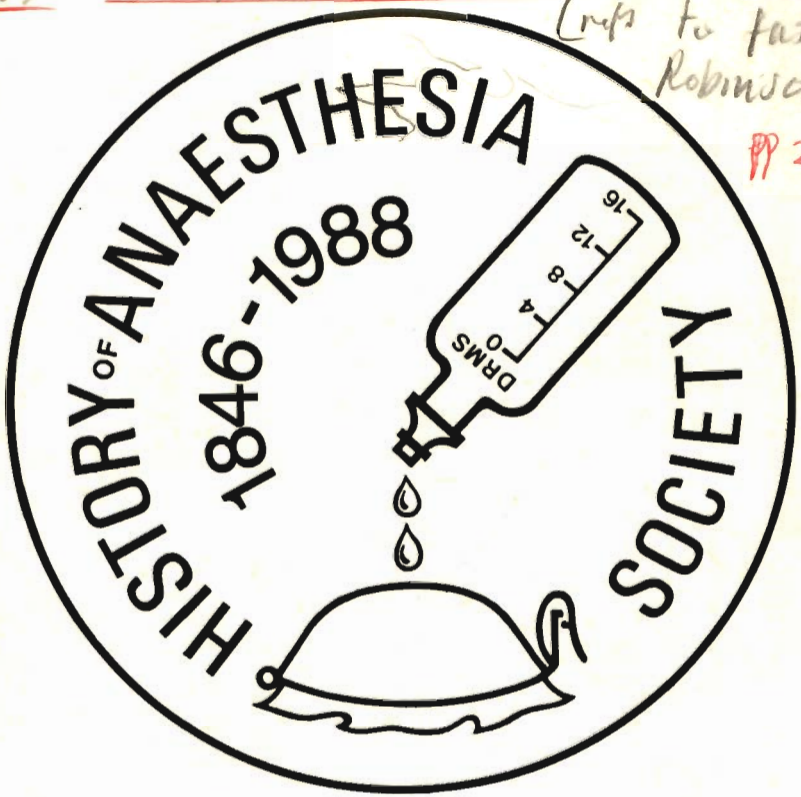
SOUTHEND

III

THE HISTORY OF ANAESTHESIA SOCIETY

BMD Early Years of Growth in Industry (refs to fatigue Robinson etc.)

pp 27-9



Volume 3

1988

Proceedings of February 1988 Meeting – Southend

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The History of Anaesthesia Society
1988

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Volume 3

Proceedings of the Meeting held at
Southend Hospital
on Saturday 6th February 1988

A SLEEPING GIANT — Dr.F.P.de CAUX

Dr D.Wilkinson

Dr.de Caux's story is a very strange story: a man of undoubted ability and an enquiring mind who stepped sideways out of the mainstream of anaesthesia at a time when he might have made a major breakthrough. A man who was struck off the Medical Register and went to prison for five years after a notorious trial at the Old Bailey. A man who died in south London twenty years ago forgotten by his previous profession. A man who should have been a giant in anaesthetic folklore but who seemingly fell asleep, and in his slumber has remained undisturbed until now. His story is not yet complete as my research is at present unfinished and I apologise for that, but I would like to present his story as I know it, to date.

Francis Percival de Caux, the son of a vicar, was born around 1893 in New Zealand. He came to England in about 1911 and started his medical training at St. Bartholomew's Hospital in 1912. The registers of attendance of students held in our archives show he was a second year student from 1913-14, a third year student from 1914-1915 and then spent three years doing his fourth year from 1915-18 and whether that has some relation to the First World War we cannot tell. His fifth year went from 1918-19 and then he spent another two years doing his sixth year from 1919-21. He passed his obstetric exam in October 1918, medicine in July 1920 and surgery in 1921. The GMC have him fully registered on the 4th February, 1921 - MRCS, LRCP.

Resident at St. Bart's

He next appears in the Bart's archive records on the 28th October, 1921, when he was appointed Resident Anaesthetist, a six month job at £80 per annum. In November 1921 he appeared for the first time in the national press when a play he had written was censored by the Lord Chancellor. A newspaper[1] of that time reads: "*Censor bans a lunacy play. Ethics of removing an imbecile child. The censor has placed an absolute ban on a play intended for the London Grand Guignol. It is the first time he has taken such drastic action concerning any playlet submitted for this theatre and the fact that Dr de Caux, a brain specialist, has collaborated in the authorship makes it even more remarkable. The play entitled 'Euthanasia' deals with the terrible question of whether the parents and a doctor have the right to destroy the life of an imbecile boy who stands in the line of inheritance to a baronetcy*". A subsequent report in December 1921,[2] showed that the play had been re-amended and was accepted for showing to the public.

At the end of his Resident Anaesthetist post he was appointed Senior Anaesthetist for a further six months at the handsome sum of £150 per year. In September 1922 his name appears for a second time in the press when the *Sunday Express*[3] ran an article entitled *"Dead man lives again. Astounding feat of surgery - heart massaged. A man whose breathing and heart beats had ceased for over an hour, was restored to life and lived for 27 hours. The amazing feat of modern surgery was performed by Dr.H.Bedford Russell, a young Harley Street specialist on a patient at St.Bartholomew's Hospital. The patient was a man of 27 years, suffering from septic tonsils; an operation was decided upon but after one tonsil had been removed the heart and breathing stopped. An astonishing battle for the man's life was then begun by Dr Russell and Dr F.P.de Caux. Pituitrin was injected straight through the chest into the heart. Dr.Russell then decided to massage the heart, the abdomen was cut and the heart massaged through the diaphragm for ten minutes. The heart remained motionless, the patient was dead. Quick as a thought, a further injection was made and the heart massaged with hands inside the pericardium;*

adrenaline was injected and this had a marked effect. Within 50 minutes the heart began to move, and at the end of an hour, the heart beat came back and the dead man breathed. "It is the most extraordinary case I have ever known", says Dr de Caux."

In December 1922, de Caux was re-appointed for a second term as Senior Resident Anaesthetist at Bart's. There was a written corollary to this job offer - that he was appointed on the understanding that he would sleep in the hospital when on call. Throughout his student days and his residency he had lived in a house in Chancery Lane. In mid 1923 he left Bart's and obtained a post as Honorary Anaesthetist at the All Saints' Hospital, Finchley Road. The Medical Register at this time notes he was a member of the Anaesthetic Section of the RSM. His first publication occurs in August 1923 in the *Lancet,*[4] consisting of a new water-sight flow meter, to be followed in October the same year by an ether inhaler, again published in the *Lancet;*[5] also a drip feed device manufactured by Allen & Hanbury's which appears in their catalogue with a description as to how it was used. Its actual formation is very similar to that of the Vinesthene inhaler designed by Victor Goldman later on.

He then moved to the West End living at 8 Wimpole Street. His first scientific paper was published in June 1924 in the *Ivory Cross Journal.*[6] In October 1924 he was cited in a divorce case, with a Mrs. Janet Etherington which may explain why, on the 4th June 1925 he married her at Marylebone Registry Office.

He continued to prosper in anaesthesia and moved house again, this time to 16A New Cavendish Street. He then became anaesthetist at the North Middlesex Hospital and on the 29th October 1927 his son Peter Anthony was born. The family obviously needed more space and he moved upmarket again, this time to 25 Weymouth Street, towards the Marylebone Road. He was now living very close to Charles King's premises in Devonshire Street and, having visited America, he returned to England and talked to King who at that time was specialising purely in ENT apparatus. De Caux had talked to Mackesson in Toledo, Ohio and persuaded King to import the Mackesson apparatus. He obviously had an interest in nitrous oxide/oygen anaesthesia and therefore a vested interest in getting these machines into this country. It was this meeting, which by setting Charles King on his career in anaesthesia, made an incredible impact on our specialty.

There was then quite an amazing interlude that has only been referred to in one book and this seemingly has been totally overlooked. In Victor Goldman's *Aids to Anaesthesia* which ran to three editions, the story is told. In the first edition of 1941 we find a list of contents with no reference to muscle relaxants which were to be introduced by Griffiths in Montreal in the following year.

Curare in 1928

In the next editions in 1948[7] and in 1952 we find a chapter on muscle relaxants in which we find this extraordinary line: "In 1928 Dr F.P.de Caux at the North Middlesex Hospital, was using intravenous injections of crude extracted curare to produce muscle relaxation under nitrous oxide-oxygen anaesthesia". I determined to try and find more proof of this. Victor Goldman is still alive and well and living in de Caux's old flat, in 8 Wimpole Street. He is now blind, but told me he saw de Caux's notes made at that time and has no doubt of the truth of the statement in his book. I looked at the old operating registers of the North Middlesex Hospital, but those for 1928 are lost, if they ever existed. One can find de Caux's name appearing in the books of the 1930's, but no further documentary evidence is to hand, as yet that is. An incidental finding was a group photograph of the members of the hospital at this time, which included Dr F.P.de Caux, the only photograph I have of him.

Dr de Caux was undoubtedly a great exponent of nitrous oxide anaesthesia. In a paper dated April 1930, in the *British Dental Journal*[8] he described a special flexo-metallic tube for dental anaesthesia, and extrolled the virtues of the Mackesson apparatus. He also referred to his own machine, a modified Mackesson, made by Charles King to his own specification. During the next three years he published a series of papers - in September 1930, in *Anesthesia & Analgesia* on glucose,[9] and a rewrite of his *B.D.J.* paper appeared in the same journal later on in the year,[10] with acknowledgment to the British publication. The *British Journal of Anaesthesia* published one in 1931[11] and a paper on premedication appeared in *Anesthesia & Analgesia*[12] in 1932 in America. In the same year a paper, in conjunction with Abel, was published in the *Clinical Journal.*[13] De Caux was now an anaesthetist at numerous hospitals but in September 1932 came a great scandal.

West End scandal

De Caux was linked with a death from septic abortion in the West End. Both the mother of the patient and a lady doctor friend committed suicide and there was a horrendous scandal, not helped by the coroner's final statements which are here quoted from a newspaper of that time.[14] Mr. Roddy said: *"Obviously it is a dangerous case, and probably a criminal one, and so long as the law regards criminal abortion as a most serious felony in regard to the person who procures it, and in procuring it causes death as being guilty of murder, it is the duty of the coroner to endeavour to find out what the person was."* He went on to say that *"the person in charge of the case, Dr.de Caux, takes no part in seeing the patient and leaves her in the hands of three other doctors, and does not sign the death certificate. I have indicated in my questions to him what my view is as to his conduct in this case which bridles with suspicion. I have a definite suspicion in my mind as to what exactly took place, but it cannot be proved by direct evidence, and the only course I can pursue is to record a verdict of death from septic abortion and leave the verdict open".*

This was the beginning of great trouble for de Caux. In September 1933 his last scientific paper was published in America.[15] He moved house at this point, north from the Harley Street area to near Regent's Park, at 26 Abbey Lodge, near Hanover Gate - a very pleasant and imposing building. His anaesthetic practice seemed to suffer little from this notoriety, he was constantly busy providing anaesthesia for dental work in and around Harley Street. About this time he went to Russia for a visit, the details of which are rather obscure, but on returning he published a paper in a strange journal called *Marriage and Hygiene.*[16] It was a scathing attack on British attitudes to abortion, citing the Russian practice of abortion on demand. His final scientific presentation was in Vienna at the 9th International Dental Congress in 1936, when he talked on nitrous oxide as a universal anaesthetic in dental surgery.

De Caux had a very good life style. He moved yet again - this time to Mayfair, 30 Green Street, now a rather delapidated building but at the time rather imposing. He also bought a huge mansion near Maidstone in Kent, which had many bedrooms in several acres of ground.

At the outset of the Second World War he sent his son to America where he now lives. In July 1942 he was remanded at Cranbrook Assizes in Kent for performing abortions in his country house; this was followed by a week long trial at the Old Bailey in September-October 1942, when he was found guilty and sentenced to five years in prison. He went to Camphill Prison on the Isle of Wight and his house was sold. In February 1943 his name was erased from the Medical Register. He left prison on the 18th January, 1946.

His subsequent life is still rather blank, to me at least. He set himself up as a cancer specialist and published a book in 1951 called *A New Light on Cancer.* In 1952 he remarried in Brighton, to a younger lady who is still alive. De Caux died at the Lambeth Hospital on the 24th October 1965 aged 72, having had a pulmonary embolism following a prostatectomy. His passing was unnoticed by the anaesthetic profession.

History looks back at a man's career and judges sometimes kindly and sometimes cruelly. De Caux was an innovator, a lateral thinker, a man highly skilled in nitrous oxide anaesthesia who experimented with curare to augment the effects of this relatively weak anaesthetic agent. Was he a man before his time - a man who visited Russia, who had seen effective birth control by abortion, who came back to this country and proceeded to try and change what he believed to be an unjust law? Or was de Caux a man gone wrong, a man to whom money was everything and anaesthesia just a means to an end? I am still pursuing this research and hope that I will be able to present a firm conclusion at a later date.

Some may believe that it is better to leave de Caux sleeping quietly. I believe his contributions to anaesthesia have been ignored for too long and that these great contributions should receive wider acclaim.

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HAMER HODGES — 1919-1961

Dr R.C.Birt

Robert James Hamer Hodges, known as Jim, was born on the 22nd April 1919, the son of a Portsmouth GP. He attended Portsmouth Grammar School and then read medicine at St. Mary's Paddington in 1938-1944, winning the Kitchener Scholarship and qualifying Licentiate in Medicine and Surgery of the Society of Apothecaries in January 1944. Why LMSA? He was anxious to qualify as early as possible. As a student he had been a keen cross-country runner and had somehow offended the Dean, Lord Warren, by taking the first fifteen on a cross-country run. During the war, medical students were seconded to other hospitals and Hamer Hodges had married a nurse while working at the Hammersmith. I think their first child was born in 1944. His father's practice had been destroyed by bombs in 1941; his father then joined the army, dying in 1943. All in all, there was a lot of pressure on Hamer Hodges to qualify and start work as soon as possible. He regretted not taking a University degree for the rest of his life. He was of course unable to present any of his research as a PhD thesis.

Once qualified, he returned to Portsmouth, working as House Surgeon, House Physician and Senior House Surgeon. He then moved back to London, to the Miller General Hospital, as Resident Surgical Officer, and to the Royal Marsden as Senior RMO. I think it was during this period he contracted pulmonary tuberculosis which at that time was treated by thoracoplasty. He must have realised that this severely prejudiced his chances of a surgical career and with the help of Dr Cope, later consultant at UCH, he obtained some experience in anaesthesia, later to stand him in good stead.

1949 saw him back in Portsmouth as a Senior Surgical Officer, I think equivalent to a Senior Registrar, at Queen Alexandra Hospital. This year convinced him that he was no longer fit enough for general surgery and in 1950, helped by his anaesthetic practice with Dr Cope, he moved sideways starting his anaesthetic career as a Registrar. He spent only a year as a Registrar becoming an SHMO in 1951. In 1952 he obtained the then two part DA as a result of which he was elected FFARCS in 1954. In the same year he was appointed Consultant Anaesthetist to the Portsmouth group of hospitals, and was made Consultant to the Thoracic Surgical Unit of the Wessex region. This, at the time, involved sessions at Southampton which later moved to Portsmouth, and also sessions on the Isle of Wight.

It was on the Isle of Wight at Ventnor that Mike Tunstall, then a young GP met Hamer Hodges while attending an operation on one of his patients and became interested in anaesthesia. Hamer Hodges obtained a lot of the data for his papers on the action of suxamethonium from these lists, which one presumes were under less pressure than those at Portsmouth. Mike Tunstall left general practice, working as a Registrar and later as Senior Registrar at Portsmouth, publishing many papers with Hamer Hodges on obstetric anaesthesia and carrying out the work leading to the introduction of Entonox at Portsmouth. His appointment was also as consultant to the Poliomyelitis Centre at Priorsdean Hospital, and of course as consultant to the Obstetric Unit at St. Mary's, Portsmouth. This responsibility for obstetrics made the six month period in America with Professor Robert Hingson, who published the first paper on the organisation of obstetric anaesthesia in 1951, an obvious choice.

Hamer Hodges had already formulated his theories on the changes in end-plate response to suxamethonium from his observations in carefully monitored clinical practice. While in America he met Francis Foldes who set up an animal experiment, which to Hamer Hodges was more a public trial of his theory than an experiment; perhaps that was what America was like at the time. Fortunately, all went well and the work was published. On his return to Portsmouth, he turned his main energies to getting his message across in the fields of obstetric and paediatric anaesthesia.

Early papers

There is a group of miscellaneous papers, which I will deal with first; one was on intra-tracheal stomach tubes, which was a quick reply to someone who had thought there was little danger of this. Hamer Hodges' case was given brandy by the ward sister and got intense pain in the chest, collapsed cyanosed and was diagnosed as having a pulmonary embolism until the chest x-ray showed the nasogastric tube was in the right lower bronchus. The patent did not survive. Another reported incompatible blood transfusion during anaesthesia in which it was thought anaesthesia was masking the signs but did not in this case.

A further paper reported a series of multiple Stokes Adams attacks during anaesthesia, and there was another from the Priorsdean work about a tracheotomy tube which was in use still in 1961 when I was an SHO. This was a typical piece of British do-it-yourself. It was made from an endotracheal tube with the distal end cut square and chamfered. A single angle was slid onto the tube using KY jelly and this had to be a tight fit, but one could choose the length of both the intra and the extra-tracheal portions of a tube. A latex collar was added. The finished tube was tailormade; you could have it cuffed or uncuffed, red rubber or plastic and, of course, in many different sizes.

Another little paper reported gangrene of the forearm after intramuscular chlorpromazine which, unfortunately, was injected quite close to the brachial artery.

Muscle relaxants

Next, a series of papers on muscle relaxants. I found seventeen publications on muscle relaxants, ranging from letters to papers. One was an annotation on decamethonium which is not available at the moment as it is locked up at the Royal Society of Medicine during their rebuilding programme. One was a letter discussing the effects of suxamethonium in myasthenia gravis and hyperthyroidism, four were concerned with pseudo-cholinesterase levels, nine with changes in end-plate sensitivity and two with effects of oxytocin on the response to suxamethonium.

Hamer Hodges took up suxamethonium as it was coming into clinical practice; it was obviously his favourite relaxant and he very quickly observed the variations in its effects, at first investigating differences in pseudo-cholinesterase levels in healthy and diseased adults and children. It became clear to him that variations in the actions of suxamethonium were not related to pseudo-cholinesterase and, as early as 1952, he had cases in which he reversed suxamethonium with neostigmine, concluding that the action of suxamethonium had changed to one which was curare-like. Most of these publications were letters but there were major papers in the *British Journal of Anaesthesia* in 1955 and *Anesthesia & Analgesia* in 1957. The paper he hoped to see in the *Journal of Pharmacology* was in the event, published as an abstract. Yendin, in 1951, was probably the first to report changes in end-plate response to decamethonium but Hamer Hodges' papers carefully explained his concept that the change in action of suxamethonium was due to a gradual alteration of the sensitivity

resistance relationship of the end plate to depolarisation and made an important contribution to the understanding of the clinical use of suxamethonium.

The letter and subsequent paper describing the change in end-plate sensitivity in patients receiving oxytocin and then given suxamethonium, refer in the main to cases on Pitocin drips for two to three days. It seems unlikely that this problem would arise in modern practice.

Paediatric anaesthesia

On paediatric anaesthesia, there are two letters, a paper and a film. Hamer Hodges felt it was unfortunate that so much attention was devoted to premedication. He endeavoured to obtain the intelligent cooperation of children and held a pre-anaesthesia class the day before surgery, explaining what was to happen to them. He used atropine or no pre-medication and thiopentone for induction. All unnecessary people were kept out of the anaesthetic room and he insisted that a strict plan was adhered to by nurses, doctors and all. No-one was allowed to be out of position, the pre-anaesthesia class had to be followed to the letter. To keep the confidence of the child nothing unexpected was allowed to take place. We have a video of Hamer Hodges film of this technique which was first shown at the Association of Anaesthetists' meeting at Stratford in November, 1959. It was very kindly loaned to us by Mike Tunstall and the Department of Medical Illustration of the Aberdeen Royal Infirmary.

Obstetric anaesthesia

There are seven obstetric papers: two on chlorpromazine, which Hamer Hodges felt should be restricted to very isolated instances — its use being contra-indicated in the circumstances that arise in general hospital obstetric practice. It is interesting to note that Jeffrey Selwyn Crawford was an SHMO in the Department whilst this work was in progress around 1957.

The other five papers outline the development of the Portsmouth standard technique which, with later modifications, forms the basis of current general anaesthesia for obstetrics. One paper described a record card devised for the study. The next compared four techniques in 264 patients, one method being the standard: thiopentone, suxamethonium, intubation, IPPV, oxygen and nitrous oxide. The second technique was the standard plus trichloroethylene, the third was thiopentone, cyclopropane-oxygen, the fourth was nitrous oxide/oxygen/ether with or without thiopentone for induction. Intubation was carried out when indicated (whatever that means) and curare was given in all caesarean sections. The comparisons made in the paper were of the incidence of fully active infants delivered using each technique over the series and, for caesarean sections, the incidence of depressed infants overall and with those who had had pre-operative fetal distress. The standard technique was better in all respects but its main feature was that it was outstandingly better if there had been pre-operative fetal distress. This, and the very clear logical case put for the standard technique in typical Hamer Hodges fashion won widespread acceptance for the method which was further enhanced by another paper in 1961 reviewing the use of the standard technique in 2,000 cases during the ten years 1952 to 1961. It is interesting to note that there was just one failed intubation in this series.

The next paper was a lecture at the November 1961 Portsmouth meeting for obstetricians, anaesthetists and paediatricians, angled slightly differently for a mixed audience, and showing a sharp drop in the Portsmouth peri-natal mortality from well above to well below the national figures.

Before he died, Hamer Hodges had prepared two chapters for the *Recent Advances* series. These were revised by Mike Tunstall and published as one chapter in 1963. With financial help from British Oxygen Company, Hamer Hodges made a film of his standard technique. Dr Andrew Doughty had this copied on to video and we have a copy available, with the paediatric anaesthesia film, for viewing.

The background to the standard technique

Early anaesthetic textbooks have, at best, a few paragraphs on obstetric anaesthesia. Obstetric anaesthetics were given by general practitioners, obstetric junior staff, and in the USA by nurses. Anaesthesia was a common event for normal delivery, although caesarean section was rare. Maternal mortality was high, roughly 1 in 200 in 1928-29, despite this there are no deaths ascribed to anaesthesia for this period. The operator/anaesthetist was discouraged, not because of the risks of anaesthesia, but because of the danger of sepsis.

In 1939, Charles Hall, an American GP, had one of his fit patients given a general anaesthetic for normal delivery. She died from aspiration pneumonitis. Enquiring among his friends, he easily found 15 similar cases, 5 of which were fatal. Medelson in 1946 took this further, instilling an extract of vomitus into rabbit lungs. This set off a number of enquiries into obstetric anaesthesia.

One of the best early papers is from Lock in Carolina, who found the main causes of death to be aspiration of vomit, followed by spinal shock which Hingson said was due to overwhelming and assassinating doses. And reading the paper he was absolutely right, but I don't think one would be able to say that sort of thing these days. The anaesthetics in use were nitrous oxide and oxygen (even for sections, and at least 10% oxygen was recommended!); the other, of course, was ether. One of the papers I saw seemed to suggest that you were a slight failure if you had to add ether to your nitrous oxide in oxygen. Whisker, in 1947, tried curare for caesarean section with inhalation agents, with local anaesthesia and on its own. Gray, in 1947, used 15mg curare with oxygen and cyclopropane, but he recommended not even inserting an airway in order to avoid vomiting. Parker in 1954, and in another paper in 1956, reported that general practitioners in Birmingham were safer with open ether than hospital doctors with oxygen, nitrous oxide and ether. Apparently, the Bart's anaesthetists were promptly told to use open ether.

There was considerable controversy about the advantages and disadvantages of intubation. Morgan and Wiley suggested both headup tilt, and crash induction in 1951. Hamer Hodges' major contribution was not to produce anything new but to evolve a logical system from the chaos that existed and to report on its use in over 2,000 cases.

Neonatal resuscitation

Counting the chapter in *Recent Advances*, there are four publications: one, on the Portsmouth sterile disposable Magill/Cole type endotracheal tube, which is still in use today (now made by Portex) and two papers in January 1960. The condition of the neonate was fundamental to the Portsmouth technique. In the early '50s and '60s Portsmouth was one of the few centres where the anaesthetist was considered partly at least responsible for the neonate and wholly responsible for its resuscitation. We were stationed at the head of a table with a very basic anaesthetic machine, delivering nitrous oxide in oxygen, with an ether bottle if required and a clip board and stop watch to facilitate completing the record card. To our right was a neonatal resuscitation trolley. We anaesthetised the mother and resuscitated the baby without moving our feet and at the drop of the proverbial hat. Hamer Hodges was a little embarassed to find that we intubated 25% of neonates; it has to be remembered

that the vast majority of cases were emergencies for fetal distress and all were lying flat on their backs compromising the placental circulation.

Hamer Hodges' tuberculous lung was treated by thoracoplasty between 1946 to 1948 while he was working at the Miller General Hospital or the Royal Marsden. Despite this he was a heavy smoker but appeared to be in fairly good health until at least 1957. It sounds as though he had one, or possibly two myocardial infarcts between then and 1961. When I was an SHO in 1961 he obviously very ill, although working. He appeared to get angina walking downstairs. It was thought at the time that he had constrictive pericarditis. He gave his lecture at the Portsmouth conference and spoke on the last day on neonatal resuscitation. He helped organise the meeting, so he must have been under a certain amount of stress. Nevertheless, his sister tells me he was as well as usual at the dinner to round off the occasion. His sudden death later that night must presumably have been due to another infarct.

It would be nice to be able to say that Hamer Hodges' standard technique dramatically reduced maternal mortality due to anaesthesia, but as with so many Health Service statistics the figures we have are totally meaningless. The maternal death rate was very high, and now is very much lower — 4420 down to 140 per million pregnancies now. Very light anaesthesia was common for vaginal delivery and classical caesarean section was rare — roughly 1% of cases. Nowadays, anaesthesia for vaginal delivery is rare, but caesarean section is common, rates varying from 10 to 30% in various units.

Despite a short career in poor health, Hamer Hodges' techniques leading to improvements in obstetric anaesthesia have been given worldwide recognition.

Acknowledgement
I would like to thank Mike Tunstall, David Hamer Hodges and Hamer Hodges' sister for help with some of the background.

THE HISTORY OF EXTRACORPOREAL CIRCULATION

Dr K.G. Lee

Prior to the 1950's, cardiac surgery was limited to closed procedures and operations outside the heart, including ingenious attempts at revascularising the ischaemic myocardium. The limitation was due to the inability to maintain a blood supply to the body on opening the heart. Open heart surgery using moderate hypothermia and temporary inflow occlusion was first performed successfully in 1952, but this only gave a modest increase in the time allowed for open heart surgery, and complex intracardiac surgery remained impossible. The advent of cardiopulmonary bypass, first used successfully in 1953, revolutionised the scope of cardiac surgery. Extracorporeal circulation is now used in many other fields, including neurosurgery, oncology and intensive therapy, but its origins go back much further than the early 1950's.

Early physiologists

The concept of artificial circulation and life support is as old as that of anaesthesia. European physiologists of the late 18th and early 19th centuries realised that the vital properties of organs could be temporarily restored after apparent death by allowing fresh blood to pass through them. The French physiologist Nysten injected gaseous oxygen into hearts quickly removed from guillotined criminals after execution in 1803, demonstrating some evidence of restoration of irritability in the myocardium. In 1811, he published the results of experiments in which he injected oxygen into the great veins of unanaesthetised dogs in an atmosphere of nitrogen; he was able to prolong their survival from four to twelve minutes.[1] Le Gallois experimented with perfusion and ventilation of decapitated rabbits using syringes, and in his book published in 1812 he was the first to mention the idea of artificial circulation.[2] He contended that life may be preserved in any part of an organism by external perfusion, even though it be separated from the rest of the body. Kay in 1828 showed that the irritability of dying muscle could be temporarily restored by artificial perfusion, while in 1849, Loebell was the first to attempt artificial perfusion of isolated kidneys.

The work of Brown-Sequard in the mid-19th century advanced the knowledge of artificial circulation considerably at the time. He demonstrated the necessity of oxygenating the perfusing blood, by whipping it in air. By the same process of whipping and filtering the blood, he was able to render it incoagulable by defibrination, and show the desirability of anticoagulation in perfusion work. He successfully perfused various organs, producing some evidence of return of reflex activity after apparent death. These included mammalian heads, and even the limbs of freshly guillotined criminals at the stage of rigor mortis (for the latter he used his own arterial blood).[3] The production of artificial perfusion apparatus for laboratory use was thus started, as indeed was the legend of Frankenstein. (Mary Shelley wrote the novel in 1818).

In 1868, Ludwig and Schmidt described an apparatus for constant pressure infusion of arterialised blood into an isolated organ from a reservoir. Von Schroder reported improvements in oxygenation in 1882, including the bubbling of air through a bottle of venous blood — the first attempt at bubble oxygenation. In 1885, Von Frey and Gruber described the first apparatus to allow constant aeration of the blood without interruption of flow to the perfused organ; they used a thin film of blood exposed to gas on the inside of a slanted, rotating metal cylinder to oxygenate with. This was the first apparatus to resemble the modern pump oxygenator in principle.[4]

These early experiments suffered from many shortcomings. A large volume of blood was needed to prime the apparatus; this usually came from a large animal — a readily available and plentiful source. Blood from a horse or sheep might be used to perfuse a dog or cat, and the experiment would thus be severely affected by transfusion reaction. The trauma to the blood from mechanical handling, whipping and aeration would have been severe; it would be devoid of clotting factors, and contain cell debris, free haemoglobin, denatured proteins and vasoactive compounds. Gaseous and particulate emboli would have been plentiful, and at best these machines could only oxygenate a few hundred millilitres of blood per minute to some 90% saturation, making them suitable only for bench perfusion of isolated organs.

Early 20th century advances

Around the turn of this century, attempts were made to improve on this apparatus. In 1895, Jacobj was the first to use an excised, ventilated animal lung as an oxygenator, and he showed good oxygenation with reduced damage to the blood. An apparatus designed by Brodie in 1903 required no additional blood for perfusion.[5]

The alternative approach to laboratory perfusion work which was also used at the time was to make a heart-lung preparation of an animal to perfuse the excised organ with; the organ would be placed in circuit between the aorta and vena cava of the preparation. These were the preparations used by Frank and Starling, and were cheaper and more readily available than artificial apparatus, but were subject to variability in performance. They did, however, lead to greater understanding of cardiovascular physiology.

1920's to 1950's

During this period, particularly after the Second World War, science and technology advanced steadily. New materials became available. Stainless steel was found to be more physicochemically inert than the copper and brass of the 19th century physiologists. Transparent plastics began to replace red rubber as a blood carrier. High quality glass was manufactured for the first time. Silicones were developed and found many uses in blood handling because of their inertness and "unwettability". Their effect on the surface tension of liquids also made them ideal antifoaming substances, dispersing gas bubbles in blood effectively.

Heparin was discovered quite incidentally in 1916 by Jay McLean, then a student at Johns Hopkins Medical School, Baltimore. He was given a research project, to study the properties of thromboplastic material extracted from animal brain tissue — coagulant phospholipid compounds known as cephalins. He went on to explore extracts of other tissues for similar substances, and unexpectedly found an extract of dog liver which had the opposite effect — it rendered incoagulable any blood to which it was added. He mentioned this finding in his results, but put it to one side.[6] McLean gave it the name "heparin" from its liver origin, and it was subsequently investigated by others in the U.S.A. It was also found to be present in other organs, including lung. During the ensuing years it was purified, its bioassay was standardised, and it was first marketed for clinical use in 1935. Heparin gave, for the first time, predictable, self-limiting anticoagulation without damaging the blood, and the later development of protamine made it fully controllable.

Greater understanding of haematology, blood incompatibility, clotting mechanisms, physiology and pharmacology was being acquired throughout this period, while parallel advances were also being made in the fields of surgery, anaesthesia and supportive care. Cardiac surgery was progressing rapidly, the operations of closure of the patent ductus

arteriosus, correction of coarctation and the Blalock-Taussig shunt all being described between 1939 and 1945. The factor still preventing open heart surgery was the lack of a circulatory support apparatus for use in man.

The artificial lung

Progress in the development of oxygenators before 1950 consisted mainly of improvements on the original 19th century ideas, incorporating 20th century technology, but the excised animal lung still provided the standard for comparison. Since the physics of gas transfer across a liquid surface were not to be fully understood until the early 1960's, development of artificial oxygenators had to be empirical, done on a trial-and-error basis. Because of the difficulty in defoaming blood before the introduction of silicones in 1950, the most promising area for the researchers was in filming the blood, to increase the surface for gas exhange. Larger and more complex rotating cylinders were devised, but they were limited by the tendancy to damage and foam blood too. Rippling the blood over a stationary screen increased its surface area by causing turbulent flow, without foaming the blood, but a steady thickness or flow of blood was needed for useful oxygenation. Materials tried for the screen included silk, nylon, glass bulbs and stainless steel mesh. The use of rotating discs for spreading the blood originated with Hooker in 1915, but the first to devise a machine suitable for use in large animals was Bjork in Sweden, in 1948. This principle was later used very successfully in humans, but has since been superceded. Other methods included the use of rotating spirals, screens and cones, and many other combinations and permutations of the above principles.[7]

The use of silicones in the debubbling chamber made the bubble oxygenator safe, and it became almost universally accepted from 1955 onwards, although modern development of the semipermeable membrane oxygenator is in turn threatening the position of the bubble oxygenator.

The artificial pump

Surprisingly, development of successful pumps lagged behind that of oxygenators. Early workers had first used constant flow perfusions from a reservoir, which had a limited duration. For longer perfusions, they used syringes and systems of non-return valves, and the syringes were later driven mechanically. The potential value of pulsatile flow was first recognised by Ludwig and Schmidt in 1868. This was achieved by Jacobj in 1890, by intermittent compression of a balloon placed in the circuit, on a "bag-in-bottle" principle. Dale and Schuster designed a more modern version of this pump in 1928, which was repeatedly adapted and widely used until the 1950's.[8] Ingenious ideas included the adaptation of an Austin 7 engine to drive a four-cylinder blood pump of this type in 1933![9] This emphasis on pulsatile flow persisted until the 1950's, and probably discouraged the development of other types of pump; it then subsided, only to be resurrected again in more recent years.

Other principles explored included the centrifugal pump and the Archimedean screw, but few of these ideas achieved any widespread application. Devices which used external compression of a flexible tube were of some value. The Sigmamotor pump utilised a row of metal fingers to sequentially compress a tube, driving blood along it; it was first used in 1949, and was very successful. The pump generally used now is the familiar roller pump. Its origin is difficult to pinpoint, since the basic design is old. Roller pumps were first

used for handling blood in the 1920's, but De Bakey's description of a manually operated roller pump for rapid transfusion in 1934 is perhaps the most well known.[10] There have been many adaptions since, but the roller pump was not incorporated into extracorporeal circulation apparatus until 1953. All the early bypass attempts in man (including the first success) used Dale and Schuster pumps.

Centrifugal pumps were never widely used, because of their tendency to damage the blood, but the recently introduced vortex pump is based on the same principle, of spinning a stream of blood into an orifice, creating pressure and flow. These new pumps are said to be less traumatic to blood than modern roller pumps.

Extracorporeal circulation in man

The first worker to perfect a pump oxygenator which could be used to perfuse whole intact animals, and feasibly humans, was the Russian Brukhonenko. He described the "Autojector", which used an excised animal lung for gas exchange in 1929, but this was not well known in the West. The credit for the idea of using artifical circulation as an adjunct to cardiothoracic surgery is given to John H. Gibbon Jnr., a Philadelphia surgeon. Even so, it was not the prospect of open heart surgery that initiated his research.

In the early 1930's, Gibbon was dismayed at the appalling mortality of pulmonary embolectomy (Trendelenberg's operation) — an operation best described in those days as a "premorbid autopsy", since it was never contemplated until the patient was near dead, and there had been only 9 survivors out of 142 operations reported. He worked in the laboratory on a means of artificially maintaining the circulation during temporary occlusion of the pulmonary artery in cats. He adapted the available apparatus, including a rotating cylinder film oxygenator and his own adaptation of the Dale and Schuster pump, and sacrificed the cats for autopsy after each experiment. He published his initial results in 1937.[11] He later allowed the cats to survive, and began to see encouraging results. Meanwhile, heparin and dicoumarol became clinically available and were used to good effect to treat pulmonary embolism, but Gibbon saw the potential for his technique in cardiac surgery. His work was interrupted by the Second World War, but he and others carried on the quest for human cardiopulmonary bypass after the war. Gibbon obtained engineering help from the International Business Machines Company (I.B.M.), but was unable to make a rotating cylinder oxygenator large enough for human use. By changing to a vertical stainless steel screen oxygenator, he obtained immediate success in trials on larger animals between 1949 and 1952. Gibbon was not, however, the first to attempt bypass surgery in man.

Dennis and his coworkers had been working on a pump oxygenator in Minnesota, using a rotating screen disc oxygenator. They performed open heart surgery on a 6 year old girl on April 5th 1951. Unfortunately, on opening the heart she was found to have a common atrium — a much more serious problem than had been anticipated, and, although the bypass performed well, the surgery failed, and the patient died.[12] There were at least two other failures, including one by Gibbon, before the first successful bypass operation was performed, also by Gibbon in Philadelphia, on May 6th 1953. The operation was the closure of an atrial septal defect on an 18 year old girl; bypass time was 26 minutes, and the patient lived a normal life afterwards.[13]

John H. Gibbon was later nominated for a Nobel prize, but it was considered that his ideas were not sufficiently original to justify the award. Interestingly, successful pulmonary embolectomy using bypass was not reported until 1962!

Other approaches

Cardiac surgery with bypass after 1953 still carried a very high mortality rate, and was not uniformly accepted. Gibbon was unable to reproduce his remarkable success in patients with more complex congenital ventricular defects; he became disillusioned and stopped using his bypass apparatus. Hypothermia with venous occlusion gave enough time to complete atrial septal defect repair and valvotomy, and was being increasingly used. Many researchers looked at other approaches to the problem of open heart surgery. Perfusion from a reservoir was limited in duration by the size of the reservoir, without refilling. Intravenous injection of gaseous oxygen or hydrogen peroxide ("endogenous oxygenation") caused pulmonary gas embolism. Single pumps substituting for the right or left heart only were tried. The use of two separate pumps to substitute for the two ventricles and the patient's own lungs for gas exchange (autogenous lung oxygenation) proved complex, but achieved some success. This was the basis of Drew's profound hypothermia technique.[14] The use of an animal lung for gas exchange (autologous lung oxygenation) continued, but this was limited in duration by the formation of interstitial oedema in the animal lung causing failure of oxygenation.

Andreasen and Watson, working in England, demonstrated in 1952 that life could be temporarily supported by a blood flow as low as 10% of the resting cardiac output, directed primarily to the brain and kidneys. They obtained low flows in dogs by occluding the venae cavae and allowing only azygos venous drainage into the heart.[15] Workers in extracorporeal circulation before that had concentrated on equalling the resting cardiac output. The azygos flow concept triggered new thinking, and groups in England and the U.S.A. began to work with controlled cross-circulation. This consisted of one animal providing a circulation for a second by vascular connections, with a flow control to prevent the donor from exsanguinating into the recipient. This principle was applied to humans by Lillehei in Minnesota in 1954, with remarkable success, leading to a number of cardiac surgery "firsts", including the correction of Fallot's Tetralogy and atrio-ventricular canal. He operated on children with congenital heart disease, using an anaesthetised, compatible parent as the circulatory donor.[16] The reason for the spectacular success of the technique probably lay in the donor's ability to correct any physiological derangement in the circulation during the procedure. This was not realised at the time, since understanding of the effects of acid/base and other physiological abnormalities was poor or non-existant. The technique was controversial, because of the risk to the normal donor. One critic described it as the first operation in history with the potential for 200% mortality. Cross-circulation fell into disrepute after the death of a donor. A safe, simple, disposable bubble oxygenator was introduced by De Wall in 1955.

Refinements

Total cardiopulmonary bypass gradually became accepted as the safest and most useful aid to open heart surgery. Refinements which followed ensured that bypass would supercede the other techniques. These include the perfection of the bubble oxygenator, the use of moderate hypothermia with bypass, the introduction of elective cardiac arrest ("cardioplegia") by Melrose at the Hammersmith Hospital in 1955, advances in sterilisation and technology of plastics, and the development of a small, compact membrane oxygenator. Pulsatile flow is now readily available, thanks to the microprocessor, but its value and necessity are still being questioned.

Conclusion

Extracorporeal circulation is an old idea, but a new science in man. It has developed by trial-and-error in a haphazard way, by many individuals working independently, trying

to achieve rapid progress without a full understanding of the underlying physical and physiological principles involved. As a result, emphasis has been on the mechanical approach to artificial circulation, within the bounds of the available technology of the day, rather than on the physiological response to it.

Cardiopulmonary bypass is now used routinely to replace cardiopulmonary function for increasing periods of time, but the physiological insult caused by it has not changed in nature — merely in severity. Cardiopulmonary bypass still remains a crude physiological exercise, which cannot easily be continued for more than a matter of hours without detriment to the patient.

The principles of extracorporeal circulation are now finding new applications in medicine, and the technology of bypass is constantly progressing. Many of the older approaches are also being reappraised, such as partial left or right heart bypass for cardiac support, and autogenous lung oxygenation. There are many advances yet to come in the field of artificial circulation.

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MEMORIES OF EARLY DAYS OF OPEN HEART SURGERY IN U.K. AND INDIA

Dr Ruth E. Mansfield

Personal memories were mainly from my work at the Brompton Hospital in U.K. where I was privileged to work with such pioneers as Brock, Tubbs and Cleland, and later, after 1969, from my time in India. Tribute must also be paid to my teachers in anaesthesia, the late Sir Ivan Magill for his endotracheal tube and many techniques, and to the late Michael Nosworthy [1] for controlled ventilation of the lungs. Both of these men helped to make thoracic, and later heart surgery safe.

In the 1950s we started with moderate hypothermia, 28° - 30°C,[2] which gave up to 10 minutes cardiac arrest in open heart procedures, enough for a closure of an A.S.D. or pulmonary valvotomy. This was achieved by two methods: a) Surface cooling, b) Veno-venous cooling.

For *surface cooling*, the patient was anaesthetised sufficiently to prevent shivering, using the drugs then available, usually with a sleep dose of 2.5% thiopentone given slowly, a relaxant and nitrous oxide mixture. Nasopharyngeal, oesophageal and rectal probes and ECG leads were placed. A large bath of water and ice was brought alongside the patient who, complete with IV drips and connected to the anaesthetic apparatus, was then immersed. To balance a Water's cannister on the side of the bath and hand ventilate the lungs while the patients' limbs were vigorously massaged to get even cooling, was quite a feat. Because of the after-drop in temperature of approximately 4°C and with the risk of ventricular fibrillation, the patient was removed from the bath at a nasopharyngeal temperature of 32°C and placed on a warming/cooling blanket already on the operating table and dried. At 28°C the open heart surgery was begun, while warming was started by the warming blanket, but if after the chest was closed the temperature was still under 36°C the patient was placed in a warm bath.

It was little wonder that Brock favoured *veno-venous cooling*. He stated that 'Immersion was aesthetically and surgically unattractive'. Using this technique developed at Guy's by Ross[3] in 1954-1956, the chest was opened under normothermia and the diagnosis confirmed. A cannula was inserted into the superior vena cava and another into the inferior vena cava. Hypothermia was achieved by hand pumping the blood from the SVC through a cooling coil and returning it at a temperature of 31°C to the IVC.

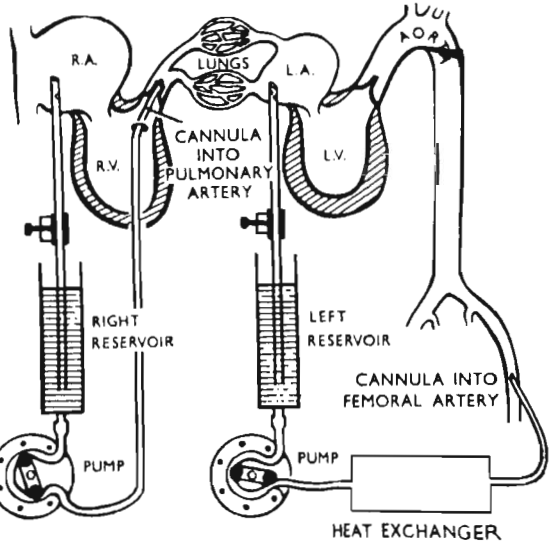
The advantages of this method over surface cooling were that cooling and rewarming was faster, the temperature achieved was more controllable with an after-drop of only 2°C, and if during the cooling resuscitation became necessary, it could be immediate as the chest was already open.

Profound hypothermia

It was then realised that profound hypothermia 15° - 12°C gave up to 60 minutes operating time without brain damage. Tubbs used the Drew technique, developed at Westminster Hospital by Drew, Keen and Benazon[4] in 1959 using two pumps to take over the two ventricles during cooling (Fig 1). Blood from the right atrium was collected in a right reservoir and then pumped into the pulmonary artery by means of a cannula inserted through the infundibulum of the right ventricle. This blood passed through the lungs, which were

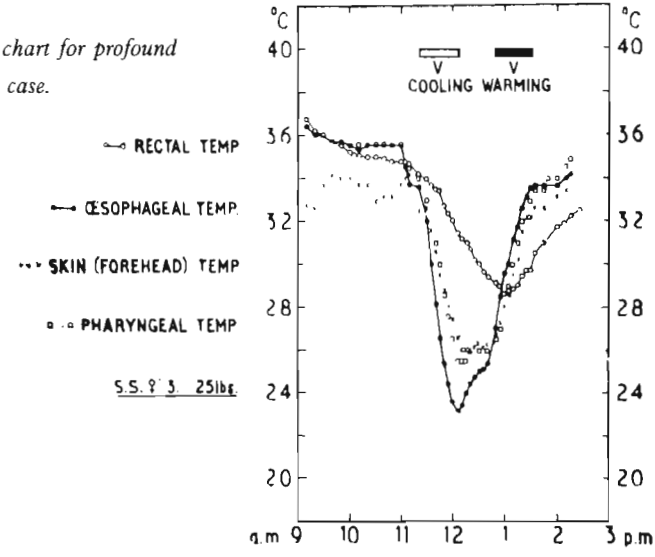
ventilated by the anaesthetist with 30% N_2O in oxygen, to reach the left atrium. A left atrial drainage tube then carried this oxygenated blood to the left reservoir from which it was pumped by the left pump into the heat exchanger. The cooled blood was returned to the patient via the femoral artery and clamps were applied when the heart stopped beating,

Figure 1.
Profound hypothermia circuit.



which was usually at about 15°C. After surgery the blood temperature could be raised by means of the heat exchanger used as a blood warmer. The heart was defibrillated at 30° - 32°C and heparin was reversed once the patient was off bypass.

Figure 2.
Temperature chart for profound hypothermia case.



Anaesthesia drugs and techniques were similar for most cardiac surgical procedures at the time. During cooling at 28°C, nitrous oxide could be turned off and 100% oxygen given for ventilation. Since carbon dioxide production falls parallel with the reduced metabolic rate of hypothermia, 5% CO_2 was added to the mixture during the cooling process and 7% CO_2 when 15°C was reached in order to keep a normal PCO_2, but during rewarming no CO_2 was added. At a temperature of 15° - 12°C ventilation of the lungs was unnecessary but they were kept inflated with oxygen during surgery which was carried out on a quiet non-beating and dry heart. On rewarming after surgery, above 30° - 32°C it became necessary to administer anaesthetic drugs again. It was important to monitor nasopharyngeal, oesophageal and muscle temperatures, as the latter lagged behind.

Advantages of this technique were:- fewer 'pump lungs' when using the lungs as the oxygenator and coronary perfusion was unnecessary for operations on the aortic valve.

But disadvantages of profound hypothermia were the time-consuming perfusion times for cooling and rewarming and the fact that it involved cannulation of both systemic and pulmonary circulations and aortic clamping for only 60 minutes.

The Disc Oxygenator

The Melrose disc oxygenator was used at the Brompton Hospital in 1960 after Melrose[5] developed it at the Hammersmith Hospital. Venous blood from the right heart was exposed to a gas mixture of 97% oxygen and 2.5% carbon dioxide in the disc oxygenator and returned via the femoral artery. The oxygenator consisted of rotating stainless steel discs. They were difficult to clean and they, of course, had to be sterilised between each use. It was usual to notify the blood bank of any expected cases as often 10 units of fresh blood were required. The oxygenator was primed with blood depending on the body surface area. Bleeding during closure, and postoperatively, was a frequent complication in my experience. Calculation of loss was by swab weighing and measurement of drainage. With the Melrose technique, cardiac arrest was achieved with potassium at a normal temperature and administration of anaesthetic intravenous drugs was necessary during the period of cardiac arrest because the circulation of blood through the brain and body was maintained by the pump throughout surgery. The lungs were kept in a state of inflation with oxygen, but not ventilated during the cardiac procedure. It was a pioneer method, sufficiently successful for Cleland's team of Melrose, John Beard the anaesthetist and theatre Sister to be invited to Russia for a demonstration and a successful case.

The Bubble Oxygenator

Then came the various bubble oxygenators, such as the Rigg bag, Temprol and others with a heat exchanger incorporated in the circuit. The entrance of air into the circuit was minimal, while oxygen was bubbled through blood and Hartmann's solution in the bag. With haemodilution, it was found unnecessary to prime with so much blood. However it was possible to use clear prime depending on the patient's haematocrit, provided fresh ACD blood was available for possible haemorrhage. Blood loss was calculated from the central venous pressure and blood could be infused into the patient as necessary from the oxygenator.

Postoperatively the patient was transferred to the ICU, hand ventilated, tube in place, and put on a ventilator at least overnight and until the condition was stabilised and breathing adequate. A tracheotomy, with its possible complications was hopefully avoided.

Memories of India

On arrival in India in 1969 open heart surgery had already been done at the Christian Medical College and Hospital, Vellore, 90 miles inland from Madras. It was a teaching hospital of 1,100 beds with, then, 7 operating theatres, but no anaesthetic rooms. The cardiac and neuro-surgical theatres luckily were air conditioned (one of which blew up during a case and I never saw the surgeons move so fast). Dr Gwenda Lewis had organised the Anaesthesia Department with staff, trainees and technicians, but sadly caught poliomyelitis resuscitating a boy. In spite of this she carried on from her wheelchair until she handed over to one of her trainees, Dr George Varkey, just before I arrived.

Drugs available then were basic, such as novacaine, xylocaine, morphia, thiopentone, ether, halothane, suxemethonium, and d-tubocurarine. Supplies of nitrous oxide and oxygen were better then in many parts of India as Indian Oxygen Co, had a plant in Madras and there was a delivery of large and small cylinders to the gas bank at CMC engineering department by lorry. This was rebuilt before the 14 new theatres and 7 anaesthetic rooms in 1973, to supply piped oxygen, nitrous oxide and oxygen to recovery room and cardiac ICU. In the latter there was also compressed air to run the ventilators (we used to say that we knew when summer had come as there were melons in the market and cardiologists in the ICU)!

Ventilation was by hand until we got a Blease Pulmoflator. Monitoring at first was with a BP cuff, arterial and venous lines and a Sambourne ECG machine, using the write-out from time to time. Electrolytes with potassium samples were sent to the biochemical laboratory by messenger. Drip sets were home-made with rubber tubing, and glass and steel needles sharpened in the CSSD, so we at first missed the disposable needles, cannulae and drip sets we have here until some disposable supplies came through.

There was a blood bank and donors were paid 10 rupees for a pint of blood, although relatives were told "NO donation NO operation".

A Melrose disc oxygenator was at first used (with the usual blood loss). This was sterilised and run by the cardiac technicians with advice from consultants. Later disposable bubble oxygenators became available.

Rheumatic infection was the commonest problem, with stenosis and incompetence even occuring in those under 10 years of age. Many mitral valvotomies were done by Stanley John, by the Brock method and valve replacements reserved for incompetence and aortic disease. There were also many congenital cases — ASD, VSD and tetralogy of Fallot, some with a haemoglobin of up to 24 gm/dl that had to be haemodiluted preoperatively.

After a visit by Mr Christopher Lincoln we started using cardioplegia, the solution being prepared in the pharmacy, and did a study on the effects on cases with and without cardioplegia with the facilities available.

Interesting incidents

At CMC, when the new theatres were built, we had trolleys with separate, movable tops and base sections, so that the patient could be transferred from the ward base directly on to the theatre base over a barrier. This was to minimise infection as there had been cases of tetanus in the old theatres. During an electricity cut, we had to bring a patient back due to bleeding. While hand ventilating in the ward, one of the surgical assistants lifted the top section of the trolley off the base, a difficult moment until it was secured and the lights came on in time to use the lift.

One evening when visiting the Cardiac ICU we found two patients on ventilators in distress and realised that the compressed air had failed, so had to connect them to pure oxygen. Being unable to contact the engineering department by telephone, I decided to go the quarter mile to that department to solve the problem. Luckily I picked up one of the anaesthetic technicians en route and found that one of the engineering staff had, unrealisingly, turned off the supply. In spite of a reprimand from the chief engineer this happened twice again, until a threat of a 10 rupees fine was threatened.

In 1980 one of Stanley Johns' postgraduate trainees, James Thomas, asked if I would be around while he restarted the Cardio-thoracic unit at *Miraj Medical Centre*, another teaching hospital founded in 1888. It was more of challenge than Vellore as the pump oxygenator was 16 years old and had to be rewired and its output checked before use. We decided at first we would start with short procedures and relatively small patients. Our first patient was a teenage girl with an ASD. All was well until we went on bypass when the cardiac sucker was not functioning, so instead of the blood being returned to the machine it was wasted. The porter standing by to bring fresh blood seemed to have gone to lunch! So we had to use Hartmann's solution in the meantime. Fortunately James Thomas closed the ASD in record time and all was well until we took her to the ICU only to find they had a case of septicaemia which had been admitted into the same room. No wonder there was trouble with her wound!

We learned by our mistakes. It was obvious that the cardiac unit should have its own ICU if infection was to be avoided. In the meantime the coronary care ward was used until its own ICU was ready.

As the pharmacy only opened at 8am and we started operating at 7.30 we had to have all possible drugs, drip sets, cannulae, syringes purchased by the patient the night before and brought to the theatre with him. On visiting the unit in 1985, we were glad to see how well it had progressed.

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ANAESTHETIZING: THE EARLY YEARS OF A GROWTH INDUSTRY

Dr Barbara Duncum

In England, in the late winter of 1846-47, the quickest way for a medical man and, indeed anybody else, to find out about painless surgery was to watch it being done in the nearest hospital. Operating sessions were open to the public and the first surgeons to follow Liston's lead held hospital appointments either in London or in towns and cities up and down the country. In those hospitals whenever word got round that a patient was to be made insensible, local physicians and surgeons eager to learn and laymen full of curiosity, crowded into the operating room.[1] That sometimes led to strange gatherings. At the Maidstone Ophthalmic Institution on the January 16th, for instance, although only two adults for minor operations and a boy with a squint were on the list, the spectators included the mayor and other members of the corporation and the officers of the cavalry depot with their two army surgeons.[2]

In early reports of painless surgery in London, each of the small number of self appointed etherists was given prominence. In reports from the provinces it was usually only the surgeon who stood in the limelight and the etherist, if he happened to be mentioned, was likely to be either one of the hospital's regular physicians or a particular medical crony of the surgeon. In private practice which catered for everyone not sufficiently poor to be eligible for hospital treatment, the role of etherist was virtually ready-made for the patient's physician. Long before etherising was thought of, most general practitioners had a link with some surgeon to whom they referred cases needing more than fairly minor surgery. The GP attended the operation — done in the patient's bedroom no matter how unsuitable — his part being to support and encourage the sufferer during the surgical ordeal. The surgeon himself usually brought one or more colleagues with him to assist. When etherising was adopted, the customary duties of the patient's physician made him the obvious person to act as anaesthetist and to monitor the patient's general condition until consciousness fully returned.

During January and February 1847 professional enthusiasm for painless surgery was shared more soberly by patients. Those operated on were thankful, and a good many others previously too terrified to agree to surgery plucked up courage and asked to be etherised and treated. Although anaesthesia often went wrong, the difficulties were generally regarded as useful experience and were described along with the successes in letters to the press. "Our office is literally inundated with details of new operations performed on patients under the influence of sulphuric ether", the editor of the *Medical Times* wrote in a leader on 27th February.[3]

A shock was in store for everybody. On March 19th, *The Times* reported an inquest on Ann Parkinson, the 23 year old wife of a Grantham hairdresser. On March 9th, at her own request, she had inhaled ether for the removal of a tumour on her thigh. She failed to rally after the operation and about 36 hours later she died. At the inquest it was said that six people had been present during the operation — her sister-in-law, her GP who operated (he was also the surgeon to the Grantham workhouse union), the etherist and two other medical men, and a nurse. After hearing their evidence, the coroner's jury returned a verdict that the sole cause of death had been the inhalation of ether vapour.[4] In fact, Ann Parkinson was the second patient in England to die some hours after inhaling

ether. The first, a 52 year old man, had died on February 12th after lithotomy at the Essex & Colchester Hospital. His death was not directly attributed to ether and there had not been an inquest but Mr R.S.Nunn the surgeon in the case, reconsidering it in March, suggested that inhaling ether had so depressed the patient's nervous system that his powers of recovery were lost. Nunn was now inclined to believe he said, that pain was a healthy indication and an essential concomitant of surgical operations which perhaps ought not to be artificially suppressed.[5] A similar argument was already persuading obstetricians that the pangs of childbirth were salutary and so had better continue to be bravely borne.[6]

Apropos of the Colchester and Grantham deaths, the editor of the *Medical Times* drew his readers' attention to several deaths on the Continent, and asked rhetorically whether ether inhalation should now be considered too hazardous for further use. Answering his own question he concluded that in careful, experienced hands the advantages of etherisation decidedly outweighed the drawbacks.[7] Most people seemed to have agreed with him; nevertheless, the number of letters from tyro etherists to the press sharply decreased and the remarkable speed and completeness of the switch to chloroform when Simpson announced its virtues in mid November 1847 showed how greatly confidence in ether had been shaken. Once again, a shock was in store.

On January 28th 1848, young Hannah Greener, inexplicably as it seemed, died inhaling chloroform for the removal of a toe nail.[8]. Her death was only the first of many. That summer, for example, the meticulous and very experienced proto-etherist, James Robinson, acting as his own anaesthetist in his private dental practice in Gower Street, lost a patient — a solicitor named Badger. The evidence at the inquest provides a glimpse as to how things were managed in a top-level dental surgery. Mr. Robinson's maid servant said she was always present when ladies were being treated. When the patient was a man the footman attended, though the maid deputised for him if he was otherwise occupied. One of the footman's duties, should the occasion arise, was to run along Gower Street to fetch medical help if the patient collapsed. The footman had indeed run along Gower Street when Mr. Badger collapsed but it was too late.[9].

In private medical practice, except when a leading surgeon brought his own anaesthetist — as Professor William Fergusson would bring Dr. Snow — the patient's GP continued to act, generally becoming not only proficient but interested in what he was doing. In English hospital practice however, there was a growing tendency to think like the Scots, that the chloroformist needed little special training and need not be a fully qualified medical man.

By March 1852 the number of chloroform deaths reported from London hospitals was becoming alarming and John Snow wrote to the *Medical Times & Gazette* (that journal's new title). His letter followed a death at St. Bartholomew's where the anaesthetist had been one of the dressers. "The office of adminstering chloroform should no more be delegated to a dresser than the important operations of surgery", Snow wrote. Nor did he think house surgeons any more suitable. Their tenure of office was too brief for adequate experience, and understandably they were more interested in watching the surgeon than the patient. In Snow's opinion, as there must always be someone on the spot to administer in an emergency, the most appropriate person was the resident medical officer. That plan had been found to answer perfectly where it had been acted on. He instanced St. George's Hospital, where Mr. Potter "was appointed to the duty of giving chloroform between two and three years ago", and University College Hospital where, as he said, "Mr. Clover has, I believe, performed this duty since the early part of 1848, with equally satisfactory results".[10]

Just a year later, in March 1853, a patient died at University College Hospital, while being given chloroform by a house surgeon. The Medical Committee then announced that although the resident medical officer should continue to act as chloroformist whenever conveniently practicable, since he could not always be available they were appointing deputies: two specially assigned house surgeons — one of whom, as it happened was Joseph Lister.[11]

At the turn of the year 1853-4 the UCH Medical Committee accepted a suggestion made to them by S.F.Statham, the junior assistant surgeon. Statham proposed that all the hospital's medical students, as part of their course of studies, should receive some practical instructions from the RMO on how to administer chloroform, and that a certificate to that effect should be among the requirements for final qualification.[12] A notable advance along the meandering trail to professionalism in anaesthesia, one might think. But whether or not the scheme was put into practice I have so far been unable to discover.

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JOHN SNOW - AN EARLY INTENSIVIST

Dr R.S.Atkinson

John Snow lived in an era long before the invention of intensive care units and by no stretch of imagination can he be referred to as an intensivist. Why then do I choose the title? The aim that I had in mind was to draw your attention to how John Snow thought about medical treatment and how he was ahead of his time in applying some of the principles of anaesthesia as then understood, to the care of the ordinary medical patient. Some of his patients had near fatal conditions and there was nothing to lose, so why not try some anaesthetic principles and some chloroform? In any case, he didn't have to worry about medico-legal considerations in those days.

If I can just refresh you a little about Snow, the man. We are indebted to Benjamin Ward Richardson for such bibliography details as we have.[1] Richardson was his friend and biographer and tells us that Snow was born in York on the 15th June, 1813 and he studied in Newcastle. As we all know, he treated cholera at Killingworth Colliery. After some time at Burnup Field in Newcastle and Pateley Bridge in Yorkshire, he came to London. He took a circuitous route through Liverpool, trudging on foot through Wales, visited an uncle in Bath and, finally, arrived in London in 1837. We know something about him as a person. He is said to have been of middle height and of somewhat slender build, of sedate expression, and had a reserved manner with strangers. In short, he was introverted and he was the sort of chap who devoted himself to scientific experimentation and rational clinical work.

In London, he proceeded to take the various examinations then available and joined the Westminster Medical Society (WMS) where he was an active participant at meetings. In 1841 - we are now talking about some 5 years before the introduction of anaesthesia - he was also interested in the principles of resuscitation. He gave a paper to the WMS entitled 'Asphyxia- on the resuscitation of newborn children' and his aim was to describe a double air pump invented by a Mr Read of Regents Circus, thereby foreshadowing his interest in resuscitation methods.

He spoke at various meetings of the WMS and wrote papers on various subjects, for example - paracentesis of the thorax. Some of these were published in the *Medical Gazette* and when anaesthesia arrived in London at the end of 1846, Snow was quick to take an interest. He had a lively mind and was adaptable to new ideas.

Snow and anaesthesia

Richardson considered why he was attracted to anaesthesia. He suggested that Snow enjoyed the rational nature of anaesthetic administration and its humane aspects and appreciated its basis in physiological knowledge. Snow started to design an improved ether inhaler and experimented with anaesthetics on animals and on himself.

He attended outpatients of StGeorge's Hospital where he used anaesthesia for tooth pulling. Eventually, the ether practice in London, Richardson tells us, came almost exclusively to Snow though, of course, ether soon gave way to chloroform. We know that Snow kept a diary of his clinical practice, from 17th July 1848 until the 5th June 1858, the last ten years before his untimely death. These diaries occupy three exercise books which on Snow's death came into the possession of Richardson and his family. Richardson's daughter-in-law, Mrs. Audrey Richardson, presented them to the Royal College of Physicians of London where they now reside in the library.[2]

Resuscitation

I found it interesting to read some of the extracts from the diaries, and am now concerned with some which are quite unconnected with surgical operations. Snow attempted resuscitation of the newborn and in one of his entries he described his only case of cardiac arrest during anaesthesia and what he did to try to resuscitate the patient. It is interesting to discover that he also had several cases of what we might describe today as 'near misses'.

He did a lot of obstetrics and it is quite clear that practice was pretty crude in the mid 19th century. We all know that the maternal death rate and perinatal death rate were high and it is fascinating to read some of the descriptions of how obstetrics was done in those days, of how chloroform was administered and how, in the absence of proper ante-natal care and so forth the babies were often delivered in perilous states. Snow described several attempts to revive stillborn or hardly breathing newborn babies. For example, it seems that as a last resort he passed a gum elastic catheter into the larynx and made attempts to inflate the lungs by blowing down it.

In another patient Snow described how he passed a female catheter into the glottis but he was clearly not satisfied with his attempts to resuscitate the patient because he took it out again, and he remarked that his fellow practitioners got much better results by blowing directly into the baby's mouth.

Snow's one anaesthetic death was during administration of amylene, a drug we don't know much about today but one which he used in a number of patients to produce anaesthesia. He gave a fairly honest description because he noted that his attention was distracted from the anaesthetic for a few seconds while he was watching the surgery and when he looked back he found the valve of the face piece had moved so as to occlude the aperture, presumably giving the patient a rather high concentration of the drug. He at once discontinued the anaesthetic and felt for the pulse which was not present in the left wrist and only a slight flutter in the right, and although the patient was breathing well, the respirations gradually became slower and deeper. Snow had to draw the surgeon's attention to the fact that all was not well. How did they treat this case? They threw cold water on his face and that didn't work very well. The patient was now becoming livid and gasping, and they began to perform artificial respiration according to the method of Marshall Hall. Then they pressed on the chest, the face being turned to one side and Snow was careful to note that at this time air could be heard going in and out of the lungs freely, in other words, he checked that the technique was actually working. He also noted that care was taken that the tongue did not fall back and he was very particular to notice the timings - 4.46 inhalation commenced, 4.48 unconsciousness, 4.49 surgery commenced, 4.54 called Mr Ferguson's attention to the fact that all was not well, 5.00 deep inspirations were still occurring and they apparently felt some kind of pulsation. They went on for 1½ hours before they gave up. At post mortem they didn't find very much to account for it all. This doesn't really surprise you but it is interesting to note that the patient is said to have drunk a pint of bottled ale a quarter of an hour before the operation! The significance of that I don't know, the patient was only 33 and presumably healthy.

What about these 'near misses'? I was quite interested to read that it was not too uncommon for a state of syncopy or fainting to occur. For instance, during the extraction of 4 molar teeth which required immense force for their removal, Snow says: "...I felt the face was rather cold during the extraction of the second and subsequent teeth and at the end of the operation there was a little cold sweat on the forehead. He appeared faint and a minute or two afterwards the pulse could hardly be felt. He was laid on a sofa and recovered from

the faintness very slowly. It was upwards of ten minutes before he became conscious, after which he felt very drowsy and it was more than half an hour before he felt able to go." They kept the patient in for half an hour if things went badly in those days! I think it is interesting that in the context of the times relatively detailed records were kept.

Tetanus

But what about other medical diseases? If you came across a patient who was dying, was about to die, was likely to die, or there was no other known therapy, why not try an inhalation of chloroform? For example, on the 7th March, 1858, Snow administered chloroform at St.Mark's Hospital to a man aged 52 affected with tetanus. "He was operated on by Mr Salmon on Monday last for prolapsus ani and haemorrhoids by ligature, and the tetanus commenced on Friday evening. The patient was conscious and able to speak. He said he was not in pain but complained of twitchings. Spontaneous contractions came on almost every minute causing him to start and his muscles remained contracted between these. The abdomen was hard, he was able to show the tip of his tongue between his teeth. He had not been able to swallow anything since yesterday. His pulse was 148 full and strong and his breathing 30 in a minute." Snow commenced chloroform. "I had only just placed the face piece on with the valve wide open (presumably to allow plenty of air to get in) when his breathing became embarrassed and I removed it. The chest became fixed and his breathing stopped, his lips became very blue and he became unconscious, the pulse becoming very slow and somewhat feeble. Mr Salmon said he thought the man was dying. The nurse, however, told us that he had had a similar attack before in the course of a morning. In a minute or two the muscles of the chest became relaxed and he made gasping inspirations at intervals and in about a minute his breathing was natural and his lips of a proper colour again and his pulse as quick as before." What did he do? "I now re-applied the chloroform." They removed a bit of sloughing tissue while the patient was asleep. "The patient slept for about 20 minutes after the operation, then he had a little spasm on his anus being touched, and the chloroform was repeated and he slept the same time as before. I endeavoured after he awoke to get him to take some egg and brandy but he spluttered it out after attempting to swallow and had a bad attack of spasm." Of course, the patient subsequently dieIn another patient Snow described how he passed a female catheter into the glottis but he was clearly not satisfied with his attempts to resuscitate the patient because he took it out again, and he remarked that his fellow practitioners got much better results by blowing directly into the baby's mouth.

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Here's another case - 11th November 1853: "Administered chloroform at 10 Mansfield Street, to a son of Mr Morris, aged 10, who was affected with lockjaw. The jaws could only be opened sufficiently to get the tip of a spoon between his teeth. Chloroform was administered so as to make him unconscious. He still couldn't open his jaw.... The

chloroform was repeated a second time and then a third time, no relaxation of jaw was effected although I carried the effect of chloroform to insensibility and as far as seems safe in such a subject".

Convulsions, mania, typhoid, cholera

Snow administered chloroform to treat convulsions in a child aged 2 years 11 months who was presumably in status epilepticus. Chloroform was given which, of course, only had a temporary effect and the child later died.

Viscount Hinton, aged 34, suffered from acute mania - "He could not be persuaded to breathe the chloroform so he was seized by three keepers and held while I administered it, first on a towel and afterwards with the inhaler. When he found he was gassed and the chloroform was beginning to take effect, he became somewhat tractable and desired that it might not be given too strong". Although he gave him several repeated doses of chloroform this did not really, I am sure, do the patient much good ultimately.

He used chloroform to treat typhoid; presumably if you have typhoid you get some abdominal pain, and that was why the anaesthetic was given. After taking chloroform the delirium never became quite as violent as before.

He even used it to treat a patient with cholera. "...She had severe cramps and almost constant vomiting. The pulse was small, feeble and frequent. The patient inhaled from a small inhaler to the extent of being made just unconscious and when she woke up in a few minutes the inhalation was repeated to the same extent. Soon after I left she fell into a natural sleep which lasted 2½ hours and she continued afterwards to improve."

Those are just a few extracts from Snow's diaries and I thought it was interesting to report some which I find quite fascinating. They show, I think, that Snow was not afraid to try unconventional methods in those patients who really had very little hope of recovering otherwise. He wasn't afraid to try the effect of chloroform and see what it would do.

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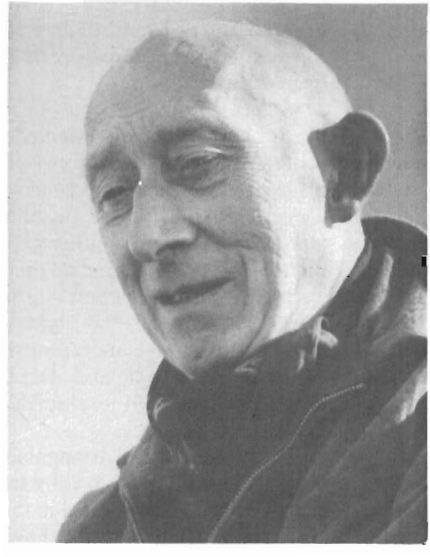
HUGH MORRISTON DAVIES 1879-1965

Dr Buddug Owen

In the early '60s I used to visit a dental surgery in the square in Ruthin, North Wales, to give dental anaesthesia. The session was interrupted on one occasion by the arrival of an unexpected patient who fortunately did not require my services. I was introduced to Mr Hugh Morriston-Davies and across a quarter of a century I remember seeing a short, bent, elfin-like man with big ears, a beaky nose, who had bright sparkling eyes and a firm handshake. I must have shaken his left hand — he had a clawed right hand — and I remember that he had great charm and firm views that there was no place for the operator-anaesthetist in the dental surgery.

Morriston-Davies was born in Huntingdon, where his father was a general practitioner, on August 10th, 1879 and it was his father who had taken the name of Morriston after the place in the Swansea valley where he had been born. He was educated at Winchester and Trinity College, Cambridge, where he initially didn't do well because he had become interested in the study of tooled book bindings. He had seen and fallen for a book with a Scotch binding and as he said years later in a radio interview,[1] "It was beautiful — that is what interested me all my life — beauty and the love of beauty".



Hugh Morriston Davies

He qualified from University College Hospital, London, in 1903, gaining the Fellows Gold Medal for Clinical Medicine and Erichson prize for surgery.

At U.C.H.

His first appointment was with Rissien Russell, the neurologist and the second with Victor Horsley whom he said he hero-worshipped. He gained his MD in 1908 with a thesis on the functions of the trigeminal nerve, showing the sensory changes in the face which followed Horsley's Gasserian ganglion operation for trigeminal neuralgia. Shortly after this, Henry Head published his work on the innervation of the skin, but he and Trotter, who was Victor Horsley's assistant at the time, queried Head's trigeminal nerve findings and decided to redo his work. They worked for two years experimenting on each other, dividing seven cutaneous nerves in all, and following each resection carried out elaborate testing during the period of regeneration. They failed to confirm Head's finding which was eventually refuted in their paper.

In 1907, Alfred Barker, who was Professor of Surgery at University College Hospital and the leading pioneer in spinal anaesthesia in this country, published the results of his first 100 cases[2] and HMD, as he was commonly known, assisted him with these. In 1909 he

became Assistant Surgeon at UCH and in 1910 — at Barker's suggestion — he went to the German Surgical Congress where he heard papers by Friedrich, Bauer, Wilms and Sauerbruch on rib mobilisation for tuberculosis and heard about the new 'underdruck' and 'ueberdruck' apparatus for use during operations on the open chest. He returned to London determined to do chest work which was a new field in England as he realised the Wilfrid Trotter would obviously succeed Victor Horsley.

Anaesthesia and the open chest

The first thing he did was to devise his own anaesthetic machine and intubating tube.[3] It was Mikulicz who had suggested to Sauerbruch that he research the problem of the open chest, and he devised apparatus to prevent collapse of the lung during thoracotomy with active respiration continuing.

He used two ways to solve the problem. Either patients breathed air at a tension greater than atmospheric or the open chest was exposed to a pressure less than atmospheric whilst the patient breathed air. He experimented with both systems and eventually favoured the hypo-atmospheric method because he thought it more physiological.

Brauer, independently of Sauerbruch, devised a hyper-atmospheric atmosphere where the lungs were kept charged at a pressure of 7-9mmHg. and his was the first machine on this system in general use.

Tiegel-Henle & Lotsch also experimented with a view to marketing cheap, simple, portable machines. Hugh Morriston Davies' reason for designing a new type of apparatus was that Sauerbruch's hypo-atmospheric machine was impractical because it took up too much room. With the Tiegel-Henle & Lotsch machines too great sacrifices had been made to secure cheapness and portability, and neither gave accurate working and constant pressure during long operations. Brauer's machine he thought was better, but administration was through a casket which enclosed the patient's head and he felt that this again wasn't satisfactory. He thought it important that the highest standard of accuracy should be insisted upon with apparatus and that no elaboration should be grudged which gave any possibility of increased safety. For safety he also decided to use an intubating tube, and because the mask, nose and pharynx were excluded, the air should be warmed and moistened.

His apparatus rested on a steel triangular base with three wheels; the front wheel had a pivot action and a handle fixed to it by which the machine was trundled about. He kept it in his office and when it was needed in the theatre it had to be wheeled along the corridors; the medical students called it his fire-engine. The main features included an air chamber working on the principles of a gas holder and fed from compressed air and oxygen cylinders at the back. The air in the chamber was at a pressure greater than that required in the lungs and after it left the chamber it passed through the rest of the apparatus which was on a tray on the front of the machine. It passed through a Stott's governor then through a modified Alcock's chloroform apparatus, then through a heating chamber and so through an endotracheal tube to the lungs. As it was exhaled, the air went through an expiratory chamber and so out into the atmosphere. Both the inspiratory and expiratory sides had manometers.

Morriston Davies thought the advantages of his machine were that the pressure of the air was constant, yet could be varied, and the expiratory and inspiratory manometers were a guide to the depth of anaesthesia. Brauer's machine cost £90, so his must have been about £60, and those by Tiegel-Henle & Lotsch were about £20 each.

Morriston Davies' intubating tube shown, like his machine in *Principles of Thoracic Surgery* by Mushin & Rendell-Baker,[4] had a movable gag (I discovered from Professor Cecil Gray that an original tube was in the Anaesthetic Museum of the United Liverpool Hospitals). In his article he said that before the pleura was opened the screw cap was disconnected and the anaesthetic given through the opening. He didn't mention how the tube was passed, nor how the anaesthetic was given through the opening but said that as soon as the pleura was about to be opened, when the air was flowing freely, the screw cap was fixed to the tube and the hyper-atmospheric circuit closed. He used his machine and tube until he admitted it was superseded and outclassed by the simpler ideas of Meltzer and Auer and by the Shipway apparatus.

X-Rays and thoracic surgery

As well as inventing his own anaesthetic machine HMD installed an X-ray apparatus in a research room at UCH, next to where Thomas Lewis worked on electrocardiography. Nothing was known of X-ray appearances of the chest diseases at the time and it was not thought to be essential, but during the first two years he took 1,000 plates. One patient who was referred to him with bronchitis he diagnosed as having carcinoma of the bronchus, and to everybody's consternation he proceeded to remove it, the first time a lobectomy had been carried out in the world (1912).[5]

He also performed many operations never previously carried out in Britain; they were mainly for tuberculosis, carcinoma, emphysema, bronchitis and one for mediastinal dermoid. He also did some vascular surgery, yet when he rose to speak on the treatment of pulmonary tuberculosis at the London Medical Society in 1914 he was asked to sit and not allowed to contribute. The physicians of the Victoria Park Hospital for Diseases of the Chest, where he also worked, wouldn't meet him, but asked their houseman to call him for certain operations, and he didn't always agree with this!

Severe injury

In 1916 he suffered a tragedy which was to alter his life. A small spicule of glass left on a piece of catgut pierced his right thumb when he was operating on a patient with emphysema. He developed an infection of his thumb and septicaemia, and when he eventually recovered he had a crippled right hand and arm. This was a time of great personal hardship. He resigned his post, by this time he was Surgeon at UCH, and became a Board official of the RAMC undertaking medicals. He couldn't afford a car and lived in Pinewood Sanatorium outside London, and had to catch the train to London by cycling two or three miles every day through woods. It was at this time that he started collecting and drawing wild flowers and he used this pastime to re-educate his right hand, eventually becoming ambidextrous.

Surgery in Wales and Liverpool

In 1918 he bought the Vale of Clwyd Sanitorium, Llanbedr Hall, outside Ruthin. He started with practically no staff, and had to do all the menial tasks himself, but made it into a place with an international reputation. The local general practitioners would invite him in to the local cottage hospital for consultation and he would assist them and teach them during surgery.

In 1922 he built an operating theatre at Llanbedr, and carried out, using his own machine and pneumothorax apparatus, collapse therapy for tuberculosis. He devised his own instruments for operations on the chest and also his own pleural fluid needles.

In 1920 the King Edward VII Welsh National Memorial Association made him their Consulting Thoracic Surgeon with headquarters at Llangwyfan near Ruthin. He later travelled to operate in Talgarth, Mid Wales; Cheshire and Lancashire. Eventually he relinquished his Welsh appointments in order to develop thoracic surgery in the North West of England. At the outbreak of the second World War he was asked by the government to form a unit in Liverpool to cope with military and civilian casualties. He started in Clatterbridge Hospital and then moved to Broad Green Hospital, and this unit became the Liverpool Regional Chest Unit in 1949. He was its director, and later became Consultant Adviser in Thoracic Sugery to the Liverpool Regional Hospital Board when he stopped operating, and he finally retired in 1959 aged 80.

Original contributions to surgery and anaesthesia

He had contributed 50 articles to medical journals and three books. The first on *Surgery of the Lung and Pleura* in 1919 was based on his London work, and the first on this subject in the English language. Two others followed — *Medical & Surgical Treatment of Tuberculosis,* and in conjunction with Robert Coope he edited *War Injuries of the Chest.* He was the first President of the Thoracic Society of Great Britain and Ireland, and the first Honorary Member of the American Society of Thoracic Surgeons. He was honoured with the Weber-Parkes Prize by the Royal College of Physicians in 1954 for the prevention and care of tuberculosis and was also given the Honorary degree of Master of Surgery by the University of Liverpool and Doctor of Law by the University of Wales.

What were his contributions to anaesthesia? I have already mentioned some, but after being told by patients that the operation of thoracoplasty, especially the two-stage operation, though painfree, was more than a human being should be expected to bear, he gave them light chloroform anaesthesia, as well as local analgesia to make them comfortable, and in his review in *Thorax* in 1948[6] he pointed out that as far back as 1912, the injection of procaine into the intercostal nerve to allay post-operative pain, which could interfere with coughing, was recognised.

The last ten years of his life were spent in a cottage on a hillside in the Clwydian Hills, where he developed a hobby of creative gardening and utilised his innovative talents by designing a system of pulleys, ropes and pads to protect himself from injury when working on an escarpment from which he had once fallen.

He was a dynamic leader and organiser of indomitable spirit and the local postmistress[7] told me that he was also self-effacing and retiring, a dedicated and caring person who had the welfare and health of the community as one of his main priorities. He died on February 4th, 1965, and his ashes were scattered on the Welsh hills. His endotracheal tube remains, but his anaesthetic machine and the original drawings of it have disappeared.

I discovered a compassionate man, who cared for the individual patient, whose meticulous attention to detail made sure that pillows and bandages were used to produce maximum comfort, who assessed patients thoroughly before instituting treatment, who found ways of relieving pain and discomfort, who insisted the equipment used was accurate and safe and who monitored his patients and his equipment. He is remembered as a pioneer thoracic surgeon but I am grateful for the opportunity, at a date so close to the anniversary of his death, to pay tribute to one who made a contribution to our specialty and who had all the attributes of thoroughly modern anaesthetist.

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THREE LADY ANAESTHESTISTS OF 1893

Dr E.P. Gibbs

When we now have a lady as Dean of the Faculty of Anaesthestists, it is interesting to reflect that it is only a hundred years or so since women were able to qualify in medicine in the United Kingdom and thus, if they wished, to practice anaesthesia.

The Medical Register was first published in 1859. It was designed for the protection of the public against unqualified practitioners and the qualification for registration was the possession of a degree in medicine awarded by any British university or equivalent body. In 1859 only one lady's name appeared on the Register. Another was added in 1866, five more in 1877 and the numbers escalated until, by 1893, there were 135 ladies' names on the Register.

The problems women faced to qualify in medicine were twofold. Firstly, universities refused to admit women to their examinations. In 1862 the London University Senate decided that "as women were neither a class nor a denomination", the University had no power to admit them.[1] However, in 1876 the Irish College of Physicians and the Queen's University of Ireland admitted five women to their examinations which accounted for five additional names to the Register of the G.M.C. in 1877. In January of 1878, the London University Senate laid down before Convocation a new charter admitting women to all degrees of the university, and other examining bodies followed later.

The second problem women wishing to qualify in medicine faced in those days was in gaining access to clinical training. In 1874, the London School of Medicine for Women was founded with a view to educating women in medicine, but it was not until 1877 that clinical access for the, then, 17 students was negotiated with the Royal Free Hospital. Thus, the way was eased for women to qualify as doctors and this is reflected in the Medical Register figures. Once qualified however, women faced a further problem in that there were few hospitals where they could gain postgraduate experience. In London there were hospitals for women and children which accepted women as medical officers and these included the Belgrave Children's Hospital and the New Hospital for Women, which was founded in 1866 and staffed entirely by women.

In addition to these problems, very few women belonged to medical societies. Even the British Medical Association refused to accept lady members until 1892. It is perhaps a little surprising to discover that in 1893, no fewer than three ladies applied to become members of the new Society of Anaesthetists. This at a time when there were only 135 ladies' names on the Medical Register.

Society of Anaesthetists

The Society of Anaesthetists was founded in 1893 in London and was the first anaesthetic society in the world. It's aims were twofold, firstly, to encourage the study of anaesthetics and, secondly, to promote and encourage friendly relations among members. At the first meeting of the provisional committee in June 1893 letters were read from three ladies asking to be permitted to join the Society.[2] The Secretary of the provisional committee was instructed to reply that the committee had no power to decide as to the eligibility of the ladies for membership of the Society. It was obvious that the gentlemen who comprised the provisional committee were not against women, they had just not thought about them

for, at the next provisional meeting in 1893, just before the first General Meeting, the Secretary reported that he had received notice of an amendment to Rule 4 of the proposed Society from Dr Dudley Buxton to omit the word 'medical men' and to substitute in their place 'medical practitioners'. This was obviously approved by the General Meeting as in 1894 Mrs Frances M. Dickinson-Berry became the first woman member of the Society which then numbered 40.

Mrs Frances M. Dickinson-Berry

Mrs Dickinson-Berry was born in 1857, the daughter of a barrister and Member of Parliament for Stroud. She was educated at home until she was sixteen and then went to the continent with her sister, where she acquired fluency in several languages and also studied art, an interest she maintained throughout her life. On her return to England, she was prompted to study at Bedford College for a year and in 1884, she matriculated. In 1885 when she was 28, she began to study medicine at the London School of Medicine for Women. It was recorded at the time that she was distinguished among her fellow students for her personal charm and good taste in dress.

In 1889 she qualified MB at the University of London and became house surgeon at the Belgrave Hospital for Children. While she was there, she achieved her first of many press reports. *The Evening News & Post* in 1890 reported "A lady doctor at a coroners' court" and said "Miss Dickinson, a registered medical practitioner gave evidence after the death of a child" and the coroner had remarked that this was he first time that he had had a lady doctor in his court. For a while, after her post at Belgrave Hospital, she became RMO at the New Hospital for Women. She married Mr James (later Sir James) Berry, a surgeon at the Royal Free Hospital.

In 1893, which was the date of her application for membership of the Society of Anaesthetists, she was anaesthetist at the Alexandra Hospital for Diseases of the Hip in Children and assistant physician at the New Hospital for Women. She maintained her anaesthetic appointment at the Alexandra Hospital and in 1906 she also became staff anaesthetist at the Royal Free Hospital. She held both positions until her retirement in 1920.

She was, however, active in other fields apart from anaesthesia. For some time earlier in this century, she was assistant medical officer to the Education Committee of the London County Council. She had articles published in the *B.M.J.* and *Lancet* in the course of her career but started in 1894 by conducting a survey of the statistics of the London School of Medicine for women between 1874 and 1888. The results of the survey (reported in the St James' Gazette) were that 159 ladies had qualified, 9 had died and 28 had relinquished their profession. She was always interested in the position and status of women in medicine. She belonged to the Women's Medical Federation and served as both it's Honorary Secretary and President. It was while she was Honorary Secretary that she wrote to the *Times* protesting the policies of Glasgow Corporation and the St Pancras Borough Council in refusing to employ medical women who were married and whose husbands were in employment.

She developed another interest which was the advancement of medical education for Serbian women. Together with her husband, she had taken many active holidays on the continent which included visits to Serbia, now part of Yugoslavia. When the Royal Free Hospital established a Red Cross Unit in Serbia in 1915, the hospital journal reported that "...the chief surgeon of the New War Hospital will have with him his wife. While in Serbia she will occupy the post of physician and anaesthetist to the institution of which her husband has charge".

This team was not in Serbia long. Initially, they dealt mainly with an outbreak of typhus and improved sanitation rather than treating war injuries of which there were very few at the time. The area in which they were working was then occupied by the Hungarians who were courteous but insisted on the team removing itself, with their help, to Odessa to carry on their work. On her return to this country, she became Honorary Secretary of a committee set up to establish scholarships for Serbian women to train here and then return home to practice medicine. She obviously retained a considerable interest in this venture as in her will she left £1,000 to the Fund. She died after a very short illness in 1934.

Mrs Caroline Keith

The second lady to apply in 1893 for membership of the Society of Anaesthetists was Mrs Caroline Keith. She was proposed by Mrs Dickinson-Berry and Dr Dudley Buxton for membership and elected in 1894. At that time, she was anaesthetist at the New Hospital for Women.

Caroline Keith was born an Alsatian and, when quite young and speaking only French, she married a Scot who spoke very little French, one Surgeon Captain Keith. She and her husband came to England where she learned to speak English and had a son. Her husband who was in the Army was later posted to India, and before leaving, he entreated her to enter the London School of Medicine and to qualify as a doctor, "so she could secure independence in case of need". This she did and qualified in Scotland (a fairly common occurence then) in 1888. By 1891, her entry in the Medical Directory shows her as an anaesthetist at the New Hospital for Women. She retained this post until her retirement in 1912.

Anaesthesia was not a full-time occupation in those days. Caroline Keith was also interested in, and good at, obstetrics and for five years from 1894 to 1899 she was Lecturer in Midwifery at Clapham Maternity Hospital. It was during this time that she also became anaesthetist at the Chelsea Hospital for Women. She was obviously very capable, well liked and very successful, but in 1912, in the prime of her life, she retired. She died in Southsea in 1925.

Miss Eveline A. Cargill

The third lady who wrote to the Society of Anaesthetists applying for membership in 1893 was Miss Eveline A. Cargill. She seems a shadowy figure.

She first appears in the Medical Directory in 1891. She qualified in 1889 in Scotland but her medical school was the London School of Medicine for Women. In 1891, she obtained her MD in Brussels (again a fairly common occurence then). Two years later, she was working as a medical officer at the Portobello Road Provident Dispensary for Women and Children. About this time she also became Assistant Anaesthetist at the New Hospital for Women. She was proposed by Dr. Dudley Buxton and Mrs Caroline Keith as a member of the Society in January 1895 but it was about this time that she ceased to be an anaesthetist. She became instead an inspector of the Waifs and Strays Society. By 1900 she had given this up and moved to Cheltenham where, presumably, she was in medical practice as from 1909 to 1916, she was Medical Inspector at the Ladies college there and is not recorded as having retired until 1920. She obviously retained her interest in anaesthesia as she attended meetings of the Society until 1898 and was still fully a paid-up member, at half a guinea a year, in 1907. She died some time in the 1930's.

I submit that these three ladies are of considerable interest to us. They come from different backgrounds and after qualifying their careers took differing forms but they obviously

knew each other and had a common interest in anaesthesia. All must have been determined women to qualify in medicine when they did, and at a time when there was a prejudice against women doctors who renounced their femininity, they were obviously professional enough and ladylike enough to gain the support and encouragement of male anaesthetists. In applying to become a member of the new specialist Anaesthetic Society and being accepted, they established the right of women whe followed them in our speciality to be regarded as having equal opportunities and rights and they led the way for the rest of the medical profession.

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THE SAD CASE OF DR.AXHAM

Dr J. Alfred Lee

In June 1922, just before I was due to start as a medical student in Newcastle, I was astonished to read in the King's Birthday Honours List, the name of Herbert Barker who had been recommended for a knighthood by the Prime Minister, David Lloyd George. The honour was for services to manipulative surgery. A furious row broke out in the press, both medical and lay, and I still remember the controversy which made such an impression on me. I shall recall the career of Barker, and of his anaesthetist, Dr Frederick Axham, then aged 70, who was crossed off the Medical Register for assisting Barker who was unregistered; also the later invitation to Barker by the British Orthopaedic Association to demonstrate his technique before a large and distinguished audience at St. Thomas' Hospital and lastly, whether there are any lessons to be learnt from this interesting and rather sad story.

Sir Herbert Barker

Let me introduce you to Herbert Barker who was most certainly an individual of outstanding personality and professional skill as a manipulative surgeon, a term he claimed to have invented. He was unqualified as a doctor and unregistered. He was born in Southport in 1869 and eventually enlisted as an apprentice to his cousin, John Atkinson, who was a well-known bone setter in London's West End (one is reminded of Sir Robert Jones and Hugh Owen Thomas and their forebears in Liverpool).

His early career was unsuccessful but in 1904 his cousin died and Barker inherited the practice, eventually settling in Park Lane. He was then 35 years old. Success came very rapidly and his patients soon included many well-known people in the world of politics, entertainment, sport, the arts, high society (including the King's son, the Duke of Kent), H.G. Wells, Bernard Shaw and Augustus John who was reputed to have said that if he (Barker) would rattle his bones he would paint his portrait free. This portrait can now be seen in the National Portrait Gallery in London. Barker was especially renowned for relieving such conditions as internal derangement of the knee joint, metatarsalgia, sacro-iliac strain, hallux rigidus and stiff neck, all by manipulation. Soon Barker realised that he needed someone to anaesthetise his patients during his manipulations and invited a neighbouring doctor to watch him at work. He chose Dr Frederick Axham, who had an address in Brewer Street close to where John Snow had been practising thirty years previously. Axham was greatly impressed with what he saw and agreed to become Barker's anaesthetist. They worked together happily from 1906 to 1911 when Axham was 70 years old. Axham knew full well what he was doing and decided that it was his medical duty to continue to prevent Barker's patients from suffering pain from his manipulations.

An important event in the story was a well publicised law case in which an increasingly well-known Barker, who attracted much envy and dislike from the London surgical fraternity, was sued by a former patient who blamed his treatment for the need for subsequent amputation of his leg. This caused a great deal of publicity in the press and drew attention to Axham's involvement as an anaesthetist. Soon afterwards the Medical Defence Union was on his trail.

In medicine, as in many other aspects of human contact, emotions set the ball rolling, and it seems probable that antipathy to the unorthodox Barker - the man who was not a member of the club, who had not joined the union, who was an outsider - rather than any feelings against the harmless Axham, resulted in a complaint being laid by the MDU to the General Medical Council against Frederick Axham. The idea was to hit Barker through Axham and to cause a serious problem for the former which it was hoped might ruin his lucrative practice. It was Barker's success which led to Axham's downfall.

Crossed off the Register

How many anaesthetists have been crossed off the Medical Register for giving anaesthetics to patients undergoing painful manipulations by an unqualified and unregistered bonesetter? I just don't know if anybody other than Axham actually has this doubtful distinction.

In 1911, Axham was a G.P. who also held the post of Medical Officer to the Workhouse of the Westminster Board of Guardians in Poland Street, W1, and as part of his duties it may be supposed that he had to give anaesthetics for what we would now call 'minor surgery' and for dental extractions. Nitrous oxide, ether, and chloroform given by the open drop method would have been the agents used. In an abstract from the Minutes of the Westminster Guardians on May 23rd, 1911, the day before Axham was crossed off the Medical Register, it is stated: *"...that there be recorded an expression of the Board's high appreciation of the devoted services of Dr F.W. Axham as Medical Officer of the Workhouse of the Union from 1886 to 1911 in attending to and alleviating the sufferings of the sick poor under his charge in the institution, that during his long and faithful service his duties were discharged with the utmost punctility and exemplary proficiency and he leaves the Board's service with the unanimous wish of the guardians that he may long enjoy a well deserved retirement".* I think you will agree that this was no mean testimonial for a man accused of professional misdoing.

The Medical Defence Union reported Dr Axham to the General Medical Council and he was required to appear before its disciplinary sub-committee on May 24th, 1911. They met then at 299 Oxford Street - that was before they moved to Hallam Street. Axham was accompanied only by his friend, the Reverend J.L. Walton, Vicar of All Saints' Church, Southend on Sea, but I have failed to find anything interesting about this charitable cleric. Neither barrister nor solicitor accompanied the accused doctor, but he addressed the Council on his own behalf.

On being asked if he was prepared to dissociate himself from Barker, Axham answered "no". The chairman of the sub-committee was John McAllister, the well known Glasgow physician whose portrait is to be seen immediately to the right as one enters the house of the Royal Society of Medicine in Wimpole Street. He was then the President of the GMC and on this occasion was accompanied by 34 of its members. The complainants were the Medical Defence Union, represented by Dr Bateman their General Secretary. The charge formulated by the Council's solicitors was *"That you have knowingly and willingly on various occasions assisted one Herbert Atkinson Barker, an unregistered person practising in a department of surgery, in carrying on such practice by administering anaesthetics on his behalf to patients coming to him for treatment and that in relation thereto you have been guilty of infamous professional conduct".* Dr Axham answered questions put to him through the chair, the room was cleared and the Council deliberated in camera. Later the chairman returned, and announced the judgement of the Council as follows: *"I have to inform you that the Council have judged you to have been guilty of infamous conduct in a professional respect and have directed the Registrar*

to erase your name from the Medical Register". There was, of course, no appeal from this verdict. A little while later Sir Edward Marshall Hall, the famous barrister, encouraged Axham to sue the GMC and said that if he would do this he would defend Axham without professional fee, but Axham did not take up the offer.

The decision was widely criticised in the press and over the years there was much agitation that the verdict should be reversed. Axham had given nearly fifty years of service to the medical profession without a blot on his name or reputation. The General Medical Council (since 1951 officially named the General Council for Medical Education and Registration) was established by the Medical Act of 1858 under which a formal medical register was set up so that the public could differentiate between properly educated medical men and women and the large number of unorthodox healers or quacks who were practising. The Council was empowered to erase from the Register the name of any practitioner convicted of a criminal offence or judged to have been guilty of infamous conduct in a professional respect. Deregistration means that if he continues to work he is at risk of being prosecuted for criminal neglect, if the patient dies he cannot sign a death certificate, his prescriptions for scheduled drugs when taken to the chemist's shop cannot be dispensed nor can he call in a legally qualified consultant if he is in trouble.

Poor Dr Axham had lost his appointment as Medical Officer to the Poland Street Workhouse and could no longer earn any sort of a living by the practice of medicine. He lived with his wife in genteel poverty until 1926 when he died in a very decrepit state at the age of 86. His last words, according to his widow were: *"I forgive them, as I hope to be forgiven".* His funeral took place in Mitcham in Surrey.

Anaesthesia after Dr Axham

When Dr Axham was prevented from anaesthetising Barker's patients by the erasure of his name from the Medical Register there was apparently no problem about his replacement. According to Barker, many registered doctors contacted him offering their services as anaesthetists, doing what Axham was no longer able to undertake. This was partly because of the very bad press that the erasure of Axham's name had attracted, and it was thought that the GMC would not be so foolish as to repeat the unwise action. One practitioner who frequently worked with Barker was Dr Frank Colley of Hove whose brother was a fashionable Harley Street physician. In after years Colley wrote enthusiastically about the quality of Sir Herbert's therapeutic work and about his outstanding qualities as a healer. The fact that Dr Colley was regularly anaesthetising Barker's patients was well-known in London medical circles and nobody did anything about it. We must remember that the officially registered dentists only made their appearance in the early 1920's and I cannot believe that the patients of some of the many unregistered dentists did not receive nitrous oxide, if nothing more potent, from registered medical practitioners before this time. Perhaps we should also remember that the first man to give ether in public, W.T. Morton in 1846, was not a qualified doctor, nor were Mr Robinson, nor Mr Squire, the first to follow Morton's example in England.

Professional recognition

This story would have been almost forgotten if it had not been for a U turn in the attitude of the medical profession to the skills of Barker, since 1922 *Sir* Herbert. Orthopaedic surgeons in London became increasingly aware of Barker's successes and they envied his prestige and wealth. The British Orthopaedic Association decided to break with tradition and invited him to give a demonstration which took place at St. Thomas' Hospital in July 1936. Lord Moynihan, then the doyen of the surgical profession and a famous President

of the Royal College of Surgeons, was a warm supporter of Barker and advised him to see the patients first and to select those he might be able to help. Over 100 surgeons attended including Lord Moynihan, Sir William Arbuthnot Lane, Mr T.P. MacMurray of Liverpool and the young Archibald MacIndoe. The final irony of the story is that Dr Zebulon Mennell, anaesthetist to St. Thomas' Hospital and due to become the President, and later Treasurer of the Association of Anaesthetists of Great Britain & Ireland, was asked officially to give anaesthetics for Barker's manipulations. For his services he was thanked by the company of distinguished surgeons and no criticism of his activity was heard, either officially or unofficially. The demonstration was impressive and a movie film was taken so that Barker's methods could be studied by those who were interested.

As he left the auditorium Barker, thinking of his old friend Dr Axham, said: *"Gentlemen, are you not now guilty of unprofessional conduct?"* Reports of this event appeared in the medical and lay press – the *Lancet*, *The Times* and the *Observer* – and very favourable most of them were. It was reported as a landmark in surgical history that at last the orthodox profession had allowed itself to learn from the unregistered, but justly famous, manipulative surgeon some of the tricks of the trade of unorthodox manipulative surgery.

Then and now

Two questions can now be asked: Was Dr Axham when he acted as anaesthetist to patients of Herbert Barker, not doing his duty as a member of a profession whose duty it is to ease pain and human suffering? Were the General Medical Council wise to prolong this ostracism? This body was accused, rightly or wrongly, of continuing the victimisation of Dr Axham, so that any registered practitioner who would like to follow in his footsteps would be inhibited from so doing. I believe in our own day it is quite common for some of our anaesthetic colleagues to give instruction to chiropodists on the technique of injecting local analgesic drugs, but I do not know whether any of them are ever asked to give general anaesthetics. Still less do I know how they would react to such requests.

I think you must agree that Sir Herbert Barker must have been a man of outstanding ability with a great gift for healing. Towards the end of his life, incidentally, he was appointed as Honorary Consultant in Manipulative Surgery to Noble's Hospital in the Isle of Man, so he very nearly made it. He was much more than a fashionable bonesetter. Our professional forebears could not stop him from practising but they were empowered, by the use of the GMC's ability to erase a name from the Medical Register, to make it very difficult for him to provide his patients with reasonably safe anaesthesia during his manipulations. Of course, their action did nothing of the sort because he was still able to get registered doctors to give anaesthetics for him. Dr Axham's erasure in 1911, and even more the agitation by well-known citizens to influence the Council to reinstate the old doctor towards the end of his life, both caused wide discussions sixty years ago. It is certain that many of Barker's supporters were not primarily campaigning for the recognition of unregistered practitioners and healers, but for orthodox surgeons to learn from Barker how to apply these skills so that the general public could receive the benefit. Even today, some of our orthopaedic colleagues still seem slow to apply manipulative skills and this is a pity. Non-registered osteopaths and chiropractors still thrive and would seem to benefit their patients, at least in some cases.

Today, there is a steady agitation for non-registered healers to be given facilities in our hospitals in the National Health Service, to ply their trade and exercise their skills. Already in the United States their battle has been won. In these libertarian times will we always be able to prevent this exclusion of the unorthodox manipulative practitioners, and if we

do will it always be to the benefit of those patients whose skeletal disabilities cause them such suffering? To me it seems ridiculous that when an obscure G.P. gave anaesthetics for Barker in 1911 he was crossed off the Medical Register and yet, 25 years later when the President-elect of the Association of Anaesthetists, whom I am not for one moment criticising, rendered the same service to the famous Herbert Barker in public, he received both praise and warm thanks. Is this a just world?.

Acknowledgement
Finally, I would like to pay tribute to Dr Barbara Duncum for some factual information and also to Mr I.F. Lisle the Librarian of the Royal College of Surgeons of England who gave me permission to consult the Barker papers deposited at the College.

PAUL SUDECK AND HIS INHALER

Dr D.D. Howat

Six years ago, when I was visiting Professor Wolfgang Röse in Magdeburg in the German Democratic Republic, he showed me his collection of historical anaesthetic apparatus and in it one piece which he could not identify. I was immediately reminded of the same piece in the Charles King Collection and which Bryn Thomas described briefly on page 98 of his "Development of Anaesthetic Apparatus".[1] I was gratified to be able to identify it as Sudeck's Chloroform Inhaler.

I knew no more about Sudeck and his inhaler than was in Bryn Thomas's description, but decided recently to find out some more about both. To British doctors, Sudeck is known best for the atrophy of bone he described after fractures particularly at the wrist. This is probably a form of sympathetic dystrophy, possibly associated with prolonged immobilisation. He is less well-known for his so-called "critical point" on the pelvic colon, the site of the anastomosis between the sigmoid and the superior rectal arteries. Sudeck's great interest in general anaesthesia is not so well recognised.

Ether analgesia

In 1901, when Sudeck had just become Director of the Out-Patients Department of the Eppendorf Hospital in Hamburg, he described some work on ether anaesthesia which he had done while acting as assistant to Heinrich Kümmel, the Professor of Surgery there. He called his paper "Das Operiren im ersten Aetherrausch"[2] - literally translated as "Operating in the first ether drunkenness or intoxication". In fact, he was making use of the analgesia which occurs during the first stage of anaesthesia. He described some 200 cases in which he had used a simple ether mask, called a Czerny mask, and poured 30 to 50 mls of ether on to it, after getting the patient to exhale fully after several deep breaths; he then applied the mask to the face and asked the patient to breathe as rapidly and as deeply as possible. He gave detailed instructions as to how the patient's attention must be completely distracted by doing this, so that he did not notice when the operation began.

The incision was made after the first or second deep inhalation of ether vapour; the preparation of the skin, the application of an Esmarch's bandage, and so on, was made before the ether inhalation began. The patient was urged to ignore the pungent smell of ether and concentrate on ignoring it - this helped to distract his attention even further from the operation. For obvious reasons the patient was not allowed to enter the stage of excitement.

Although Sudeck performed many minor operations such as incisions of abscesses, with this technique, he also amputated legs in old and ill people without any complaints of pain and even opened and drained the abdominal cavity in cases of peritonitis. If necessary, he was prepared to proceed to deeper anaesthesia. He did not claim the technique as a new discovery, but felt that it was not employed as much as it deserved, since it produced virtually no complications. Vomiting was rare and the patients recovered all their faculties soon after surgery.

In 1902, Sudeck[3] published another paper describing his further experiences with this technique, again with the Czerny mask. This mask was a simple cylinder, open above and below, within which were laid several layers of stretched flannel on to which the ether was

poured. A fairly close fit on the face was achieved by attaching a rubber ring to the lower end of the mask. In this paper, Sudeck recorded the different ways in which patients reacted according to their temperaments. He stressed that consciousness and the sense of touch were preserved, but that if the stage of excitement supervened, the operation should be stopped and the patient allowed to recover. As the analgesia persisted for a short time, the operation could often be completed when the patient had regained consciousness. Since he resected lymph glands in the neck, repaired tendons, curetted bone and even excised a small tumour of the median nerve and performed its resuture, Sudeck obviously became expert in the method.

Sudeck's inhaler

In 1903, the following year, Sudeck[4] described his own mask, which he used predominantly for ether, although he considered it suitable also for the administration of chloroform. It was made all in metal and consisted of a face-mask taken from a Roth & Dräger chloroform and oxygen anaesthetic machine, which was manufactured about that time. The mask was moulded to the shape of the average adult face and he seldom found it necessary to add a rubber rim. A beaker was attached to the mask, but was divided from it by a metal base, in which was inserted a one-way, inspiratory valve with a mica diaphragm. On the side of the face-mask was another one-way, expiratory valve of similar type.

A piece of gauze was placed in the upper chamber, which as well as having an open top, had two holes, one on each side. Thus ether could be poured on to the top of the inhaler if the patient was supine, or into the side if he was in either the left or the right lateral position. It was therefore a non-rebreathing system, with the deadspace in the mask portion only. The whole device was quite small, about 13 cm or 5'' in height and measuring 7 cm or 2¼'' in diameter at the base of the upper chamber. With the exception of the gauze, which was replaced, the whole was easily sterilised by boiling.

The mask in the Charles King Collection is somewhat different. It consists of a slightly larger facepiece, into which has been fitted a separate upper chamber; this has an eccentrically placed hole into which a sponge can be fitted. The mask in Professor Röse's possession differs only in having hooks, presumably for the attachment of a head-harness. When and by whom this inhaler was altered, I have not been able to discover. Professor Ole Secher informed me that it was an adaptation of a Dräger mask designed for oxygen or Carbogen, that is, oxygen and carbon dioxide therapy. Sudeck wrote that *his* mask was produced by the Dräger factory and marketed by a firm called Leonardt Schmidt & Co. in Hamburg.

He used his mask for general anaesthesia, but also found it invaluable for the induction of ether analgesia. For longer operations, he would give the patient a subcutaneous injection of 10 to 20 mg of morphine half an hour beforehand, sometimes with up to 0.5 mg of Scopolamine. In a later paper, published in 1909, Sudeck stated that he had modified his method: he allowed only a few drops of ether to fall on the mask while the patient inhaled deeply and he increased the drip rate as the ether vapour was tolerated. He believed that this method of producing analgesia was particularly suitable for general practitioners to use.

Incidentally, the cost of Sudeck's inhaler was 12 marks in 1903. The London *Times* of May 1st that year quotes the exchange rate as 20 marks 70 to the pound sterling, so that the price was about 11s. 7d. or 58 new pence.

Nitrous oxide in Germany

Sudeck was also instrumental in re-introducing nitrous oxide into Germany, where it had not been used for many years. In a paper published in 1926, he compared the relative advantages and disadvantages of ether, nitrous oxide and Narcylen (the name given to purified acetylene). Of ether and nitrous oxide I need say no more. Acetylene, like ethylene and cyclopropane, is highly explosive, but its advantage was that it was non-toxic and could be used with 20% oxygen. However, it caused some rigidity of the muscles, particularly those affecting expiration, and was somewhat irritating to the airways, as well as having a rather unpleasant smell. It was much cheaper than nitrous oxide, which was not manufactured in Germany at that time, but had to be imported from England.

Sudeck[5] gave a detailed, reasoned and balanced account of the advantages and disadvantages of the three agents, pointing out that, while ether could not be dispensed with at that time, especially for operations which required muscular relaxation, the greater potency of Narcylen and the higher oxygen concentrations which could be employed compared to nitrous oxide should not outweigh the dangers of explosion. He recommended that nitrous oxide should be used in spite of its expense and that its safe administration should be mastered.

With his assistant, Helmut Schmidt, Sudeck[6] devised an anaesthetic machine for use in thoracotomy, whereby the anaesthetic gases could be administered under raised pressure. It was less cumbersome than Sauerbruch's pressure chamber, but it depended on the mask being closely applied to the patient's face. The size of the pressure-swing with respiration - and therefore of the "pendelluft" or rebreathing from one lung to the other - was reduced, as was the mediastinal swing, by an ingenious method using a spirometer with an adjustable pressure valve. Its description was published in 1926. You will appreciate that this was over a decade before Guedel and Nosworthy separately introduced the use of controlled ventilation.

The apparatus was admittedly bulky, but simple. It had also been used for nitrous oxide and oxygen anaesthesia and in 1924, with the help of the firm of Drager, Sudeck and Schmidt began work on an anaesthetic machine which included this principle, but also had a circle-absorber system, which Drager believe is the first of its kind, although its prime purpose was to conserve the very expensive nitrous oxide. The apparatus was supplied with or without the raised-pressure-attachment.

Life and achievements

Paul Hermann Martin Sudeck was born in Pinneberg in Schleswig-Holstein, just north of Hamburg, on 28th December, 1866, the year of the Austro-Prussian War which established the hegemony of Prussia and the beginning of the unification of Germany. He came from a family of lawyers; his father was a Councillor of the Supreme Court of Schleswig-Holstein. Hamburg was a free port, one of the powerful Hanseatic League, and Paul became a citizen of that city in 1881, at the age of 15, and later, when he was 24, a Bürger or Freeman. After school in Altona in Hamburg, he attended the Universities of Tübingen, Kiel and finally Würzburg, where he was awarded the degree of Doctor of Medicine, with a thesis on poisoning by potassium chlorate. He obtained his licence to practise there in 1891, at the age of 25.

After 3 years as an assistant in the Institute of Pathology in Würzburg, he returned to Hamburg, where, after 2½ years of assistantships in medicine and surgery, he climbed up the surgical ladder to become the equivalent of Senior Lecturer or Reader with the title of Professor in 1919 and finally full Professor of Surgery in Hamburg University in 1923, at the age of 57. He retired in 1935, after 12 years in the Chair of Surgery and died on 28th September, 1945, a few months after the end of the last war in Europe. Thus his life spanned almost exactly the rise and fall of unified Germany.

Of the man I have not been able to discover much. In 1900 he married Agnes Vogler and had 5 children, 3 girls and two boys. Two of the girls died in childhood. He seems from his publications to have been a modest man. Judging by his writings at the beginning of the century, he did not appear to have read many foreign authors on anaesthesia, but, twenty years later, his reading was more extensive and he quoted English, American and French authors and their work on gas anaesthesia. In several places he pointed out that his work on ether and nitrous oxide was not new and was recognised by many authors from 1847 onwards. In his papers on nitrous oxide and on the hyperbaric anaesthetic machine which he gave at meetings of the Association of North West German Surgeons in Hamburg, he gave full recognition to his assistant, Helmut Schmidt, and handed over the description of the apparatus to him, because of his particular expertise in technical and practical investigation.

In the records of the University of Hamburg, Paul Sudeck is described as well-known for his careful surgery, is said to have had a considerable appreciation of the arts and is recognised as having had a keen interest in anaesthesia.

I believe that his contribution to our specialty is worthy of our appreciation.

Acknowledgements
I am indebted to Professor Ole Secher of Copenhagen, Professor Ursula Weisser of the Institute of the History of Medicine of the University of Hamburg, and Dr M. Schinkmann, Medical Director of Drägerwerk, Lübeck, for much information.

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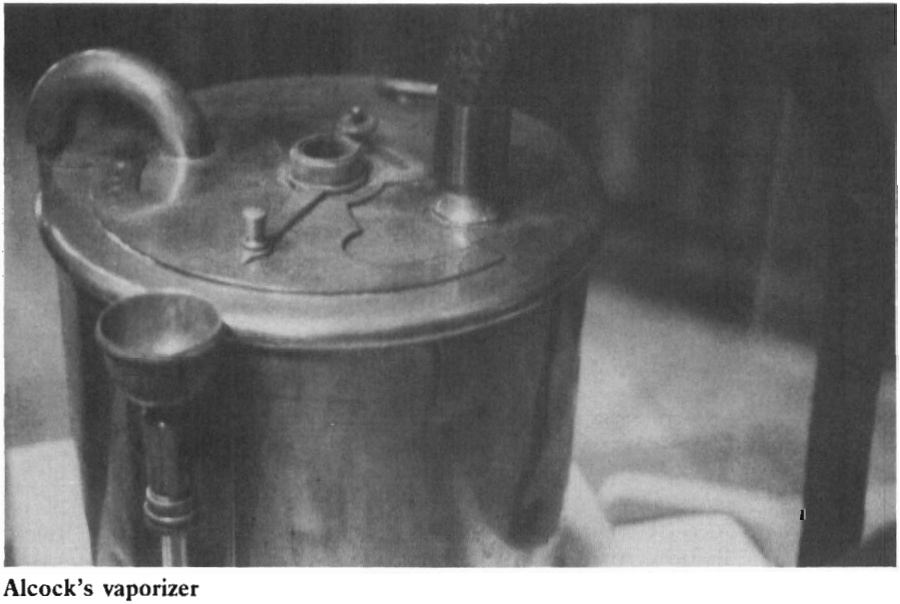
A FORGOTTEN CHLOROFORM VAPORIZER IN ITS HISTORICAL SETTING (N.H. ALCOCK)

Dr D. Zuck

This story started five years ago in 1983, during a visit to my brother in Toronto. One of the places I was taken to was the Museum of the Academy of Medicine because, knowing my interest in medical history, they wanted to show me the Osler collection of which they are very proud. So I saw a photograph of the great man's birthplace, which was north of Toronto, his microscope and celebrated inkstand, and his winter coat; and then we wandered into another part of the museum, and there I saw a chloroform vaporizer unlike any I had seen before. It was labelled simply as a chloroform vaporizer of about 1915. It was of English make, the name and address of the manufacturer were clearly stamped on it, and I felt I ought to have known it. I asked permission to photograph it. This was refused, but I was able to draw a rough sketch. After my return home I tried unsuccessfully to identify it. It did not appear in Bryn Thomas's book. A search of the journals from 1910 to 1920 was fruitless, nor was it illustrated in any of the contemporary textbooks, and the manufacturer, C.F.Palmer, a well known instrument maker, seemed to have disappeared completely. But the apparatus continued to haunt me, and at the History Symposium last July I spoke to a number of knowledgeable people and showed my sketch, but no-one could help. About the same time there was a change of curator in Toronto, and my brother obtained permission to photograph the apparatus, which he did under conditions of some difficulty. He was able to send me a number of transparencies, so now I can show you the features that especially intrigued me.



Alcock's vaporizer

Firstly, its size; it is much too large for the amount of chloroform it might be expected to contain, and this made me wonder whether perhaps it had a water jacket. Secondly, the air inlet has a corrugated ferrule, and this raised the possibility that it might be a plenum apparatus. Thirdly, it was calibrated, and appeared to have some facility for temperature compensation. So I started my search again and, in the reprint of A.Goodman Levy's book,

Chloroform Anaesthesia, which was generously donated to all participants in the symposium by Janssen's, I found the first clue and a reference. An urgent visit to the Wellcome Library to examine the relevant journal brought confirmation.

The apparatus was designed by Dr N.H.Alcock, lecturer in physiology at St.Mary's Hospital Medical School. His description, which was published in 1908, was brief and modest: "The apparatus consists of a circular copper vessel 5" in diameter and 4½" deep which contains 150cc chloroform. One and a quarter inches from the bottom is fixed a shelf, closed except for two oblong holes. Immediately above and touching this shelf is a movable circular plate pierced by two triangular holes. This can be rotated by a hollow central rod, so as to vary the size of the openings into the space below. Air supplied either from a small foot bellows or an electric blower, enters the chamber by a tube opposite one aperture and leaves by another, taking up more or less chloroform vapour according to the size of the apertures. A thermometer in the hollow rod indicates the temperature of the chloroform below, and a water jacket surrounding the chamber serves to keep the temperature between certain limits". Alcock mentioned that the apparatus was to be used to make observations on the effects on man of the inhalation of known percentages of chloroform, and we shall come to these shortly. At the end of his communication he expressed his thanks to the manufacturer, C.F.Palmer, for the many useful practical suggestions he had made and this, for me, confirmed the identity of the apparatus. Actually, Alcock's description tells us very little about its appearance; it has an elegant filling device, with a glass tube to indicate the contents and a drainage arrangement also. There is a percentage scale and a pointer, and at the lower end of the percentage scale there are some temperature calibrations.

In use, the temperature of the chloroform was read on the thermometer and the appropriate graduation on the temperature scale was lined up against the index. This corrected for temperature variations between 60° and 70°F within 0.1% error in concentration. Alcock claimed the concentration delivered was independent of shaking, and as we shall see, this was of some significance. The percentage scale was calibrated in ¼% intervals from 0 to 3½%. At the top end of the scale the word 'Dangerous' is engraved. The vapour-air mixture is delivered via a flexometallic fabric-covered tube to a translucent amber face-mask with an integral expiratory valve. Alcock calibrated and tested the apparatus using the densimetric method of Waller and Geets which was the precursor of the better known chloroform balance with which it is often confused. So it is then, a calibrated plenum vaporizer with a facility for temperature compensation. Alcock's description of the mechanism may have been incomplete. Certain features appear to have been borrowed from H.E.Levy's regulating chloroform inhaler of 1905 and Alcock, in a very perceptive comment indicates that it is to Levy that we owe the modern concept of vaporizer design.

Now, why should a lecturer on physiology at St. Mary's Hospital Medical School design a chloroform inhaler of this type at this particular time?

Alcock, Waller and chloroform anaesthesia

Nathaniel Henry Alcock was born in County Donegal in 1871 and graduated MD at Trinity College, Dublin in 1896. After demonstrating anatomy and physiology in Dublin and Manchester he moved to London University in 1903 to work with A.D.Waller. Anyone here from the Royal Free Hospital may be interested to know that he lived nearby, 22 Downshire Hill, in Hampstead. Augustus Desire Waller was the son of A.V.Waller of Wallerian degeneration fame. He had been lecturer on physiology at St.Mary's since 1885 and in 1887 he was the first to record the electrical activity of the heart. Concern about the deaths and morbidity associated with chloroform anaesthesia dated back almost to the

time of its introduction and had been the subject of a number of enquiries. These are fully described by Dr Duncum in her book. Waller's public involvement with the problem began in 1897 at the annual meeting of the British Medical Association in Montreal, when he spoke about the potency of chloroform as revealed in vitro by its action on nerve and muscle preparations, and he showed a chart of deaths under chloroform produced from the Registrar General's returns. Early the following year he repeated the message at a meeting of the Society of Anaesthetists, and emphasised the importance of being aware of the dosage that was being administered. In 1901 he set out a programme of research which he persuaded the BMA to fund, the fourth requirement of which was "A careful redetermination of the percentage of chloroform required for various degrees of anaesthesia" and in July of the same year, 1901, the BMA appointed a new chloroform committee with Waller at its head. The anaesthetist, Dudley Buxton, of University College Hospital, served as the committee secretary. It immediately co-opted the distingushed physical chemist, Vernon Harcourt, who had devised a combustion method for estimating the amount of chloroform in air. The majority of chloroform deaths occurred during induction, and current theory, which was propagated by Waller, attributed them to a high concentration of vapour. This was the concept of relative overdose - the sudden inhalation of a strong mixture - perhaps after a period of breath-holding, which then travelled as a bolus to the brain and paralysed the medulla. Waller's experimental work on the potency of chloroform using nerve and muscle preparations had led him to this belief and the committee seemed to have become fixed upon it. Although it was disputed by Levy even before his work on ventricular fibrillation, it had a long life - it was taught to me in the early 1940's.

The BMA Chloroform Committee

The committee started with the premise that "chloroform, like all other drugs, must possess its dose", hence the urge for what was called the dosimetric method of administration and the need for a reliable calibrated inhaler with a safe upper limit. Harcourt took the task of designing a suitable apparatus and this was described in 1903. It had a rigid connection between the vaporizing bottle and the face mask which, because this was a drawover inhaler, had to make an airtight fit with the face however restless the patient might become during induction. Obviously any movement of the mask would be transmitted to the bottle. Buxton quickly took up the Harcourt inhaler and became a strong advocate of it, but other anaesthetists were not happy about the interminable time it took to anaesthetise some patients. Later, in 1903, Waller produced a long report in which he showed that, of three inhalers tested - Junkers', Dubois' and Harcourt's - the last was the least accurate under clinical conditions. "During agitation of the bottle such as might easily occur in the attempt to keep the mask applied to a restless patient, I have seen the percentage as high as five times the nominal value." Since the upper limit of the Harcourt apparatus was claimed to be 2% and it was an absolute tenet both of Waller and the Chloroform Committee that no more than 2% was needed during induction, and certainly never for maintenance, this was a serious charge. Waller also came out strongly in favour of the plenum principle as opposed to drawover inhalers, like Harcourt's which he later called vicious. The committee refused to accept his report, whereupon he withdrew from it and continued to work and publish independently. It is significant, however, that although both Harcourt and Buxton continued to deny the charge of inaccuracy, two further models of the Harcourt inhaler, both designed to reduce shaking, were produced, the portable neck model and the stand model. Conversely, some anaesthetists developed the practice of deliberately shaking the bottle in order to increase chloroform vaporization and speed up the induction.

In 1903 Waller reported a series of animal experiments in which the effects of known inhaled percentages of chloroform were observed. Alcock is mentioned as one of the participants,

and there can be little doubt that Alcock's later work was inspired by Waller. During this time, the University of London, following a major reorganisation of its structure and function, had set up its own physiology department and Waller was appointed director. In 1904, Alcock was appointed to replace Waller in the appointment he had held at St.Mary's — clearly Alcock was highly regarded.

Presentation of results to the R.S.M.

The observations on the administration to man of known percentages of chloroform that Alcock had promised, were reported at the meeting of the newly formed Section of Anaesthetics of the Royal Society of Medicine on the 9th November, 1908, presumably its first meeting. Alcock explained that his purpose was two-fold. He wished to investigate whether the results of the many experiments on the actions of known percentages of chloroform and animals were equally applicable to man, and he hoped to reduce "the disadvantages that are inseparable from the administration of an active drug in unmeasured quantities". He began with a brief description of his vaporizer. The final design had been adopted after a long series of trials. He had paid great attention to ensuring accuracy and reliability under actual conditions of surgical anaesthesia and had repeatedly shown that the maximum error under ordinary conditions did not exceed 0.1%. I would point out here that neither of Alcock's descriptions of his apparatus contained any illustrations, and it is perhaps because of this that it is virtually unknown today and was so difficult to identify.

Alcock then reported the results of his study of 50 patients. The anaesthetists were Drs. Blumfeld, Beaumont and Collum of St.Mary's Hospital. The percentages inhaled were carefully noted and plotted against time on squared paper. Ten such plots are reproduced in the publication. They demonstrate the concentration required for induction and maintenance of anaesthesia in patients of different age, build, degree of nervousness and so on. The average induction time was 8 to 9 minutes and up to 3% of chloroform was needed. The break in the chart indicates the move from the anaesthetic room to the operating theatre and hence the duration of induction. In general, it was possible to reduce the concentration progressively during the operation. The amount of chloroform vaporized averaged about 1cc per minute, and for ordinary healthy adults the anaesthetic charts showed great similarity.

Attention was then directed to the effects of age, build, alcoholism and the type of operation. Conclusions could be drawn only tentatively because the groups were small. Young children seemed to require less chloroform, fat people took more than thin, and so did alcoholics. As regards the operation, the duration and the severity of stimulation were significant. Alcock drew the conclusion that anaesthesia with known percentages of vapour is at least as easy and certain as by the ordinary open method. During induction, the concentration should rise by steps of ¼% every quarter of a minute until 2% is reached in 2 minutes. Thereafter the increase should be slower, up to 3% in 5 minutes if necessary. When induction is complete, 2% is usually ample, reducing gradually to 1% after 25 minutes with due allowance for individual variations.

Alcock's paper was followed by a discussion. Dr Blumfeld was most enthusiastic about the apparatus. It gave excellent results, and the experienced anaesthetist would find an enormous saving of labour, but "that saving of labour for the anaesthetist meant a good deal of extra labour in other directions". In a hospital theatre such a machine was of immense value, but outside he feared it was not. If each anaesthetist could be supplied with a boy to work the bellows, an electric fan and a motor car to carry the boy, the machine and the fan, conditions would be ideal and he would always take Dr Alcock's apparatus with

him. In hospital, however, it was a great advantage to have such an instrument from the teaching as well as the practical aspect. He thought every hospital should have such an inhaler of this pattern in order that students might learn something about the percentage of chloroform vapour required to produce the different stages of anaesthesia in varying types of patients.

Dr Collum reported a post-operative death in an already comatose patient with a suspected cerebellar tumour whom he had not wanted to anaesthetise. He did not think the apparatus had anything to do with the death. "The apparatus was exceedingly interesting and it was scientific, but there was rather a lot of it. He had already mentioned the inconvenience arising from the noise it made, and unless one had a laboratory boy to work the bellows an electric fan was needed. He had seen the boy looking very sorry for himself after a couple of hours at the bellows in the summer time. He was certain the general practitioner would not carry it to his cases in the country if he had to travel on a bicycle. Dr Blumfeld said it was a useful instrument to have in hospital for teaching students, but what was the use of teaching students about an apparatus they would not be likely to use? Therefore, though he thought the apparatus a valuable one, he did not see that it had a very wide field of utility.

Dr A.G.Levy congratulated Dr Alcock upon the success of his inhaler, on its extreme simplicity and on the scientific and clear way in which he had brought the subject before the Section.

In his reply Alcock thought his apparatus could be made more portable. In his opinion the class of person to whom it would be of most service would be the country practitioner who had about 30 cases of anaesthesia a year. He was often short-handed and was out of practice with anaesthetics, and the trouble in carrying the apparatus about would be more than compensated for by the ease and certainty with which the anaesthetic could be administered. As regards noise, the present bellows was almost silent. He had used oxygen instead of air in one test case with manifest benefit - an old lady, very fat, known to have a fatty heart, with gallstones. He was told that if he succeeded in anaesthetising her and she was safely got off the table, the machine might be regarded as a success. At the end of the operation she came round in the usual time and her pulse was better than before. Where there was suspicion of cardiac failure he thought that was the way to attempt to prevent difficulties.

Chloroform vaporizers in 1910

Clearly, no single feature of Alcock's vaporizer was original, but it was the first to incorporate all of them. It was the first plenum vaporizer with temperature stability provided by a water jacket, calibrated, temperature compensatable, and accurate to 0.1% over a wide range of flow. It was the culmination of the dosimetric movement.

The BMA Chloroform Committee reported in 1910 - it examined the methods in general use for the administration of chloroform, the douche method, the drop method and regulating or percentage inhalers. These latter, 14 in all, ranged from Snow's to Alcock's but of these 14 only 2 incorporated a reliably calibrated temperature compensated scale. These were Alcock's and Levy's. Alcock's, being a plenum apparatus, had the advantage that oxygen could be added to the inspired mixture without upsetting the calibration. Among the others, Junkers' was unpredictable, Roth Draeger's was a mechanised drop bottle, Dubois' was expensive - it cost £20 - and it was cumbersome and rather inflexible. Waller's chloroform apparatus, on his own admission, was hardly a suitable machine for the rough

and tumble of everyday clinical use, and Harcourt's was unreliable and depended for its temperature compensation on the anaesthetist having a warm hand. Yet it was Harcourt's that the committee favoured; it had, in the committee members' eyes, the essential virtues of "simplicity, exactness and portability and that the mixture of air and chloroform is automatically limited to a maximum of 2%". Buxton attached to the report a three page appendix describing how to use it. It is unrealistic to think that it might have been displaced from the committee's favour by any other. About Alcock's apparatus the committee wrote at some length. It recognised that "a series of successful applications of this inhaler for surgical work has been recorded and it has been used with considerable success in hospital practice". However, it was a plenum apparatus, and in the eyes of the committee it suffered from all the drawbacks of these - complexity and lack of portability. It was evident that no member of the committee had used the apparatus himself and so it was dismissed.

As Dr Boulton has pointed out in his paper on the Junkers' inhaler in *Survey of Anaesthesiology*, not until the late 1950's did the calibrated, temperature compensated, plenum vaporizer become a feature of anaesthetic machines. The reason Alcock's vaporizer, with all the advantages that it appears to us today to offer, did not become popular with contemporary anaesthetists, should have become clear. Firstly, Buxton had mounted a great public relations exercise in favour of the Harcourt inhaler, and then most clinical anaesthetists felt no need for a dosimetric method of administration at all. Portability was more important than accuracy to the itinerant jobbing anaesthetist of the Edwardian era.

In any event, Alcock did not remain long in London to champion the use of his vaporizer. In 1909 he had published a textbook of practical physiology which was very well received, and in 1911 he was elected to the Chair of Physiology at Magill University, Montreal. Sadly he occupied it for only two years. He died of myeloid leukaemia in 1913 at the age of 42. Sir William Osler, in an obituary, expressed the great feeling of loss to all those who knew him. Let us leave the last word with Levy: "Alcock's plenum inhaler is compact and simple in construction and it would appear that some such apparatus as this most nearly approaches what is required. This apparatus should be adjusted for a higher rate of delivery than 20 l/min and the temperature correction should be extended to wider limits. It should then be efficient for the great majority of cases". As far as I have been able to find out, the Toronto apparatus is the only one in existence, but if anyone knows of another, I should be very pleased to hear of its whereabouts.

NOTE: A fuller account of the Alcock chloroform inhaler has been published in *Anaesthesia:* Zuck, D. The Alcock chloroform vaporizer. *Anaesthesia* 1988, 43:972-980.

R. LAWSON TAIT — HIS INFLUENCE ON ANAESTHETIC PRACTICE

Dr E.T. Mathews

Robert Lawson Tait, a Birmingham surgeon, was described by William Mayo as the father of modern abdominal surgery. Tait was one of the most dynamic personalities of the Victorian period. One obituary, that in the *British Medical Journal,* said of him "He showed a want of respect for age and authority which was remarkable, even in Birmingham ... he was aggressive and unconventional ... an original thinker who was never afraid to back his own opinions and fight for them for all he was worth".[1]

In a relatively short life — he died at 54 — he wrote some 328 papers and 270 letters on medical subjects. These included many references to anaesthesia. Tait was born in Edinburgh in 1845, his birth was not registered. By some he was believed to be the natural son of James Young Simpson. Tait was educated at Heriots Academy and Edinburgh University. Whilst a student he became a pupil of Simpson, lived in his house and assisted him. Simpson made a great impression on Tait, particularly by his work on chloroform. Tait's interest in anaesthesia began at this time.

In 1867, Tait left Edinburgh for Wakefield. Whilst there, he published his first paper on anaesthesia and a paper on the treatment of tetanus.[2] He used woorali, a crude preparation of curare, in the treatment of tetanus. This was one of the earliest reports of the therapeutic use of curare in England.

Tait in Birmingham

In October, 1870, he moved to Birmingham. The 1870's were an interesting time to arrive in Birmingham. It was the beginning of the Chamberlain era in politics. The town council led by Joseph Chamberlain took over the private companies supplying water, gas and sewage drainage. Tait liked the mood of change in the town, stayed and later became a town councillor, serving on the public health committee with great distinction.

Soon after arriving in Birmingham, Tait applied for a post as surgeon at the Birmingham General Hospital. He was unsuccessful. He then joined with Arthur Chamberlain, a brother of Joseph, in a campaign to establish a Womens Hospital. In less than a year they had succeeded. Tait was appointed to the staff and rapidly established a national and international reputation and surgical practice.

Involvement with anaesthesia

Tait expressed a particular dread of deaths under anaesthesia. If he believed death threatened, he would close the abdomen, leaving the operation incomplete.[3] He was influenced by Benjamin Ward Richardson to change from sulphuric ether to methylene ether, believing it to be safer. However, it was with methylene ether that Tait was to have his first death under anaesthesia. This was in June, 1873. His anaesthetist at the time was Dr Louisa Catherine Fanny Atkins, a very interesting person. She was said to be a lady of great spirit, highly connected by birth and educated in France. She left home as a young girl, went to India, soon after arrival she married a Colonel Atkins, many years her senior. He died within three years, she then decided to train in medicine. She went to Zurich, one of the few schools then open to women, where she graduated MD in 1872. This degree was not acceptable for registration in England. She came to Birmingham where Tait, who strongly believed in the right of women to practise medicine, accepted her. In 1874 Tait published

a paper of some 13 pages on the medical education of women, setting forth his views.[4] Dr Atkins achieved registration in 1878 when the Irish College opened its doors to women.

Tait published an account of this death under methylene ether anaesthesia, with a commentary by Dr Benjamin Ward Richardson.[5]

Tait was awarded the Hastings Gold Medal of the B.M.A. in 1873 for his essay on diseases of the ovary and their treatment.[6] This work included a section of six pages on anaesthesia. They include much sound advice — on the importance of an empty stomach, the removal of false teeth, the use of the lateral position for patients who vomit. He also stresses that "even with an anaesthetic as safe as ether, it is absolutely necessary that the whole of the administrator's attention should be engrossed with it".

Later in 1873, Tait was to come into serious conflict with the editor of the *British Medical Journal*. Tait organised a conversazione on anaesthesia in Birmingham — among the invitations he included representatives of the three London weekly medical papers. The B.M.J. refused his invitation. The editor attacked Tait over his arrangements for this meeting. He wrote in the journal that "such a meeting may degenerate into offensive and invidious public advertisement" and went on to state that it was a professionally objectionable exercise.[7] Tait replied that it was his intention to provide an occasion for Dr Benjamin Ward Richardson and Dr Norris to acquaint the profession with the results of their studies.[8] He also pointed out that the lay press were not invited and that the B.M.J. had published accounts of some 40 similar meetings in recent issues. The editor as usual had the last word, implying that Tait would get away with it on this occasion, but that he had been warned.[9]

Warming of anaesthetic gases

In 1876, Tait drew attention to the undesirable effects of inhaling cold anaesthetic gases. He described his apparatus for administering warm ether vapour in *The Practitioner*[10] and the *Lancet*.[11] In Sykes' *Essays on the First Hundred Years of Anaesthesia* this apparatus is subject to much ridicule,[12] but only gives the reference to the *Lancet* and omits any mention of the report of its successful use in *The Practitioner*. Sykes writing in 1960 must also have missed the 1937 paper of Coste and Chaplin[13] which showed how difficult it was to ignite or explode ether vapour produced in this way. It is not my aim to defend Tait's apparatus but to stress that he reported the importance of breathing warm gases in 1876. As with his advocacy of open ether it was only after some years that Tait's use of warmed vapours was followed by others. Interest in the subject continues. A recent report from Philadelphia[14] claims the use of warmed gases produced a 31% reduction in recovery room time following even short anaesthetics. The authors make no reference to Tait's original contribution in this field. The omission is to be expected for as Sir Francis Shipway[15] wrote about Lawson Tait's contributions to anaesthetic practice — "these discoveries have been assumed to have originated in America" and also "It is fairly obvious that these (Tait's) are the first published accounts of open ether and of warmed ether. It is curious that they have been so long neglected".

Anaesthetic staff

Tait's private practice was extensive. He attracted on occasion fees of up to £1,000. For this practice he engaged Dr Ann Elizabeth Clark. Dr Clark was born in 1844 at Street in Somerset, of a Quaker family. She trained in Edinburgh along with Miss Sophia Jex Blake and other pioneer women until 1874, when the school was closed to women and then went to London to the new School of Medicine for Women. She went on to Switzerland

to obtain a degree, the MD Berne; then later to Ireland to obtain the licence of the Irish College to get on the Medical Register. In 1883 she became an MRCPI. For many years she gave anaesthetics for Tait, impressing the overseas surgeons who came to watch him, and noted the expertise of his lady physician anaesthetist.[16] Dr Clark wrote papers on tetanus and incontinence but I have not traced any papers by her on anaesthetics. Tait reported that she used ether chloroform mixtures in a Clover's inhaler very successfully. Other observers commented that she did not use the rebreathing bag with this apparatus.

In his hospital practice anaesthesia was administered by a nurse. For many years this was Sister Emily Nowers. In June 1895 Dr Mary Sturge, MD London, was appointed as anaesthetist to the Womens Hospital. The report of the Medical Staff Committee for 1895 reads; "During the year an addition to the staff of the hospital has been made by the appointment of Dr Mary Sturge as anaesthetist. This addition is a source of satisfaction to the Board as, although they have every reason to be satisfied with the care the anaesthetics have been administered by Sister Emily, they have always held the opinion that anaesthetics ought only to be administered by a fully qualified practitioner".[17]

The Management Committee saw the appointment from a different viewpoint, their report states: "This appointment relieved the sister in charge of a very trying duty, and enabled her to give more time to the housekeeping. The new arrangement has resulted in an important saving in the housekeeping which it is hoped may be still larger in the present year". The accounts show that the anaesthetist was paid £ 22.10s. for the part of the first year.

At the annual meeting in 1897 the medical staff reported that the position of the anaesthetist on the staff had been questioned. To regularise the situation they proposed a formal resolution that the anaesthetist be included in the membership of the staff. This resolution was strongly opposed by Arthur Chamberlain and Lawson Tait.[18] Chamberlain opposed it on the grounds that the anaesthetist was paid and also had very little to offer. Tait said that he endorsed Mr Chamberlain's remarks, and did not consider that the anaesthetist — who must necessarily be a junior — should be put on the same level as the surgeons and himself. The proposal was withdrawn.

Tait's anaesthetic

Tait's more positive influence on the development of the speciality was indirect, and I believe he was not aware of it. In 1897 Tait had an operation for urethral calculus. The surgeon was Gilbert Barling, then a young surgeon but later to become Sir Gilbert. The anaesthetist was a young man who had qualified the previous year in Aberdeen. Now Tait was not the ideal build for an anaesthetic. He was described by contemporaries as a short, stout man with a magnificent head, thick bull neck, corpulent body, podgy legs and small hands and feet, or as another saw him, the body of Bacchus and the head of Jove.

The anaesthetic was ether. Barling's account reads: "Just as the perineal incision was made, I noticed that the patient was breathing badly. I saw he was black in the face and no air was entering his chest. The sight was an alarming one and to add to the trouble the anaesthetist dropped his tray and bolted from the room". Barling continues: "I had visions of a coroner's inquest at which I, as a junior surgeon just beginning to get on his feet, would appear in the public's eye as the person who had killed Tait, the best known surgeon in Europe and America".[19]

I believe this incident was beneficial to the development of the speciality because that year Barling urged the young Dr McCardie to specialise in anaesthesia.[20] McCardie is regarded

by Bryn Thomas[21] and others, as the first provincial anaesthetist to devote himself exclusively to the speciality. As to the young anaesthetist from Aberdeen, I have found no evidence that he was given any career advice following this episode. However, I have been able to trace his subsequent career. He took up psychiatry and became the superintendent of a private mental hospital of which he was also the licensee.

Conclusion

The rapid decline in Tait's professional standing, and his financial failure about this time cannot, I hope, be blamed on the hypoxic episode. He had many problems; he was involved in a libel action, was in dispute with the MDU, was involved in the Darwin controversy (he was a strong supporter of Darwin), and in the anti-vivisection movement. He was the subject of slanderous allegations about his private life which were almost certainly untrue; all this in addition to his urinary problems. Despite his many original contributions to surgery and anaesthesia, his end was sad. He had to sell his yacht on the Solent, his houseboat on the Avon, his steam launch on the Severn, his country houses in the New Forest and at Cropthorne, his fishing cottage at King's Bromley, and to give up his private hospital, dispense with his staff and sell his treasured collection of curios. He died at his house in Llandudno, on the Conway side of the Great Orme, he was cremated in Liverpool, his ashes were returned to Llandudno, and later his widow had the urn buried in Edinburgh, in Warriston cemetery near to the Simpson family grave. The stone is inscribed: 'She hath done what she could'.

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LIST OF ATTENDING MEMBERS

Dr. A. K. Adams	Cambridge
Dr. J. G. Allen	Bristol
Dr. R. S. Atkinson	Southend
Dr. A. M. Barr	Reading
Dr. M. Bembridge	Leeds
Dr. J. Bembridge	Leeds
Dr. J. A. Bennett	Bristol
Dr. D. D. Beynon	Southend
Dr. R. Binning	Brighton
Dr. R. C. Birt	Southend
Dr. Boughton	Southend
Dr. T. B. Boulton	Reading
Dr. J. Bowes	Bristol
Dr. E. G. Bradshaw	London
Dr. J. Canning	London
Dr. B. Collier	London
Dr. I. M. Corall	London
Dr. D. J. Daniel	Cleveland
Dr. H. T. Davenport	Northwood
Dr. B. T. Davis	London
Dr. G. P. Dickson	Birmingham
Dr. O. P. Dinnick	Liss
Dr. B. Duncum	London
Dr. R. H. Ellis	London
Dr. R. Eastley	Leics
Dr. F. R. Ellis	Leeds
Dr. C. A. Foster	Suffolk
Dr. C. A. Fuge	Bath
Dr. E. P. Gibbs	Basildon
Dr. W. B. Gough	Solihull
Dr. M. B. Gough	Grimsby
Dr. P. Goulden	Dewsbury
Dr. G. Hall-Davies	Worcs
Dr. H. B. Hannah	Wilts
Dr. J. D. Henville	Oxford
Dr. Higgins	Southend
Dr. C. G. Holden	Derby
Dr. J. A. Horton	Gosforth
Dr. D. C. Howat	London
Pr. A. R. Hunter	Stockport
Dr. N. S. Kaduskar	Nuneaton
Dr. J. A. Lee	Southend
Dr. K. G. Lee	Nat Heart Hospital
Dr. W. G. Loyn	Dyfed
Dr. R. E. Mansfield	London
Dr. H. R. Marrett	Coventry
Dr. R. H. Marsh	Northampton
Dr. E. T. Mathews	Birmingham
Dr. I. McLellan	Leicester
Dr. J. A. Monro	Bucks
Dr. P. Morris	Manchester
Dr. A. F. Naylor	Witham
Dr. J. Ormrod	London
Dr. B. Owen	Rhyl
Dr. A. Padfield	Sheffield
Dr. G. M. Paterson	Oxford
Pr. J. P. Payne	London
Dr. E. Plumpton	St. Leonards
Dr. D. L. Pryer	Devon
Dr. M. A. Rucklidge	Lancaster
Dr. G. B. Rushman	Southend
Dr. M. van Ryssen	W. Sussex
Dr. D. Schiller	Hockley
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Dr. J. R. Spears	Chelmsford
Dr. D. H. Spears	Chelmsford
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Dr. P. J. Stow	Sevenoaks
Dr. D. S. Taylor	Southend
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Dr. D. A. Walmsley	Chelmsford
Dr. J. Wandless	Leics
Dr. C. S. Ward	Huddersfield
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Dr. R. W. Weller	Bristol
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Mrs. C. Wiseley	Hon Guest
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