to see this man at work. The operation was a thymectomy for myasthenia gravis; a vertical incision was made over the sternum, the bleeding controlled with diathermy, and the sternum split revealing the mediastinum and both lungs being ventilated with cyclopropane. This was my introduction to the wonders of anaesthesia. The fact that we could have been blown up by a slip of the diathermy point did not register until many years later. Rendle Short, a very popular general surgeon of the old school before the days of specialist surgeons, grumbled on the way home: 'what with the chest surgeons working from above and the gynaecologists working from below, there will soon be little for the general surgeon but to browse on the scanty foliage of the umbilicus'.

Hillingdon Hospital

The fact that there were radical changes in the health services in Britain before the introduction of the National Health Service in 1948 is sometimes overlooked. The Local Government Act of 1930 abolished Poor Law institutions and handed the provision of health care to the County Councils. Hillingdon, one such Poor Law institution became a general hospital under the Middlesex County Council, with the establishment of the chest surgery unit for the County. The hospital was enlarged in 1939 by the addition of an Emergency Medical Service hospital in pre-fabricated buildings adjacent, intended as a country refuge for St Mary's in the event of their being evacuated from Paddington; the whole comprising 500-600 beds. The County Council began the construction of a Tuberculosis Sanatorium at nearby Harefield. The staff were whole time salaried doctors with a Medical Director in charge. Later surgical and anaesthetic staff from London hospitals attended on a sessional basis.

The thoracic surgeon was Libro Fatti, a South African who came to study in Britain and remained for the duration of the war. Returning to South Africa after the war he established a famous unit at Groote Schour University Hospital in Cape Town, where twenty years later the first heart transplant was performed. The anaesthetist was H J.V Morton, a pupil of Michael Nosworthy at St Thomas' Hospital, one of the chief protagonists of cyclopropane anaesthesia in Britain. Fatti and Morton formed a busy and innovative team. Connell anaesthetic machines[1] were imported from the United States for cyclopropane anaesthesia. Following the publication of R E Gross's[2] paper from Peter Brent Brigham Hospital, Fatti tied a patent ductus arteriosus in 1939, one of the first such operations to be done in England, the procedure being filmed by a crew from Pinewood Studios. Meanwhile the two of them had, by 1944, done 600 bronchoscopies under thiopentone anaesthesia (requiring remarkable sleight of hand). The same year Morton published his MD thesis in the *Lancet*: Tobacco smoking and pulmonary complications after operations.[3]

H J V Morton

Morton was an ingenious innovator. In those days before the use of antibiotics, operations on the lungs were accompanied by volumes of pus and he and Fatti adopted the prone position for operations on the lungs as described by Overholt.[4] Morton designed a system which allowed the pus to drain into the face mask round an endotracheal tube without a cuff. He introduced a kymograph into the theatre to study breathing patterns. With John Blease, he introduced the first commercial ventilator for use with cyclopropane. He also co-operated with J R Esplen to design the Fazakerley ventilator.

Morton became a prominent member of the emerging specialty of Anaesthesia. He was a founding member of the newly created Faculty of Anaesthetists, President of the Section of Anaesthetics at the Royal Society of Medicine, and Honorary Secretary of the Association of Anaesthetists, of which he was a member of Council for many years. He was secretary of the first sub-committee for the study of deaths associated with anaesthesia. He was one of the first anaesthetists to take an interest in statistics, when Bradford Hill had shown smoking to be a cause of lung cancer.

Use of cyclopropane

I joined this distinguished team in 1949. Chris Mullard, who had replaced Libro Fatti, started operating on the heart by dilating a stenosed mitral valve with a finger through the left atrium. Cyclopropane was used routinely for all major surgery, except when the diathermy was used. Michael Nosworthy, at St Thomas' Hospital, used the Waters to-and-fro system,[5] but Morton preferred to use the circle system; having tried himself to breathe to-and-fro through a Waters soda lime canister, he found it too abrasive and very hot. The Connell anaesthetic machine was ideal for closed circuit use as it could be made absolutely gas tight, unlike the Boyle machines then in common use, which leaked at every joint.

The test for leakage was to place another bag in place of the mask, and with a manometer in the circuit to raise the pressure in the system to 20 cms of water by squeezing the rebreathing bag; no gas should be lost to the system after holding for one minute. When using a leaking system the anaesthetist tended to replace the loss with more oxygen. This resulted in loss of nitrogen and consequent collapse of the alveoli as the oxygen was absorbed. Gross remarked that at the end of each operation for tying a patent ductus the lung is re-inflated before closing. Certainly most of the complications attributed to cyclopropane were due to collapse of the alveoli in the lungs. While operating with Mullard on a lobectomy, for instance, he would be asked to stop every 15 minutes to re-inflate the good lobe. There was no means of measuring the concentration of the gas in the circuit. This was probably 5-15%. An experienced operator could tell by smell about how much cyclopropane there was in the system. Unfortunately this practice of 'sniffing' fell into disrepute as some practitioners succumbed to the habit, one at least falling off his stool during an operation to everyone's embarrassed amusement.

Explosions

Cyclopropane is highly flammable; this finally put to an end its clinical popularity. Morton and Professor Ronald Woolmer were deputed by the Association of Anaesthetists to represent them at a meeting with the Ministry of Health. 1956 saw the publication of their *'Report of a Working Party on Anaesthetic Explosions'*.[6] Morton took the danger to heart; nothing pleased him more than experimenting with explosions. He filled a Higginson's syringe with a mixture of cyclopropane and oxygen, which he took to a meeting of the Section of Anaesthetics at the Royal Society of Medicine; he succeeded in blowing the President's cigarette lighter out of his hand, and brought down the cobwebs from the ceiling of the Barnes Hall.

The possibility of using cyclopropane for dentistry was mooted, until a dentist reported that he had seen a spark from a tooth broken during an extraction. Morton obtained a shoe box full of teeth from the Dental School and proceeded to crack them in the dark. Having demonstrated that it could happen, he put a tooth and a pair of forceps in a balloon filled with cyclopropane which he succeeded in detonating; he photographed the explosion at night out of doors!

In Britain the danger of explosion had been treated rather casually. Dr Boyle had a spirit lamp under his ether bottle to keep it warm. Cyclopropane and oxygen was a much more dangerous mixture, the results being often fatal to the patient and to the operator. Frankis Evans reported that 74 explosions occurred in the USA in 1930 alone.[7] Nevertheless, some surgeons used the diathermy for haemostasis after making the skin incision and would then put it away. This was most alarming in the hands of thoracic surgeons, who were holding their diathermy point only millimetres from the lungs, full of explosive gas.

However, static electricity was a more elusive danger. Precautions required all anaesthetic apparatus to be earthed. This meant that the floor itself had to be conductive. Building conductive floors added substantially to the cost of new hospitals; the use of cyclopropane was soon abandoned and halothane took its place.

Endoscopy was a constant source of worry, surgeons fiddling with their electrical contacts; such was the danger that when I joined St Peter's and St Paul's urological hospitals in 1956, we removed the cylinders of cyclopropane. Shortly after, Sir Ivan Magill came on a visit to anaesthetise a friend. When the patient started moving he called for the cyclopropane; as there was none I turned on the halothane for him. I asked him afterwards if he had not used halothane, as all consultant anaesthetists had that year been given a small bottle by the manufacturers. 'Oh yes,' he said, 'I found it very good for cleaning my pipe.'

Postscript

I left Hillingdon in 1964 and did not use cyclopropane again. To my surprise I found the old Connell anaesthetic machine I had used at Hillingdon in the Association's museum twenty years later, with a label 'HALOTHANE' in my handwriting on the ether drop bottle.

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THE HISTORY OF CARBON DIOXIDE IN ANAESTHESIA

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Introduction

CO_2 has an important role in anaesthesia and in the understanding of its physiology. This paper will examine the history of CO_2 and its relation to anaesthesia by reviewing its discovery, early experimentation and attempted use as an anaesthetic. It will also look at the absorption of CO_2 in the development of circle systems, its measurement and some of its clinical uses.

Discovery of carbon dioxide

In the mid-17th century, Robert Boyle (1627-1691), an English chemist, and Van Helmont in Belgium, recognised the existence of 'elastic fluids' which were similar to air. In 1660, Boyle described 'fermentations' and 'corrosions' producing 'factitious airs' which extinguished flame and life.[1,2] Van Helmont applied the term 'gas sylvester', sylvestris meaning 'of the wood', which was used as a general name for gas and sometimes for one particular gas. One of these gases was CO_2, perhaps named because it was thought to be 'exhaled in marshy and woody places'. He knew that some of the gases were poisonous or inflammable and he produced CO_2 by heating charcoal, by fermentation, and by the action of distilled vinegar on calcium carbonate, but he lacked a specific test for the presence of CO_2.[1-3]

CO_2 was isolated in 1757 by Joseph Black (1728-1799), Professor of Chemistry at Edinburgh. It was the first gas to be isolated. He wrote a book in 1755: *Experiments upon magnesium alba, quicklime, and some other alcaline substances*. He proved that limestone and chalk lost weight when burned to quicklime and managed to collect the gas. This gas could also be obtained from chalk by the action of acids. The term 'fixed air' was applied by Black to CO_2 in 1756 because it was 'fixed' in calcareous materials and liberated by fire or acid. Black therefore related it to substances which produce and absorb it, and was also acquainted with its toxic properties.[1-3]

Early experimentation with carbon dioxide

A French chemist, Antoine Laurent Lavoisier (1742-1794) worked on CO_2 in the early 1770s. He recognised the place of CO_2 in the respiration and combustion process, described its properties and determined its composition for the first time. He used caustic alkali to absorb CO_2, probably using a type of closed circuit, and an open circuit with valves, to separate inhaled from exhaled gases. He determined the CO_2 output of man and recognised the toxic properties of inhaled CO_2 by performing experiments on animals.[3] CO_2 was sometimes called 'mephitic air' by the scientists because an animal would soon die when immersed in the gas.[2]

Joseph Priestly (1733-1804) was an English nonconformist minister and scientist, best known for describing nitrous oxide in 1772 and isolating oxygen in 1774.[4] He was drawn to working on CO_2 by Black's work and also as a consequence of living in the neighbourhood of a public brewery. He experimented with 'fixed air' in a Leeds brewery around 1767, exposing frogs until comatose, and then reviving them again in fresh air.[1,2]

Thomas Beddoes (1760-1808), who was born in Shifnal, lectured in chemistry at Oxford. In 1793 he moved to Bristol to found The Pneumatic Institution, which opened in 1798. He believed that breathing 'exotic gases' might provide a cure for consumption, and the Institution had the capacity to synthesise and deliver gases to patients.

Beddoes was important for his research into the physiological effects of breathing gases. He applied medicine to the body by means of the lungs rather than the stomach, a more controllable method of administration, and he was possibly the first to use a gas for the relief of pain. He used CO_2 as a topical agent; carbonic acid gas stopped the pain of his blistered finger. He also used yeast, which was known to produce CO_2 by fermentation, as poultices which were applied to the diseased parts of patients. Inhalations of CO_2 were used for internal growths. However, these treatments were neglected and resisted by other scientists, as CO_2 would not heal cancer. Beddoes probably destroyed nearly the whole of his work at the end of his life when he was convinced that his 'pneumatic medicine' had failed.[2,5]

Also working at the Pneumatic Institution around 1800 was Humphry Davy (1778-1829), an English scientist. He is best known for inventing the miner's safety lamp and using nitrous oxide, which he named laughing gas, as an analgesic whilst Director of the Institution. He experimented by breathing the 'exotic gases' himself. He found that hydrocarbonate acted as a sedative, and on attempting to inhale pure CO_2 developed laryngeal spasm. In 1801 Davy left the Pneumatic Institution, and became Director of the Laboratory and Assistant Lecturer in Chemistry at the Royal Institution in London.[2,4]

Carbon dioxide as an anaesthetic agent

Henry Hill Hickman (1800-1830) was an English general practitioner based around Ludlow and Shifnal, Shropshire. He was influenced by the work of Beddoes and both he and Beddoes were influenced by a book called *The Connexion of Life with Respiration* by Goodwyn. It is reported that Hickman had a kind nature and this is why he endeavoured to free his patients in his country practice from the pain of surgery.[2,5]

He exposed animals to carbonic acid gas from the reaction of sulphuric acid and carbonate of lime, or by placing them under a glass cover surrounded by water. By breathing in carbonic acid gas, he found that there was a cessation of respiration and temporary loss of consciousness, during which time he performed surgical procedures on the animals. They were then resuscitated by warmth and artificial respiration. This temporary and reversible suspension of life was termed 'suspended animation' and he produced a pamphlet on this in 1824. He intended that this could be applied to the human subject. Hickman also thought that this method of using CO_2 resulted in a reduction in blood loss, now thought to be due to deep anaesthesia, causing a 'failing pulse'.[4-6]

Hickman's efforts to publicise his experiments in the United Kingdom and abroad were unsuccessful, and it was only many years later that the significance of his work was recognised. A memorial tablet, set up in 1930 where Hickman is buried (from Henry Wellcome who took up his cause) states that Hickman is the 'earliest known pioneer of anaesthesia by inhalation'. Hickman used CO_2 as the first gaseous anaesthetic for surgical operations on animals in 1824 and he is, therefore, the originator of the idea of producing insensibility for surgery by inhalation.[4, 5]

Absorption of carbon dioxide

John Snow (1813-1858) was born in York and is known for describing the stages of anaesthesia and designing inhalers for ether and chloroform. He administered chloroform to Queen Victoria during childbirth in 1853 and 1857. He also demonstrated that cholera was spread by contaminated drinking water. In 1838 he was a newly qualified GP and he was interested in a report in the London *Times* about the death of a night watchman. At the coroner's inquest, there was testimony that the man may have died from inhalation of carbonic acid. (It is now known that the death was probably due to carbon monoxide).[7]

Snow went on to perform experiments on animals with CO_2, showing that more than 5-6% inhaled CO_2 in air produced 'deep and laborious breathing' and that less than half this amount was fatal when formed at the expense of oxygen in air. He controlled the concentration of CO_2 in closed spaces with limewater, and in later years used caustic potash solution to absorb carbonic acid gas from a closed system apparatus in which he rebreathed mixtures of chloroform and oxygen, or ether and oxygen. Snow also understood the concept of mechanical dead space. He noticed that when air was breathed through a long tube, inspiration would draw back expired air and produce 'alarming symptoms'.[7]

Snow's work was influenced by Sir Robert Christison, a student of Thomas Charles Hope who was successor to Joseph Black as Professor of Chemistry at Edinburgh, and who had also visited Lavoisier in Paris. He was also influenced by a Professor Graham, who published work on absorbing carbonic acid gas remaining after the explosion of fire damp in coal mines, by inhaling air through a cushion filled with slaked lime and sulphate of soda.[7]

In 1915, Dennis Emerson Jackson (1878-1980) a pharmacologist working at the University of Washington, St Louis, introduced apparatus for circle and 'to and fro' CO_2 absorption systems, in order to reduce the cost of anaesthesia with nitrous oxide and oxygen. However, clinical colleagues showed no interest in his absorption apparatus and ventilator and therefore it was only used by Jackson on dogs in his laboratory.[8]

The work of John Snow and Dennis Jackson was recognised by Ralph Milton Waters (1883-1979), who became the first University Professor of Anesthesia in the United States in 1933. In 1924, he introduced apparatus with a CO_2 absorber for use with nitrous oxide, oxygen and ether anaesthesia. Waters simplified Jackson's apparatus by removing a motor. He experimented with soda lime granules and containers, and recognised that complete rebreathing was convenient, economical and had benefits for the patient, retaining heat and moisture. The weight of the absorber made it difficult to maintain a gas-tight fit with the mask and soda lime got hot, requiring hourly canister changes. Waters presented the results of two and a half years' experience in operated humans.[8, 9]

A circle system, with CO_2 absorption (using valves) was used by an anaesthetist Brian Sword (1889-1956), in 1926. It was only widely used from 1930, after he had introduced it further in the United States.[8]

Measurement of carbon dioxide

In 1884 Svante Arrhenius (1859-1927) from Sweden, used conductivity to prove the existence of ions, and produced a theory of electrolytic dissociation in 1887. In the same year Wilhelm Ostwald (1853-1932), a German chemist, made the first electrometric measurement of hydrogen ions and identified a relationship between H ion concentration and acid strength. In 1893, he used H^+ electrodes to determine the dissociation constant of water.[10, 11]

Lawrence J Henderson (1878-1942), Professor of Physiology at Harvard, described the variables influencing the neutrality of blood in 1907 and S P L Sorensen, Professor at the Carlsberg Laboratories at Copenhagen, introduced the concept of 'buffer' and 'pH'. Max Cremer (1865-1935) discovered an electric potential proportional to the H^+ concentration difference across thin glass membranes, leading to the production a glass pH electrode in 1909.[10,11]

Karl Hasselbalch (1874-1962) was a Danish physiologist and a pupil of Sorensen, and in 1917, using a H^+ electrode, was the first to measure the correct pH values of blood at 37°C and to distinguish between metabolic and respiratory disturbances, compensated or uncompensated. He adapted Henderson's mass law for carbonic acid to the logarithmic form to produce the Henderson – Hasselbach equation. This expresses the buffering action of bicarbonate/carbonic acid in blood: $pH = pK_a + \log(HCO_3^-)/pCO_2 x0.23kPa$.[10,11]

The apparatus of John S Haldane (1860-1936), a Scottish born physiologist, was used to measure the volume percentage of CO_2 in a gas mixture. The volume of gas in a burette was measured before and after removal of CO_2 by potassium hydroxide.

Following on from the Haldane apparatus, Donald D Van Slyke (1883-1971), a chemist at the Rockefeller Institute in New York, produced a manometric device used to measure the total amount of CO_2 in serum, the Van Slyke apparatus, in 1924. This was the most reliable method used in the 1930s and 1940s for diagnosing acidosis. Oxygen and CO_2 in the blood were released into a burette by the addition of a liberating solution. These gases were then converted to a non-gaseous substance by a chemical reaction. The pressure drop in the burette was then measured for each gas.[10, 11]

During the polio epidemic of 1952, workers at Copenhagen, including the chemist Paul Astrup (born 1915), and the anaesthesiologist Bjorn Ibsen (born 1915), noticed among the patients an increase in blood bicarbonate, as measured by the Van Slyke apparatus. They suggested that this may be caused by CO_2 retention. This observation led to artificial ventilation of patients with polio and effectively the establishment of the first intensive care unit by Ibsen.[10, 11]

In his method, Astrup equilibrated a sample of blood with two gases of different CO_2 concentration. The pH of the blood sample was measured before and after with a pH electrode. A blood pH/ pCO_2 plot was generated and led to the production of equipment which gave all the relevant values for expressing the acid-base status of blood, a method used by clinicians today. Ole Siggaard-Anderson and Astrup defined 'standard bicarbonate' and 'base excess'.[10, 11]

Richard Stow at the Ohio State University in Columbus developed a pCO_2 electrode during a polio epidemic in the United States in 1954. To stabilise this electrode, J F Severinghaus, Professor of Anesthesia, California University and A F Bradley (his technician) added bicarbonate to the electrolyte and incorporated pO_2 and pCO_2 electrodes in a common thermostat in 1958.[10,11]

Clinical uses of carbon dioxide

From the early 1900s, CO_2 was used to stimulate respiration during anaesthesia and control the speed of uptake of volatile agents during induction. Yandell Henderson, Professor of Physiology at Yale wrote in 1925:

> 'An almost complete control of respiration is afforded the anesthetist by the use of CO_2 mixed with O_2. By its use, rapid induction and termination of anesthesia and any desired volume of breathing and depth of anesthesia are at his command'. [12]

Mixtures of oxygen and CO_2 were adopted almost universally in resuscitation and given to patients with respiratory failure, around this time. However, evidence began to accumulate against CO_2 for this use. Therefore, around 1955, the Medical Research Council Committee for Research on Breathing Apparatus for Protection against Dangerous Fumes and Gases recommended that pure oxygen only should be given in first aid to patients with respiratory failure requiring manual artificial respiration. CO_2 was known as a respiratory stimulant, but a depressed respiratory centre was less and less able to respond to an increased pCO_2.[13]

Others who made contributions about the physiology of CO_2 and its relation to anaesthesia include J F Nunn (born 1925), who wrote *Applied Respiratory Physiology, with Special Reference to Anaesthesia* in 1969. William W Mapleson, Professor of Anaesthesia at Cardiff University published an analysis of the fresh gas flow needed for the elimination of CO_2 from single tube breathing systems, in 1954.[14]

In recent years CO_2 was still used by some anaesthetists to restore normocapnia at the end of peroperative IPPV. However, removal of carbon dioxide cylinders from anaesthetic machines has been suggested to avoid its accidental administration, which may lead to hazardous side effects.

In the 1980s and 1990s capnography developed from a research instrument into an essential monitoring device for patient safety. It is used in the early diagnosis of circuit disconnections, oesophageal intubation, low cardiac output and indicates carbon dioxide production and adequacy of alveolar ventilation. The first infra-red CO_2 measuring and recording apparatus was introduced by K F Luft in 1943. The early monitors were bulky, expensive and unreliable. Capnography (together with other monitors) has been shown to detect adverse incidents early and is accepted as helping to prevent anaesthetic morbidity and mortality. Minimum monitoring standards have been published in the United Kingdom since 1988. Capnography is part of these standards as recommended by the Association of Anaesthetists.[15, 16]

Summary

Over the last three centuries, carbon dioxide has been used as an analgesic, an anaesthetic and an agent to treat illness. It has had an important role in the understanding of the physiology of anaesthesia and intensive care. It has been used as an aid to anaesthesia and now is an essential monitor for patient safety.

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20th Congress of the British Society for the History of Medicine
The University of Reading, 4-7 September 2003
President: Dr Denis Gibbs

Reading was a good choice for an excellent meeting. Although it has no Medical School it has strong connections with the wider medical profession. The University is situated in an attractive park of mature trees of virtually all species that can be persuaded to grow in the English climate. Conference facilities are very good and the residential rooms, all en-suite, unusually comfortable. The food in the Cedar Room cafeteria where we had our lunches is of gourmet quality (sadly more than can be said of the Congress dinner held in one of the halls of residence).

BSHM meetings traditionally include both invited and submitted papers. On this occasion rather more invited ones were given, many though not all of the highest quality. Perhaps the two outstanding papers were the first and the last. Professor Vivian Nutton of the Wellcome Centre in the University of London was invited to give the opening lecture. His topic '*Greek medicine in Rome: Sir Clifford Allbutt and after*' was an erudite blending of the ancient and the modern, beautifully presented. The last paper, submitted by Andrew Seal (an English-trained surgeon now practising in Vancouver) brought to light a rare and little-known book, the *Epitome of Andreas Vesalius*. Cambridge University Library has a copy, possibly unique in that it is the only known one to be in colour. Seal is the first to have made a detailed study of this during a sabbatical year in Cambridge. We were privileged to be the first to hear about it, and to learn how Vesalius himself linked it as a 'pathway, or as an appendix' to his better-known treatise *De humani corporis fabrica* of 1543. We were shown also how the historiated initial letters provide an insight into aspects of 16th century Italian medicine.

In between were twenty eight papers of great variety, speakers coming from Britain and overseas; the latter included Professor Barry Baker from Sydney and speakers from Turkey, Iran and Slovenia. Of the four contributed by anaesthetists none were on anaesthetic topics, perhaps a sign of the way the study of medical history can lead into far-flung fields.

Visits were made to the Cole Library of historical medical books in the University, to the Reading Pathological Society Library, of which Dr Marshall Barr is Honorary Consulting Librarian, and to the Royal Berkshire Hospital Museum. Barr is also Chairman of the Berkshire Medical Heritage Centre. An interesting visit to Mapledurham House on a beautiful evening provided an unexpected bonus, a splendid view of Concorde flying into the sunset on one of its last flights.

At the end of the meeting Dr Aileen Adams was installed as President for the next two years. Dr Ann Ferguson has been elected Honorary Secretary.

Many historians do not realise that they are automatically members of the BSHM if they are members of a constituent society. Membership is corporate, not individual, and hence many of us are members several times over by belonging to bodies such as the History of Anaesthesia Society, the Section of History at the Royal Society of Medicine and the Friends of the Wellcome Centre, among others. It is the responsibility of society secretaries to circulate BSHM Newsletters. Three-day congresses are held every two years; in the years when there is no Congress the Poynter Lecture is given by a distinguished speaker.

A K Adams

Book Reviews

Chloroform - The Quest for Oblivion. Linda Stratmann. Sutton Publishing Ltd, Stroud, UK, 2003, pp258. £16.99.

Despite its subtitle *The Quest for Oblivion*, this is a book about the history of chloroform and not that of anaesthesia. There is mention of both ether and nitrous oxide, but not of any other anaesthetic agent, and the short section on local anaesthesia is limited to a discussion of attempts to use chloroform for this purpose. It is, therefore, inevitable that the reader is given only a limited understanding of the contextual place of chloroform in the development of inhalation anaesthesia. The text also implies that chloroform was largely superseded at an earlier date than was in fact the case, particularly in the developing countries. A heavy emphasis on the use, or attempted use, of chloroform for murder and other crimes is, perhaps, intended to appeal more to the lay reader than to the student of the history of anaesthesia. There are plenty of references but there are many omissions where a reference should have been provided, and also many instances where what appears in the text to be a reference to a primary source, turns out to be a secondary one.

The author acknowledges help from the History of Anaesthesia Society but there are no references from the Society's *Proceedings*, and in some cases there certainly ought to have been. For example there is no mention of the work of Maltby and Adams on religious objections (or the lack of them) to obstetric anaesthesia. On the other hand, there are a number of references from pharmaceutical journals (perhaps because the author trained as a dispenser) which are often ignored by medical authors.

The book is well written and is very readable. I suspect that most of the Society's members will find some facts and stories of which they were previously unaware.

Henry Connor

50 Jahre Deutsche Gesellschaft für Anästhesiogie und Intensiv medizin. Tradition und Innovation. Schuttler J, Ed. Berlin, Heidelberg: Springer-Verlag, 2003, pp584.

Writing anaesthesia history was considered to be a proof of professional maturity by the famed anaesthesia historian Gwenifer Wilson. In 1987 she authored the enviably beautiful *Fifty Years (1934 – 1984) of the Australian Society of Anaesthetists*. The Dutch followed with four decades of similar history in *Van aether naar beter (1948 - 1988*) and with *Het kan nog beter* in 1998. Dr N Parbhoo recorded the *Five decades of the South African Society (1943-1993)*. This was followed by the grand work *History of the Association of Anaesthetists of Great Britain and Ireland (1932 – 1992)* by Thomas Boulton, which appeared in 1999. The year 2002 saw the appearance of the *50-year Jubilee Book* of the Swiss Society of Anaesthetists. The Scandinavians also produced their joint 50 years commemorative book. The *WFSA – 50 years* has been announced by the World Federation of Societies of Anesthesiologists, and is planned to appear in 2004.

No two books are really alike; a proof that the past can be recorded in many different ways. The most recent addition to the history of national anaesthesia societies is the impressive *50 Jahre Deutsche Gesellschaft für Anästhesiogie und Intensivmedezin*, edited by J Schüttler and superbly produced by Springer-Verlag. The subtitle qualifies the 50 years as 'Tradition and Development'. One could add 'Reunion with the many' to the subtitle, because the book revived vivid memories of many distinguished German colleagues that I have had the honour and fortune to know. One also recalls the unforgettable professional events which took place in Germany.

This monumental work is beautifully produced, with 574 pages, intimidatingly comprehensive but not an easy read. Following the celebratory forewords of various institutions the book consists of four thematic parts. Some attention is paid to anaesthesia in Germany before 1945. The history of scientific journals is interesting to read, but I failed to understand why publishing in English never became popular in Germany. The development of sub-specialties in anaesthesia like intensive care, pain treatment and emergency medicine is followed by a long list of individual histories of German University Departments of Anaesthesia. Connecting the 66 different chapters there are lovely photographs of historical items, some perhaps from the H Stoeckel Anaesthesia History Museum in Bonn.

The book is well illustrated and extremely precise, which is amazing considering the immense quantity and variety of data presented. There is a good index of names, but I greatly missed a subject index. The book will certainly find many individual buyers, and will have to be on each German departmental bookshelf. The *50-year Jubilee Book* testifies to the notable contributions of German medicine to anaesthesia in general; but one misses a chapter putting German anaesthesia history into the generally known global context of anaesthetic history.

To me the most important part of the book is the description of how difficult it was for anaesthesia to become an independent specialty in Germany. Sir Robert Macintosh visited Germany before the 2nd World War, and the students laughed long and loud when they were told that anaesthesia had become an academic science in the UK. The same arrogant attitude, so discouragingly lacking in imagination and the feel for novelty, is also evident from the categorical negative response in September 1939 from the medical establishment to Prof Killian's request for independence of anaesthesia. It took the shocks of war and the undeniable foreign influence before German anaesthesia started its successful 50 years.

In short, the *50 years* is so excellent that the Editor, Prof Schüttler, all contributors and the German Society should be congratulated, and the publishers will hopefully consider making it available in English.

Joseph Ruprebt

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Cholera, Chloroform and the Science of Medicine: A Life of John Snow.
P Vinten-Johansen, H Brody, N Panech, S Rackman, M Rip, with the assistance of D Zuch. Oxford University Press, 2003. Pp 437. ISBN 0 195 13544 X. £39.95.

John Snow has long been revered for his pioneering medical work in the 19th century, most notably by anaesthetists and those working in public health. But the majority of writings on Snow have polarised into the two camps of anaesthesia and public health. As a result he has perhaps been regarded as a somewhat quixotic figure, well-known in parallel but unconnected fields. What this new book does is provide a synthesis of Snow, a holistic account of a mid-19th century medical doctor, whose primary aim was to use the science of his day to improve medical understanding of disease and clinical treatment of ill-health. By retelling Snow's story through the cohesion of science, a far more rounded account is achieved which unifies his broad interests that, in the specialist-driven 21st century, can appear disparate.

The team from Michigan State University who researched the book were assisted by David Zuck, who will be well known to many readers. They took the sensible decision to have one writer at the helm and thus the narrative is consistent and flowing, much of it told through Snow's own words. It follows Snow's life chronologically, from his early years as the eldest son of a working class family in York, through a medical apprenticeship to Mr William Hardcastle, surgeon-apothecary in Newcastle upon Tyne, during which he attended the beginnings of the Newcastle School of Medicine and first encountered cholera in the 1831/2 epidemic. He then spent time as an assistant to two general practitioners; Dr John Watson in Burnopfield, county Durham, and Dr Joseph Warburton in Pateley Bridge. It was around this time that he became committed to two causes to which he held fast for the rest of his life; temperance and vegetarianism. He attended many public meetings on the subject of temperance and helped establish the York Temperance Society during the summer of 1836. By this point though, Snow was ready to start on the next leg of his training and travelled south to London. He took lodgings in Bateman's Buildings near Soho Square, and in October 1836 enrolled at the Hunterian School of Medicine in Great Windmill Street.

The Hunterian School was a continuation of the first school of anatomy in London, and here Snow was taught the very latest techniques of the new 'hospital' medicine which had emerged in the post-revolutionary Paris hospitals. At the core of this approach was the integration of outward lesions of the body with inward pathology. Students were trained to examine patients using Laennec's innovative new instrument; the stethoscope, and experimental research using chemistry, physiology and vivisection was encouraged. In October 1837 Snow enrolled at the Westminster Hospital for six months of surgical practice and by 1838 had qualified as both apothecary and surgeon. The authors rightly draw attention to the importance of these first two years in London as equipping Snow with both the vision and the skills that were to lie at the core of his future work.

Once qualified, Snow set up in general practice in Soho, bucking the usual trend which was for young doctors to return to their home towns after qualification as it was easier to make a living. His practice was slow to build but he used these years fruitfully, becoming an active member of the Westminster Medical Society (later to become the Medical Society of London) and the Royal Medical and Chirugical Society. It was also during this period that he undertook much research into the physiology of respiration, investigating such subjects as asphyxia and carbon monoxide poisoning, and the book traces well the trajectory of his intellectual development in these areas. So it was that when news arrived in London in December 1846 of the discovery of the powers of ether to induce unconsciousness (and thus insensibility to the pain of surgery). Snow was immediately receptive to the potential of this new technique. He was unusual in pursuing both the theory and the practice of anaesthesia, and rapidly became respected and valued within the London medical community and further afield for these skills. It is hardly necessary to say to readers that his contribution to the establishment of the specialty of anaesthesia was so great that it is still valued in the 21st century.

But while he was building up his anaesthetic practice in 1848 cholera returned to London, and by the following year around 53,000 deaths were registered for England and Wales. Snow put his mind to work on the key question of the day; what was the cause of cholera and how was it transmitted? His radical theory that water was a significant means of transmission won him few followers. When the next cholera epidemic struck London in 1854, Snow saw this as an opportunity to collect proof and validate his suggestion. The Broad Street outbreak is retold in diary form and is a vivid recreation of the living conditions of the working classes in mid-19th century London. By juxtaposing all elements of the story; the experiences of individuals and families living in the area, the action taken by the authorities and the reporting of the outbreak in journals and newspapers, it becomes evident that Snow had set himself a truly monumental task in his aim to convince his peers and the authorities that water was a major factor in the spread of cholera. The removal of the handle of the Broad Street pump has reached anecdotal status within the history of public health and has been frequently misrepresented. What is not commonly known, however, is the misuse of his mapping of the cases of cholera in relation to the location of the water pump, and the chapter setting this into its true context is refreshing.

The book also makes clear that, in Snow's view, it was the investigation into the supply of water to districts in South London by the Lambeth and Southwark and Vauxhall water companies which was a far meatier proof of his theory. The several chapters covering both these epidemiological studies are particularly good, dispelling the myths and reconstructing his focused and singular approach to the problem. The legacies of his work for the later 19th and 20th centuries are clearly outlined in the concluding chapter and reinforce the authors' claim of his permanent relevance to both history and medicine. The book is beautifully produced with lots of illustrations, tables and section headings within chapters, which make it a very easy read and reflect Snow's own lucid style of communication. The frequent use of quotations from his writings and from Dick Ellis' painstaking transcriptions of his Casebooks bring his work to life, and convey the intensity and passion which accompanied his many activities.

Snow's ambition and desire to make a difference in humane terms gave him the courage to take hold of science and use it to the full in his medical practice. This book confirms just how significant his achievement was and will be enjoyed by doctors and historians alike.

Stephanie J Snow

A shorter version of this review appeared in the *New England Journal of Medicine* on 01-01-04. We are grateful to the Press for agreement to publish it here.

HENRY REX MARRETT MRCS, LRCP, FRCA, DA
An appreciation

Dr T B Boulton Past President HAS

Doctor Henry Rex Marrett, 'Rex' to his many friends and an Honorary Member of the History of Anaesthesia Society, died on Friday 7 March 2003 in his eighty-eighth year. He was a remarkable physician who served his country, the profession of medicine, and his chosen specialty of anaesthesia during an eventful period of history. His professional career spanned the Second World War and the introduction and development of the British National Health Service.

Early years and education

Rex was the second son of Doctor Henry Norman Marrett, the Medical Superintendent of Merivale Tuberculosis Sanatorium in Essex. Dr Norman Marrett had also served in the Royal Army Medical Corps (RAMC) in the Salonica campaign in the First World War, and Rex was destined to serve in the RAMC in Northern Europe in the Second World War.

The young Rex Marrett was educated at Felsted School where, in addition to his academic studies, he was a keen sportsman. This interest was maintained; Rex was a county hockey player and played for the Eastern Counties team. Later on in his life he became Captain of Kenilworth Tennis Club and Captain and President of the Coventry Golf Club.

Importantly, Rex also became interested in practical mechanical engineering while at Felsted. In fact he once told me that, at one time, he had an aspiration to become an engineer. In the event, however he chose to follow his father and take up a career in medicine.

Service in the Second World War

Rex Marrett qualified in medicine from Saint Bartholomew's Medical College in 1940, shortly after the outbreak of the Second World War. He did not lose any time. He took up an appointment as trainee House Anaesthetist to the anaesthetic department, headed by Dr Langton Hewer, at the wartime Saint Bartholomew's Emergency Medical Service Sector Hospital which was accommodated at the Hill End mental hospital near St Albans.

Within eighteen months he had passed the examination for the Diploma in Anaesthetics, the only qualification in anaesthesia available at that time. It is interesting that Rex was not the only medical man with engineering skills to take up anaesthesia in that period. This was an advantage in those pioneer days when necessary repairs, invention and modifications of equipment were part of the stock in trade of physician anaesthetists in a way that modern regulations would not permit nowadays. Very importantly, at that time he married Jacqueline Marsh (Jackie), whom he had known from teenage years. He undoubtedly regarded this event as the most important item on his CV.

Rex remained at Hill End until 1943. He rose rapidly through the training grades to become a Senior Registrar. The Emergency Medical Service hospital at St Albans dealt with many major casualties, both civilians from the London air raids, and military personnel, especially those evacuated after Dunkirk and from the North African theatre of war.

Doctor Langton Hewer and his team were evaluating the then new and non-flammable anaesthetic agent trichloroethylene during this period.[1] Rex designed and built a portable air draw-over apparatus that could be used for relieving pain during the dressing of large wounds as well as for major surgery in the operating theatre. Of course this draw-over apparatus did not require cumbersome medical gas cylinders and he foresaw its use under battlefield conditions with the army in an article published in the *British Medical Journal*.[2]

Rex Marrett joined the wartime RAMC in 1943. He went ashore on Juno Beach with a Casualty Clearing Station in close support of the D-Day landings in June 1944. The unit dealt with many allied and enemy casualties in the bridgehead during the heavy fighting before Caen was captured and the British broke out of the Falaise pocket. At this stage Rex was promoted to the rank of major and posted to the 6th Field Surgical Team.[3] This was a small highly mobile unit consisting of a surgeon, an anaesthetist and ten other ranks. It operated immediately behind the fighting troops. In fact, in the confused and heavy fighting of the Battle for the Ardennes, the Field Surgical Team found themselves ahead of the fighting troops on one occasion. Rex related how he looked out of the window of a school where they had recently set up their equipment, and saw German motorcycle reconnaisance troops passing by on the road outside.

Later the unit handled many casualties resulting from the crossing of the Rhine, and thereafter in the rather more rapid advance to the north through Bremen and ending up in Hamburg on VE-Day.

I was ten years Rex Marrett's junior and found myself, in my turn, in the RAMC, in my case in a military hospital in North Malaya during the terrorist emergency in the nineteen fifties. By coincidence I had the services of (to me then) an aged sergeant operating room assistant who had been with Rex in Northern Europe. He was always polite and had many stories to tell, but I was left in no doubt that my talents did not measure up to those of Major Marrett.

Throughout the Northern Europe campaign Rex used the portable anaesthetic apparatus he had built in St Albans, but he also, more importantly, manufactured another anaesthetic machine by modifying German apparatus designed to facilitate rescue from smoke filled atmospheres. This machine required only a minimal flow of cylinder oxygen.[3]

Rex Marrett's two devices attracted the attention of senior surgical and anaesthetist officers visiting the Field Surgical Team. They noted that his equipment was far superior for use in the field to apparatus that was officially issued to other units. After return to the United Kingdom in 1945 Rex was relieved of other duties for nine months and asked to design and build a prototype for a field anaesthetic apparatus for the army.[3] This machine was to be suitable for use in both base and field hospitals at home and overseas and in all climates. Rex built his all-metal machine with great ingenuity. First he built a hard wood model, and then a brass prototype. Both of these performed satisfactorily in clinical trials. The apparatus incorporated specially designed reducing valves and, for the first time, many features that have since become standard in all anaesthetic apparatus for use with closed and semi-closed circuits with oxygen, nitrous oxide, ether and trichloroethylene and later other volatile anaesthetics. In addition there was a facility for the use of draw-over air-ether if cylinder gases were not available.[3,4]

The machine was patented by the Ministry of Defence in Rex Marrett's name and manufactured commercially by Airmed Ltd of Harlow.[3,4] By the time that I was in Malaya in the nineteen fifties, I was lucky enough to have the benefit of being supplied with a production model of one of Rex's versatile machines. I was especially grateful for the draw-over facility in Malaya during a temporary shortage of cylinder gases due to flooding on the railway on which we relied for supplies.

Rex Marrett's name was placed on a Royal Commission list on awards for wartime inventors. This list also included the names of Frank Whittle of the jet engine and of Bailey of the sectional bridges but whereas Whittle received one hundred thousand pounds, Rex received just four hundred and fifty pounds, with which he purchased a caravan.

The National Health Service

Rex was now one of a number of very experienced and enthusiastic wartime physician anaesthetists who were destined to take over as consultants in the British National Health Service from a largely general practitioner based service when the NHS was inaugurated in 1948.

After the enforced separation of the war Rex Marrett was ready to settle down to family life. However, following demobilisation in 1946, Rex had a further rather unhappy year of separation in London as a civilian consultant to the Army. This appointment was combined with somewhat restricted private practice in the capital with surgeons who often showed a somewhat supercilious attitude towards the emergent specialty of anaesthesia. Rex was then appointed in December 1947 to one of the posts for anaesthetists that more far-sighted Health Authorities like Coventry were creating in anticipation of the start of the NHS in July1948. The honorarium at that stage was but one thousand pounds per annum, but with the promise of a salaried consultant appointment at the start of the NHS, as well as private practice as the first specialist anaesthetist in Coventry, the situation was favourable. Unusually in the United Kingdom, Rex worked initially and happily with two nurse anaesthetists who had very competently borne the burden of much of the routine anaesthesia in Coventry since the blitz.

Coventry was indeed in a sorry state in 1947 after the wartime devastation due to enemy air raids. As is well known the courage and progressive attitudes and actions of its citizens resulted in the resurrection of that great city, the hospital service had grown and developed, and, with Rex Marrett's forward thinking, the anaesthetic department also prospered.

The advent of the revolutionary anaesthetic agent halothane in the late nineteen fifties led to the publication of careful research by Rex and an account of clinical use of the agent in the closed circuit.[5] He also developed, in the late nineteen fifties, the Medrex apparatus.[6] This was designed for a novel technique for outpatient dentistry using oxygen, nitrous oxide and halothane. This technique provided a smooth and pleasant induction without the hypoxia associated with the nitrous oxide and oxygen administrations of that era and presented a relaxed jaw for the operator. By 1963, after five years of use, over 1500 anaesthetics had been administered with this apparatus.[6]

Rex Marrett's national reputation grew. He was elected to Fellowship of the Faculty of Anaesthetists of the Royal College of Surgeons in 1953 shortly after the formation of that body. He became a Past President and Honorary Life Member of the Society of Dental Anaesthetists, a Founder Member of the Hickman Anaesthetic Society, and an Honorary Member of the History of Anaesthesia Society.

Other interests

His love of engineering continued throughout his life. He had a penchant for renovating veteran cars, taking part several times in the London to Brighton run, and when his walking disability finally became too difficult, he designed and built a golf-buggy that he called Percy, in order that he could continue to play golf.

Rex Marrett the man

I have endeavoured to describe the achievements of this great man, but what of his personality. A fellow member of the History of Anaesthesia Society recently described Rex Marrett to me as 'the perfect English gentleman'. This may be considered to be an old fashioned description, but it says it all. He was cultured, courageous, courteous, generous, tolerant of the views of others, and loyal and loving. That is certainly a description of Doctor Rex Marrett who we honour and for whose life we give grateful thanks.

Our sympathies go out to Jackie, his wife of some sixty years. They had two sons, interestingly one is an engineer and the other an administrator in the golfing world.

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