THE HISTORY OF ANAESTHESIA SOCIETY PROCEEDINGS

Volume 15
Proceedings of the Guernsey Meeting
24th-25th June 1994
Proceedings of the History of Anaesthesia Society

Editor     Dr A M Barr
Publication Coordinator    Dr F E Bennetts

The Society acknowledges with thanks the photographs from Dr Mike Scott of Bristol

The contribution of Abbott Laboratories to the preparation and printing of these proceedings is gratefully acknowledged.
Addendum. Vol 15, HAS Proceedings

Foot of p 75 should read ... "long periods of boredom. Illness was common - notably gastro-enteritis, ear infections and prickly heat. VD, ..."

ERRATUM - VOL 17, Page 107, line 19.
The cardiovascular effects of dantrolene sodium in dogs.
The correct reference is *Anaesthesia* 1975; 30: 318-322
THE HISTORY OF ANAESTHESIA SOCIETY

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MEMBERS PRESENT AT THE GUERNSEY MEETING

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Name</th>
<th>Location</th>
<th>Name</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr A K Adams CBE</td>
<td>Cambridge</td>
<td>Dr W J Moore</td>
<td>Illinois, USA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mr N Andrews</td>
<td>Chesterfield</td>
<td>Dr R G C McKinlay</td>
<td>Guernsey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr R S Atkinson</td>
<td>Southend</td>
<td>Dr R K McGregor</td>
<td>USA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr A M Barr</td>
<td>Reading</td>
<td>Dr C A B McLaren</td>
<td>Wootten Bassett</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr A J Bennett</td>
<td>Bristol</td>
<td>Dr P Morris</td>
<td>Manchester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr F E Bennetts</td>
<td>Taunton</td>
<td>Dr R C Naishby-Luxmoore</td>
<td>Cosham</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr T B Boulton</td>
<td>Reading</td>
<td>Dr A F Naylor</td>
<td>Basildon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr K Budd</td>
<td>Bradford</td>
<td>Dr D A Nightingale</td>
<td>Liverpool</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr J Brookes</td>
<td>Aberystwyth</td>
<td>Prof J Norman</td>
<td>Southampton</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr M Bruce</td>
<td>Jersey</td>
<td>Dr B Owen</td>
<td>Rhyll</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr P T Bull</td>
<td>Marsfield</td>
<td>Prof B Panning</td>
<td>Hanover, Germany</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr P D M Costen</td>
<td>Guernsey</td>
<td>Dr A Powles</td>
<td>Lincoln</td>
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<td></td>
</tr>
<tr>
<td>Dr P Drury</td>
<td>Liverpool</td>
<td>Dr J Pring</td>
<td>Truro</td>
<td></td>
<td>Guernsey</td>
</tr>
<tr>
<td>Dr R S Edmondson</td>
<td>Leeds</td>
<td>Dr C I Pratt</td>
<td>Cardiff</td>
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<td></td>
</tr>
<tr>
<td>Dr M Evans</td>
<td>Australia</td>
<td>Dr B Roberts</td>
<td>Colwyn Bay</td>
<td></td>
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</tr>
<tr>
<td>Dr A Fuge</td>
<td>Bath</td>
<td>Dr E C Rouse</td>
<td>Barmet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr E Gibson</td>
<td>Cobham</td>
<td>Prof L Rendell-Baker</td>
<td>Reading</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr G B Gillett</td>
<td>London</td>
<td>Dr P Simmons</td>
<td>Aberdeen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr G Hall-Davies</td>
<td>Birmingham</td>
<td>Dr T G C Smith</td>
<td>Ipswich</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr G W Hamlin</td>
<td>Blackburn</td>
<td>Dr I Smith</td>
<td>Amphill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr H B Hannah</td>
<td>Chippenham</td>
<td>Dr P Stow</td>
<td>Leeds</td>
<td></td>
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</tr>
<tr>
<td>Dr S R T Headley</td>
<td>Wimbledon</td>
<td>Mr P Sykes</td>
<td>Poole</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr E Holmes</td>
<td>RAF, Germany</td>
<td>Dr S R Swindells</td>
<td>Bristol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr J M Horton</td>
<td>Cambridge</td>
<td>Dr M A Skivington</td>
<td>Leicester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr B Hovell</td>
<td>Hull</td>
<td>Dr M Scott</td>
<td>Amsterdam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr D D C Howat</td>
<td>London</td>
<td>Dr W Turner</td>
<td>Torbay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr M T Hyder</td>
<td>South Shields</td>
<td>Prof D M Vermeulen-Cranch</td>
<td>Cardiff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sir David Innes Williams</td>
<td>Wimbledon</td>
<td>Dr B Whittard</td>
<td>Huddersfield</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr G Jones</td>
<td>Edinburgh</td>
<td>Dr B Weaver</td>
<td>Chesterfield</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr M Knowles</td>
<td>Basingstoke</td>
<td>Dr C S Ward</td>
<td>Cheadon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr G van Konijenburg</td>
<td>Netherlands</td>
<td>Dr M J Wolfe</td>
<td>Reading</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr J R Lane</td>
<td>Jersey</td>
<td>Dr G M J White</td>
<td>Manchester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr W G G Loyn</td>
<td>Aberystwyth</td>
<td>Dr E Young</td>
<td>London</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr S McGowan</td>
<td>Dundee</td>
<td>Dr T M Young</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr A G MacDonald</td>
<td>Glasgow</td>
<td>Dr D Zuck</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr H R Marrett</td>
<td>Coventry</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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# PROCEEDINGS OF THE HISTORY OF ANAESTHESIA SOCIETY

Volume 15

PAPERS PRESENTED AT THE GUERNSEY MEETING 24th-25th JUNE 1994

<table>
<thead>
<tr>
<th>Paper Title</th>
<th>Author(s)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research into anaesthesia by a surgeon: Thomas Nunneley</td>
<td>Dr K Budd</td>
<td>9</td>
</tr>
<tr>
<td>Joseph Weiger: An Austrian pioneer of anaesthesia</td>
<td>Prof. B Panning</td>
<td>14</td>
</tr>
<tr>
<td>A brief history of the Marrett Anaesthetic Head</td>
<td>Dr H Rex Marrett</td>
<td>18</td>
</tr>
<tr>
<td>Davy and the blue gas</td>
<td>Dr J Pring</td>
<td>24</td>
</tr>
<tr>
<td>F W A Sertürner and the isolation of morphine</td>
<td>Dr F E Bennett</td>
<td>28</td>
</tr>
<tr>
<td>John Harrison and the bimetallic strip</td>
<td>Dr C A B McLaren</td>
<td>34</td>
</tr>
<tr>
<td>From Wrexham to Rheims in 1847</td>
<td>Dr B Owen</td>
<td>37</td>
</tr>
<tr>
<td>The history of Cyprane</td>
<td>Dr R S Edmondson</td>
<td>41</td>
</tr>
<tr>
<td>The John Tomes Dutch Dental Students Society</td>
<td>Prof. D M E Vermeulen-Crench</td>
<td>43</td>
</tr>
<tr>
<td>The mysterious death of Mr James Toynbee</td>
<td>Dr S R T Headley</td>
<td>46</td>
</tr>
<tr>
<td>In somno semi securitas</td>
<td>Dr P Sykes</td>
<td>49</td>
</tr>
<tr>
<td>Anaesthesia in wartime and under seige conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The siege of Ladysmith</td>
<td>Dr B Hovell</td>
<td>55</td>
</tr>
<tr>
<td>War of ideas</td>
<td>Dr J A Bennett</td>
<td>59</td>
</tr>
<tr>
<td>A model occupation</td>
<td>Mrs Pat Costen</td>
<td>65</td>
</tr>
<tr>
<td>Organisation &amp; setting up of dressing stations for D-Day</td>
<td>Prof. L Rendell-Baker</td>
<td>69</td>
</tr>
<tr>
<td>Anaesthesia with the Australian Army in Vietnam</td>
<td>Dr A Marshall Barr</td>
<td>74</td>
</tr>
<tr>
<td>An anaesthetist's experience during the Falklands War</td>
<td>Dr P T Bull</td>
<td>77</td>
</tr>
<tr>
<td>Medical and first aid facilities in fixed fortifications</td>
<td>Jurat C W Partridge</td>
<td>79</td>
</tr>
<tr>
<td>The Intersurgical Lecture by Sir David Innes Williams</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avenues of ambition: The rise of other specialist associations</td>
<td></td>
<td>80</td>
</tr>
<tr>
<td>Unveiling of the Clover Plaque - Cavendish Place, London</td>
<td></td>
<td>82</td>
</tr>
<tr>
<td>Book Review Early Medical Services</td>
<td></td>
<td>83</td>
</tr>
</tbody>
</table>
RESEARCH INTO ANAESTHESIA BY A SURGEON
- THOMAS NUNNELEY OF LEEDS

Dr K Budd
Consultant in Pain Management and Anaesthesia, Bradford

'The hunt for new anaesthetic agents, which began almost as soon as the use of sulphuric ether was well established, covered a wide field.'

Barbara Duncum, 1947

In the late spring of 1870, two surgeons died within one month of each other. Although they had interests in anaesthesia, the ways in which they were associated with the subject and by which the medical world remembers them are totally dissimilar. Sir James Young Simpson - the 'father' of chloroform anaesthesia - who died on 6 May 1870, needs no further comment. Thomas Nunneley, however, is somewhat less well-known and few anaesthetists will ever have heard of him.

Nunneley was born in 1809 in Market Harborough, son of a gentleman of property in Leicestershire. Educated privately, he was apprenticed in medicine before entering Guy's Hospital from where he qualified in 1832 LSA, MRCS. His mentors during this time were Astor Key and Astley Cooper; he became good friends with the latter, a relationship which lasted until Cooper's death. After completing his medical education on the continent, mainly in Paris where, under the auspices of a nephew of Laennec, he became a master of the stethoscope, Nunneley returned to Britain and Leeds where he was soon to be appointed as surgeon to the Eye and Ear Hospital. Here he was to rapidly establish a considerable reputation being 'one of the first surgeons outside London to devote himself to the especial study of ophthalmic surgery in its scientific aspect'. With over a thousand cataract operations to his credit, his reputation was such that he was invited to become one of the first 300 Fellows of the Royal College of Surgeons of England, on 11 December 1843. In addition to his surgical commitment, Nunneley was actively involved with the Leeds Medical School. He had been appointed to the Council in 1835 and, in addition to teaching, was researching and publishing in the areas of toxicology and ophthalmic anatomy and physiology.

It was during this time that he began a major work on researches into potential anaesthetic substances. The fruits of this work appeared both as a book, and in 1849 in the Transactions of the Provincial Medical and Surgical Association, the forerunner of the British Medical Journal. In the foreword to the work, Nunneley states his reasons for investigation:

'The practical application of these agents (ether, chloroform and any other agent used as an anaesthetic) is a most important question and one that deserves to be well and thoroughly investigated. ... This enquiry is to assist in affording that information and to furnish evidence from which such inferences and deductions may be fairly drawn; as shall,
if possible, render their practical application safe and certain as the nature of the case admits.'

He also stated that he felt there was insufficient information available to the profession 'to enable us to arrive at an accurate and certain conclusion as to their [anaesthetic agents] practical value'. Nunneley then instances the five aspects he wishes to clarify about each agent, namely, the mode of action, physiological action, symptomatology, suitability and possible antidote.

**Investigation of potential anaesthetic agents**

He describes a series of nearly 400 experiments in which a variety of agents were administered to a wide range of subjects via several differing routes. The agents were:

- Alcohol
- Chloroform
- Sulphuric ether
- Nitric ether (ethyl nitrate)
- Acetic ether (ethyl acetate)
- Chloric ether (chloroform/alc. soln.)
- Hydrochloric ether (ethyl chloride)
- Hydriodic ether (ethyl iodide)
- Hydrobromic ether (ethyl bromide)
- Dutch oil (dichloroethane)
- Aldehyde (acetaldehyde)
- Chloride of carbon (tetrachloroethane)
- Iodoform
- Bromoform
- Olefiant gas (ethane)
- Oleum aetherium Ph Linn.
- Spiritus aethis intimi Ph Linn.
- Light carburetted hydrogen (methane)
- Coal gas
- Benzole (benzene)
- Camphor
- Oil of turpentine
- Creosote
- Protoxide of nitrogen (nitrous oxide)
- Hydrocyanic acid
- Hydrogen
- Carbonic acid (carbon dioxide)
- Carbonic oxide (carbon monoxide)
- Bisulphuret of carbon (carbon bisulphide)
- Sulphuretted hydrogen
- Heavy oil of wine
- Spiritus vini of the Pharmacopæia
- Chloroform and spirit of wine mixed

These were to be administered by five different routes:

1. Inhalation in various degrees of concentration, for a limited period.
2. Inhalation for a prolonged period.
3. Internal administration by stomach or rectum.
4. Injection into veins.
5. Limited application to skin - local action.

After each administration there followed a trial of various remedies and presumed antidotes. In addition, post mortem appearances were recorded 'when death has been occasioned'. These experiments were carried out on 'animals taken from the four classes of the vertebral division and also some of the invertebrates have been used'. Nunneley's experimental subjects
included dog, cat, rabbit, birds, toad, frog, fish, newt, cockroach, spider, slug and snail, and when considering the permutations possible, he wrote:

'Those who have been in the habit of making similar experiments upon animals will, no doubt, readily admit that the enquiry, conducted as it has been, amidst the interruptions of constant and active professional engagements, has not been accomplished without considerable expenditure of time and labour.'

In addition to the 363 descriptions of experiments and their findings, together with 56 post-mortems, Nunneley also performed some studies on human subjects:

'Dutch Oil was given to seven medical students. Six were rendered perfectly insensible, whilst the other gentleman was made most happy, declaring the seventh heaven was nothing; he was in the ninth - nay, the eleventh; and hoped he might never come out of it.'

In addition to purely experimental work, Nunneley also administered some of his anaesthetic agents in his clinical practice:

'March 8th: Three operations at the Infirmary. All did well. (with Dutch oil)

March 17th: Through the politeness of my friends Messrs Smith, Hey and Teale, the Dutch Oil has been given in four operations with success.'

In the conclusions to his study, Nunneley writes:

'The substances which appear to possess the greatest power and the effects of which are the least objectionable are: the oxide of ethyl, the gaseous carburetted hydrogens (of which common coal gas is perhaps the best), chloric ether, hydrobromic ether, chloroform, Dutch Oil, and the chloride of carbon.'

He also concludes that the best method of administration is by inhalation and that oxygen is of value in overdosage.

Sound advice

In addition to the specific findings concerning the agents tested, Nunneley also delivers some homilies concerning the practice of anaesthesia in general:

'Be sure that air can easily and fully pass into and out of the lungs. It is of considerable importance that the stomach should not be distended with food: if it be, vomiting is much more likely caused and, I think, a fatal result is more easily induced in such a condition. I consider safety is much rather to be found in the avoidance of an overdose than in seeking for an antidote or remedy against the effects of it. So long as the heart
acts and respiration at all goes on, the mere withdrawal of the anaesthetic is followed by the restoration of functions."

He also advocates the use of a metal tube placed into the larynx for use with artificial respiration in cases of respiratory arrest during anaesthesia and drowning. Nevertheless, all that Nunneley wrote was not without blemish!

"Nitrous oxide should never be used as an anaesthetic and its action is not altogether as harmless as it is stated."

Although the action of anaesthetic substances is upon the nerves, it is not primarily and directly upon the cerebral masses and sensorium, but upon the peripheral expansion of the nerves.

In spite of these errors, Nunneley's final statement is both profound and eminently true, today as well as one hundred and fifty years ago:

"The hardest and last lesson medical men learn and when learnt, in consequence of the ignorance of those with whom we have to do, requires no little moral courage to carry out, is when not, as well as when, to interfere."

Of the substances tested by Nunneley, few were investigated as potential anaesthetics by others. Apart from diethyl ether, chloroform and ethyl chloride, only ethyl bromide gained any sort of recognition, albeit briefly. In 1877, Laurence Turnbull and J Marion Sims in America used ethyl bromide with varying degrees of success but in 1880, John Clover was writing in the British Medical Journal against its adoption as an anaesthetic. However, German dentists had success with it ten years later, as did J F W Silk in England in 1891.

Nunneley was nothing if not persistent. Sixteen years after his early experiments, he demonstrated at the 1865 Annual Meeting of the British Medical Association in Leamington two substances, bromide of ethyl and chloride of olefiant gas, which for some time past he had used as anaesthetics. He stated:

"... that he had not lately performed any serious operation in private practice not in the Leeds Infirmary without the patient being rendered insensible by one or other of these agents, each of which he believes to possess important advantages over chloroform. Both act speedily, pleasantly and well. The patient is kept insensible for any length of time. No disagreeable symptoms resulted from their use."

Attainments, personality and controversy

The above statement was the final public association of Nunneley with anaesthetics, but what of the man? In addition to his researches and large public and private practices, he was associated with the Leeds School of Medicine for over a quarter of a century as a lecturer on
anatomy and surgery. His attainments as a physiologist were great and his knowledge was regarded as exact and extensive.

He was twice President of the Leeds School of Medicine and, in 1864, was elected as one of the honorary surgeons of the Leeds General Infirmary. For many years he was an active member of the Leeds Philosophical and Literary Society and had been for three years a Liberal member of Leeds Town Council. Not all was sweetness and light, however, for being known as 'a man of strong feeling, somewhat impetuous in action and of great decision of character, the straightforward, uncompromising manner in which he promulgated his opinions may not always have been palatable to those who held opposite views'. He was openly criticised by his fellow surgeons for 'operating upon a case thought unsuitable by themselves and whom Nunneley had reported cured but was dead within twelve months'. (Infirmary Weekly Board, 19 January, 1855). Even the year before his death, Nunneley took on the great Lord Lister in the pages of the British Medical Journal over the antiseptic system of the latter. Nunneley's 'without it many cases are as good as those of my colleagues with it' was silenced with Lister's broadside 'that he [Nunneley] should dogmatically oppose a treatment which he so little understands and which, by his own admission, he has never tried, is a matter of small moment'.

The following year, Nunneley was dead, but with almost his last breath he was exchanging blows in print with an Infirmary colleague over a question of statistics. As ever, his opponent had the final word: 'by what arithmetical process Mr Nunneley arrives at such conclusions, I am at a loss to divine, unless he prefers that backward reckoning by which "Lord Dundreary" counts his fingers and makes them number eleven'. For all his faults, Thomas Nunneley was a man of enterprise, energy and vision in many aspects of life. Unfortunately, his enterprise in anaesthetic research appeared to make no great steps forward. Few contemporary anaesthetists are aware of Thomas Nunneley or what he achieved; but then this could be said of so many.

References
3. Nunneley T. On anaesthesia and anaesthetic substances generally. Transactions of the Provincial Medical and Surgical Association. 1849; 167-381.
5. Turnbull L. Artificial Anaesthesia. 1877; p.228.
7. Silk JF. Correspondence. Transactions of the Odontological Society of London. 1891; N.S.23:120.
The news of the discovery of ether anaesthesia was announced in Vienna on 10 January 1847 in an article in the daily newspaper Augsburger Allgemeine Zeitung. The new method was first used in the university hospital by the leading professors of surgery, Franz Schuh and Joseph von Wattmann, on 27 and 29 January. The possibility of painless surgery was enthusiastically taken up not only by the medical authorities but also by an unknown surgeon and dentist who became almost forgotten soon after his death. His name was Joseph Weiger. Although he is sometimes mentioned in the literature, it has taken more than 150 years for his place in the development of anaesthesia to be recognised. In 1991 a letter to Anesthesiology pointed out Weiger's priority in anaesthetic 'polypharmacy' and another unrelated publication drew attention to his importance generally as an early anaesthetist. Both publications referred to a book edited by Joseph Weiger in 1850 describing the use of ether and chloroform for performing painless operations. A year later he published a second book which was written in Latin and described the use of a mixture of ether and chloroform. These two books given an interesting impression of the work of Weiger.
Weiger's first book (1850)

According to its title this work describes not only the use of ether and chloroform for painless operations but also a special alloy for false teeth. The dedication to Jackson and Morton and the preface give Weiger's reason for writing this book, and he expresses his intention to pass on his obviously immense anaesthetic experience gained in more than 21,000(!) operations. A general introduction of 32 pages summarises the contemporary knowledge of anaesthesia, mainly with ether but also with chloroform. Weiger reports on experiments with ether performed by himself, his co-workers and other medical persons and the names of many medical doctors, professors or scientists of other faculties are given. The pro's and con's of general anaesthesia per se are discussed and his method of using ether is described exactly. Weiger used a pig's bladder fitted with a face mask made of pasteboard. It seems that he had recognised the value of 'verbal premedication' because he describes in great detail his methods of preparing patients for anaesthesia by positive suggestion. In the introduction Weiger describes mainly his experiences in dental anaesthesia but he also mentions his work in general surgery and obstetrics. Chloroform is only discussed to a lesser extent and then mostly as a potentially dangerous substance which might be used as an additive to ether. Obviously Weiger had recognised the danger of this substance, but it cannot be said that he simply refused to use it as he had administered it in several hundred cases without accident. His reservations seem to have come only from reading the academic and public press.

Following this introduction, which occupies approximately one quarter of the text, other contributions can be found which are summarised in Table 1.

<table>
<thead>
<tr>
<th>Title or contents</th>
<th>Author</th>
<th>Year</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>Weiger</td>
<td>1850</td>
<td>1-32</td>
</tr>
<tr>
<td>Death connected with chloroform</td>
<td>Confevron</td>
<td>1849</td>
<td>32-40</td>
</tr>
<tr>
<td>Ether in dental operations</td>
<td>Weiger</td>
<td>1847</td>
<td>41-43</td>
</tr>
<tr>
<td>Reports of patients or witnesses of ether anaesthesia</td>
<td>Weiss and anonymous</td>
<td>1847 and 43-59</td>
<td></td>
</tr>
<tr>
<td>Scientific analysis of anaesthetics in Weiger's practice</td>
<td>Hammerschmidt</td>
<td>1847</td>
<td>59-69</td>
</tr>
<tr>
<td>First experiences with chloroform</td>
<td>Weiger</td>
<td>1848</td>
<td>69-71</td>
</tr>
<tr>
<td>Combination of ether and chloroform (first experiences)</td>
<td>Weiger</td>
<td>1848</td>
<td>71-78</td>
</tr>
<tr>
<td>Accounts by 109 patients of their experiences of anaesthesia</td>
<td>Patients or witnesses</td>
<td>1847-1850</td>
<td>78-115</td>
</tr>
<tr>
<td>Fatalities with chloroform (France)</td>
<td>Anonymous</td>
<td>1847</td>
<td>115</td>
</tr>
<tr>
<td>Fatalities with chloroform (England)</td>
<td>Anonymous</td>
<td>1850</td>
<td>115-116</td>
</tr>
<tr>
<td>Appendix (platinum alloy for artificial dentures)</td>
<td>Weiger</td>
<td>1850</td>
<td>117-136</td>
</tr>
</tbody>
</table>

Table 1. Survey of the contents of the first book (1850)
It would take too much space to review in detail all these articles and reports but it can be seen that Weiger gives an impressive account of his own contribution and those of others to the subject of anaesthesia. Some of these articles had previously appeared in the lay press, others in academic journals.

Historically, Weiger's own paper on the combination of ether and chloroform seems very important. It is one of the first written accounts of anaesthetic 'polypharmacy' and was published on 15 January 1848 in the academic journal Zahnarzt (Dentist). Also of interest and importance is the reprint of Hammerschmidt's article which was also first published in the academic press. The translated title is: 'A statistical analysis of the suitability and safety of ether for dental operations', and it covers the first 165 days of Weiger's use of ether. An accurate survey was made of 547 operations performed on 293 patients (145 male, 148 female). Of these, 19 were children (5-12 years), 43 'aged' (>50 years) and 57 were considered to be at increased risk because of extreme nervousness, apoplectic habitus or pregnancy. The only difficulties mentioned were the inability to induce sufficiently deep anaesthesia (10), nausea (17) and bad dreams (28). By contrast, pleasant dreams were reported in 52 cases, possibly an effect of the 'verbal premedication' of Weiger which was mentioned above.

Perhaps the most important part of the book is the account of patients' recollections. This chapter describes 109 contented patients who wrote enthusiastically of their gratitude and relief in Weiger's notebook immediately after anaesthesia. Impressive testimonials of their acceptance of this discovery can be found among these lines. Many of the names are those of upper class people such as noblemen, scientists, physicians, officers, artists and so on.

The appendix about the platinum alloy gives the impression that possibly one of the purposes of this book was self-advertisement. Weiger draws attention to his invention of a better tolerated material for false teeth and it seems obvious that he wanted to attract patients with the promise of painless extractions.

**Weiger's second book (1851)**

One year after publication of his first book a second appeared. It was Weiger's doctoral thesis and was written in Latin. Its title announced an account of the combination of ether and chloroform for safe and pleasant anaesthesia. The contents are listed in Table 2.

<table>
<thead>
<tr>
<th></th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td>7-9</td>
</tr>
<tr>
<td>History of anaesthesia</td>
<td>10-29</td>
</tr>
<tr>
<td>Own anaesthetic experiences</td>
<td>29-45</td>
</tr>
<tr>
<td>Chloroform</td>
<td>45-58</td>
</tr>
<tr>
<td>References</td>
<td>59-67</td>
</tr>
</tbody>
</table>

**Table 2. Translation of the contents of the second book (Weiger's thesis 1851)**
In the historical section Weiger presents a well-researched survey of contemporary knowledge. The section is supported not only by the reference list but also by 56 scientific footnotes. Here he cites German, French, Italian and English authors and it seems that he had a very good knowledge of the important literature and access to the sources; for example, he mentions details from James Robinson's first textbook of anaesthesia of 1847. The description of Weiger's own anaesthetic experience is a repetition from his first book.

The chapter on chloroform describes his own experiences with this agent. In December 1847 he had published observations of his use of chloroform anaesthesia on 22 occasions and some weeks later on 15 January he presented his first 350 cases in the academic press. After 150 further cases he came to the view that the new substance as a single anaesthetic agent had no real advantages over ether. At the same time he was aware of the dangers from reports of fatal cases. He discusses some of them and cites the opinions of international scientists. Finally, he presents his invention of a mixture of chloroform and ether. This is similar to his recommendation in the first book but he has changed the composition to 1 part chloroform and 9 parts ether. It is of interest that this mixture was recommended by Charles T Jackson in his book *A Manual of Etherization* in 1861, indirectly citing Joseph Weiger. In the last section of the book Weiger presents a survey of the international literature containing 80 titles. To this can be added the 56 references he presented in the footnotes indicating that he must have been a very busy reader in addition to undertaking his practical work. Weiger's second book was not the last publication of this impressive worker. In 1858 a paper appeared on the dangers of chloroform and the safety of ether (cited in reference 3); in 1860 he wrote his last paper based on his experience of 109,311 cases of general anaesthesia (cited in reference 6).

References

Editor's Note: Professor Panning explained during discussion the reason for Weiger's extraordinarily high personal anaesthetic figures. He counted every tooth extracted as a separate anaesthetic! Many of our NHS managers and their political masters would be proud of him. Dr Peter Costen made this point while doing the major part of preparing this paper for publication.
In most people's life span there is a time when you happen to be around when a particular circumstance occurs that makes a big impression on your future. This happened to me in 1941 when I was a resident anaesthetist under Dr C Langton Hewer at St Bartholomew's Hospital, St Albans.

One morning, the Senior Medical Officer from the pharmaceutical division of ICI came to give Dr Hewer a Winchester bottle containing a colourless liquid they named Trilene. It was, he said, purified trichloroethylene, and Dr C F Hadfield of the newly formed Medical Research Council had asked Dr Hewer to evaluate the anaesthetic properties of the substance.\(^1\)\(^2\) It transpired that a chemist, Mr Chalmers, had inhaled the vapour of some trichloroethylene he had in his shop for the treatment of trigeminal neuralgia and put himself to sleep. Wisely he got in touch with Dr Hadfield. During the assessment stage we confirmed that it had considerable analgesic properties and found it most useful for changing plasters. These were done in a room some distance from the theatres, which meant transporting a Boyle's machine, so I adapted a Walton bottle by cutting a hole in a Valor stove wick and making in my workshop a simple one-way inlet valve. Thus it was possible to draw air over the Trilene and exhalation took place through an expiratory valve near the facepiece.\(^3\) With this very simple apparatus I was able to change plasters and painful dressings etc. in the wards. The analgesic property of Trilene was later to play an important part in the relief of pain in maternity cases. There being no such department at Hill End, it was left to others to develop apparatus for analgesia in labour.

![Figure 1
Trilene analgesia apparatus 1942](image)
It was becoming increasingly obvious that portable apparatus would be necessary for medical units in the mobile warfare that was being used in 1942 and talk of invading Europe was also in vogue. Trilene was good for induction and maintenance of light anaesthesia, but would not give muscle relaxation for abdominal surgery. Therefore added a second similar Walton bottle with ether. With this machine I was able to give satisfactory conditions to the surgeons, but found that I had to solder in a tap so that I could add a minute amount of oxygen to compensate for the reduction in tidal volume during deep anaesthesia.

As Barts had introduced Trilene to the profession, we had many visitors and the chief of the Canadian Medical Corps was impressed enough with this apparatus to get some made. I left Hill End and joined the Army, taking my apparatus to Normandy in June 1944. I found that I could leave it by the patient's head on a stretcher or table while my surgeon got on with the major injuries leaving me free to tidy up the smaller ones, so increasing production!

The city of Caen was our next objective. On exploring the surrounding area I found a rescue breathing apparatus. I quickly realised that it was a closed circuit with a sealed canister of soda lime, two one-way valves and two corrugated tubes.

Figure 2
German rescue apparatus
A similar apparatus in the Guernsey War Museum has been kindly lent for the meeting by the owner, Mr R L Heaume. At this time there were three ways of giving an anaesthetic in the 'field': (1) by the open drop method on a Schimmelbusch mask, (2) ether with the Oxford vaporiser, which was good, but its casing had to be filled with hot water to give the correct concentrations of ether and induction was tricky, and (3) by an old first world war field pattern Boyle's machine which was encased in a beautiful inch thick mahogany box and took two men to lift it.

Clearly, in highly mobile warfare with ammunition and food as first and second priority, anaesthetic gases and machines were way down the list. There was an obvious need for a small, light apparatus for forward units, like my own No.6 Field Surgical Unit. This consisted of a surgeon, anaesthetist, eight men and facilities for an operating theatre with ten emergency beds. All this was contained in two 3-ton lorries and a Humber 4-wheel-drive staff car.

The local REME unit lent me a soldering iron, and I modified the rescue apparatus into a very efficient closed circuit machine. I had to use a coffee tin for the soda lime canister instead of the sealed one, as I had to rejuvenate the soda lime by spreading it out on a biscuit tin lid and heating it over a Primus stove. By attaching one of the Walton bottles with the one-way valve I had the perfect answer.

Figure 3
Wartime Closed circuit apparatus
I scrounged an oxygen cylinder complete with an Adams reducing valve and by turning the cylinder key very gently till I could just feel the gas from the tubing against my ear I was able to anaesthetise dozens of casualties on one cylinder. I subsequently found that my ear test indicated a flow of about 1 L/min, enough to keep the patients pink. Being in a forward and mobile unit we were visited by various 'Brass Hats'. Much interest was taken in this apparatus, in particular by Lt Col Scriven o/c anaesthetics in Europe, and Brig Arthur Porritt, later Lord Porritt, o/c surgery.

After VE Day I was posted to various RAMC hospitals in England relieving those who had had no break, and eventually was asked to stay at Shaftsbury Military Hospital. Colonel Scriven who knew that I was a partly trained engineer and had my own workshop, sent for me and asked if I had any ideas about designing a machine and stand, of unit construction as far as possible, portable, closed circuit and with no rubber parts so that it could be used in all parts of the world. It also had to embody the techniques used at the time, eg insufflation for T's & A's, semi-open circuit, closed circuit and the draw-over should the gas supply fail. The reason for this specification was that current machines consisted of many individual parts pushed together with tapered joints which leaked, and not all parts were received from Army stores to form a complete machine.

After presenting my ideas I was interviewed by the Director General of the RAMC, General Hood, and seconded from normal duties for nine months to hopefully produce some result for evaluation. After looking at many makes of apparatus it was clear to me that the vaporisers and soda lime canister would have to be hard soldered into one unit, and by making them into a circle this achieved rigidity and compactness. Initially I decided to make all the models out of hardwood as it was easy and quick to turn up on the lathe and to modify until it was time to make a real prototype in metal. Finally, I came to the right design of wooden apparatus that worked successfully on 20 different types of case. This model having been approved by General Hood and Colonel Scriven the way was clear to make the final prototype in brass and copper. I was able to invent the first interlock between the Trilene and soda lime thus preventing any more accidents arising from the decomposition of Trilene by the soda lime over-eating. Both these models, to my great sadness, have been lost by the firm that eventually made the machines.

I was then posted to the RAMC headquarters hospital at Millbank, making frequent visits to the patent department of the Ministry of Defence. A patent was filed in my name as was the usual practice in those days. Now it was a question as to who would be chosen to make it. I suggested BOC but they turned it down. A gentleman in the Ministry of Defence suggested a small firm, Airbourne Equipment Ltd, of Harlow, Essex, later to become Airmed Ltd. This firm was making the oxygen masks for air crew and had as their managing director a previous employee of the old anaesthetic apparatus firm of Coxeters. As they were a subsidiary of the optical instrument makers Clement Clarke Ltd., they were ideally suited to making this machine, which required precision engineering and further design for manufacturing purposes.
Finally, I designed the assembly of the three drums in such a manner that it required a special spanner to remove them. This was done to prevent the enthusiasm that some orderlies had of polishing everything to hand including the drums of Boyle's machines, thus destroying the gas-tight fit required to prevent ether and chloroform entering the circuit when the taps were turned off.

In both an engineering workshop and anaesthetic practice safety procedures must be rigidly observed. This training guided my design of the Marrett Head. I designed the stand of lightweight construction with the 6 cylinders and 3 reducing valves arranged in a circle, making one complete unit for issue from Army stores. (Figs 4 and 4A) New reducing valves had to be designed, because the old Adams valves were bulky and unreliable, and the rubber seals deteriorated in the tropics.

Figures 4 & 4A
The Marrett Apparatus 1948-9
With advances in techniques and the advent of relaxants, some modifications in design became necessary. The most important were moving the $O_2$ bypass to the patient side of the machine, preventing the rebreathing bag from being closed off and switching to transparent jars for the soda lime. (Fig. 5) The modifications were published in 1958.  

Figure 5  
Modified Marrett Head 1958

References

DAVY AND THE BLUE GAS

Dr J Pring
Consultant Anaesthetist, Penzance

Penzance is 8 miles from Lands End, and 5 hours by train from London. Whether you approach from the west or the east you will notice the large dome above Lloyds Bank, and if you walk up Market Jew Street towards the bank you will soon reach the statue of Penzance's most famous son, Sir Humphry Davy. Davy was born in Penzance on 17 December 1778, but a stone's throw from his statue - in fact, if you look over his shoulder you can just see the plaque which commemorates his birthplace. Davy left school near his 16th birthday. His father died soon afterwards, leaving a number of debts and Davy, as eldest son, had to choose a profession to help support the family. He was duly apprenticed to John Bingham Borlase, surgeon/apothecary and later physician in Penzance. Just opposite Davy's statue is Peasgoods pharmacy, where that apprenticeship took place. According to Jim Saulter, the current owner of Peasgoods, Davy is reported to have blown up the cellar during the time he was there! On one of the windows in the lane at the side of the shop you can see a picture of Davy hard at work! This may not be an accurate representation of fact, but it interests the tourists and is good for business.

At 17 Davy began seriously to educate himself - theology, geography, languages, physics, mathematics and, at 19, chemistry, reading Lavoisier's *Traité Elémentaire* in French. As Bingham Borlase's apprentice, Davy undertook 'not to play any unlawful games whereby his said master may have any loss, or haunt Taverns and Playhouses ....' However, just round the corner from Peasgoods, in the Green Market, is the Sir Humphry Davy pub. I'm led to believe that the name of the pub, previously the St John's House, only changed to the Sir Humphry Davy pub about 12 years ago, and that it was built for the St Austell brewery in the 1930s. So Davy shares with John Snow the honour of having a pub called after him. The pub sign includes four appropriate items - the gear at the head of a pit, a miner's lamp, some chemical apparatus, and a book.

Experiments with gases

Joseph Priestley had isolated dephlogisticated air (later named oxygen by Lavoisier) in 1771, and nitrous oxide in 1772. In 1794 Thomas Beddoes founded the Pneumatic Institute in Bristol for the treatment of pulmonary TB and experimented with the therapeutic inhalation of gases and vapours. Davy's work on nitrous oxide had begun after reading a paper on it by Dr Samuel Latham Mitchell, an American physician, who believed it to be the principle of contagion (i.e. a poison). Davy, by a 'few coarse experiments', proved that this theory was incorrect. Dr Beddoes had been Reader in Chemistry at Oxford and had read Davy's essays. He recognised in Davy's experiments on heat and light, and in his experiments on nitrous oxide, signs of an uncommon talent. Here was a young man who could be of service to, and who could be served by, the Pneumatic Medical Institution which he was seeking, with the aid of various subscribers, to establish in Clifton. This was to provide a laboratory for research, a
Theatre for lecturing and a hospital for patients. The whole scheme was experimental, of course. Davy was appointed Superintendent in 1798. As Denis Smith states, if Davy ever made vital practical contributions towards the inhalational anaesthesia that was to come, they were his demonstration of nitrous oxide's respirability, his attention to its purity and his discovery of its analgesic effect, having himself experienced the relief the gas gave to dental pain. Nitrous oxide's name, 'laughing gas', is attributed to Davy.

Beddoes had established his clinic to investigate the curative powers of the newly discovered gases, and it was fortunate that he first studied their effects on animals. He had been able to prepare and store oxygen, hydrogen, carbon dioxide, and hydrocarbonate or water gas, and had found that water gas (a mixture of hydrogen and carbon monoxide) killed a pigeon very quickly when mixed with one-third of its volume in air. Used in dilution, patients complained of vertigo. Later, when Davy inhaled it undiluted, he had a narrow escape from death and gave a graphic description of how ill he felt. Davy produced his nitrous oxide by heating ammonium nitrate, as it is still manufactured nowadays, but even in 1800 he was aware that at high temperatures water, nitrous acid, nitric oxide and nitrogen could be formed. He inhaled nitrous oxide in its pure form on a number of occasions and experienced a 'fullness of heart accompanied by loss of distinct sensation and of voluntary power'. Recovery was swift: '... in 10 minutes he had recovered his natural state of mind'. In January 1800 he published a 580-page volume entitled: *Researches Chemical and Philosophical, chiefly concerning N2O, or Dephlogisticated Nitrous Air, and its Respiration*.

The poet Southey described Davy's gas as that '... which excites all possible mental and muscular energy, and induces almost a delirium of pleasurable sensations without any subsequent dejection ... Davy has invented a new pleasure for which language has no name. I am going for more this evening, it makes me strong and happy.' Davy and his colleagues experimented by breathing the gases themselves, and his conclusions on the use of inhaling nitrous oxide are temperately stated: 'As nitrous oxide in its extensive operation appears capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place'.

Henry Hill Hickman in 1824 had the idea of respiring a gas to render the individual insensible - he used animals - to enable an operation to be performed. Unfortunately, he chose the wrong gas - carbon dioxide! Davy, on the other hand, chose the right gas, but didn't make the most of it.

**To the Royal Institution**

The year 1801 marked the beginning of a major phase in Davy's life when he was appointed to the Royal Institution in London. He conducted original research in galvanism and electrochemistry, which resulted in the discovery of sodium and potassium, announced in his Second Bakerian Lecture to the Royal Society in 1807. The lecture caused a great sensation, and his next new course on electrochemistry was crowded. By further experimentation Davy showed that four more metals existed - calcium, barium, strontium and magnesium. One of
the attenders at Davy's lectures was a young Michael Faraday. In 1813 Davy's eye had been
injured by an explosion of nitrogen chloride, and Faraday acted as Davy's secretary for some
days. A few weeks later, following the dismissal of a laboratory assistant, Davy sent for
Faraday and offered him the post. It has been said that Michael Faraday was Davy's greatest
discovery. A course of Davy's lectures for the Board of Agriculture - on the connection of
chemistry with vegetable physiology, part of a wide effort to convert farming 'from a mere art
of blind processes into a rational system of science' - was eventually published in 1813 under
the title: *Elements of Agricultural Chemistry.* The book dealt with plant physiology, soils and
soil analysis, as well as with the improvement of land by burning, irrigation, fallowing,
rotation of crops and with grassland.

Miners' safety

On the left of the pub sign is what most people associate with Davy - his lamp. Most gases
are invisible, including methane (fire damp or marsh gas) and its aftermath 'choke damp' or
CO₂. Methane was not found in the Cornish tin mines, but it was, and is, a problem in coal
mines. For flammability or an explosion you need a fuel, an oxidant, and a source of ignition
(the miners' lamps or candles). The steel flint mill invented by Charles Spedding around 1740
produced a feeble shower of sparks, and not much light, but insufficient heat as a rule to
explode fire damp. If there was a reason in a pit to believe fire damp was a problem, a
'fireman' was sent in - some lucky miner swathed in damp sacking as protective clothing, with
a candle on the end of a very long pole to push cautiously around corners! Better ventilation
was not the answer, and as demand for coal increased so the mines were going deeper, and the
dark galleries got longer. Explosions became increasingly frequent and caused considerable
loss of life.

It was some 3 years after an explosion at Felling Colliery, near Sunderland, in 1812, when 92
pitmen were killed, that Davy's aid was positively invited to help solve this problem. Davy
found that the flame of an explosive mixture of coal gas and air would pass along a tube 1/4" in
diameter, but when the diameter of the tube was decreased to 1/7" he couldn't make the
mixture explode, even though coal gas was more explosive than fire damp. He also found
that flames passed more readily through glass than metal tubes of the same diameter, due to
the cooling effect of the metal. He found, too, that the explosion would not pass through fine
wire gauze (which is, in effect, a bundle of narrow bore tubes of extremely short length).
Safety depended too on the fineness of the mesh - with less than 576 apertures/ square inch an
explosion occurred when the gauze became red hot towards the top.

In: *On the Safety Lamp, with some Researches on Flame,* Davy stated: 'In plunging a light
surrounded by a cylinder of fine wire-gauze onto an explosive mixture I saw the whole
cylinder become quietly and gradually filled with flame; the upper part of it soon appeared
red hot; yet no explosion occurred'. The wire gauze lamps, which were ready by January
1826, not only gave protection, but acted as detectors, for they burned more brightly at the
approach of danger. You could also see to work by them! Davy had warned that there was
no hazard except in exposing the lamp to a strong current, when there was a risk of passing
the flame through the gauze. The remedy was a tin screen, which slides upon the frame-wires of the lamp, and encircles the gauze cylinder to an extent of about 1/2 to 1/3rd of its circumference. There were still explosions - lamps might be damaged in a rock fall, and sometimes proper care of the lamps was not taken and damaged wire gauzes were not replaced.

The Cornish tin miners risked being killed by underground explosions (gunpowder or dynamite), roof and rock falls, breaching flooded workings, and machinery accidents - as well as from fire. The tin miners used to carry naked candles on their helmets for illumination. Carelessly discarded candle ends - or a candle holder stuck into a piece of timber, occasionally caused fire, and the added hazard of smoke and oxygen lack. A rare type of gas explosion in Cornwall was caused by the accumulation of pockets of fire damp in underground workings, produced by the decay of old timbers. At Ding Dong mine in 1868 workmen were reopening a section which had been abandoned about 20 years before, when a violent explosion accompanied by a blue flame threw two of them down and severely scalded them. Three days later a managing agent caused a second explosion by inserting a candle fixed to the end of a long pole. After a third explosion, when somebody carrying a naked candle entered the mine, no one was allowed to enter until Davy lamps had been procured - 'whose flames were elongated and surrounded by flickering blue haloes'.

Miners used the term 'foul air' to describe polluted atmospheres encountered underground. The introduction of the compressed air drill in the 1870's and the 1880's was the mining equivalent of the Sanders injector! Prior to that, ventilation of mines left much to be desired, and there were many 'ends' where a candle would not burn and a man could easily be rendered unconscious or even die through lack of oxygen. In blind tunnels there might be raised carbon dioxide levels - a School of Mines student was killed like this in recent times. There was an interesting article in the British Medical Journal in 1993 on the 'Stythe gas' or 'choke damp' in Nottinghamshire - a lady moved into a new house on a rainy day and found neither her gas fire nor cigarette lighter would work. With changes in atmospheric pressures mines 'breathe', releasing carbon dioxide produced by decomposing timber underground - in this case maximum ambient CO₂ concentrations of 7.05%, and 0₂ down to 8-9% (in the cupboard under the lady's kitchen sink!) were recorded.

Conclusion

Humphry Davy was an outstanding scientist and electrochemist who initiated work on the 'blue gas' (N₂O). He discovered a number of important elements, and made a major contribution to miners' safety when he invented the lamp which he refused to patent. He presented a treatise on agricultural chemistry, and refuted the myth that all acids contained oxygen. He more than helped the fortunes of the Royal Institution and he 'discovered' Michael Faraday.
FW A SERTURNER (1783-1841) AND THE ISOLATION OF MORPHINE

Dr F E Bennetts

Consultant Anaesthetist (Retd) Medway DHA, Kent
Medical Adviser, Abbott Laboratories Ltd.

Developments in chemistry during the latter part of the 18th century led not only to the synthesis of new drugs - 'new chemical entities' as they might be called today - but also to the purification of plant extracts used as medicines. These herbal remedies consisted mainly of impure vegetable derivatives containing a number of inert as well as pharmacologically active substances, but in unknown quantities and varying proportions.

Of the active substances used in medicine around 1800, opium, which had been medically important since Ancient Egypt, was clearly of interest to Friedrich Wilhelm Adam Serturner, who was born in 1783 in Neuhaus near the town of Paderborn in what is now the German Land of North Rhine-Westphalia. At the age of 16 he became an apprentice in a pharmacy in Paderborn and in 1806 moved from there to Einbeck and later, in 1820, to Hameln - better known to us as Hamelin, the Pied Piper's town.1,2
An era of upheaval

Serturner's upbringing must have been profoundly affected by the tremendous civil and military upheavals occurring in Europe between 1790 and 1815. During the second half of the 18th century German intellectual life, like that of Britain and France, had flourished. A succession of thinkers - Goethe (1749-1832), Schiller (1759-1805), Kant (1724-1804) - and creative artists - Haydn (1732-1809), Mozart (1756-1791), Beethoven (1770-1827) - made this period of German enlightenment one of the greatest in Western history. We cannot doubt the influence this must have had on Serturner and his contemporaries.

Revolution in France was perhaps a consequence of this northern European renaissance and the formation of Napoleon the First's short-lived Empire pushed the boundaries of France eastwards by force of arms. Many of the North German states thought it wise to ally themselves with Buonapart in the Confederation of the Rhiine. Virtually all the boundaries of these states were redrawn under Napoleon and the area including Paderborn, which had been a petty bishopric, became part of the Kingdom of Westphalia given to the Emperor's brother Jerome, to rule as monarch.

The invasion of Russia began the downfall of Buonapart; the Confederation of the Rhine disintegrated, and its members hurried to join what was going to be the winning side. The Congress of Vienna in 1815 allocated Westphalia to Prussia. So, when the young Serturner started his apprenticeship in 1799 in Paderborn his ruler was a local Prince-Bishop, but three years later in 1802, he became a citizen of Prussia and only four years after this, just as his apprenticeship was completed, he became the subject of a French - more accurately, perhaps, a Corsican - monarch of the Kingdom of Westphalia. After the final defeat of Napoleon, Serturner, by moving to Hameln, put himself into the newly independent Kingdom of Hanover (had he stayed where he started, he would have gone back to being a Prussian again). These then, were just a few of the changes affecting Serturner and all who lived in central Europe during the first two decades of the 19th century.

Morphium

Then as now, war, conquest and the intellectual stimulus, albeit shortlived, of progressive foreign rule, may have positively influenced the trend toward scientific advancement in minds already inspired by the German enlightenment. Certainly the young Serturner, a country pharmacist's apprentice published his first paper on opium in 1805 at the age of 22, while in the following year a further paper described a new substance derived from opium which he found to produce sleep in a dog. He believed this to be 'der eigentliche betaubende Grundstoff' - the specific narcotic element of opium. The 1806 paper from 'Herr Serturner of Paderborn' was entitled in translation: *A description of a purified opium acid: including a chemical investigation of the notable newly discovered substance from opium.*

1
The new substance was a weak base, being soluble in acidic solutions from which it could be precipitated by ammonia. The chemical experiments which led to its discovery and those which Sertturner carried out after the isolation of the new, highly active material, were described in detail in a further much delayed paper which appeared eleven years later in 1817. This was entitled in rough translation: On morphium, a new salt derivative, and meconic acid - the main components of opium.

Sertturner had called his opium extract morphium, after Morpheus, the Roman mythological sender of dreams of human forms who was the son of Somnus, god of sleep. It was realised that many other nitrogen-containing compounds could be prepared by similar methods and the
term alkaloid was coined in 1818 by W Meissner and the suffix -ine applied to the group. Morphium became morphine.

The political history of the period helps explain the 10 year interval between Serturmer's first announcement of his discoveries and the publication of his definitive paper, a delay which allowed 'other people' to perform their own experiments with morphine. The original work was carried out under relatively peaceful conditions in a quiet satellite of the French Empire but things changed dramatically with the subjugation and break-up of Prussia and North Germany. The continuing excesses of war raging up and down central Europe may have delayed his obtaining publication in prestigious Leipzig, where the printing presses were to be found, about 250 km away from Serturmer.4

Human experimentation

Having achieved pharmaceutical isolation of morphine, Serturmer turned to pharmacology. We have to remember that his discovery antedates the injection syringe and needle by almost 50 years and the standard way of administering a drug at the time was by mouth. A translated account of his experiments reads as follows; note the precise description of the pharmacokinetics and dynamics and his thinly veiled annoyance with incompetent plagiarists:

'The most remarkable property of morphine is its action on animals which consume it. To obtain a reliable assessment of this action I myself acted as a subject and persuaded others to do the same since experiments in animals may fail to give correct results. In order to prevent accidents it is my duty to draw attention to the unpleasant action of the new substance, since it has been stated publicly that several people have been given fairly large quantities of it without any noticeable effect. If the material consumed by these people was really morphine then it is obvious that it was not dissolved by the gastric juice. My earlier observations [presumably his papers of 1805 and 1806], of which these people seem to have been unaware, caused me to state categorically, that one must take the substance dissolved either in alcohol or in small amounts of an acid since it is scarcely soluble in water and probably not dissolved in the stomach.

In order to subject my previous experiments to a rigorous test, I persuaded three people under the age of seventeen [1] to join me in taking morphine. In view of my previous experiences each person took only half a grain [say 15 mg] dissolved in half a drachm of alcohol and diluted with a few ounces of distilled water.

The face, particularly the cheeks, became flushed, the eyes turned red and on the whole vitality appeared to be increased. An additional half grain was taken thirty minutes later. This caused an intensification of the symptoms, transient nausea, dull headache and stupor. Without waiting for the full consequences, which might have been bad enough, we took another half grain of morphine fifteen minutes later, this time in the form of a coarse powder, together with 10 drops of alcohol and half an ounce of water. A response occurred quickly in the three young men and soon reached a maximum. It consisted of
pain in the region of the stomach, weakness and stupor with a near loss of consciousness. I shared the same fate. Lying down, I got into a dreamy state and in my extremities felt slight twitches, which were synchronous with the heart beat and most pronounced in the arms.

'These symptoms, which were signs of poisoning, combined with the poor condition of the three young men worried me so much that in spite of the fact that I was only semi-conscious I took a quarter of a bottle [say 200 ml] of strong vinegar and made the others do the same. As a result of this we all vomited severely, and one subject, who was of a delicate constitution and whose stomach had discharged all its contents, suffered continuously for several hours from severe and very painful retching. It seemed to me that vinegar caused morphine to produce the severe and continuous retching. For this reason I gave the subject magnesium carbonate and this at once stopped the retching. During the night we all slept heavily. Towards morning we began to be sick again, but this at once stopped after a large dose of magnesia. Failure to defaecate, loss of appetite, dizziness, stupor, headache and peripheral pain were observed also and these symptoms lasted several days.'

Before his isolation of morphine, Sertturner had extracted another substance in pure form from crude opium. This he called 'meconic acid'. Similar human experiments were then carried out, but '.....the consumption of 5 grains of meconic acid failed to produce even the slightest effect'. No doubt the three young men were relieved.

The similarities between Sertturner's experiment and James Young Simpson's first trial of chloroform, 40 years later, remind us of the dangers, which are no less today, of phase I trials of new drugs.

Recognition

Priority of discovery was disputed, and it is not surprising to find in the political climate of the time that the claimant was French. The pharmacist Derosne, in 1804 - the year before the publication of Sertturner's first paper - had isolated crystals which he considered to be a salt, from opium juice, but these were later thought probably to be a mixture of morphine and narcotine. Derosne certainly did not realise the basic nature of his isolate.

To be fair to the French, the internationally famous chemist J L Gay-Lussac (1778-1850) realised the importance of Sertturner's discoveries and brought them to the scientific world's attention. In 1831, soon after the French throne had passed to Louis Philipe, a patron of arts and science, the Institut de France awarded Sertturner the Prix Monthyon, worth 2000 francs:

'... pour avoir reconnu la nature alcaline de la morphine et avoir ainsi ouvert une voie, qui a produit de grandes découvertes médicales.' [for having recognised the alkaline nature of morphine and thereby opened the way to great medical discoveries]
By this time other workers, especially in France, were active in this field and a number of alkaloids were isolated from opium and other naturally occurring substances. Robiquet (codeine), Pelletier (1784-1841) and Caventou (1788-1842) - almost exact contemporaries of Serturner - were leading workers and quinine, strychnine, veratrine and emetine were among their discoveries.

Serturner's versatility is shown by his subsequent studies of the composition of corrosive alkaloids and his views on the nature of cholera, which he considered to be caused by a living organism which might be combated by disinfectants and by boiling drinking water. John Snow may have reflected similarly while in general practice in the north of England at the time, and later in London. Snow's first publication on cholera was in 1849, eight years after Serturner's death.

As with many drugs of prime importance, the story of morphine - its leading role in pain relief, adoption into practice, detailed analysis, elucidation of structure, sites of action and so on - is still far from complete. But honour is due, I think, to the obscure pharmacist, working far from the centres of learning and in times of great upheaval, who was responsible for isolating, purifying and identifying many of the actions of the drug which has proved a faithful friend to every anaesthetist and given relief to countless millions.

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THE SEARCH FOR THE HOLY GRAIL:
JOHN HARRISON AND THE BIMETALLIC STRIP

Air Commodore C A B McLaren, Retd
Consultant Adviser in Anaesthetics to the RAF 1983-1993

The search for a Holy Grail continues in all walks of life. In anaesthesia we still seek the ideal inhalation anaesthetic agent. Halothane at first seemed to be the answer, but the potency of the new agent required the design and construction of vaporisers which would ensure an accurate concentration and delivery of the anaesthetic vapour, throughout the range of the ambient working temperatures. In nearly all modern temperature-compensated vaporisers a bimetallic strip is used to regulate the gas flow into the vaporising chamber.

The bimetallic strip relies upon the difference in the coefficients of expansion of two dissimilar metals. When two strips of dissimilar metal are joined tightly together side by side and subjected to a change in temperature, one will expand more than the other, producing a deflection of the strip. This movement can be used to vary the size of the entry port in the vaporising chamber, which in turn alters the volume of the carrier gas passing into the chamber.

A navigational problem

The history of the bimetallic strip began in the early years of the eighteenth century, in the search for a different Holy Grail. This was the perfection of a system for use at sea, to determine longitude. Sun and star shots could give latitude but many ingenious and cumbersome instruments had all failed to accurately calculate longitude. The solution to this problem had assumed great importance with the development of England as a maritime power increasing in wealth and prestige. One of the main reasons for the foundation of the Royal Observatory in 1675 was an attempt to find a solution, but 40 years later the answer was as elusive as ever. There were so many shipwrecks resulting in loss of life and valuable cargo, the Lords of the Admiralty were driven to petitioning Parliament to do something about it.

The disaster which finally brought action occurred on the night of 22/23 October 1707. The War of Spanish Succession had by this time been in progress for seven years, and Admiral Sir Cloudesley Shovell's fleet of five ships was returning from Gibraltar (which had been captured in 1704). In a thick fog, four of the vessels including the Admiral's flagship, all loaded with the spoils of war, were wrecked on the Gilstone Rocks south of the main Scilly Isles. More than 2000 were drowned, including the Admiral. The wreck of his flagship, HMS Association, was discovered in 1967 and several artefacts from it can be seen in the museum in Hugh Town, St Mary's island.
Reward offered

On 8 July 1714, Act 12, Queen Anne chapter 15, was passed. Large financial rewards were offered for anyone devising a system for the accurate determination of longitude. The rewards were up to £20,000 (in today's currency almost £1,000,000), dependent upon the accuracy of the method. The full amount for error within 30 miles, £15,000 for 40 miles, and £10,000 for not exceeding 60 miles, to be tested on a voyage from England to the West Indies.

During the deliberations on the bill, Sir Isaac Newton enumerated various methods for determining longitude which had already been suggested: 'True in theory but difficult to execute .... one of which is by a watch .... but by reason of the motion of the ship .... variation of heat and cold, such a watch hath not yet been made'. The offers of such large sums of money by Parliament stimulated many ideas to win the prize. Several contenders even published their own books on why their ideas were correct.

John Harrison, horologist

At this time, 1714, John Harrison, the eldest son of a carpenter, was 21. He was born in the West Riding village of Foulby in March 1693, and baptised in the village church of Wragby before the family moved to Barrow-on-Humber in Lincolnshire. Even as a small boy he had been fascinated by machinery and without any formal education or apprenticeship was already making clocks. The movements and dials of his first three clocks still survive.

To keep clocks accurate it is necessary to produce a pulse of accurate and constant duration. Galileo is credited with the discovery that the pendulum could satisfy this requirement. However, the application of his work failed to produce the accuracy required for navigation. The principal problems were the effects of changes in temperature and of friction.

Harrison, who had now been joined by his younger brother, set about trying to solve the problems. He noted in all pendulum clocks the large swings in accuracy depending upon the ambient temperature. In 1730 he commented: '....but there is no Wire of any metal whatever, whereof to make a pendulum, but what it is continually altering its length according to ye degrees of heat or cold; & this I discovered two years ago'.

The solution

'... and to correct this altering of ye Leangth of ye Pendulum, I compose it of nine wires, viz 5 of steel and 4 of brass'. The metals were arranged so that their thermal expansions counterbalanced each other. Thus, in 1730, the first bimetallic strip was described. Astonishingly, the new pendulum was accurate to within one second in a hundred days.

Harrison and his brothers produced a series of clocks, H1, H2 and H3, which were transported in turn to London and their accuracy was demonstrated. In 1736, the first sea trial was made.
but as the clock was four feet square, even though proving accurate, Harrison elected to make a smaller clock with other improvements. This took a further 22 years! H4 was finally demonstrated in 1760. This new chronometer performed excellently when taken by Harrison's son, William, to the West Indies. By a quirk of fate the beer supply on HMS Deptford became contaminated, and so it was necessary to put into Madeira for provisions. Using the H4, William was able to predict that they were really 100 miles nearer to land than judged by the navigating officer - much joy all round! The navigation to Jamaica was equally successful.

The Board of Longitude was not so enthusiastic. They changed the rules for the reward, although they did award Harrison £2,500. The wrangling went on despite further successful trials. Harrison, by this time 79 years old, petitioned George III in January 1772. The King is alleged to have remarked '...these people have been cruelly wronged', and then exclaimed: 'By God, Harrison, I will see you righted'. It took another eighteen months before Act 13 George III chapter 77 duly received the Royal Assent and Harrison was awarded £8,750. Including other moneys previously received from the Board of Longitude, the final sum came to more than £20,000. At last, John Harrison had won the full Longitude Prize. Three years later, on 24 March 1776, he died on his 83rd birthday.

Thus, just over three hundred years ago, one Holy Grail was finalised. Today, even with the use of a bimetallic strip, now made of Invar (36% nickel and 64% iron) and brass (63% copper and 37% zinc) we are still looking for our Holy Grail.
FROM WREXHAM TO RHEIMS IN 1847

Dr Buddug Owen
Retired Consultant Anaesthetist, Rhyll, N Wales

Following the successful use of ether in London in December 1846, the Caernarvon & Denbigh Herald, published weekly in North Wales, reported many anaesthetic-related events during 1847.

February 13: This account of an amputation was described by Dr Gemmell at the Llangollen meeting. It mentions vomiting, the mouth of the apparatus being readjusted, and the patient being aware but pain-free.

February 27: Again an amputation '...on a boy of 7 or 8 years who had become entangled in the machinery of a manufactory ... The patient although insensible of pain appeared conscious of what was proceeding'.

March 20: At the Llangollen meeting, I described this report of Dr Pierce's anaesthetics quoting '...all those ... (under the influence of ether) ... were not in the least conscious of pain, but they had delightful dreams...'.

March 27: An account of a death from inhaling ether vapour, of a female named Parkinson, at Spittlegate Lincoln, who inhaled at her own request. She had suffered for some time from a tumour of the leg which 'was removed when she was in a state of insensibility. The operation was successfully performed but congestion of the membranes of the brain having supervened deceased never rallied. ... The Coroner fully exonerated the medical attendant from all blame.'

April 10: The correspondence column refers to a fatal accident reported on 27 March. A carter named Thomas Smith had been dreadfully injured by a cartload of bricks, and died the next day in the County Infirmary in Bangor. The victim was riding in the cart instead of leading the horses and got down without stopping them. One or more of three carts passed over him and he suffered a compound comminuted fracture of the right thigh implicating the joint, a bad compound fracture of the same leg and also a bad fracture of the left leg. A 'Friend of Humanity' drew attention to the inhumanity shown the victim. He had been placed inside a cart and driven six miles to the Infirmary over poor roads. No porter had been available to lift him out and aid had to be summoned from a neighbouring public house. Twenty-four hours later the ether experiment was practised - one leg amputated, a tourniquet placed on the other, but before that leg was amputated he mercifully died. The correspondent points out the suffering experienced during his transport to hospital, lack of porters on arrival and the fact that he had the smock frock which he was wearing when the accident occurred changed to another one to go to the theatre. Death was presumably due to blood loss, shock and inadequate resuscitation.
April 17: Report of amputation of a leg by surgeon H A Roberts at the Penrhyn Hospital. 'The patient, a quarryman, inhaled the vapour of ether for the space of four minutes when it was apparent that he was fully under its influence. The operation was quickly performed and he had no recollection of what had occurred, neither did he feel any pain. He is going on favourably.' This is the paper's first report of anaesthesia without complication.

May 8: Another anaesthetic reported, with Mr Richards in Bala successfully amputating a thumb.

June 12: A carter in the employment of Mr Bects, railway contractor, stumbled and fell at Llanfair Anglesey and the cart, passing over him, inflicted lacerated wounds on the right leg and completely crushed the left leg. He was conveyed to the Infirmary where amputation of the left limb was performed. With his own consent the ether vapour was administered previous to the operation through an apparatus made by Messrs Wood of Manchester, the best of the kind for this purpose. During the operation he shouted and talked like a drunken man, and on recovery said he had heard the sawing of the bone but felt no pain.

August 7: Report taken from the Liverpool Chronicle of a major operation where anaesthesia was not mentioned. This was for the extirpation of the upper jaw bone containing a large tumour in its cavity, with part of the cheek bone, performed with perfect success by Mr Faison, Surgeon, assisted by Mr Lewis. The patient was a young woman who bore it with marvellous fortitude. We believe this is the first time this operation (one of the greatest in surgery) has been performed in Liverpool...

August 7: From The Welshman an account of 'Restoring Suspended Animation after Drowning in Carmarthenshire.' 'An extraordinary case of resuscitation after drowning occurred recently. A youth having fallen into the City Road basin, was not got out until 1/4 hour had elapsed. He was conveyed at once to the Wenlock Arms where 2 surgeons promptly attended. A man in the tap room stated he would restore the boy and he was allowed to make the experiment. He closed the mouth of the boy with his hand and by applying his mouth to the nostrils (by strong suction) actually succeeded in restoring the lad in a few minutes to the astonishment of all present. This man had previously restored another individual in the same manner. This singular and extraordinary case has excited considerable attention and speculation and led to the conjecture that an instrument might be constructed that would answer in similar circumstances of suspended animation and might be applied in a variety of other instances. Since this case occurred a new Patent Hydraulic Machine has been invented by a gentleman named Read for the restoration of persons in cases of suspended animation.'

August 14: A letter from John Williams of Corwen headed: 'On Sudden Deaths' points out the importance of laying the patient flat if he has had a fit.
September 4: 'Last week, Mr Jones of Grosvenor St, London, performed an extraordinary operation in dental surgery by the aid of ether. He extracted 7 teeth while the patient was under the influence. The instrument of inhalation (which was only used once) was Dr Snow's invention and the quantity of ether taken into the system was nearly 1 and 1/2 ounces. Although the lady is only 20 years old and in delicate health, upon her recovery she expressed herself perfectly unconscious of having suffered pain.'

November 7: Report of a new anaesthetic agent to supersede ether, with a long column on the first use of chloroform by Simpson.

December 11: A letter from Rheims states that a carpenter, whose foot was lacerated by a nail which brought tetanus, was subjected to the repeated influence of ether, by which means the mortal symptoms gradually became less distressing and the patient was ultimately saved. A cure of this terrible affliction is, we believe, extremely rare in medical practice.'

Survey of the year's reports

Of the 14 incidents quoted, anaesthesia may not have been used for the major oral surgery in Liverpool. 2 reports were concerned with resuscitation and positioning, the Rheims case could be regarded as an example of intensive care using an anaesthetic agent to control tetanus, and chloroform is heralded as a new anaesthetic. The remaining 9 reports are of ether anaesthesia: 8 in the first 6 months and only 1 in the second half of the year as the technique became more common and less newsworthy. There were 2 deaths, and of the 7 survivors only 3 were completely anaesthetised, but all were pain-free. Vomiting is mentioned only in the first case.

Apparatus

The February report from Wrexham intimates the apparatus had a mouthpiece. At an extraordinary meeting of the Pharmaceutical Society of London on 13 January, 7 ether inhalers were displayed, and on 23 January John Snow announced his first inhaler, so the one used in Wrexham is a matter of speculation.

The apparatus described in June was made by Messrs J & W Wood, cutlers and surgical instrument makers of 74 King Street, Manchester. The Manchester museums and reference libraries had no reference to anaesthetic equipment made by them, but Professor Tom Healy was enlightening. The Manchester Guardian of 3 February gives an account of the first anaesthetic by a doctor in Manchester. The apparatus used was that invented by Dr Boott and Mr Robinson. It was furnished by Mr Wood, the surgical instrument maker of King Street, who kindly attended with the instrument and with the aid and superintendence of Mr Bowring, the house surgeon of the Infirmary, regulated the inhalation of ether. Robinson and Boott had used the lowest glass conical chamber of a Nooth's apparatus, and one of Read's flexible inhaling tubes. The only illustration shows this to have a mouthpiece. John
Snow put no restriction on the making of his apparatus, so it is possible that the inhaler used in June was a copy by Messrs Wood of Snow's but, of course, there is no proof. The September report is quite definite, indicating a Snow inhaler and the amount of ether used. An original Mark 2 Snow inhaler is to be seen in the Wood Library-Museum and has been described by Dr R Calverley. As with 5 of the 7 inhalers shown in London in January 1847, Snow's valves were made by John Read.

**John Read, instrument maker**

The Patent Hydraulic Machine invented by a man named Read was not easy to trace. Search for an early type of ventilator drew a blank. At the Patent Office I found two patents on Raising and Forcing Fluids. The Royal Pharmaceutical Society was more helpful. John Read (1761-1847) was a chemist and is listed in the Post Office Directory of 1834 as Read, John, Patentee of the Stomach Pump etc, 35 Regent Circus, Piccadilly. The Directory of Surgical Instruments in 1826 lists him as a Veterinary Instrument Maker (Inventor of the Stomach Pump) and in 1829 as a Surgical Instrument Maker.

I am grateful to David Zuck for further references on Read. In 1820 he was awarded a patent for 'An improvement in Syringes'. Spherical valves within the chamber provided unidirectional flow which permitted the syringe to be used as a pump.

In October 1841 Snow read a paper before the Westminster Medical Society 'On asphyxia and the resuscitation of stillborn children'. Snow related that in 1838 Read had prepared a syringe to ventilate adults. He had improved his apparatus, and Snow suggested he make a similar one of small size for the newborn. It consisted of two syringes, one of which, by a tube adapted to the mouth and closing it, withdraws air from the lungs, and the other returns the same quantity of fresh air through a tube fitted to the nostrils. Read's valves were essential to the action. It was possibly the adult version of this apparatus which was referred to following the Carmarthenshire near-drowning.

The newspaper journey from Wrexham to Rheims certainly provided interesting links between some famous and some less well-known pioneers who deserve further study. I hope to be able to present more on John Read.

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My career in anaesthesia began in 1947 at the age of ten, helping my father manufacture the original Cyprane Trilene Vaporiser. He read chemistry at Magdalen College, Oxford in the early 1920s and stayed on to do research for two years. On leaving Oxford he obtained a post with Coxeter & Son Ltd who were looking for a chemist to improve the purity of their nitrous oxide and, in particular, to tackle the irritating problem of residual water vapour freezing in the reducing valve. Attempts to overcome this difficulty, such as a hot water jacket, were not very effective and a bunsen burner flame was positively hazardous in this era of flammable anaesthetics.

The problem of removing water vapour was solved by passing the nitrous oxide through columns of silica gel and my father went on to further improve the purity and monitoring of nitrous oxide production. He also became involved with the design of anaesthetic apparatus for Coxeters and was obviously well thought of as he was made a director. Shortly before the second world war Coxeters were taken over by BOC and soon after the war my father fulfilled his long standing ambition of setting up his own business.

In 1947 he left BOC, moved from London back to his native Yorkshire and set up Cyprane (the name derived from cyclopropane) in the garage of an old house in the Pennine village of Oxenhope. His BOC colleague, Wilf Jones, joined him and Lord George Wellesley, a director of the old Coxeters showed his faith in the venture by investing in the shares and becoming a non-executive director. Although loath to travel north of Watford his business advice and contacts were invaluable. It proved to be a good investment for him.

The first product was the Cyprane inhaler, a simple hand-held Trilene inhaler designed mainly for obstetrical analgesia but also used in other fields such as dentistry. The patient held the apparatus and if too much was inhaled it fell away from the face—a 1947 P.C.A.S. The Cyprane inhaler was very successful with worldwide sales. Production increased and two more refugees from BOC, Bill Hanson and Eddie Moore, joined. In 1950 the firm moved to larger premises in nearby Haworth.

About this time the Central Midwives Board produced a demanding specification for more accurate Trilene vapourisers. This required temperature compensation from 55-95°F and percentages of 0.5 or 0.35% Trilene ± 20%. After a good deal of research and development, Cyprane produced the Tecota (Temperature Compensated Trilene Apparatus) using a brass/invar bimetal strip thermocompensatory mechanism. This was also a success, the only rival to pass the specification being the Emotril. The research involved in producing the Tecota laid the foundation of Cyprane's next big step forward.
In 1956 halothane appeared. Its virtues were immediately apparent but its potency demanded an accurate and reliable vaporiser. Use in Boyle's bottles had resulted in disasters and when Cyprane were approached by Johnstone & Brennan from Manchester they quickly produced the Fluotec which swept the world. There was a third move to a yet larger factory a few miles down the road in Keighley.

Having done a year's anaesthesia I joined Cyprane in 1963. My job title caused some discussion. My father suggested 'Apprentice Boss' but I thought this looked rather flippant on my cv if I returned to medicine and smacked of nepotism if I stayed with Cyprane. I was therefore designated Medical Research Manager and spent an enjoyable and useful year working on the transition from the Mark 2 to the Mark 3 Fluotec. The Mark 2 had two faults. The first was accumulation of thymol preservative around the control spindle making it stick. This was cured by a fundamental redesign using a fluon plate mechanism instead of the spindle. The second fault was the non-linearity of output at low flows which was cured by raising the resistance across the vaporiser and redesigning the by-pass and vaporising chamber orifices so that the change from laminar to turbulent flow occurred at the same time.

By 1964 the firm employed some 60 people and I decided to return to medicine rather than become a businessman. My father who wanted to retire therefore sold the business to his American agent, Fraser Sweatman, whence a few years later it returned full circle to BOC. Mark 4 and Mark 5 'Tecs appeared for various agents without fundamental design alterations. The latest 'Tec for desflurane is a totally new design approach to cope with the low BP of desflurane, but has retained the clean looks and user friendly aspect of previous Cyprane products, which I think account for their success.

Cyprane made other excellent apparatus: the AE patient-demand O₂/NO₂ machine was rivalled only by the BOC Walton 5. It coincided, however, with the decline of the dental 'gas' and was never actively marketed, as all energies were occupied with the 'Tec vaporisers. An excellent machine, similar to the Tri-service apparatus for field use, the 'Haloxair' was manufactured but never achieved great sales for similar reasons. Low resistance draw-over 'Tecs designed for the AE dental machine and the Haloxair are still available.

I am pleased to say that although the firm now has a large and prestigious new factory, it is still located in the same area and continues to flourish, although sadly the name 'Cyprane' is fading in favour of 'Ohmeda'.

The father of British dentistry

Sir John Tomes was born in 1815 near Stratford on Avon. As a medical student at the Middlesex Hospital he delivered a lecture to the Royal Society on the microscopical structure of teeth. He became a surgeon-dentist and anaesthetist at the Middlesex Hospital. His design of a new dental extraction forceps in 1841 was revolutionary, having displaced the traumatic pelican and key in almost every country. He gave lectures at the Royal Society on dental physiology and surgery which formed the basis of his book *A System of Dental Surgery*, published in 1858. The book was translated into French and German and had four editions, the last in 1897. He became a Fellow of the Royal Society, a Fellow of the College of Surgeons and, in 1883, an Honorary Fellow.

Tomes as anaesthetist

On 25 January 1847 Tomes gave the first anaesthetic for surgery at the Middlesex Hospital, using the Bell inhaler for a lithotomy. From his diary it is clear that he had already given ether several times before this for dental extractions in the out-patients department.

His book, *Dental Physiology and Surgery*, has 18 pages on dental anaesthesia, describing his experiences and the changes in circulation and respiration. He considered chloroform unnecessary and dangerous for extractions which only lasted a few seconds, but for difficult extractions it could be indicated. He advocated minimal dosage to produce analgesia, the patient always having an empty stomach, strict silence during anaesthesia, and adequate recovery time with the patient lying down. In the second edition of *A System of Dental Surgery*, he stated that a patient under the influence of ether, chloroform or nitrous oxide required the undivided attention of the administrator and that the operator should never administer these agents single-handed. Local analgesia, achieved by cold techniques or by electrical currents, he considered innovations which would be discarded as the novelty of using them had worn off.

Due to Tomes' efforts, in 1860 the College of Surgeons introduced the Licentiate of Dental Surgery examination, for which he was an examiner. He was a founder member of the Odontological Society and became President of the British Dental Association. By the time the Dental Register was instigated by Parliament in 1878, he had retired. His was the major influence in raising the status of dentistry in Britain for which he was knighted in 1886. He died at Caterham in 1895.

Dentistry in the Netherlands

In 1865 a law was passed in the Netherlands which allowed only the medically qualified to extract teeth and, if necessary, use general anaesthetics. Since the teaching of dentistry was minimal and the interest of doctors in both dentistry and anaesthesia was almost non-existent, an acute shortage threatened of practising dentists. The law was changed in 1876 to allow training for non-medically qualified dentists to be set up in Utrecht. For this training a good
basic school education was not considered necessary. The day-to-day practice of dentistry was still considered to require manual dexterity and little theoretical knowledge. There was no question of it being an academic study. It was argued that a higher standard of training would last too long and make dentistry too expensive. This new law allowed the local treatment of teeth and the making and fitting of dentures, but did not allow the use of any drug or medicament which could have a general effect on the patient. There was no question of these non-medical dentists being allowed to administer an anaesthetic. The standard of dental training, given by medical teachers at the Utrecht school, was low and out of date.

Dentz, the father of Dutch dentistry, became a lecturer at the Utrecht School of Dentistry in 1877. He was medically qualified but was also a good practical dentist, having learnt from his non-medical dentist father. Dentz believed that a full medical training was necessary in order to practice dentistry. His lectures were directed to medical students, but he did allow non-medical students to attend, provided they had a good basic 5 years general education. On completion of training in dentistry they would then have to pass a state, but not an academic, examination. Some of these students proved capable of passing the state examinations at a high level. They set about improving the scientific, cultural and social status of dentists. Several went to Anglo-Saxon lands to follow the more liberal training there, and to take the state examination on their return. Their enthusiasm and successes changed the attitude of Dentz. He no longer considered that it was necessary to have a medical qualification in order to become a dentist of stature, and decided to help them further. The Dental Clinic used for practical instruction was dilapidated, with cramped facilities and poor equipment. In 1895 a larger, more modern clinic was acquired. To equip the clinic, the dental students collected money. They set up a reading room and library.

A new Society

In 1897 a student study group was formed to improve the scientific standard of their training. Who inspired them? The Englishman, Sir John Tomes. On the advice of their senior lecturer, Dentz, they chose the name The John Tomes Dental Students Society. The object was to hold extra-curricular meetings with invited speakers. Each student was expected to present a paper, which amounted to one meeting a week. Membership was open to students of dentistry who had passed a theoretical first year examination at a university. A further object of the Society was to stimulate and organise cultural and social activities.

Debating, music, theatre, automobile and riding clubs were formed and, in the course of time, many more clubs resulted. Contacts were made with other student societies in the universities. Sports events were arranged. A year book was published and ceremoniously personally presented by council members to University authorities and staff, to Dental Associations, to Burgomasters and to representatives of the Queen of the Netherlands in each of the provinces. The John Tomes Council had a meeting room in Utrecht: there was a council table, an embossed tablecloth and chairs embossed in gold thread with the John Tomes emblem. A Society flag was presented in 1925. The walls of the room are lined with photographs of sporting and social events, with diplomas and with many old and new books on dentistry. The Tomes students were liberally minded. They favoured the acceptance of women students and teachers into dentistry. They were actively involved in petitioning for improvement in the prevention of dental caries, particularly in school children.
During the Second World War the Society went underground, but returned stronger than ever afterwards. The John Tomes Society played an active role in obtaining recognition and academic status for dentists. In 1947 the limitations of the 1876 law were finally removed, giving dentistry full academic status. Five university dental schools were subsequently opened, including the upgrading of the original dental school in Utrecht. The Society campaigned against dentists advertising themselves and against unqualified dentists. They particularly exposed the unqualified dentists who, in the 50s to 70s, lured patients to so-called Evipan-Institutions, to have total extractions under Evipan.

Unfortunately, the Utrecht dental school and two others were closed in 1989, due to an excess number of dentists, and for financial reasons. There will be no more students to join the John Tomes Society. However, it will continue for some years to come as the John Tomes Reunionists.

Anaesthesia and Dutch dentistry

Why did Dutch dentists, even John Tomes dentists, never refer to Tomes in his capacity as an anaesthetist? There are several reasons. Dutch dentists were forbidden by law to administer dental anaesthesia themselves, so they never received tuition in anaesthesia and never saw it being used. Anaesthesia was considered a necessary evil and was avoided whenever possible. Dentists therefore paid more attention to the prevention of caries and to developing behaviour management methods for patients who were anxious and difficult to treat. Anaesthesiology only became a recognised specialty in the Netherlands in 1948. There had never been reason for dentists to approach anaesthetists, because they saw no indication for general anaesthesia in dentistry.

In 1979 I was approached by a John Tomes dentist who was unable to offer good quality dentistry to his anxious and handicapped patients. We started working together and a postgraduate course was set up. Now dentists collaborate gladly with anaesthesiologists, although they wisely avoid general anaesthesia if possible. They strongly believe in behaviour management methods, together with local analgesia. Where this proves inadequate they are now trained to use inhalation conscious sedation. For intravenous sedation and when general anaesthesia is indicated, they seek the help of an anaesthesiologist.

Conclusion

In 1986, a few John Tomes Society members went to England to visit his grave in Caterham Cemetery. They found the headstone in a deplorable state. If British dentists had forgotten their professional father, the Dutch had not. After two years of fund raising, the original stone was replaced by a replica on Sunday, 12 June 1988. It was unveiled by the assistant curator of East Surrey Museum. The Mayor attended, the Vicar gave his blessing and Mr Luke Alderlieston, President of the John Tomes Dental Students Society spoke of the events that had led to this touching ceremony.

Bibliography
THE MYSTERIOUS DEATH OF MR JOSEPH TOYNBEE

Dr S R T Headley
Retired Consultant Anaesthetist

The story begins 140 years ago when Mr Joseph Toynbee, the first recognised specialist in ear, nose and throat surgery, took up residence in Wimbledon at an imposing house facing the common, called Beech Holme. There it remains to this day in an area still greatly favoured by London consultants, and where I have lived for 45 years.

My interest in this remarkable man was initially stimulated by a talk given by Mr Leslie Salmon, distinguished ENT Consultant of Guy's Hospital, to the Wimbledon Literary and Scientific Society in November 1991 when I discovered that, in addition to being an important medical man residing near my home, Toynbee had been a student at St George's Hospital, my own school, and had died in 1866 possibly as the result of an experiment with anaesthetic drugs. He was buried in St Mary's churchyard (my own church) and is commemorated by a little drinking fountain at the top of Wimbledon Hill, as the founder of our local village club.

Joseph Toynbee was born in 1815 at Heckington, Lincolnshire, second son of George Toynbee, and one of fifteen children. He was educated at King's Lynn Grammar School, and was apprenticed at the age of 17 to Wm Wade of the Westminster General Dispensary in Soho. He also studied anatomy at the little Windmill Street School of Medicine (becoming an expert dissector) and in 1834 entered as a student in St George's and University College Hospitals, London. Becoming a MRCS in 1838, he was soon appointed curator to the museum of the Royal College of Surgeons where his expertise in microscopy and dissection resulted in his being elected a Fellow of the Royal Society, at the age of 27. With this background he soon obtained an appointment as an assistant surgeon to a small hospital in Golden Square, Soho - the St George's and St James' Dispensary - and was included in the first list of Fellows of the College of Surgeons on the issue of its new charter.

He became particularly interested in the diseases of the ear, partly owing to his realisation of the total inadequacy of the aural surgeons of this time and to a belief that deficiency in ventilation, nourishment and sanitation in the poor was a contributory factor. A crusade to improve these conditions became one of his abiding passions. Setting up in private practice in Argyll Street, St James and, later, Saville Row, he finally established a very large practice. Simultaneously, over a period of 20 years, he dissected upwards of 2,000 human ears, many obtained from mental hospitals - a priceless collection which was destroyed in the Royal College of Surgeons by bombing during World War II.

A successful specialist

Toynbee was appointed to the newly built St Mary's Hospital, Paddington in 1851, as its first ear, nose and throat specialist. He only had two beds - typical of the attitude then prevailing to the speciality. Perhaps he could now be said to have arrived at the height of his career -
consultant to a teaching hospital, professional recognition, a good private practice - with many celebrities amongst his patients, including Queen Victoria successfully treated for tinnitus, and a happy family life in Wimbledon with nine children. His second son, Arnold, was the social philosopher and economist, and founder of Toynbee Hall. He associated with the famous authors and artists of his day and he was able to find time to be a founder of the Wimbledon Village Club and become treasurer of the Medical Benevolent Society contributing a handsome £500. Finally, in 1860, he published his great work *The Diseases of the Ear, their Nature, Diagnosis and Treatment.*

That is the background of this highly successful professional man with a happy family life. However, like so many of his successors in our profession, he began to have trouble with his hospital governors over a number of different points. In addition, amongst his colleagues and students he seems to have been regarded as rather odd for his ideas about public health and benevolent work, with disagreements and lampooning not infrequent occurrences. In 1864 he resigned from St Mary's Hospital and for the next two years it would appear from his daughter Gertrude's writing that he had intervals of depression. This was evidenced by letters to friends and relatives, although on the day of his death he wrote a cheerful letter to his son Willie. It is important, before discussing his death, to know a little of his enquiring mind. Among many of his ideas was the concept of creating an artificial tympanum in the cure of deafness. Tinnitus, he believed, might be relieved or cured by injection into the ear via the Eustachian tubes of chloroform and hydrocyanic acid.

**Unexpected demise**

Mr Toynbee was having a consultation session in his rooms on the afternoon of Saturday, 8 July 1866 - presumably consultants worked longer hours in those days! After a late lunch he was awakened from his afternoon sleep on the surgery couch by his servant, a Mr Samuel Butler, at ten to four to inform him a patient wished to see him. Previously at 1.30pm his butler had been told not to disturb him for an hour or so while he had his customary sleep. He was surrounded by papers, a watch was on the table. He quickly got up, sat on a chair and the patient was shown in. After a quick consultation, the patient left announcing he would return on Monday. The butler was again told not to disturb his master unnecessarily and it was not until 5pm, when another patient called that he re-entered the room and found him again lying on the couch, this time with a piece of cotton wool over his mouth and nose. Thinking him still asleep he removed the cotton wool, realised all was not well and immediately summoned medical aid. This seems to have been available fairly rapidly in the form of a Dr Markham who realised on arrival that Mr Toynbee was quite dead. He did try artificial respiration but to no avail.

At the inquest Dr Markham stated there was a strong smell of chloroform in the room and on the cotton wool. At hand there were two papers, one concerning the effect of chloroform on tinnitus by inhaling it through a rag or sponge and by strong expiratory effort forcing the vapour into the middle ear; a Valsalva's manoeuvre presumably. The other paper concerned the effect of combining the chloroform with hydrocyanic acid. On the chair was an unopened
6oz bottle of ether and a half empty 1oz bottle of hydrocyanic acid. Under the sofa, near at hand, was a machine made of indiarubber - presumably a Clover's apparatus - and an empty 6oz bottle of chloroform with no stopper. There was no smell of hydrocyanic acid. Death appeared to be due to chloroform poisoning and was confirmed at post mortem though the involvement of hydrocyanic acid could not be ruled out.

The questions which arise from this unfortunate end, at the age of 50, to a brilliant career, are several: was it a suicide or was it an accident? If it was suicide, given he had sufficient professional and personal problems, why should he choose to commit it in the course of a regular consulting session and when he was still in busy practice and, for the most part, happy in his private affairs? If it was an accident, why should he use on his own person such a lethal combination and quantity of drugs with no assistance at hand? He must have been familiar with the dangers of chloroform as he possessed a Clover's apparatus. He was obviously interested in the effects of hydrocyanic acid as two days before his death he had written expressing his opinion that by using Clover's apparatus its vapour could safely be applied to the tympanum by inhaling to the back of the throat, holding the mouth and nostrils, thus forcing it into the ears - removing the 'singing' (ie tinnitus) and 'other nervous sensibility'. Being familiar with Eustachian catheters why not attempt to use one of these with more direct effect?

Is it possible to die from self-administered chloroform? As soon as one loses consciousness one ceases to administer it. Perhaps it was a case of primary cardiac arrest, as we used to call it. More likely it was the prussic acid, ery well known as a quick-acting killing agent, and first used by myself at the age of 11 while collecting butterflies on the South Downs.

The verdict of the Coroner's jury was: "That the deceased met with his death accidentally, while prosecuting his experiments by inhaling a combination of chloroform and prussic acid and the jury desire to express their deep sympathy with the family of the unfortunate deceased gentleman".
IN SOMNO SEMI-SEcuritas
A Chapter of Anaesthetic Accidents

Mr Peter Sykes
Retired General Dental Practitioner, Ampthill
President, Society for the Advancement of Anaesthesia in Dentistry

Considering the cheerful ignorance with which anaesthesia was first used, and the primitive nature of the equipment available, the early years were remarkably accident-free. There is, of course, no way of gauging morbidity, but the worst possible outcome of any anaesthetic is the death of the patient, and it is a result which can be recorded without equivocation. I could find no record of any anaesthetist deliberately murdering a patient on the operating table, so that any who have done so presumably got away with it. Deaths under anaesthesia can be assumed usually to have resulted from accident, and if we examine the deaths directly associated with anaesthesia, we can gauge to some extent the accidents which have occurred, and the reasons for them.

The first recorded death in England occurred under chloroform in 1848 - two years after the first successful general anaesthetic had been demonstrated professionally. The victim was a young girl of 15, Hannah Greener, who was to have an ingrowing toe-nail removed. In the parish register, alongside the entry in the left margin, the Registrar has noted: 'Died from the effects of chloroform'.

John Snow investigated deaths under chloroform during the first ten years of its use, before the numbers began to increase dramatically. In 1848 he wrote:

'After seeing how rapidly the vapour of chloroform kills animals when it pervades to a certain extent the air they breathe, and when we recollect that it came all at once to be generally administered without any previous teaching on the subject in the schools, it ought not to surprise us .... that a few cases have occurred in different parts of the world in which the exhibition of chloroform has been attended with fatal results.

'I am of the opinion that ether is incapable of causing this kind of accident, for the blood may imbibe with safety so considerable a volume of its vapour that the quantity which the lungs can contain at once adds but little to that effect. And I consider that a patient could only lose his life by ether from its careless continuance for several inspirations after well-marked symptoms of danger had set in.'

Snow found in the first 10 years, 25 deaths from chloroform in England and Wales, 6 from Scotland and 19 from the rest of the world. These figures cannot be accurate. It is hardly likely that the whole of the rest of the world should produce a lesser number of deaths than England and Wales alone. What they demonstrate is that Snow, although well read, would not have had access to, or even perhaps, been able to read in the original, much of the foreign
medical press, and deaths from overseas were much less likely to be reported in the English journals. Nevertheless, there had by this time been a number of deaths under chloroform around the world. By 1882, Henry Lyman, of the USA, had collected case reports of 410 deaths associated with chloroform, 27 associated with ether and 8 with nitrous oxide. Of the last 8, one was due to the patient inhaling a bottle cork which had been used as a dental prop! Whether it was the dentist, the anaesthetist or the patient who had emptied the bottle is not recorded. These figures made $N_2O$ seem incomparably safe, but it must be remembered that its use was largely confined to dental operations which were invariably short, and performed upon basically healthy patients. Most general surgery was carried out under ether or chloroform, not infrequently upon moribund patients because surgery was often the last resort.

By 1876 it was beginning to be realised that there were certain common features to some of the accidents, and that factors other than the toxicity of the drugs themselves or the susceptibility of the patients might be of importance. In England, Dr Lauder Brunton had come to the conclusion that irritation of the fifth cranial nerve under light anaesthesia might stop the heart through the vagus. He drew this conclusion to explain dental fatalities, but it was known that many other minor operations were liable to stop the heart under chloroform - removal of the toe-nail having a particularly bad reputation. Lauder Brunton's contemporaries pointed out that by no stretch of the imagination could either the trigeminal or the vagus be connected anatomically with the toe-nail. With our present knowledge of widely different surgical stimuli causing cardiac arrhythmias it is surprisingly uncommon for anaesthetists routinely to use local blocks in association with general anaesthesia.

More recently, it was reported that sinus arrest had been induced by a trivial nasal stimulation. A nineteen old girl was anaesthetised with alfentanil, followed by thiopentone and suxamethonium and with nitrous oxide/oxygen in a circle system for maintenance. A temperature probe inserted into the left nostril caused a sudden and profound decrease in heart rate. The probe was withdrawn and the heart rate immediately recovered. Reinsertion of the probe led to sinus arrest of almost three seconds duration, which resolved when the probe was withdrawn. Since the maxillary branch of the trigeminal innervates the nasal mucosa, the case provides a modern justification for Lauder Brunton's theory propounded 114 years earlier.

Chloroform was more dangerous, for staff as well as patients, when used after dark. The operating rooms of those days were lighted by gas, and above the operating table would be a multiple gas burner. In 1899 it was reported that, after giving chloroform to a midwifery case in a small room with three gas jets burning, a violent coughing and gasping for breath was induced in the attendants that the forceps could not be applied, and the operation had to be concluded under ether. Following a 4-hour operation in Westphalia, Germany, the previous year, a nurse collapsed, and two days later died. Five years before, a letter to the *Lancet* had explained that when chloroform came into contact with a naked flame, highly toxic phosgene gas was produced.
In 1906, twelve years after that letter, John Bouchier-Hayes gave the remedy — it was to dip cloths in ammonia and hang them up near the lights. Ammonium chloride was formed, and phosgene gas eliminated. Phosgene was one of the poisonous gases used extensively in the First World War, and before gas masks were developed the remedy was the same as Bouchier-Hayes' — to soak a cloth in one's own readily available source of ammonia and breathe through it! Not the most immediately attractive of methods, but no doubt the more frightened you were, the more readily available was the source of ammonia.

Not all accidents were due to ignorance; stupidity has always played a part in human affairs, and anaesthesia is no exception. Ferdinand Sauerbruch, the German surgeon, says in his autobiography:

'The operation was proceeding normally when, through a cause we were never able to ascertain, the glowing cautery set light to the ether vapour used as the anaesthetic. The violent explosion that followed was repeated almost immediately as an oxygen cylinder blew up. The patient was killed on the spot, the sister and the assistant were injured, and I lost an eardrum.'

This is exactly like saying, 'I dropped a lighted match into the fuel tank when, through a cause we were never able to ascertain, the vehicle caught fire.'

In the early days, all anaesthetic agents were freshly prepared before use. Iron cylinders containing compressed gases were introduced in about 1870, and with them the possibility of confusion. All cylinders initially were painted black, with the chemical formula for the gas, or its name, stencilled on in white, much as it is today. In the early simple apparatus this was of no concern because the only gas used was nitrous oxide, diluted as necessary with air. When the oxygen, too, was presented for use in anaesthesia, some method of distinguishing it from the N₂O had to be devised and the accepted way of doing this in the UK was to paint a white band around the top of the oxygen cylinder. It was not until many deaths had occurred from connecting the cylinders up wrongly, or from giving the wrong gas, that an attempt was made to prevent this by painting the cylinders in different colours; however, deaths due to the wrong gas continued. Lundy's 1942 textbook described a mechanical method of making wrong connections theoretically impossible by altering the standard cylinders and yokes. Unfortunately, it did not, in fact, make wrong connection impossible. You have to be very clever indeed to make things idiot-proof. Even the introduction by Heidbrink in 1954 of the pin-index system has not fully resolved the problem. Wrong gases continue to be administered. A meticulous checking of the gas cylinders does not guarantee that the gas in the cylinder will be the one which it should be. As recently as 1991 a report from Hong Kong described how a series of patients were given oxygen and nitrous oxide from properly coloured and pin-indexed cylinders, but became hypoxic. The anaesthetic machine, flowmeters and vaporisers were all expertly checked without finding anything amiss. Only when the contents of the cylinders were checked was it discovered that the oxygen cylinder in fact contained pure nitrogen. No explanation was ever forthcoming.
As soon as complicated pieces of equipment were invented to improve the delivery of anaesthetic drugs, the problems which still beset us today began to appear. The famous Clover bag slung over the shoulder caused at least one death. In Clover's technique, a measured dose of chloroform was put into the bag, which had a fixed capacity, and which was then filled with air by means of a bellows. The patient breathed only from the bag, no additional air being given. In theory, the chloroform vapour could not exceed 2.8%, which practice had shown to be safe, but in 1873 a patient in Broadmoor Asylum died. It was found by Clover that the bag had not been fully inflated and therefore the chloroform vapour had been too concentrated.

In 1857, the German anaesthetist, F E Junker, invented a chloroform vaporiser which consisted of a draw-over bottle into which air was pumped by a hand operated bulb, the outlet being connected to the patient by way of a face mask. If the tubes were connected in the wrong way, the patient received liquid chloroform when the bulb was pumped. Although many attempts were made to correct the fault, the wrong connection was not made impossible until 1892. Along the way, several delightfully imaginative pieces of apparatus were designed for the better delivery of chloroform, such as Hewitt's modified Junker's inhaler and Tyrell's inhaler, which went one better by incorporating one bottle for ether and another for chloroform, both conveniently accommodated in the anaesthetist's waistcoat pockets. Even these intimately supervised pieces of apparatus could go wrong. As late as 1931 there was a death from explosion when a similar tandem system was being used. The ether bottle had been turned off and oxygen was being passed through the chloroform. It was an oral operation and a pencil light was introduced into the mouth. There was an explosion in the mouth, the anaesthetic apparatus blew up, and the patient died. Later experimentation showed that the oxygen took up some ether vapour on its way to the chloroform. A 4-volt electric spark would not ignite ether and air, but would ignite ether and oxygen; the torch was driven by a 4-volt battery.

Although we have virtually ceased to use flammable anaesthetic agents, we are still aware of the dangers of explosion if such agents are used with anaesthetic machinery which is not adequately earthed and protected from static electricity sparks. Less wellknown, perhaps, is the danger present when an oxygen bottle is opened. In the 1960's, a colleague of mine burned down part of his dental surgery building when the oxygen cylinder valve was opened suddenly with the reducing valve closed. The sudden liberation of high pressure oxygen had compressed the air in the space between the two valves and the heat caused an explosion. It is, of course, the principle which is used in a diesel engine. I later discovered that a similar accident had been reported as far back as 1931.

In 1925 a 16 year old boy was having a broken jaw reduced and splinted under ether and oxygen anaesthesia. After about 25 minutes the teeth were being dried by the time honoured method of heating the nozzle of an air syringe and blowing the warmed air on to them. The spirit lamp for warming the syringe was about six feet away, there were no other naked lights near, and the nozzle of the syringe was not red-hot. On the third application, there was an explosion at the back of the boy's mouth: he died in ten minutes and autopsy revealed rupture.
of the bronchi and collapse of the lungs. The case was reported in the British Medical Journal, and in subsequent issues, several correspondents making suggestions about the cause, varying from catalytic action to bits of burning wick on the nozzle, but no definite conclusion was ever reached.

Giving the wrong strength of solution is a comparatively common mistake. I was taught to write prescriptions in drachms and ounces, and the symbols used for those quantities were so alike as to make confusion almost inevitable. The pharmacist needed a good knowledge of common dosage in order to be able to interpret some people's writing. Nowadays, we make things safer by using the metric system. Unfortunately, it is only too easy to multiply by ten by omitting or misplacing the decimal point and so we still read of deaths caused by overdosage.

It is also surprisingly easy to misread a label. Very frequently we see what we expect to see. In 1988 a British dentist killed a patient under most unfortunate circumstances. He commonly used intravenous diazepam, preceded by atropine in order to protect against bradycardia, which was then the standard technique. In his practice, drugs of this nature were kept in a special cabinet and only drawn by his nurse when needed. It was the practice routine for the unopened ampoule of the drug to be placed on a tray for the dentist to check before being drawn up into a syringe and labelled by the nurse. After it had been drawn up and labelled, he again checked that it was the correct drug before he injected it. On this occasion he performed all his normal checks, so far as he could recollect afterwards. He then injected the atropine, his patient went into ventricular fibrillation and died, despite prompt and efficient CPR. Devastated, the dentist retrieved the glass ampoule for pharmaceutical analysis and, as he looked at it again, he realised that it was labelled adrenaline, not atropine. The practice never used adrenaline and did not keep it in stock except as part of the emergency kit; both the nurse and the dentist had seen what they expected to see and read 'adrenaline' as 'atropine'.

In a paper from the USA, Tinker et al. in 1989 reviewed 1,175 anaesthetic-related claims on insurance companies for medical malpractice, and concluded that of 1,097 cases where sufficient information was available to make a judgement on its probable value, some 31.5% of cases would have been improved by the application of additional monitors which means, of course, that 68.5% would not. They considered that the monitors most useful in mishap prevention were the pulse oximeter and the capnograph. In 1986 an editorial in Anaesthesia stated that: ‘There is firm evidence that a considerable reduction in the incidence of avoidable mortality and severe morbidity could be achieved by the simple expedient of increased vigilance by individual anaesthetists’.

Anaesthesia is as near to death as most people will come until they die. Any procedure which interferes so drastically with human physiology must constitute a hazard, with an inescapable mortality. Even when death is not actually caused by the anaesthetic, it will still be reported by the press as if it were. The aim must be to reduce the danger of anaesthesia to the very minimum possible, and it is very evident that the single most important factor in doing this is good patient management. All too often, it is a failure here which is responsible for a fatal
outcome: inadequacy of the anaesthetist, not of the anaesthetic. It is a truism much quoted that there is no safe anaesthetic, only a safe anaesthetist. It is equally true to say that it is not possible to solve the problem of anaesthetic mortality by throwing more technology at it.

Once apparatus began to assume greater importance and became more complicated, accidents which previously had been confined to human error were compounded. If it is true that to err is human but to foul things up completely requires a computer, then it is equally true that the greater the complexity of the machine, the more opportunities there are for the operator to get it wrong.

Anaesthesia nowadays is certainly more safe than it used to be, even 30 years ago. The use of sophisticated machinery has enabled advances in techniques to be made which have revolutionised surgery and greatly improved human life expectancy, but there is still no substitute for the keen pair of eyes and the educated pair of hands. Throughout the ages, deaths have occurred in the advancement of medical knowledge. It is always dangerous to be part of a developing frontier, but if one death takes place because of an unavoidable error, then it is a death too many. If one were to sum up the lessons to be learned from the literature, then a modification of one well-known sentence would suffice - the price of safety is eternal vigilance.

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ANAESTHESIA AND THE SIEGE OF LADYSMITH

Dr B Hovell, Consultant Anaesthetist, Hull

The second Anglo-Boer War started in October 1899. It was fought between the citizen army of the Transvaal and the Orange Free State and the British. The Boer objective was to invade Cape Province and encourage an uprising amongst pro-Boer sympathisers living there. Taking the ports of Cape Town and Durban were further objectives, to prevent the British landing reinforcements. The initial attacks by the Boers caused the numerically smaller British forces to take defensive positions in Mafeking, Kimberley and Ladysmith. The Boers then halted their advance to besiege these towns. The delay proved fatal to their plans and gave time for the British to send a large army which, by May 1900, had relieved the besieged towns, flung the Boers back, and captured their capitals, Pretoria and Bloemfontein.

Ladysmith was named after Juanita, wife of Sir Harry Smith, governor of Cape Province. She was a famous beauty whom he had rescued from the French at the siege of Badajoz in 1812 and subsequently married when she was 14 years old. The town was situated alongside the Durban to Johannesburg railway line - a dry and dusty place subject to flooding. Intense heat, violent storms, flies, scorpions, ants, spiders and snakes were just some of the pleasures of life for its 8,000 inhabitants. In the early part of the war General Sir George White, afraid of being cut off by the Boers, retreated to Ladysmith with his 13,000 troops and the siege of Ladysmith began. It was to last 118 days. The British maintained a 14 mile perimeter on the plain around the town.

The Boers in the surrounding hills bombarded the little town with large siege guns of French and German manufacture; the British replied with some naval guns they had. During the siege the Boers fired over 16,000 shells but caused little damage and few deaths to the well dug-in and well spread out population. Far more people were killed by enteric fever.

Medical facilities at Ladysmith

Initially, the Town Hall was used as a hospital, but after it was hit by shellfire White negotiated with Joubert the Boer leader, for a neutral zone to site a hospital. So, 3.5 miles out of town under the noses of the Boers, 15 minutes by rail, a 300 bed tented hospital was created at Intombi. Over the next four months it expanded to 1,900 beds and received a total of 10,673 patients, many fever cases. In the tents it was a tight squeeze to fit in the operating table, the instruments and the personnel. Lighting was by acetylene or candle, water was at a premium and the heat and dust were oppressive. Flies were everywhere in spite of sticky fly papers. The doctors operated in riding breeches, shirts, sleeves rolled up, and tropical helmets. The junior surgeons gave the anaesthetics. In this war for the first time army doctors were augmented by civilians who included such eminent volunteers as Sir William McCormac, President of the Royal College of Surgeons of England, Sir William Stokes, Frederick Treves, Watson Cheyne and Makins, all doyens of the surgical scene. These few
were paid £5,000 for a year in South Africa. Sir William Stokes died there of jaundice and pleurisy, aged 61 years.

Most war wounds were from bullets rather than shells and the effects of the new high velocity bullets were of great interest to the surgeons. These wounds were less liable to become infected than those of earlier wars. Because of this, together with antisepsis and the favourable climate, the incidence of wound infection was very low. Treatment was therefore more conservative than expected and operations were less common. The exception was for head wounds where trephining was widely practised. Head injuries were often given morphine to keep them quiet.

Transport of the injured was by stretcher, cart and rail. The D'Hoolie stretchers were carried by Indian bearers, who were organised for the army by Gandhi during his early career as a lawyer in South Africa. These body snatchers as they were called, had to carry injured men long distances over very rough ground at times. On arrival at the dressing station of a field hospital, triage was carried out and hopeless cases were given large doses of morphine. X-rays, discovered in 1895, were soon made use of by the military, and a machine was in action at Ladysmith. When surgery was performed it was mainly for extraction of bullets, primary and secondary amputations and trephining, though cholecystotomy and resection of bowel with insertion of Murphy's button were performed at Intombi by Dr Campbell in whose unpublished diary they are described.

**Anaesthesia and resuscitation**

Only passing mention is made to anaesthesia in the Boer war literature. Why is this? Firstly, anaesthesia had slipped into an uninspiring routine which held little attraction for most doctors and was taught badly, if at all, in Britain. Secondly, a large percentage of doctors were trained in Scotland which meant that their anaesthetic training, such as it was, was based on an open chloroform technique. Many of these Scottish graduates found their way into the army, others to countries of the British Empire. It is not surprising that those doctors detailed to give anaesthetics did not record their results, and easily settled into the army routine of chloroform anaesthesia, tried and tested in battle since the Crimean war. Chloroform had many virtues for battlefield use. Where ether had been tried it was said to be too volatile in a hot country although the army did supply Clover's inhalers and ether as standard equipment. Nitrous oxide, favoured in more erudite circles, was unsuitable for logistical reasons. Anything not shipped by rail had to go by cart over very rough tracks on the veldt. This was both slow and costly in animals. Over 350,000 horses were to die in this war, let alone the mules and oxen, many from overwork. General Buller, in his march to relieve Ladysmith had no such logistical qualms. He travelled with iron bath, kitchen, feather bed and 600 bottles of wine.

I came across only one civilian anaesthetist who volunteered. Dr H J Scharlieb, assistant anaesthetist at University College Hospital went as a surgeon with the Langman Hospital under the direction of Arthur Conan Doyle. Goodman Levy, who in 1911 described
ventricular fibrillation due to chloroform, had recently left Africa. Had he stayed he would probably have served in the column from Rhodesia marching to the relief of Mafeking and Baden Powell.

Boer War anaesthetic practice

On arrival at a field hospital the patient was given a sort of pre-med in the form of Bovril and/or brandy. Morphine was given if required. His garments were removed or cut away and he was put in a night shirt whilst still clinging grimly to his boots and cholera belt. Some men were phlegmatic, a few even refused any anaesthetic. Treves, in his book, *The Tales of a Field Hospital*, describes two cases induced with chloroform where the patients relived their recent battle experiences as they sank deeper under the anaesthetic.

Monitoring and postoperative care were minimal. Blood pressure was not recorded. In Intombi there were only 32 nurses and 22 doctors for 1,900 beds helped by 152 orderlies and bearers. Complications were seldom described. The wooden wedge, Mason’s gag and tongue forceps were available and even a tracheotomy set. Cardiovascular collapse was treated with strychnine, often in large doses, and brandy. Sometimes musk, a medullary stimulant, was used. Serious shock from blood loss was treated by elevation of the legs, subcutaneous ether, strychnine and, occasionally, rectal saline. Campbell describes a case in Ladysmith where axillary intravenous saline was given. Postoperative pain was controlled with morphine and sometimes dilute chloroform inhaled from capsules. Postoperative nausea was no doubt largely ignored. One drug, called cerium oxalate, the Zofran of its day, was mentioned by Hewitt and might have been available to the civil surgeon. This drug is still currently available nearly 100 years later, in the Austrian and Spanish pharmacopoeias as Novonausin.

Some of these cases, dehydrated, toxic, undernourished and wounded, must have presented a serious challenge to novice anaesthetists using open chloroform. We will never know - they did not think it worth reporting. Dr Campbell did record some details of a doctor’s life in the siege and describes his feelings - the emotional lability, the hope of a quick clean death, the boredom and the preoccupation with food. On 19 November he records the arrival of British wounded handed over by the Boers. They had been ambushed near Chievely when their train was derailed. This was the occasion made famous by the capture of Winston Churchill. By December the whisky was all gone, by January it was dry bread and horsemeat.

Medical arrangements of the Boers

The Boers had no formal army medical service as they had no regular army. They had only the Red Cross and volunteer groups from abroad. Behind the front lines were the first-aid posts. They were manned by one doctor, or even a medical student, four untrained attendants and some bearers. Occasionally, the single handed doctor had to operate with or without anaesthesia. Who would give the chloroform in this situation, I wonder? One doctor on the Boer side at Ladysmith was a Dr A C Neethling, MB ChB (Edinburgh 1899) who left his post as house surgeon to Bradford Infirmary to serve there.
In 1990 Professor Ole Secher addressed this Society on the subject of Hildebrandt who assisted August Bier to perform the first spinal anaesthesia experiments in 1898. Hildebrandt in 1899 volunteered for the staff of the first German ambulance on the Boer side and helped Boer and British alike in the battle of Magersfontein. I wonder if he gave any spinal anaesthetics there? Certainly nothing is written about the use of local anaesthesia in this war, though cocaine eye drops were probably very useful.

The siege of Ladysmith ended on 28 February 1900, but the war dragged on till 1902. Anaesthesia was not advanced at all by this war, which probably represented the high water mark for chloroform.

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Footnote:
Dr Hovell presented two interested asides to this paper:

a) a slide of the first whole body X-ray, taken in 1896, exposure time 30 minutes. The radiologist was Dr W J Morton, son of the pioneer of ether anaesthesia;
b) a stethoscope used by Lord Lister, and a slide showing it being used by Dr Arthur Lister, an anaesthetic registrar from Scarborough and descedent of the great man.
Outstanding achievements in surgery and anaesthesia in the First World War evolved not from good planning, but from the presence of English and American men and women of outstanding talents who came together in an almost random and totally unplanned way. Very importantly, they were in the main volunteers occupying the most senior posts in civilian life. Such surgeons, anaesthetists, physiologists and nurses were to benefit surgery, anaesthesia and resuscitation in a way which is only now being fully realised.

**Influence of Sir Frederick Treves**

In terms of its general organisation, the Army Medical Service was perhaps most profoundly influenced by Sir Frederick Treves (1857-1923) the eminent surgeon from the London Hospital. Treves had witnessed at first hand the capabilities of the Army Medical Service in 1899 when, at the age of 46, he volunteered to lead a civilian surgical team to participate in the South African War. As consulting surgeon to the Field Force he took with him not only his own field surgical equipment but his own nurses as well.

The tenor of this criticism spread to the conduct of the RAMC. Treves, whilst being totally patriotic and supportive during the campaign was later able to redress his opinions and became scathingly critical of many aspects of the medical conduct of the war. It took two Royal Commission Enquiries to fully reveal these problems. In his evidence, Treves stated: ‘Any success of the work in Natal depended on the fact that the military medical organisation was entirely thrown aside. Regulations, petty bureaucracy, paperwork and general red tape, made it virtually impossible to act in medical emergencies without total disregard of official procedures. Senior medical officers spent more time working as junior administrators than doctors’. He than listed the many defects that he had observed, the chief among which were the totally inadequate transport facilities and delay in the evacuation of casualties to ambulance field hospitals; antique surgical equipment, field hospital outfits too elaborate - half of which could be thrown away; and the English military hospitals at home which did not come up to the standards of the workhouse infirmaries in terms of conditions, equipment and staff training. Most of these observations, together with many others, were acted upon and incorporated into updated Army medical regulations, and the revised RAMC Training Book, published in 1911, gives ample evidence of Treves' influence.
Anaesthetists had, in England at that time, no awareness of managing the particular problems of the war wounded, shocked and hypovolaemic patient. Physiological research was confined to animal laboratories and involved enormously cumbersome equipment. Few, if any, anaesthetists concerned themselves with the clinical physiological aspects of their subject. Hewitt, as early as 1893, in his book *Anaesthetics and their Administration*, had directed the attention of anaesthetists to the intravenous injection of saline solutions as a method of raising the blood pressure, but this suggestion failed to attract interest. Indeed, Charles Hadfield, a contemporary medical student at St Bartholomew's Hospital, wrote later: '...anaesthesia at the beginning of this century was in a static condition, was tacitly assumed to have reached its zenith, and no further improvements were expected or even sought'. Conditions remained much the same until shortly before the war.

Although aware of the chloroform controversy emanating from the Hyderabad deliberations, Treves' knowledge of and sympathy for anaesthesia was probably limited to those observations made by Dr Frederic Hewitt, his anaesthetic colleague at the London Hospital, together with those he had witnessed during the Boer War when morphine and chloroform would have been given concurrently. He supposedly (according to his bibliography) wrote a paper on chloroform anaesthesia, but no trace can be found of its whereabouts and his authority in this respect remains unproven. Indeed, in the RAMC Training Book, so much influenced by Treves, no reference is made to anaesthesia in the surgical management of patients, except to say: 'Before an operation of any magnitude, the patient should go to bed for a day or two', and elsewhere: 'A small table is available for the anaesthetist's use'. The extent of the anaesthetic equipment in the surgical field pannier was a chloroform drop bottle, gauze, and ampoules of chloroform to a total of 3 lbs (approximately 1.5 litres).

It is therefore difficult to evaluate Treves' estimation of anaesthesia as a specialty or of anaesthetists as colleagues. A somewhat enlightening story is told of the occasion in June 1902, in connection with King Edward VII's appendicitis, when Treves telegraphed Lord Knutsford, the then Chairman of the London Hospital, instructing him: '...to tell the anaesthetist (Dr Hewitt) and Nurse Haines that they would be wanted next morning at the Palace' for what turned out to be a drainage operation of an appendix abscess - an operation somewhat less stormy than the anaesthetic.

An opportunity arose in 1908 for anaesthetists to draw attention to the prevailing lack of interest in anaesthesia as a specialty in military surgery. With the establishment of general hospital units within the newly formed Territorial Army, Treves wrote an open letter to the *British Medical Journal*.

Robert James Probyn-Williams, Senior Consulting Anaesthetist and Instructor in Anaesthetics at the London Hospital and the then President of the London Society of Anaesthetists, entered into correspondence with Treves and the War Office. He received the following reply:
'Dear Dr Williams,

July 2, 1908

'There is no such post as Anaesthetist in the Army Medical Service, nor does an Anaesthetist figure among the staff of a General Hospital.

'This applies to the Regular Service. In the Territorial Force there will be four General Hospitals in London and there can be no doubt whatever but that Anaesthetists will be required for these Hospitals and that their services will be very highly appreciated. The Territorial Force is being mobilised on the lines of the Regular Army and therefore no such post as Anaesthetist appears.

'I think you would do well to join one of the General Hospitals as a Physician or Surgeon, it being understood that in the event of invasion you would act in your usual capacity as an Anaesthetist.

'Very slow progress is being made in the actual details of the organization although the medical service is perhaps ahead of any other branch in the matter of completeness.

Yours very truly,
Frederick Treves'

The consequence of these somewhat final pronouncements was that no anaesthetists were available at the beginning of World War I to supervise or advise on the conduct of anaesthesia to the wounded in the western front. The Territorial Army General Hospital units in and around London were staffed by eminent instructors such as Probyn-Williams and administrators in anaesthetics, such as H E G Boyle and Trewby, who were shortly to deal with wounded soldiers being shipped from the battlefield.

Although the particular anaesthetic and surgical needs of the wounded seemed poorly provided for, greater attention was paid to the physiological needs of gas-stricken casualties - a particularly threatening hazard on a mass scale. Consequently, teams of chemists and physiologists were sent to Europe, together with plentiful supplies of oxygen, a commodity which was to prove of value in the development of anaesthetic techniques.

The American Hospital in Paris

England declared war on Germany on 1 August 1914 and within one month the Germans had advanced and were within reach of the north east of Paris. The American community in Paris, feeling a sense of impending isolation, were anxious to establish an American Civilian Hospital in the city and requisitioned a high school for this purpose - the Lycée Pasteur at Neuilly sur Seine in the west of the city. An approach for manpower was made to George Crile, the eminent surgeon at Lakeside Hospital, Cleveland, Ohio, and he enthusiastically volunteered to head a surgical, anaesthetic and nursing team to staff and run one surgical unit at the Paris Hospital of 80 -100 beds complete with operating theatre. Lakeside Hospital would furnish
all instruments, anaesthetics, dressings, surgeons, nurses etc. for a period of three months. Thereafter, the plan would be for other American centres (for example, Johns Hopkins) to send their teams on a three monthly rotational basis. In addition, Crile would undertake to do research: 'Observing the effects of fear and exhaustion on the human body, opportunities for which were abundant, might never be available again and would be of the highest scientific and practical value'. These were the avenues of research in which Crile excelled. His experience in clinical and academic medicine had made him a pioneer and world authority in the field of surgery, anaesthesia, resuscitation and clinical management of shock. The physiological control of blood pressure had been the object of six years' research. He was early to recognise the value of adrenaline in the management of asystole and to clinically prove the value of blood transfusion in the management, amongst other things, of haemorrhage and shock - even before the classic work of Landsteiner on the grouping of blood.

One month after his 50th birthday, Crile set sail in December 1914 with a team consisting of two anaesthetists (Miss Agatha Hodgkins and Miss Mabel Littleton), two operating room nurses, himself, three surgeons, neurologist, clinical pathologist and three special researchers, together with equipment for the management of nitrous oxide anaesthesia. The machine favoured at this time was the Ohio Monovalve introduced in 1912. The team sailed via England where they encountered problems with the steel cylinders of nitrous oxide which were marked Very Inflammable. One of the staff with a German-sounding name was responsible for the custody of the cylinders. He was immediately placed under suspicion and had a hard time convincing the authorities. After a long explanation by Crile himself, the officer concerned said 'Well, I don't know you or anything about you, but you look good to me and I am going to let you and your gas pass'.

Awaiting Crile's arrival was a characteristic and friendly letter of welcome from Berkeley Lord Moynihan (then aged 50). At the height of his civilian surgical career he had volunteered for and was appointed Consulting Surgeon to the British Army. His renowned reputation, his commanding personality, and ability as a public orator, were all qualities which were likely to impress the Army Generals, and his views would be greatly respected.

Moynihan arrived in France in December 1914 with his assistant from Leeds, Captain Braithwaite. They were based in Rouen and with the aid of a Daimler car were able to inspect the work of the RAMC close to enemy lines. He had already made many professional contacts with Crile at conferences in America and in London prior to the war, and he was a great admirer of his work. In 1913, his revised textbook on abdominal operations referred in great detail to Crile's technique of Anoci Anaesthesia, which consisted of local and regional blockade with light general anaesthesia using nitrous oxide and oxygen. In the wartime circumstances in which they both found themselves, Moynihan sought immediately to meet Crile, who was anxious to demonstrate the value of his nitrous oxide-oxygen techniques for the war wounded.
Nitrous oxide anaesthesia

There is no clear evidence, however, that such techniques were immediately adopted by the British Army at that time. Indeed, Moynihan and Crile both returned home in 1915 and, whilst the teams of Americans following Crile to Paris would presumably have used similar anaesthetic techniques, Moynihan's influence and enthusiasm may not have been heeded by the War Office and its medical hierarchy. A similar fate befell the introduction of blood transfusion which Crile had promoted actively during his 1915 tour of duty.

In 1917, with the United States now officially engaged in hostilities, Crile again returned to France to find that, two years on, no plans whatever had been made for the use of transfusion in the English or French armies. There had, however, been a recent sudden awakening of interest in nitrous oxide anaesthesia, and demands for its use were outstripping the supply by its English manufacturers. This revival may have been triggered by the observations of Surgeon General Sir Anthony Bowlby, an eminent Bart's surgeon who, with others, had been very concerned by the large number of deaths occurring during the course of ether and chloroform anaesthesia.

In order to pursue this matter, he had commissioned a young Guy's Hospital physiologist turned temporary Army anaesthetist, Captain George Marshall, to investigate and, hopefully, remedy the situation. This he did in valuable work carried out in the casualty clearing stations some eight miles behind the front line near Ypres in 1916. As a result, he was able to pioneer the use of nitrous oxide anaesthesia as a means of reducing mortality in the British Army as well as to investigate the effects of the other agents and techniques then currently available.

These results were embodied in Marshall's classic paper devoted to anaesthesia for battle casualties which appeared in the British Medical Journal in 1917. The utilisation of oxygen, as part of the method, proved of little difficulty as it was in plentiful supply for the management of gas casualties. In order to administer nitrous oxide he set about designing and constructing a locally-made apparatus which was the forerunner of the more sophisticated equipment being developed and used by Boyle and Trewby, two assistant administrators in anaesthetics at St Bartholomew's Hospital, who were engaged as medical officers and anaesthetists to the Territorial Army Hospital at Camberwell in England. Boyle had, additionally, acquired a Gwathmey nitrous oxide-oxygen apparatus in 1916 and was freely able to extemporise - leading to the Boyle machines that were presented at the Royal Society of Medicine in 1918.

It is more than likely that Marshall was aware of the details of the Gwathmey apparatus in France. Indeed, James Taloe Gwathmey had, at the age of 54, volunteered his services in France in 1917 and brought with him the apparatus he had introduced in 1912.

Thus it was that, two-thirds of the way through the First Great War, with the combined skills of pioneer American anaesthetists, surgeons, English physiologists, and eminent and perceptive English surgeons, the specialty of anaesthesia rapidly advanced in a way which had
been totally unforeseen at the outbreak of war. 'The best talent', said Crile, 'had been concentrating on the battle line, for this was not a war of men but a war of ideas.'

References
A MODEL OCCUPATION

Mrs Pat Costen, Co-organiser of Guernsey meeting.

While nursing in ICU and Recovery, Mrs Costen took an Open University Degree in Art and History of Art.

Demilitarisation

On 19 June 1940 the demilitarisation of Guernsey was ordered. A meeting of all doctors recommended the total evacuation of the population but the States of Guernsey (the island government) voted to recommend the evacuation of all men of military age, and of as many of the civilian population as would or could leave. Priority was given to school children. It is difficult to imagine the utter confusion as parents made the heart-breaking choice of whether or not to send their children away, not knowing how long it would be before they would see them again. Some sent their children, some went with them, some kept them in Guernsey. A week later, 17,000 people had gone, leaving 25,000 behind.

Eleven doctors stayed and these included an M O H, a psychiatrist and Dr A N Symons who came out of retirement to organise the medical services. The majority of anaesthetics were given by Dr W B Fox and Dr Alistair W Rose. Dr Rose is the only one of the eleven still alive today. The pre-war techniques they used were induction with ethyl chloride or Evipan (hexobarbitone) followed by ether or chloroform, or spinal anaesthesia using cinchocaine.

The single most traumatic event of the period occurred on 28 June, when the Luftwaffe mistook a line of tomato lorries waiting at the dock, for ammunition trucks. In the ensuing air raid 29 people died. There were 46 admissions to hospital where two theatres operated from 11 pm until 4 am. Dr Rose recalls feeling ‘very unsteady’ after inhaling ether for several hours.

Occupation

On Sunday 30th the German occupying forces arrived and immediately all previous lines of communication with the outside world were cut. The Germans requisitioned the Victoria Hospital in St Peter Port, including all its equipment. The staff transferred to the Country Hospital in the parish of Castel (our present psychiatric hospital). Dr Fox lived in at the hospital for the duration of the occupation and covered most of the obstetric work.

In the meantime, the States formed a Controlling Committee to organise the management of civilian services. Dr Symons sat on this committee as Health Services Officer. The president was Major Ambrose Sherwill, the Guernsey Procurer and H M Attorney-General. At a full States meeting five weeks after the occupation began, attended by the German commandant, Major Sherwill made a long speech. The title of this paper is taken from a passage in that speech:
"May this occupation be a model to the world - on the one hand tolerance on the part of the military authority and courtesy and correctness on the part of the occupying forces and, on the other, dignity and courtesy and exemplary behaviour on the part of the civilian population: conformity - the strictest conformity - with orders and regulations issued by the German Commandant and the civil authorities."

This philosophy was to influence the lives of all and ensured that as good a medical service as possible was maintained in circumstances unique in British history. One example of both sides’ insistence on adhering strictly to international agreements governing war occurred early in the period. In February 1941 the Germans tried to employ Dr Rose as an anaesthetist and to pay him. The move was vigorously opposed by Dr Rose and Dr Symons on the grounds that Dr Rose could later be charged with assisting the enemy. Dr Symons suggested that if the Germans were to order Dr Rose to work for them, then he would have to comply. Under the rules of war, however, the Germans were unable to issue such an order. Finally, it was agreed that, in the event of a large raid, the Guernsey doctors would treat their own civilians first, then would treat any Germans in exactly the same way, in order of severity of wounds. They also agreed to treat any German in any emergency - but without pay.

**Unusual sources of medical supplies**

After the first few months, medical supplies began to dwindle so new sources had to be found, and here serendipity took a hand. The German command had ordered the removal from book shops and libraries all books critical of Hitler and his regime. An officer was despatched with an interpreter to carry out the order. At Boots the chemist, the interpreter happened to mention to Mr Butterworth, the pharmacist, that in civilian life he worked for a pharmaceutical supply company - A Krause & Co of Hamburg. The Guernsey authorities requested that a German soldier going home on leave be allowed to deliver an order and cash to this company. For the first two years of the occupation A Krause & Co were regular suppliers to the island, shipping by rail to Granville, France, through Messrs Sohenker & Co of Paris. Later, when this route to Germany was cut, other suppliers were found in France, whilst the Red Cross in Geneva managed to get drugs through. The Island maintained supplies of anaesthetic agents throughout and had enough stocks of chloroform and ether to send some to Jersey in November 1944.

Other medical supplies were a problem. Insulin provision appears to have been spasmodic, though never stopped entirely, and diabetic deaths did occur. It was probably impossible to stabilise those patients. On one occasion Dr Symons requested that some men be allowed to visit the abattoir to collect thyroid glands as stocks of thyroid were running low. In the event, stocks were replenished and the glands were not needed. In November 1942 Dr Symons further requested that three men be given permission to visit Petit Bot valley to collect sphagnum moss ".... to be used instead of cotton wool for such cases as colostomies. This must have been done, as no sphagnum moss survives in Guernsey today!"
The supply of one medicine in particular exercised them greatly. In a letter to the Feld Kommandantur, Dr Symons explained that: '...there are many to whom the lack of a certain amount of stimulant means a serious deprivation owing to sickness or debility.' Such patients were given a certificate entitling them to a bottle of spirits a week. Dr Symons' own wife was a sufferer. It appears that word of these certificates caused an outbreak of the complaint because Dr Symons had to write to all doctors to notify them that '...it has been decided that no new certificates shall be granted except in such cases as a doctor shall certify that without such stimulant the patient will be in danger of death within a period of hours.'

One hero of the occupation was Mr R O Falla, a Guernseyman with fluent dialectal French who travelled to France frequently with enough money to buy any commodity he could lay his hands on. On one occasion he returned with £10,000-worth of false teeth! Despite such efforts, many shortages were inevitable. Much of the later correspondence from the German commandant to Dr Symons is typed on the back of Red Cross message counterfoils in an obvious attempt to save paper. Dr Rose remembers his excitement at exchanging a bar of soap for a tree to burn for fuel. Fuel was rationed from the start and many Guernsey people were delivered and indeed operated on by candlelight.

**D-Day and after**

On D-Day the Islanders did not need their illicit radios to tell them what was happening. Aircraft flying over and the sound of shelling and bombing were clear indications. Plans were drawn up to cope with casualties in the event of air raids by the Allied Forces. However, Guernsey was bypassed, and there followed eleven months of siege conditions before the Germans surrendered, with only visits by the Red Cross ship Vega with supplies and parcels for the Guernsey people to alleviate suffering. Eventually, on 9 May 1945, the British Navy arrived to liberate the island.

There had been horror. People had been sent to prison and concentration camp and never returned. Some had come close to starvation, especially those living in town with no land to cultivate or those with no money to buy on the black market. For some needing medical treatment unavailable on the island, liberation came too late. But taken overall, those in authority did manage to make the occupation as civilised as circumstances could allow.

When asked about his father's problems with anaesthesia during this time, Dr Tony Fox wrote: 'I do not think that anaesthesia was a particular problem. ...[He] used to spend most of his time in the occupation fishing - in a rowing boat. I have his German identity card - Doctor William B Fox - fisherman.'

Soon after liberation, Dr Peter Heyworth, who had left Guernsey to join the RAF as an anaesthetist, returned with the endotracheal tube. From that day, slowly and inexorably (and unconnected with anti-German feeling) the Schimmelbusch mask disappeared from Guernsey operating theatres to take its place in anaesthetic history.
Acknowledgements

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THE ORGANISATION & SETTING UP OF DRESSING STATIONS FOR D-DAY

Dr L Rendell-Baker
Professor of Anesthesiology, Loma Linda University
California, USA

Preparation of a beach group

For operation 'Overlord', the invasion of continental Europe planned for June 1944, 5,000-man beach groups were formed in 1943. Their function was to handle up to 2,000 tons of supplies across each beach per day to support the assault troops. Nos. 20 and 21 Field Dressing Stations with attached surgical and transfusion units were to form forward surgical centres as part of No. 5 Beach Group. The surgical centres would operate on urgent abdominal and chest cases. The others would be evacuated to Britain. The FDS staff consisted of 4 medical officers, 1 dental officer, 1 non-medical officer, a quartermaster and 95 other ranks.

Training for the Beach Group's role in the invasion started at the Combined Operations Centre north of Ayrshire. From Spring 1943, beach landing exercises took place every two weeks, at first along the Ayrshire coast. Later the Group travelled to Amroth on the Pendine Sands in Pembrokeshire to experiment with off-loading beached coastal steamers. After 7 days a storm tore up the beach and brought the exercise to an abrupt halt. The surgeon in charge of our surgical unit for this exercise fortunately didn't believe in window dressing. His unit was ready to operate at a moment's notice with all instruments, gowns and dressings sterile. This was just as well as we had a soldier who collapsed after a fall from a truck and was rushed to the surgical unit with a diagnosis of ruptured spleen. The surgeon had identified some universal donors amongst our soldiers so they were bled while the patient was given plasma. The splenectomy went quite satisfactorily and the patient was resuscitated with the blood from our donors and plasma. This case greatly impressed the inspecting 'top brass' who seemed astounded that we really could operate.

By December 1943 the required figure of 2,000 tons per day had not been achieved so the Beach Group spent Christmas in bitterly cold weather on the cliffs above Gullane Sands, just south of Edinburgh, until finally we achieved the magic figure, largely due to the fact that by then we had DUKWs. These amphibious lorries could drive down to the beach, enter the water, go out to the ship, load up with supplies and then come back and unload at the supply dump.

At this time German intelligence had been fed the false information that we were training to invade Norway. Later, when our Division left Scotland, special signal units remained there to maintain the same radio traffic so that the enemy would not be aware of our movement south. A phantom US army group was also created in East Anglia with General Patton said to be in command and planning to launch an assault in the Pas de Calais, while our 3rd British Infantry Division and 5th Beach Group were stationed at Waterloo behind Portsmouth.

For our final exercise we embarked on transport ships in Portsmouth which took us to the beaches off Littlehampton where we climbed down netting on the sides of the ships into Landing Craft Assault for the beach landing. Apart from getting very wet when we landed in quite deep water, the exercise went off faultlessly. We were then transferred to a
harbed-wire secured holding camp behind Brighton where we were issued with French invasion francs and briefed as follows:

Queen Red Beach, where we would land was better than those we had encountered on exercise. It would vary between 400 yards deep at low tide and 20 yards at high tide. It was expected that 22,000 troops would be landed on the first tide and that there would be 3,000 casualties on our sector during the assault. Each Field Transfusion Unit would embark with 100 bottles of blood and would receive a further 450 bottles daily thereafter.

The real thing

At 1500hrs on 5th June at Newhaven we boarded Landing Craft No.534 which had previously been used for the landings in Sicily and Anzio. Before we set sail we were served a meal of potato salad and corned beef which I didn’t feel was very suitable before a sea voyage. At 1700hrs we sailed. The sea became quite rough as we passed the Seven Sisters Cliffs which we saw through the haze and I wondered if I would see these familiar sights again as an 80% casualty rate had been predicted. Very soon most of the troops were being sick. I began to feel nauseated and went up on deck to find we had turned south and I realised that this must be the assault we had planned for. At 0600hrs maps and charts were issued indicating that the target was Caen in Normandy. At 0800hrs we received a radio message that the assault had been successful. We were then passing through shipping lanes marked by flagged buoys. As far as the eye could see there were ships of all types. It was rather like traffic going three abreast down a motorway. The noise was incredible, as the Navy had all possible ships firing at the shore batteries and softening up the assault areas. When the British battleship Warspite fired its salvos from 15” guns over our heads it wasn’t so much the noise as the concussion which was quite unnerving.

From the aerial photo handed out at the briefing session it was clear that there was a strong point very close to our beach landing site at Queen Red. The map showed our route about a mile inland to establish a Field Dressing Station close to Hermanville church. H-hour for the assault on our beach was 0725hrs. Our Commanding Officer, Lieutenant Coombes and 14 men were to land 60 minutes after H-hour to set up the beach dressing station. I was to bring in the main party about 11.15.

Our party consisted of 6 officers and 54 men. The Navy provided us with one of the driest of landings in only 2 feet of water as compared with waist deep on our British disembarkations. There was a deal of urgency to get off the ship as a German 88mm gun was firing along the beach in our direction from Ouistreham and the ship next to ours was hit. Once off the beach we struck inland through the remains of seaside cottages which had been fortified by the Germans with tunnels connecting each house with its neighbour. By the time we arrived there was no sign of small arms fire from these buildings. Unfortunately, not all the German defenders were eliminated. That evening the Beach Group Commander was killed by machine gun fire from one of the ruined houses.

Once through the cottages we turned west along the lateral connecting road and soon began to notice heavy machine gun fire coming from a strongpoint further down the road. I had some difficulty identifying the small side road turning off for Hermanville. The Germans had cut down the woods shown on our map along this road. My colleagues later reported that quite a lot of mortar fire was landing in our vicinity. However I was too preoccupied trying to locate the correct turning to pay much attention to it. Once we found the correct road we went inland about a mile towards Hermanville church and set up the dressing station in orchards close by. The preliminary aerial bombing,
unfortunately, had missed the targets along the beach and landed inland on the farm fields where we were to set up our dressing station. Injured cows on the site had to be put out of their misery with a .38 calibre shot through the head.

At the eastern end of Sword Sector the 1st Commando Brigade under Brigadier Lord Lovat landed at H-hour to capture the guns at Ouistreham and to link up with the British 6th Airborne Division along the bridges over the River Orne. A Free French Commando Battalion was included with these forces. The French inhabitants of Ouistreham and Riva Bella came out to welcome their Free French liberators like long-lost heroes. By the time we arrived, 3½ hours later, the Free French were well advanced in their celebration and were decidedly inebriated. The Commandos who came back through our unit reported they had captured the villages overlooking the city of Caen, so we anticipated that our 185th Brigade which had landed that afternoon would be able to capture Caen that evening as planned. Unfortunately, their Brigadier was non-aggressive by nature and was reported to have ordered his troops to dig in well short of their objective. Warren Tute, in his book on D-day, says that the British infantry, lacking tank support, were stopped 2½ miles from Caen by the 21st Panzer Division’s tanks. The Germans had launched a counter attack which almost reached the coast very close to our location. Happily, we knew nothing about this. The 250 gliders bringing in reinforcements flew over this armoured thrust and so unnerved its commander that he pulled back, fearing to be cut off.

We soon began to get a trickle of wounded and by the evening things were fairly hectic with lots of stretcher patients on the ground. Unfortunately, the surgical team failed to appear. We found later that their landing craft was stuck on a sandbar offshore, under fire from the beach shelling of the Germans, while the British naval vessels were firing over their heads onto the German batteries. The back-up surgeon and anaesthetist arrived later that evening with their instruments in their rucksacks. The FDS had an operating tent and a folding operating table with a canvas top together with a pan to boil the instruments for sterilisation. The Army didn’t provide us with any sterilised dressings so while we had been waiting in Britain to embark, we collected gauze rolls from the Army supply and had the local hospital’s volunteers fold them into abdominal mops which were then packed in large biscuit tins and autoclaved and sealed. The supply of dressings saved the day when the main surgical team failed to arrive. We had also collected a large supply of Pentothal as we had few other anaesthetics available.

The initial medical supplies we had consisted of the 26lbs we were able to carry in our rucksacks. Fortunately, by late afternoon all our vehicles, consisting of 3 3-ton trucks, 1 of 15cwt, the water truck and an ambulance had arrived. Only an amphibious jeep had sunk on leaving the LCT. When this transport arrived we were able to set up our tents and function quite satisfactorily. A medical problem arose on the first day when we received members of the 51st Highland Division who had recently been transferred from Egypt. Many of these soldiers became incapacitated with high fever due to a resurgence of malaria precipitated by the strain of battle. Fortunately, we found quinine tablets in our standard wicker British Army medical supply haskets which were fitted with rings on each side so that they could be carried by mules in India. We’d never had cause to open these before but they proved a godsend.

Surgical Unit activity

When our surgical team, consisting of a surgeon, an anaesthetist and assistants arrived, they set up their operating room in a tent attached to the rear of their truck. They sterilised their instruments by boiling them in a pan over a Primus stove on the tailgate of the truck. As anaesthesia equipment they had an Oxford Vaporiser which gave precise percentages of ether in air. Hot water was poured into the central container and melted the
calcium chloride crystals. When the temperature rose on the thermometer, they knew that the vaporiser was ready for service. It was fitted with a bellows so that one could assist the ventilation with ease. For induction, ethyl chloride could be squirted into an induction bag to obtund the patient’s cough reflex before commencing with ether from the main vaporiser. They also had Pentothal but of course, no muscle relaxants. The only cases the surgical unit operated upon were those which couldn’t tolerate further delay. Lord Lovat came into our unit with a through and through gunshot wound on one flank and the exit on the other. Laparotomy showed that the bullet had coursed through the muscle planes and never entered the abdominal cavity. Early on we were pleased to receive a visit from the Army’s consultant surgeon, Arthur Porritt, the famous New Zealander, and former Olympic athlete. He recommended that our unit be given four nurses to handle the post-operative nursing. They arrived in short order, making a tremendous difference to the care provided.

After about ten days, the postoperative patients were moved down to the beach for return to Britain on a landing craft. One evening we sent a postoperative abdominal case to be evacuated to Britain, only to receive him back about 0800hrs the next morning. The landing craft had been torpedoed and he ended up swimming in the water for some time before being rescued and brought back to us, apparently little the worse for his experience. The first use of penicillin I ever saw was on a soldier with gas gangrene in the posterior compartment of his thigh. I expected it would be necessary to amputate his leg. However, after the wound was opened widely and penicillin had been given, his leg and his life were saved. By D-day plus 1 we had the Field Ambulance Surgical Unit and the Field Transfusion Unit and everything was going full blast. In the first three days we handled 1,025 patients between the 20th and 21st FDSs. We evacuated a total of 1,700 injured back to Britain in the first week.

After a month, with Caen still not captured, Montgomery called for a massive air attack on 7th July. Lancaster and Halifax aircraft dropped 2,573 tons of bombs as a preliminary to a three-sided assault on the city. As we were situated only six miles away from the target zone we had an awe-inspiring view of the raid. On 9th July, after fierce fighting, in which the British and Canadians suffered almost 5,000 casualties and 3,000 civilians were killed, the city of Caen and its nearby airfield were at last in British and Canadian hands.

Management of battle fatigue

General Montgomery’s battle plan was to draw German strength to the eastern end of the front near Caen so that an armoured breakout might be made through St Lo, outflanking the Germans and forcing them back over the River Seine. Though this did in fact work in the long run the British soldiers who were opposite Caen took a tremendous pounding. Even the best troops have their limits of endurance. After a soldier had been confined in a slit trench for four days under continuous bombardment, his ability to function or resist could be lost.

When our job as a forward surgical centre in the Hermanville area was completed early in July our unit was moved west of Caen. Here we became a Corps psychiatric centre. We had attached to us a Corps psychiatrist who guided our care of these patients. They came to us in large numbers, stuporous or unable to focus their attention on their immediate problems. The psychiatrist’s plan of treatment was as follows: first the men received a hot meal, then they were given a large oral dose of a barbiturate to produce sound sleep. When they awoke they received a second meal and a second dose of barbiturate. Upon waking after this they were seen by the psychiatrist to determine those who could be sent back to their units after further treatment and those who would probably never recover enough to return to the battle.
Another feature of the treatment was strenuous exercise, playing soccer to vent their feelings of frustration and anger. Unfortunately, gaps in the teams had to be made up by RAMC orderlies who were usually somewhat less robust than the infantry soldiers. One of our problems was to keep our own staff sufficiently patched up so they could continue playing football. Generally, about half the patients were returned to their units and the other half were sent back to Britain.

German surgery

As the German Army fell back through northern France, 21 FDS was sent to Amiens to take over a French civilian hospital which held over 700 German casualties. They had no German medical officers and no surgeons. To solve this problem our commanding officer went down to the prisoners of war cage and called for all German medical officers who claimed to be surgeons to report for duty. He returned with six alleged surgeons. They were each sent up to the wards to choose a patient to operate upon and watched to see how they performed. From these trials we selected three competent surgeons. The anaesthesia was provided by a German orderly who used open drop ethyl chloride on a mask large enough to cover the whole face. His idea of anaesthesia was that, providing the patient was not moving, it was satisfactory. He liked to have them phonating throughout most of the procedure, for that way he knew they were still breathing.

A few days later a British mine disposal officer was brought in having lost both feet to a land mine. We took him straight to the operating theatre and called for the German surgeons to come quickly. Meanwhile, a dispatch rider was sent to obtain supplies of blood. Fortunately, we had plenty of freeze-dried plasma, so we set up an i.v. line and commenced pumping in plasma as fast as possible until the blood arrived. We got four units of blood which was given rapidly. Meanwhile, the surgeons arrested the bleeding and cleaned up the two stumps. They looked extremely concerned about the amount of fluid being pumped into the patient but at the end of surgery, when they asked how the patient was, and we reported that the blood pressure was 120/70 they couldn't believe it. They had never seen such a blood transfusion given in the whole of their military careers. The German Army did not have a blood transfusion service. In place of plasma and blood they had Periston. This was a 3½% solution of poly-vinyl pyrolidine in normal saline. It was supplied in 200ml ampoules. We did not come across any giving sets in the German Army medical stores we depended upon to treat our 700 German POW patients. It was our impression that this plasma substitute was given in 200ml doses.

In April 1945 it was clear that the war in Europe was drawing to a close. Our FDS had not sustained any casualties at all. However, in the Pacific, Japan was still fighting doggedly and the prospects of participating in the invasion of the Islands of Japan was far from appealing. So on 1st April I replied to an HQ invitation and volunteered for anaesthetic training.

Conclusion

It is clear to me that the concept of the FDS worked well in the Normandy campaign, forming a good basic unit to which specialist functions could easily and effectively be grafted. However, this was a relatively static campaign by comparison with the Persian Gulf war where tank divisions moved forward so rapidly that they ran out of helicopter transport range. Casualties, had they occurred, would have been difficult to collect from the forward forces. Maybe in future one should think in terms of helicopter-borne medical units that could be advanced rapidly to the scene of the engagement.
ANAESTHETIC EXPERIENCE WITH THE AUSTRALIAN ARMY IN VIETNAM

Dr A Marshall Barr
Consultant Anaesthetist, Reading
Honorary Editor, History of Anaesthesia Society

Background

In April 1967, I left a Staff Anaesthetist post in Western Australia to spend a year as Specialist Anaesthetist with the Australian army in Vietnam. The 2nd World War left Australia very Asia-conscious, and owing a great debt to the United States for deliverance from the threat of invasion. Post-war, Australians were vehemently anti-communist, a view confirmed by the defection in Canberra of the Petrovs, with information on communist plans for world domination. In the 60s, the domino theory of successive countries falling to communism was actually happening, and expansionist Indonesia was causing fright. In Vietnam, a stand as in Korea seemed to be called for. When the US asked, Australian troops were sent - first advisers, then in 1966 a Task Force of two battalions plus logistic support. Compared to the American commitment of half a million, the total was about 5,000 Australian servicemen.

The fighting Task force was based at Nui Dat, and the Logistic Support Group about 15 miles south in the sand dunes behind the beach at Vung Tau. This was previously the French resort of Cap St Jacques, south-east of Saigon and 10 degrees north of the equator. There, in 1966, 2 Field Ambulance set up in tents. Their anaesthetist was Max Sloss who, at that time, was at registrar level in his training. One year later the tents were being replaced by Kingstrad huts, and we arrived to the luxury of an air-conditioned operating theatre.

8 Field Ambulance/1 Australian Field Hospital

Our unit was a Field Ambulance in name only, and soon changed to the more accurate title of Field Hospital. We had 60 beds, and were tasked with the hospital treatment of all Australian sick and wounded. The holding policy was 30 days. If a patient was not going to be fit for duty in this time, he was evacuated by air to Australia, on a fortnightly Hercules flight staging through Butterworth, Malaysia.

On the surgical side, our unit had one surgeon, one anaesthetist, two general duty Medical Officers with some surgical and anaesthetics experience, five Operating Theatre Technicians and, later, four nurses, one of whom was always rostered to theatre duty. We had two operating tables, two Boyle's machine, one CIG Midget portable and one EMO. For ITU we had one Bird and one Bennett ventilator, neither of which was used. Our agents were thiopentone, suxamethonium, curare, pethidine, N₂O, halothane and ether. The standard intravenous device was the 14 gauge catheter-within-needle Intracath. Our supply system was via the US Army. The back-up facilities were the 400 bedded US 36 Evacuation Hospital.
a mile away, and specialist services including neuro and chest surgery at the 24th and 93rd Evac Hospitals at Long Binh, near Saigon.

Casualty Management

The main injuries were from mines and high velocity rifles. With helicopter evacuation it was normally less than 40 minutes from injury to hospital. Chest and head injuries were diverted to the US specialist hospitals. The more common limb and abdominal cases were landed 100 metres from our theatre/resuscitation building. The theatre team would meet the 'dust-off' helicopter on the landing-pad, and carry the wounded on a litter to the triage area adjacent to theatre. The routine was O₂, a peripheral drip, increments of iv pethidine to full analgesia, rapid crystalloid 1 - 2 litres, cvp measurement via an external jugular line, colloid only if there was a delay in cross-matching. After 10 units of stored blood, a unit of fresh blood was given, donated by soldiers of the Logistic Support Group. This differed from the US system of many litres of crystalloid, followed by low-titre O-positive uncrossmatched blood. In my year, we had no 'Da Nang' lung, no requirement for postoperative ventilation and no coagulation problems.

Still in the triage area, the casualty was stripped, searched for all injuries, and x-rayed. Penicillin was started iv at the rate of 10 mega units daily. In theatre, following a rapid sequence induction, the standard principle was followed of débridement and delayed primary closure.

The casualties came in bursts. The policy of quiet periods was to maintain training, while having staff and facilities available to deal with casualties at 30 minutes notice. We ran short lists, eg circumcisions, plantar warts, ingrowing toenails and appendectomies, training the MOs and technicians in airway management, drips and surgery. We used the J:MO to have experience if the N₂O supply failed, which almost happened during the Tet offensive. I used brachial blocks for hand injuries and spinals for leg injuries. There were several severe burns for which I used a lytic cocktail. The heavily-muscled soldiers sedated with a mixture of pethidine, morphine and chlorpromazine co-operated in turning themselves for widespread débridement which they accepted without complaint.

Problems

Surgical and anaesthetic problems were minimal. Considering the circumstances, the staff and facilities were satisfactory.

We all suffered some degree of stress. Although Vung Tau proved to be a very safe area, there was always a worry that one might be a target. The climate was wearying, the combination of heat, rain, wind and sand being most unpleasant for tent-dwellers. A considerable burden for the single surgeon and anaesthetist was knowing that we had the only real expertise. Fatigue due to intensive activity meant we sometimes had to close the theatre and send our casualties to the 36 Evac hospital. In contrast, there were also long periods of
tropical fevers and malaria were frequent in the medical wards. Alcohol and cigarettes were amazingly cheap, and amazing quantities of both were used. The greatest stress was awareness that we were in an unpopular war, with fading support from home.

The Tet offensive

In February 1968 we were swamped with casualties. The Tet offensive was all around us, but our area was fortunately untouched by enemy action. The casualties came from our own troops and Americans sent on from the 24th and 93rd Evac hospitals. These 'transfers in' had received minimal or no treatment because the transferring hospitals were fully occupied. This meant two weeks of unremitting work, with triage assessments often being changed as new helicopter loads arrived, and the Vung Tau recreation centre being converted to a convalescent hospital to create more hospital beds.

From the casualties we learnt the truth about the Tet offensive. They described seeing literally hundreds of dead VC on roadsides all the way around Saigon. All had a flag and clean uniform in their pack ready for their victory march through the capital. Instead, they suffered a huge military disaster. But the western media were by now vehemently against the war. They reported the success of the enemy in being able to mount such an attack despite 500,000 US servicemen in Vietnam. The United States never regained confidence and the war was lost.

Conclusion

Tet was the turning point, but the war continued. During the next three years the Australian medical facilities continually improved, with the hospital expanding to over 100 beds. My description is a one year 'snapshot' of a still relatively primitive set-up, in which much good work was done, thanks largely to the quality and training of our supporting staff.
ANAESTHESIA AT SEA DURING THE FALKLANDS WAR

Dr P T Bull
Consultant Anaesthetist, Mansfield, Nottinghamshire
Formerly Surgeon Commander Royal Navy

The Royal Navy had almost abandoned its plans for hospital ships when, with the need to recapture the Falkland Islands in April 1982, it became necessary to have a floating base hospital in the South Atlantic. The school cruise ship SS *Uganda* was hastily requisitioned and converted in Gibraltar, to carry a basic hospital unit. I was appointed at two days notice to be head of the very small Anaesthetic Department.

The Department had 3 main areas of responsibility: casualty reception, an operating theatre of 3 tables and a 20 bed ICU. Our staffing comprised 2 anaesthetists (1 Consultant, 1 senior registrar), 2 ODAs, 2 ICU sisters, 1 ICU staff nurse, 7 ICU nurses (SEN), 1 casualty sister and 1 P&O sister. The passage out was used for intensive training, particularly in casualty handling and resuscitation. Stores were sadly deficient, particularly ventilators, drugs and disposables. These were partially made good on the journey south, but the need to supply other ships and shore units meant a strict non-wastage system, and a continuous demand for re-supply. Eventually we carried, in addition to the basic scale equipment, 2 model M Boyle’s machines with 1 circle absorber unit, 4 units of the Tri-Service apparatus, 2 Penlon Oxford ventilators with air compressors and 3 Pneupac ventilators.

Action began with the admission of Argentinian wounded even before the sinking of HMS *Sheffield*, then increased gradually to include the battles at San Carlos on May 21 and then Darwin/Goose Green a few days later - but reached a maximum of 160 admissions in a 4 hour period on the day of the Bluff Cove incident.

Casualty reception

Casualties were received by helicopter mainly from the field hospital at Ajax Bay, but also direct from damaged ships and any major cases transferred from warships. One anaesthetist was always present for resuscitation and triage if necessary. He was assisted by available medical officers, particularly the radiologist and oral surgeon. Omnopon 2mg/ml iv was used liberally to achieve analgesia, and Haemaccel for initial volume replacement.

Operating theatre

The basic rules of battle surgery were followed regarding debridement and delayed primary suture. Adaptation to the situation meant less than ideal sterility: surgeons usually wore gloves only, much disposable equipment was sterilised with Cidex, and syringes and needles recycled in case of need [the latter was never necessary]. Plastic bags were used to occlude burns. An 'anaesthetic nurse' system was used, allowing the ODAs to look after stable cases.
while the anaesthetists were occupied elsewhere, the ICU and casualty reception areas both being adjacent and within shouting distance.

The commonest anaesthetic technique was fentanyl, alcuronium, thiopentone with a modified rapid sequence induction and N₂O/O₂ maintenance using halothane and a low flow circuit. Nerve blocks and iv regionals were impractical because of multiple wounding. Two spinals were given, one for a casualty carrying a 'malignant hyperpyrexia risk' card. Four epidurals were used to deal with postoperative stump pain. The Tri-Service apparatus was used as the third anaesthetic machine and found to be invaluable, particularly in its saving of medical gases.

Intensive care

Inadequate numbers and experience of staff were compensated by enthusiasm and hard work. They were greatly assisted by the P&O Officers and crew, by the Royal Marines bandsmen, naval ratings and junior medical officers who found time from their other duties. On one occasion manual ventilation was needed for 3 patients when only 1 functional ventilator was available. Fortunately, 2 East Radcliffe machines arrived later from shore bases to ease the situation. Tracheostomies (6) proved difficult to manage due to shortage of tubes and humidifiers, and to language problems with the Argentinians. Entonox was invaluable for dressing changes.

Statistics

Of 730 admissions, some 150 were Argentinian wounded. Many of the 420 anaesthetics given were repetitions on the same patient, often up to 5 times. The delayed and repeated surgery required is reflected in the numbers of anaesthetics before (211) and after (208) the surrender. Three deaths were all accepted as unavoidable due to the severity of the injuries. These figures may flatter to deceive. How many others may have survived long enough to reach a medical sanctuary if more helicopters had been available or the war not largely fought at night?
GUEST LECTURE

THE PROVISION OF MEDICAL AND FIRST AID FACILITIES IN FIXED FORTIFICATIONS IN THE LAST 100 YEARS

Jurat C W Partridge, Architectural Consultant, Alderney

Jurat Partridge gave a most detailed and knowledgeable lecture on the changes in architecture of fortifications in response to modernisation of military thought and weaponry. He emphasised the development of accommodation and medical facilities within the complexes. Of particular interest was his description with many illustrations of the facilities in the grandes ouvrages of the Maginot Line. These included infirmary, operating room, pharmacy, gas-proof accommodation, and independent power, water sources and sanitation.

The German defences of the 'Atlantic Wall' demonstrated the final phase of reinforced concrete fortifications. Dressing stations and hospital bunkers featured prominently, including the underground hospitals of the Channel Islands. Most of the audience were surprised to learn that German casualties after D-Day were shipped to the Jersey Underground Hospital.

Following this talk, many delegates and guests visited the Occupation Museum and the huge, derelict Guernsey Underground Hospital.
THE INTERSURGICAL LECTURE

AVENUES OF AMBITION:
THE RISE OF THE SPECIALIST ASSOCIATIONS

Sir David Innes Williams
Retired Consultant Urological Surgeon,
The Hospital for Sick Children and St Peter's Hospital, London

Editor: This dazzlingly erudite full-length lecture can only be summarised here.

Sir David's message was that the associations have been avenues of ambition for their members, seeking such benefits as an entrée to the elite, a platform for their proposals and a ladder on which to climb the medical hierarchy. It is through these ambitions of individuals that advance of the group is achieved. As examples, he outlined the histories of the associations for obstetrics and gynaecology, psychiatry and pathology.

The elite attitude of the older Royal Colleges, and their failure to support the new specialties contributed to their breaking away. A notable exception to this trend was public health - a specialty with a long history, and experience of negotiation with government. The MOH's lost prestige in the National Health Service and accepted Faculty status in 1974 in the Royal College of Physicians.

The British Medical Association recognised the specialties much earlier, incorporating sectional conferences into the Annual Meetings, developing specialist groups and working on their behalf. Those specialties which have established new colleges with charitable status still rely on the British Medical Association to argue the case for their members' salaries.

The Royal Society of Medicine, founded in 1907 with 17 Sections, recognised the specialist nature of consultant practice, but its sectional structure stifled the independence of specialist bodies. Academic discussion was promoted, but a national role for the specialist group was inhibited. One by one independent specialist associations have been set up in parallel or in competition with the Sections.

There have been common themes in the evolution of these associations. Their foundation has often been by a keen young man who ensures the co-operation of a great man who then becomes the first president. The youthful instigator will usually come from the provinces rather than the capital. The London establishment tends to resist, their aspirations already satisfied by positions of prestige, and personal and professional contact with court and government circles. Many associations start as elitist, particularly academically, but as numbers increase there is a transition to a national mode. With rare exceptions, the specialties developed earlier in Europe and North America. There, self-referral bypassing the general practitioner boosted specialist practice as did the huge hospitals of Germany and Austria with
their opportunities for specialist study. International societies often preceded the British associations.

All mature associations have a journal, the editorship being another Avenue of Ambition. All are greatly involved in postgraduate education. It was the formalisation of the senior registrar training programmes which added enormously to their importance. Not all have the same medico-political clout, dermatology and paediatrics making an interesting contrast.

Finally, all associations offer glittering prizes to the ambitious specialist - scholarships, medals, honorary fellowships, rituals and regalia to add dignity. Presidents will hopefully appear in the Honours list. Is it surprising that specialist associations multiply?
UNVEILING OF A CLOVER PLAQUE

On 2 March 1994, a Green Commemorative Plaque to Dr Joseph T Clover was unveiled on the wall of 3 Cavendish Place, London, W 1, by his granddaughter Miss Dorothea Clover, in the presence of Mr Anthony Clover (great grandson) and Mr James Clover (great great grandson). Also present were Honorary and Council Members of the History of Anaesthesia Society, representatives of the Royal College of Anaesthetists, the Association of Anaesthetists, Westminster City Council, the Borough of Marylebone and Messrs Kings of Sheffield.

The photograph shows Miss Clover and James Clover at the reception on the premises.
Book Review

*Early Medical Services - Berkshire and South Oxfordshire from 1740*
Margaret Railton, Polmood Publications, £10.95, pp 256, ISBN 0 952411008

This impeccably researched record of medical developments in the workhouses, unions, dispensaries and voluntary hospitals, and in the communities of East and West Berkshire and South Oxfordshire is of much greater importance than as a specialist local history. The pattern of events is equally applicable to the rest of the country, and the author convincingly demonstrates that by 1850 the foundations had been established upon which the future NHS was to be built. She also makes some penetrating observations on parallels with modern medico-political problems. Of particular value to those interested in the history of our specialty is the detailed background of health care in the provinces at the time of the introduction of anaesthesia. The number and type of operations in the Poor Law institutions, dispensaries and hospitals are documented from a wealth of primary sources. The first use in Reading of ether (1 February 1847) and chloroform (December 1847) are described from the minutes of the local medical society and from reports in the *Berkshire Chronicle*.

This quality hardback publication, with 80 illustrations, is obtainable by sending a cheque for £13.20 (£10.95 + £2.25 p&pp) payable to Polmood Publications, Bentleys, Waltham St Lawrence, near Reading, Berkshire, RG10 0PL. All proceeds go to local hospices.

Marshall Barr