Historical Remarks Regarding Intravenous Ether Anesthesia

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(Dedicated to the late Dr. Rod Calverley)

Inhalation anesthesia and the intravenous administration of drugs form the two main pillars of general anesthesia. Often a combination of the two techniques is used, thus minimizing side effects and augmenting desirable qualities.

The modern era of intravenous anesthesia began in 1871 when the French physiologist and surgeon, Cyprien Oré (1828-1889), in Bordeaux reported the successful administration of chloral hydrate in animal studies, a drug the hypnotic action of which had been announced at a meeting of the Berlin Medical Society two years previously by the German pharmacologist, Oscar Liebreich (1839-1908). Liebreich published a monograph on the subject which was translated into French. Oré may have been stimulated by Liebreich's book, as a few months later he employed the drug favorably in human beings and wrote a monograph about this new anesthetic technique. Despite the reported encouraging results, the method did not become popular. The complicated technique and the fact that the required dose was close to toxic levels were probably the explanation. However, it was only a question of time before other researchers in the field would find less toxic drugs for use intravenously.

In search for alternatives, Ludwig Burkhardt (1872-1924), a surgeon in Würzburg (Figure 1), published in 1905 his experiences with a new technique, the infusion of chloroform or ether intravenously. Born in 1872, Burkhardt graduated at Maximilian's University in Munich in 1895. First at the Department of Pharmacology at the University of Würzburg, he became involved in basic research. He then began surgical training at the University of Würzburg, where he was able to perform his experiments with intravenous ether anesthesia. He recommended the method enthusiastically and endorsed its clinical use. In 1913 he was appointed chairman of the section on intravenous anesthesia techniques during the International Medical Congress in London, being regarded as the father of this type of intravenous anesthesia. He died at the age of 52 in Nuremberg, where he had become a noted surgeon.

Burkhardt's aim was to find a dosage dependent method of providing anesthesia via the intravenous route. He was convinced that anesthesia could be better achieved by the intravenous administration of vapors than by the inhalation of drugs using the currently available anesthetic apparatus. He suggested the suspension of vapors in a concentration of about 4-5 percent in a warmed Ringer's solution. By this means he sought to minimize the unwanted side effects of long-acting drugs like chloral hydrate, ethyl urethane or hedonal. He stated that the infused vapors were indeed eliminated through the lungs so that accumulation of the drugs was virtually excluded and a controllable anesthetic became a reality. Another advantage was the fluid replacement peripheratively; thus importance of fluid replacement was becoming more accepted and was being recommended in textbooks. From the beginning, Burkhardt had good results with the technique and published several papers recommending it. In reference to this infusion method, note must be made of a paper published in 1911 by the pharmacist Walter Straub (1874-1944) in Freiburg. He suggested the...

Figure 1. The surgeon Ludwig Burkhardt (1872-1924).
Anesthesia History Association Spring Meeting, 1997

The Anesthesia History Association’s fifth annual Spring Meeting will be held April 3, 1997, at the Woodlands Inn, Colonial Williamsburg, Virginia. The opening plenary session will be delivered by Audrey C. Shafer, M.D., Assistant Professor of Anesthesia, Stanford University School of Medicine, and the author of “Metaphor and Anesthesia” (Anesthesiology 83:1331-1342, 1995).

Abstracts for 20-minute papers are invited on historical aspects of anesthesia, critical care medicine and pain management. Abstracts on medical humanities and/or ethical topics that relate to the history of one or more of those broad areas are also invited. Abstracts should be no longer than one 8½″x11″ sheet of paper. If possible, abstracts should indicate the research problem, sources used, methodological approach, and may contain no more than 10 references.

Abstracts may be submitted by mail, fax or electronic mail (plain text format). Disk submission in DOS-compatible form is also permitted. Abstracts submitted in electronic format may be made available to registrants in advance of the meeting and at various Internet sites as chosen by the Organizing Committee. ALL accepted abstracts will be included in the abstract book distributed to meeting registrants.

Individuals who wish to organize a paper session around a theme should contact the committee. DEADLINE FOR SUBMISSION of all abstracts is January 31, 1997.

Address inquiries and abstracts to: A.J. Wright, MLS, Chair; AHA97 Spring Meeting Organizing Committee; Department of Anesthesiology Library, University of Alabama at Birmingham; 619 19th Street South, JT 965; Birmingham, AL 35233-6810. (205) 975-5114, ext. 304 (voice); (205) 975-5963 (fax); E-mail to meds002@uabdpo.dpo.uab.edu or to awright@ms.jt.anes.uab.edu

Annual Anesthesia History Association Dinner

New Orleans is the place; the Westin Canal Palace is the hotel; October 22, 1996, at 6:30 p.m. is the time for the Annual Dinner of the Anesthesia History Association.

The guest of honor this year will be Dr. Gwen Wilson of Australia, the first Laureate of the History of Anesthesia of the Wood Library-Museum of the American Society of Anesthesiologists.

Dr. B. Raymond Fink will be inaugurated as the next president of the AHA and Dr. Selma H. Calmes will present the first Calverley Memorial Lecture.

On the insert accompanying this issue of the Bulletin, please send your reservations no later than October 1, 1996, to: Dr. Ted C. Smith, Secretary-Treasurer, 350 Fairbank Road, Riverside, IL 60546.

Fourth International Symposium on the History of Anaesthesia, 1997

In cooperation with the Anesthesia History Association (USA) and the History of Anaesthesia Society (UK), the German Society for the History of Anaesthesia will host the Fourth International Symposium on the History of Anaesthesia in Hamburg, Germany, from April 26 to 29, 1997, just following the Annual German International Anaesthesia Congress, April 23 to 26. The meetings will be held in the Congress Centrum.

All anesthesiologists interested in the history of anaesthesia are urged to attend this meeting. In addition to a stimulating program, special social programs are being organized to acquaint those attending with the cultural, artistic and other special sites in and around Hamburg.

Further information may be obtained by writing to: Prof. Dr. J. Schulte am Esch; Department of Anaesthesiology; University Hospital Eppendorf; Martinistrasse 52; D-20246 Hamburg, Germany.

For abstract forms to present a paper on the history of anaesthesia, please write: M CN – Medizinische Congress; Organisation Nürnberg GmbH; The History of Anaesthesia; Wielandstrasse 6; D-90419 Nürnberg; Germany.

The deadline for submission of abstracts is December 15, 1996.

History Day at the ASA

At the American Society of Anesthesiologists Annual Meeting in New Orleans, History will be featured Tuesday October 22, 1996. From 9:00 until noon, there will be a free paper session encompassing all subjects within the field. Papers from across the world will be presented. This session should not be missed!

At 1:00 p.m. the Wood Library-Museum will sponsor the annual Wright Memorial Lecture. Just prior to the address, the first Wood Library-Museum Laureate will be presented. Gwenifer C.M. Wilson, MD, MBBS, FANZCA, noted Australian anesthesiologist and historian, will be honored.

Joseph Artusio, MD will present the Wright Lecture titled From Symmetrical to Asymmetrical: A Historical Perspective. In his presentation, Dr. Artusio will trace the history of various anesthetic agents, noting that ether, for example, is a symmetrical molecule while halothane is not. Anesthetic management has also become more complex with time. Dr. Artusio's talk will be both thought-provoking and interesting!

At 2:00 p.m. the History Panel will convene. The panel is titled In Celebration of Letheon and will be moderated by Maurice S. Albin, MD, DSc and Douglas R. Bacon, MD, MA. Six papers will be presented. Dr. Gerald Zetlin will speak on William T.G. Morton and October 16, 1846, followed by A. J. Wright's talk, The Surgeons at the MGH and the Cointing of the Term Anaesthesia. Dr. Bacon's presentation is titled The News of Letheon Spread World Wide, and Dr. Leroy Vandam will address Morton's Adversaries. Dr. Elizabeth Frost will proffer And The Fight Went On., while Dr. Albin will conclude the program with Morton as a Civil War Anesthetist.

Tuesday evening the Anesthesia History Association will hold its annual Dinner Meeting. Election of officers and council members will take place. An interesting lecture will cap the evening.

History Day at the ASA! An event not to be missed!
The Lewis Wright Memorial Lectureship*

by C.R. Stephen, MD, CM, FFARCS
Professor Emeritus of Clinical Anesthesiology, Washington University School of Medicine, St. Louis, Missouri

There are not many left who had the privilege of knowing Dr. Lewis H. Wright as the tall, quiet-talking man who always appeared to have time for a conversation regardless of the press of people at a busy meeting. But there we were, at the New York Postgraduate Assembly in 1947, discussing the place of d-tubocurarine in the future practice of anesthesiology. What were the roots of this innovator, Dr. Lewis H. Wright, and how did he play such a large part in the development of anesthesiology?

He was born in North Dakota on July 9, 1894, the same year and in the same state as another of our founding fathers of anesthesiology, Dr. John S. Lundy. However, there is no evidence that these two men knew each other for a number of years: they soon left North Dakota and went their separate ways. Lew Wright was raised in Vermont and then at the age of 18, moved to New York to study medicine, and so he did at the Medical College of Georgia, receiving his M.D. degree in 1925. For the following five years he practiced obstetrics and anesthesiology, the latter of which stirred his imagination. The peripatetic nature of his education, plus his interest in anesthesiology, prompted him to join E.R. Squibb and Sons in 1930. This decision marked his lifelong interest in things pertaining to anesthesia and the history of the specialty, a role he played with great distinction.

He made it his task to attend medical conventions in every state, to visit hospitals and get to know anesthesiologists in their own environment (an easy endeavor in the early years). He was in the forefront of the development of cyclopropane and in 1940 conceived the idea of curare possibly being a muscle relaxant for use in anesthesia. Squibb prepared a biologically standardized compound known as Intocostrin and Wright was the man designated to sell it to the profession. He tried unsuccessfully with Drs. Stuart Cullen and E.M. Papper, who found in the laboratory in animals that it was unsuitable, producing abundant salivation, bronchial spasm and respiratory depression. The skeptics were numerous as he approached them. But at the New York Postgraduate meeting he talked with his friend, Dr. Harold Griffith of Montreal, who thought the idea had merit and proceeded to use it cautiously in his daily practice as a supplement to cyclopropane. The result revolutionized the concept of anesthesia administration, as reported by Harold R. Griffith and G. Enid Johnson in Anesthesiology 3: 418-420, July, 1942, in an article titled, "The use of curare in general anesthesia."

Dr. Wright's career was temporarily interrupted by the Second World War in which he served in the U.S. Navy in the Pacific area from 1943 to 1946. Returning to the New York area, which was his home base, he was appointed Chief of Anesthesiology at the U.S. Naval Hospital, St. Albans, New York with the rank of Commander, U.S.N.R. On his return to civilian life he was appointed to the faculty of the New York Medical College.

One of the many friends with whom Lew Wright formed a close association was Dr. Paul Wood, a New York anesthesiologist who had studied with people such as Dr. James Gwathmey. Both of these men had at least two interests in common. They were interested in organizational matters pertaining to anesthesiology and they were collectors, Wood of books and memorabilia associated with anesthesiology, and Wright of bleeding bowls, scarifiers and anything pertaining to the history of anesthesia. Wood's collection accumulated to the point that it almost drove him out of house and home, so Wright arranged for it to be stored and catalogued in the Squibb building in New York as a gift from the Squibb Pharmaceutical Company. This building was also the headquarters of the fledgling American Society of Anesthesiologists and the American Board of Anesthesiologists. It was Dr. Wright who promoted the idea that this historical collection should be perpetuated and named the Wood Library-Museum, and it was so incorporated under the laws of the State of New York. It was housed in various places in the city until, in 1949, the House of Delegates of the American Society of Anesthesiologists officially established a non-profit corporation called the Wood Library-Museum of Anesthesiology and designated it as the "repository for the archives and paraphernalia pertaining to the field of anesthesiology."

The distinguished career of Dr. Wright ended on August 20, 1974. As stated in the memorial address, "He was dynamic, even when he envisioned a problem he could not resolve, but just thought of possible solutions."

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use of an electric powered roller-pump apparatus for the infusion of fluids under variable but constant flow conditions and recommended its use for anesthesia purposes (Figure 2). We are not aware that surgeons ever took notice of this article; nevertheless it shows that at that time a modern technique was at hand for the intravenous route of anesthesia administration.

One of the most prominent and reputable German surgeons during this period was Hermann Kümmell (1852-1937), the chairman of the “New Hospital Eppendorf” in Hamburg (Figure 3). He began his medical career in Berlin, but went to Hamburg where he soon realized the need for specializing in the surgical arena. Thus he became a protagonist of German anesthesia and two of his pupils, Paul Sudeck (1866-1945) and Helmut Schmidt (1895-1979), had distinguished careers. Early in his practice of surgery, Kümmell became an enthusiastic of the new intravenous ether anesthesia method. He also had an open mind about the technique of administering anesthesia, and his pupil Sudeck became a prominent pioneer of inhalation anesthesia techniques in Germany.

Next to Burkhardt, Kümmell became the leading champion of the intravenous anesthesia technique, discussing its advantages and disadvantages in Germany and abroad. To minimize embolic complications, he suggested a constant flow of the infusion. The apparatus was first described by Heinrich-Wilhelm Schmitz-Peiffer (1880-1944), an assistant in the surgical department at Eppendorf. Its advantages (continuous flow) became widely accepted and it was never abandoned (Figures 4, 5). Other authors praised this technique and recommended its extensive use when indicated.

Among those who approved of this new technique of anesthesia abroad were the surgeons William Francis Honan (1886-1935) and Wyllis Hasseler of New York. In a review article, they described the technique and reported their results. They suggested the concomitant injection of the narcotic-like Isopral (trichlorisopropyl alcohol) or Hedonal (methyl-propyl-carbino-urethane) to reduce the time of induction and reduce the need for the ether infusion, especially in robust individuals. The “mono IV-anesthesia” with Hedonal, an hypnotic, was first described by Heinrich Dreser (1860-1924) of Munich (he also made the first pharmacologic studies of aspirin in 1900) and became very popular in Russia, being recommended by the Russian pharmacologist Nicolai Pavlovich Krakow (1865-1924) of St. Petersburg. The surgeon Sergej Federow (1869-1936) from the Military Academy was enthusiastic about this technique using Hedonal, to the point that it was called “The Russian method” for some time. However, Burkhardt and Kümmell were not in favor of this method, fearing complications with the Hedonal, particularly long-lasting depression or unstable hemodynamics.
In the United Kingdom, Felix Rood (1872-1933) became devoted to this technique. As anesthetist of the London Throat Hospital, he noted a long list of indications for it and in an article compared it with other methods of general anesthesia. He introduced a specially designed infusion system with an integrated drip-chamber and a heat exchange device to prevent hypothermia developing in the patient with the large amounts of fluids used (Figure 6). He was impressed by the stable perioperative hemodynamics and the lack of postoperative vomiting and pulmonary irritation.

As noted by Burkhardt, Kümmell, Schmitz-Pfeifer, Rood and others, the intravenous ether anesthesia technique was particularly appropriate in hypovolemic patients. Thus, it was a logical step to use it in wounded soldiers during the First World War. Two German surgeons, Alfred Wetter (1882-?) and Wilhelm Dieterich (1885-1951) favorably discussed this indication in their reviews, being impressed with the rapid induction and recovery and with the lack of pulmonary infections in these high risk patients.37,38

A few years later, a similar indication was discussed by the obstetrician Rudolf Dryoff (1893-1966) in Ulm for hypovolemic pregnant patients. Unlike others, he suspended the ether in "Normosal", a solution with volume expanding properties, thus promoting a stable circulation. He recommended the infusion ether technique in selected patients having obstetric surgery (Figure 7). His technique was generally accepted and described in one of the leading operative gynecologic textbooks of the period.

In the late twenties, several articles about the intravenous ether technique were published in German journals. Members of the surgical department of the Nuremberg Hospital were particularly impressed with their results: more than 1000 consecutive patients receiving this type of anesthesia had no fatal complications. When Burkhardt died in 1922, his successor, Professor Erwin Kreuter (1876-1956) realized the advantages of this unusual anesthesia method and did not hesitate to praise it. In collaboration with others, he called for further intensive research and discussed the potential aspects for the future.41,42

During this time a new short-acting intravenous anesthetic drug, a barbiturate called Pernocton, was introduced into clinical practice by Rudolf Bumm (1899-1942), a member of the surgical department of the Charité. His first report at the annual meeting of the German Surgical Society in 1927 received little attention because at that time the severe side effects of the rectally administered Avertin (tribromethanol) were dominant. A similar disregard in 1929 was given to the surgeon Martin Kirschner (1879-1942), chairman of the surgical department of the University Clinics in Tubingen, when he presented a similar paper.43

During the thirties, enthusiasm for the intravenous ether technique waned. The success of the ultrashort-acting barbiturates, in Germany hebarbital (Epyan) and in the United States sodium thiopental (Pentothal) and their derivatives, made the ether infusion method superfluous.44,45 Surprisingly, after World War II the intravenous anesthesia technique was praised in German textbooks of surgery and described as "an advantageous anesthesia technique with some special indications".46,47 This limitation evidently reflected the lack of experienced anesthetists in the German-speaking countries after the war at a time when endotracheal anesthesia was rarely done, in contrast to the Angloamerican world where it had become so widely accepted as an essential part of modern airway management.

In conclusion, the intravenous ether infusion technique for anesthesia was an important step forward for several reasons. It was an impetus to develop short-acting drugs. It enhanced pharmacologic investigations of the dynamics of intravenously administered drugs. It promoted knowledge of different methods of phlebotomy with development of needed equipment for its use. Last but not least, it markedly increased the knowledge of problems associated with the perioperative administration of fluids.

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Kochsalzinfusionen auf die Chloroformwirkung während und nach der Narkose; nach experimentellen und klinischen Beobachtungen. Arch klin Chir 75: 1179-1196, 1905.


24. Kiimmell M. (Kiel) Personal communication about Wilhelm Schmitz-Peiffer, April, 1991.


26. Wepfer A. Die intravenöse Isopral- (Kassel): Personal communication


31. Anonymous Obituary. Memorial Service. Willard-Soulther Museum inaugurated a series of historical lectures at the annual A.S.A. meeting in 1967, and in 1975 began to name them the Lewis H. Wright Memorial Lectures. As the following list indicates, they have included a panorama of what is best in our historical heritage. (An index to Dr. John W. Wenden, Dr. Harry Sokol and others for information included above.)

1970: *David M. Little, Jr., M.D., In the Beginning (On Horace Wells).
1971: James Harvey Young, Ph.D., Crawford W. Long, M.D. — A Georgian Innovator.
1978: W.D.A. Smith, M.D., Henry Hill Hickman: Quack or Anti-Quack?
1980: John W. Pender, M.D., Contemporaries of Lewis Wright.
1984: B. Raymond Fink, M.D., Leaves and Needles: The Discovery of Local Anesthesia.
1989: Nicholas M. Greene, M.D., They Also Served: Contributions by Non-anesthesiasts to the Development of Anaesthesia.
1993: *M. T. “Pepper” Jenkins, M.D., Epochs in Intravenous Fluid Therapy: From the Goose Quill and Pig Bladder to Balanced Salt Solutions.
1996: Joseph F. Artusio, Jr., M.D., From Symmetrical to Asymmetrical.

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He was a cool diplomat and very persuasive. He never stepped on the sensitive toes of his colleagues, but infused them with his enthusiasm, optimism, and ability to meet the challenge with a friendly-shaped policy. One of his memos reflects his attitude toward life, “Egotism is the anesthetic provided by nature to dull the pain of being a damn fool.”

The Board of Trustees of the Wood Library-Museum inaugurated a series of historical lectures at the annual A.S.A. meeting in 1967, and in 1975 began to name them the Lewis H. Wright Memorial Lectures. As the following list indicates, they have included a panorama of what is best in our historical heritage. (An index to Dr. John W. Wenden, Dr. Harry Sokol and others for information included above.)
Cyanosis – An Historical Treatise

Dr. David Zuck, at present President of the History of Anaesthesia Society (HAS) published the following paper in the Proceedings of the HAS (16:25-33, 1994). We are much indebted to Dr. Zuck and the Editor of the HAS for their kind permission to reprint this article in the Bulletin.

Cyanosis in the Early History of Anaesthesia

Dr D Zuck
Hon. Consulting Anaesthetist to the Enfield Health District; President, History of Anaesthesia Society

On May 1st, 1847 Gideon Mantell of Lewes, surgeon and amateur geologist, discoverer of the iguanodon and other dinosaur fossils, recorded in his journal:

‘Went to Bartholomew’s Hospital, and witnessed two operations under the influence of ether: the first I have seen. The loss of sensibility in both instances was complete, no consciousness of the operation. But the effect on the system was appalling, though transient.’

What he meant can be gathered from a letter written by Dr Charles Locock of Hertford Street, London, to his friend James Young Simpson, some three months after the introduction of ether:

‘Many thanks for your pamphlet on the ether inhalation, with which I have been much interested. People here and in Paris are getting frightened about it, as the arterial blood becomes black under its influence.’

Disturbing reports had appeared almost from the outset. At Guy’s Hospital a patient’s face had been much congested and at St Thomas’s there was so much coughing and turgidity of the face that the operation had been abandoned. At St Bartholomew’s a patient’s breathing was once or twice laborious, the abdomen heaving a great deal, the face, and even the whole surface of the skin, somewhat purple the greater part of the time. And as regards Mr Tomes’s celebrated case of lithotomy at the Middlesex:

‘...after breathing deeply and tranquilly for about two minutes, his countenance became livid.’

Present-day anaesthetists will have no doubt that what was observed was cyanosis resulting from respiratory obstruction, yet such an explanation does not feature in any of the early accounts. Rather it appears that a chemical cause was being proposed. Dr James Pring of Weston-super-Mare wrote of the state of uncertainty among the profession about the propriety of using ether. French physiologists had described a dark, fluid state of blood in etherised animals, and a similar state had been seen repeatedly in this country by surgeons operating on patients under the influence of ether. The arterial blood exhibited the same change. The question was whether the change was due to a deficiency of oxygen, or whether it was an independent chemical change, in which case it would occur equally in blood removed from the body.

To test this thesis he had collected two samples of arterial blood from a sheep, one of which had been mixed with a small quantity of washed ether. Within three minutes the blood was almost black, and the coagulum was much softer than usual, while the unexposed blood remained florid, and coagulated normally. The experiment had been repeated with oxygen added to the ether bottle the oxygen had neither prevented the colour change, nor could the blackened blood be restored by oxygen. The conclusion was that the change was purely chemical. Whether to continue to use ether, in the face of this evidence, was for the surgeons to decide.

Dr Pickford of Brighton, an early exponent of bashing the media, went even further. The public had been led by the daily press to expect perfect immunity from pain, without fear of any ill effects or consequences, but he wished to undeceive the public. What of the pulse, respiration, and countenance, during the state of insensibility? The circulation becomes first rapid then slow and feeble, the respiration laboured and stertorous, the countenance livid, the lips and tongue are blue, the pupils dilated, the muscles universally relaxed, the functions of the brain and nervous system suspended and the patient, to all intents and purposes, is a senseless corpse. The condition had been compared by some to drunkenness, by others to asphyxia, or to apoplexy of the congestive form. But etherisation was more alarming and dangerous than any of these: there was a chemical and vital alteration in the constitution of the blood itself. Ether robs the blood of its oxygen, intensely blackens it by the solution of its corpuscles and their contained haemoglobin, chemically deprives it of its powers of coagulation, and renders it unfit for the purposes of life. A black vitiated blood circulates through the system, analogous in many particulars to that in putrid and malignant fevers. This impaired condition of the blood is not even partially corrected until atmospheric air has been breathed for some time, and sufficient lymph corpuscles have found their way into the circulation to replace those destroyed by the ether. The ether has dissolved the blood corpuscles, and permitted its contained haemoglobin to escape. Under the microscope numerous remains of the capsules of corpuscles could be seen.

Conflicting reports on cyanosis

In the face of all this, it is remarkable how little the bluish discoloration of the skin or the blood features in the early books on etherisation. Robinson, reporting on some 120 operations, mentions only one patient whose face was much congested, another who turned very red, or rather purple in the face, one with congestion of the face and head, the colour being somewhat livid, and one where the symptoms of congestion of the brain were so apparent that it was thought more prudent to delay the operation. Two of these cases appear to be identical with ones mentioned above. Robinson must have been aware that there was concern, because he quotes Boot reporting the observation of the surgeon, Mr Hale Thomson that, in his operations, under the full effect of ether, the arterial blood presented its usual appearance, nor was there any reason to suspect asphyxia.

John Snow, too, minimised its significance in his first treatises. Neither mention the word cyanosis, neither contain any indication of the recognition of respiratory obstruction. In fact, Snow was at pains to point out that in his patients:

‘The blood that flows in operations is not much altered in colour, the patient’s lips remain unchanged in hue. only when the patient has been holding his breath, or coughing, have
I observed the arterial blood to be a dark colour; and I consider that those writers who have described it as being, usually or always, of a venous appearance, must have used inhalers that did not allow a proper supply of air. The blood always coagulates on the floor of the operating theatre, and the black blood which flows during an amputation when the tourniquet is applied, constantly becomes afterwards red on the surface from exposure to the air.

Any problems with respiration were attributed only to the unsuitability of the apparatus. Snow repeatedly emphasised the importance of wide bore tubing and low resistance to breathing. Also, he was concerned to refute the suggestion, implicit in the comments quoted, that ether alters the blood chemically, and interferes with coagulation.

If one read only Snow's own writings, one would conclude that his patients were rarely cyanosed. Only once does he refer, and in general terms, to one or two patients whose faces became purple, but should this occur: 'there need be no alarm'. The face-piece may be removed if thought propel; but breathing always becomes extremely regular when the next degree is attained. However, from early 1847, the Lancet published eye-witness accounts of the operating lists under general anaesthesia at the London teaching hospitals, and it is instructive to compare these descriptions of the same cases with those that Snow published later in his book. For example, on 28 January at St George's Hospital, Snow is described as having anaesthetised a little boy with a long sequestrum in the tibia. The account continues: '...inhaled – operation commenced after one and a half minutes – inhalation stopped a minute later just as his face was becoming rather purple, and the pulse feeble.' Snow's own account makes no mention of cyanosis, only of coughing, which he attributed to existing bronchitis. It is disconcerting to find that one's hero at times made the same mistakes as the rest of us.

We read of cyanosis in other accounts also. In a case of bilateral amputation at the London Hospital after a train accident, described as 'the most formidable operation as yet performed... under the influence of ether' it is said that: 'The blood in the small arteries was much darker than usual, so that it was really difficult to distinguish it from venous blood.' Of Mr Nunn's fatal case in Colchester, the account reads:

'After having inhaled the ether for eight minutes, the patient became fully under its influence, even to the extent of stertorous breathing, and the face and lips presented a livid hue."

The disquiet continued. John Denham, in 1849, reporting on the use of chloroform in labour paints a fearful picture of the evils likely to arise from its use... apoplectic stertor, convulsions, partial paralys... the blood blackened, the brain poisoned, and other still more formidable consequences, are among the number of dangers mentioned as liable to be induced by the state of anaesthesia.'

Edward Murphy, in 1850, also remarked on the dark colour of the blood:

'It may be chloroform – it may be the imperfect oxidation of the blood – that produces the alteration, whichever is true, the question is well worthy of an attentive examination.'

Theories of cyanosis

Of the observers cited, only Murphy and Pring suggested that hypoxaemia might be a factor, and researchers into the history of medicine of the first half of the nineteenth century may come to share the view that there were two populations of doctors at large, the younger moderns, who knew what we would regard as the 'right' answers, and the older traditionalists, who clung to the 'elements of medicine' of the eighteenth century. The physiology textbooks of the early part of the nineteenth century reveal conflicting ideas about the process and functions of respiration, and the cause and significance of the colour difference between arterial and venous blood. This uncertainty includes the remnants of earlier beliefs, chemical, physical and mechanical, which ramify throughout the whole of the succession of systems of medicine.

Before Harvey, the difference in appearance of arterial and venous blood was attributed to the presence in the former of a bright red, thinner blood, together with the higher type of pneuma, the vital spirit. Harvey himself denied that there was any difference in colour between venous and arterial blood, and for this he was criticised as an inaccurate observer by Colen. Keilin more perceptively pointed out that it was in support of his revolutionary thesis that it was the same blood that circulated from the veins to the arteries and round again that he had to deny even a difference in colour.

Harvey's discovery, with its implicit erosion of the dominion of Galenic physiology that centred round the heart, raised questions about the lung function, the purpose of respiration, and the source of body heat, and these were addressed by the remarkable group of investigators who centred round Robert Boyle, and became the original members of the Royal Society.

The first recorded observations of the change of colour that blood undergoes when exposed to air was published by the anatomist Carlo Fracassati of Bologna in 1665. It was a classical observation that when blood was collected in a bowl it formed a clot with a red surface above, and darker parts below. This was seen as the sedimentation of its constituents, the light spirituous part uppermost, the humours below, with the heaviest, the black melancholy humour, at the bottom. But Fracassati showed that if the clot was turned over, its dark undersurface on exposure to air soon became a florid red. This observation overturned classical physiology. It was quickly picked up and confirmed by Robert Boyle (1627-1691) and by Robert Hooke (1635-1703), who noted also that when the red surface was progressively sliced off, the exposed dark beneath soon became florid.
The in vivo site of this colour change was demonstrated by Richard Lower (1631-1691) on the open thorax of a dog. Lower's suggestion that the change of colour was due to absorption of particles from the air was elaborated by John Mayow (1641-1679) who, in his Tractatus Quinque identified them as ‘nitro-aerial’ and attributed to them several of the properties that today are associated with oxygen.

However, this was only one of several explanations of the colour change, which can be classified as chemical, physical and mechanical. The chemical suggested that combination with certain aerial particles caused the change of colour; the physical and mechanical, that the churning and moulding through the lungs caused a change in their shape that caused them to reflect light more brightly. So, while it might be thought that Mayow had put respiratory physiology on the right path, the mechanical physiology associated especially with Boerhaave delayed progress by the best part of a century. Haller, in the middle of the eighteenth century, actually denied that the blood changed colour at all during its passage through the lungs.

So chemistry took a back seat until the elaboration of the lime-water test and the demonstration by Joseph Black in 1756 that fixed air, or carbon dioxide, is given out during exhalation. This was soon followed by the confirmation by the Italian anatomist, Giovanni Cigna, that blood did change colour, and that the change depended on contact with air. Lavoisier’s experiments with the ice calorimeter established that oxygen is consumed, and related it to the amount of heat generated. Thus respiration became equated with combustion, in this case the combustion of waste carbon compounds, and the question then arose, where did this process take place? Two theories were proposed.

While some suggested that it took place throughout the body, ideas about the constitution of the organs and tissues were not far advanced, and the favoured site, supported by Lavoisier among others, was the lungs. This would account for the generation of heat but, if waste carbon compounds were being combusted in the lungs, it followed that since all the oxygen being inhaled would be used up in the production of an equal volume of carbon dioxide that would be breathed out, neither gas should be found in the blood in the systemic circulation nor was it, until some fifty years later. So the darker colour of venous blood was explained by the accumulation in it of carbon which, as everyone knew, was black.

The second theory, associated with Lagrange and Hassenfratz, proposed that the reaction took place in the periphery. The demonstration of tissue respiration by Spallanzani at the beginning of the nineteenth century gave support to this, and by the 1820s the idea that the reaction took place in the peripheral capillaries was strongly gaining ground.

A change in nomenclature
Cyanosis is as old as haemoglobin, and much older than man. It is a state that we all pass through at each end of our lives. It used to be, and perhaps still is, one of the clinical signs that medical students are early on taught to look out for, so the absence of the word ‘cyanosis’ in any of Snow’s writings was surprising. In the Oxford English Dictionary I was astonished to find that the first recorded use of the word was in 1834, in a book by John Mason Good, The Study of Medicine. Good, who based his work on the nosology of Cullen, itself inspired by the botanical classification of Linnaeus, listed Cyanosis or Cyanosis, or Blue skin, as the third species of the Genus Haematica. His and other contemporary medical textbooks attributed cyanosis solely to congenital heart disease, and specifically to a patent foramen ovale. The first and second species of the genus were aneurysm and varix, and the connection between the three was that in all of them there is turbulent blood flow. Only slowly from the 1840s on, did the connection between cyanosis, other categories of heart disease, and pulmonary disease, become recognised.

Of course, the earlier word for blueness of the blood was lividity, but lividity appears to have carried a sinister connotation: it was associated with terminal conditions, and was hardly regarded as a readily reversible state, especially with no oxygen cylinder at the head of the bed. I think the question of why Davy’s suggestion regarding the use of nitrous oxide as a pain relieving agent was not taken up may be answered, in part at least, by the contemporary view of lividity. In March 1800, in the company of Astley Cooper and others at a meeting of the Askesian Society, William Allen, lecturer in chemistry at Guy’s Hospital (later of Allen and Hanbury’s), inhaled what he called gaseous oxide of azote (nitrous oxide) and recorded in his diary that: ‘The company said that my eyes were fixed, face purple, veins in the head very large, apoplectic stertor. They were all much alarmed, but I suffered no pain and in a short time came to myself.’ But a purple face, apoplectic stertor and dilated head veins were the signs of a stroke; and also current at that time and for the next thirty years, was the belief that blue or venous blood was poisonous to those tissues accustomed to being perfused with arterial blood. So, although Allen came to no harm, it is not surprising that the experiments were abandoned.

We know from his writings that John Snow kept himself fully aware of the latest developments in physiology. At the beginning of Part 17 of his series of publications On Narcotism by the Inhalation of Vapours, he surveyed contemporary theories about the chemistry of respiration and its site in the body, and referred to the researches of W F Edwards, and of H G Magentis who, in 1837, demonstrated the presence of oxygen and carbon dioxide in the peripheral blood. Snow dismissed the lungs as the site of formation of carbon dioxide, and believed that the reaction took place in the capillaries of the systemic circulation. Also, the phenomena of asphyxia, previously attributed to an excess of carbon in the blood, were now known to be caused by want of oxygen in the arterial circulation. In the same series of essays Snow had clearly distinguished between anaesthesia and asphyxia, so he obviously felt no reason to be concerned by the fears raised by Drs Pring and Pickford. Also, as against his confessed disposition not to allow an occasional risk to stand in the way of ready applicability, his experience with cyanosed patients who recovered and appeared none the worse for it, would soon have deprived the condition of its anxieties.

Would it have been easy to detect slight cyanosis in Snow’s time? Artificial lighting was generally by candle or gas, both of which shift the colour temperature towards the red end of the spectrum, so it is reasonable to excuse failure to detect slight cyanosis, unless operating in daylight. However, we know that operations were usually performed about mid-day, and that operating theatres were lit by skylight. Also, of course, there was no shortage of accounts of cyanosis being observed.

Landmark publications after Snow’s death were by Stokes, who described the absorption spectra of oxygenated and reduced haemoglobin, and Pfliuger, who showed that the respiratory reactions take place not in the capillaries but in the tissues. In 1923, Lundsgaard and Van Slyke established that blood appears cyanosed when it contains 5g of reduced haemoglobin, and that this is an absolute figure.

For how long was cyanosis a feature of clinical anaesthesia? Those who have read Hewitt’s Anaesthetics and their Administration have noted that he describes two types of anaesthesia, simple and complex. Complex anaesthesia was what occurred in practice, and consisted of simple anaesthesia plus a varying degree of asphyxia, evidenced by cyanosis. Nitrous oxide anaesthesia was always

Continued on Page 19
From the Literature

A. J. Wright, MLS


- Describes the life and career of Dr. Gwenifer Wilson, named as the first Laureate of the History of Anesthesia by the ASAs Wood Library-Museum of Anesthesiology. Dr. Wilson will formally begin her four-year term at the 1996 ASA annual meeting in New Orleans in October.


- Describes various developments in the history of blood gas measurements.


- Dr. Bacon continues his efforts to document professional and academic organization of anesthesia in America prior to World War II. This piece examines the role of Frank H. McMechan, MD, in organizational efforts. 3 illus., 12 refs.


- Examines such surgeon/anesthesiologist pairings as Mayo/Lundy, Lahy/Sise and Schmidt/Waters. As usual with Dr. Bacon's articles, this one is stuffed with relevant information. 8 portraits, 3 graphs, 31 refs.


- This excellent article traces the development of Waters' department and those of his "heirs," or former residents and their trainees. Another entry by Dr. Bacon in his series of articles documenting academic anesthesia in the United States—a subject in great need of such efforts. Based in large part on the Waters papers, University of Wisconsin. 5 illus., 5 tables, 16 refs.


- Examines changes in treatment after the founding of the ASRA in 1923. 9 illus., 29 refs.


- This entry in the journal's "Cover Note" series describes Johannes Friedrich von Esmark's 1879 mask, designed for battlefield use. When are they going to issue this fine series of notes in book form? 1 illus., 6 refs.


- Describes the ca. 1890 mask designed by Swiss surgeon Theodore Kocher (1841-1917); mask was designed for use with either chloroform or ether.

1 illus., 8 refs.


- Another in the excellent "Cover Note" series published by this journal. Brief description of the life and work of German surgeon Curt Schimmelbusch (1860-1895). 1 illus, 4 refs.


- Gardner, an anesthetist at Charing Cross Hospital, first described his mask in an article published in the -British Medical Journal- in January 1908. Gardner also wrote the Manual of Surgical Anaesthesia first published a few years later. 1 illus., 3 refs.


- Describes work of Paracelsus, Valerius Cordus, Frobenius, Eli Ives, Richard Pearson and R.J. Thornton. 5 illus., 4 refs.


- This French-language article has not been examined.


- Investigates, via material obtained under the U.S. Freedom of Information Act, the supposed large number of casualties during barbiturate anesthesia for surgery after the Japanese attack on Pearl Harbor. "...it is clear that the rumoured death rate from this cause has been greatly exaggerated." 2 tables, 12 refs.


- Fascinating description and analysis of Holmes' device for producing carbonated water. 1 illus, 14 refs.


- Dr. Bergman relates numerous examples from the 1790s to the 1840s. 2 illus., 17 refs. (available from the author).


- Brief review of the topic. 3 illus., 1 table, 31 refs.


- This item has not been examined.


- This German-language article has not been reviewed.


- A better overview of pre-1900 anesthesia history would be hard to find. Simply excellent. Contains an appendix, "Chronological History of Anesthesia and Related Events" (pp. 30-32). 1 table, brief bibliography. 70 refs.


- Brief outline of private and academic careers of Dr. Agoston. Portrait.


- Excellent overview of the discovery of and research on this condition. 126 refs.


- Notes the event which took place October 14, 1995, at Seneca Falls, NY. Also notes that four stringed musical instruments made by Dr. Aggar have been donated to Columbia University. 2 illus., 3 refs.


- Dr. Calmes continues her fine documentation of the early female pioneers of the specialty. 42 refs.


- Dr. Calmes, along with the late Rod Calverley, MD, one of the founding members of the Anesthesia History Association, describes the genesis and history of the WLM Fellowship program.


- Good overview of the topic. 5 illus., 51 refs.


- This fine biography of Read (1889-1959) focuses on "his 35-year quest to change obstetric practice." Read's publications include the popular Childbirth Without Fear (1944). 80 refs., numerous footnotes.

Clark EB. The sacred rights of the weak: pain, sympathy, and the culture of individual rights in antebellum America. Journal of American History
RESERVATION FORM

Annual Meeting and Dinner
Anesthesia History Association

TUESDAY, OCTOBER 22, 1996
Terrace Room
Westin Canal Plaza
Canal Street, New Orleans

6:30 p.m. — No-Host Social Hour
7:30 p.m. — Business Meeting and Dinner
8:15 p.m. — First Calverley Memorial Lecture
The Economic History of Anesthesia
Selma H. Calmes, M.D.

Name ______________________________________________________
Address ____________________________________________________
Number of Reservations _______________________________________
Names of Guests _____________________________________________

Amount Enclosed (Cost: $60.00/person) ___________________________

Make your check payable to the Anesthesia History Association. Please mail promptly (no later than October 1) to:
Dr. Ted C. Smith
350 Fairbank Road
Riverside, IL 60546

This article has not been examined.


A rambling, disjointed effort. Considering how much work needs to be done on this topic and how many authors are listed on this article, it's a disappointment, to say the least. No illustrations or references, either!


Describes the controversy involving this agent; two deaths occurred under Snow’s administration. 15 refs.


Brief description, adapted from another source, of Dr. George E. Holtzapple’s 1885 discovery. 1 ref.


This report includes early French accounts of self-inhalation of ether and conscious analgesia. 1 ref.


This article was published in 1995.


This Dutch language article has not been examined.


This monumental work by the late Dr. Ellis is favorably reviewed (how could it not be?) in Br J Anaesth 75:826-827, 1995, by A. Macdonald and in Anaesthesia 82:1390-1391, 1995 by NA Bergman.


Dr. English briefly introduces the reprint of his 1969 article for the journal’s “Classic Paper” series.


This item has not been examined. Presumably it has something to do with Faraday’s anonymously published essay of 1818.


This German-language article details work by Schrotter in Vienna and Throst in Hamburg. Illustrations of instruments at the Ingolstadt Medical History Museum.


This letter notes other such events in Spain and France in the 19th and 20th centuries. 6 refs.


Brief reflections on the life and career of Dr. Miller.


This article has not been examined.


In response to an earlier article (MacDonald AG. A short history of fires and explosions caused by anesthetic agents. Br J Anaesth 72:710-722, 1994) this letter notes other such events in Spain and France in the 19th and 20th centuries.


Lengthy, detailed history of the topic. 30 illus., numerous refs.


Notes that St. Paul’s “descriptions fulfill the criteria for migraine without aura of the 1988 Headache Classification.”


This monograph has not been examined.


This book chapter has not been examined.


Considers pain on a broad scale; surgical pain and anesthesia are briefly discussed. 10 illus., 80 footnotes.


Reviews the pharmacodynamics and pharmacokinetics of this induction agent and compares it favorably with “its younger cousins.” German language.


Describes and gives background to a letter recently acquired by the Wellcome Institute for the History of Medicine from English novelist Elizabeth Gaskell (1810-1865) to Ann Scott, wife of the principal of Manchester’s Owens College. The letter is undated, but the author conjectures a time early in 1854. Letter is reproduced in full. 1 illus., 83 refs.

Hirschmuller A. E. Merck and cocaine. On Sigmund
**Literature. . . Continued from Page 11**


**This French-language article has not been examined.**

---. Physiology of pain in the XVIII century. *Cah Anesthesiol* 43(3):331-335, 1995. This French-language article is primarily a reprint of a portion of a surgical work by Herman Boerhaave (1624-1738).


Porter R, Teich M. *Drugs and Narcotics in History*. New York: Cambridge University Press, 1995. Roy Porter of the Wellcome Institute of the History of Medicine in London is perhaps the most prolific medical historian and editor on the planet. One of his recent obsessions has been Thomas Beddoes, about whom Porter published an excellent book several years ago. In this collection of essays, Porter and Teich bring together a number of pieces, including one by Scarborough, Maehle and Acker on aspects of opium use in the 18th and 19th

Poterack KA. 100 years (or so) of the modern anesthesia record. ASA Newsletter 59(11):16-17, 1995.

Dr. Poterack describes his research on this topic during his 1993 Wood Library-Museum of Anesthesiology Fellowship. 2 refs.


This French-language article about respiratory resuscitation in the enlightened century has not been examined.


This German-language article has not been examined.


One of a series of occasional pieces on history published by this journal. The article describes such items as the late nineteenth-century moveable hyperbaric surgical chamber. 5 illus.


Describes developments since the work of Paul L. and colleagues at the Mayo Clinic in 1950. 83 refs.


This fascinating article describes the 1857 trial in which Lincoln prosecuted; one of the major questions of the trial was "Could an overdose of chloroform cause insanity?" 4 illus., 51 footnotes.


Dr. Spielman was a Wood Library-Museum of Anesthesiology Fellow in 1993 and in this article describes his research "into the history of anesthesiology and pain control through art," concentrating on Crawford Long. 3 illus.


Examines the painting "The Four Doctors" by John Singer Sargent; the physicians are William Halsted, William Welch, William Osler and Howard Kelly, the four giants of Johns Hopkins Medical School. 1 illus., 2 refs.


The author makes an impressive case for the role of Herb (1863-1943) as an important figure in the pre-War II history of the specialty. Herb was the first physician-anesthesiologist at the Mayo Clinic and the first female physician at Presbyterian Hospital in Chicago. One of her employees at Presbyterian, Alice McNeill, MD, founded the Department of Anesthesiology at the University of Alabama at Birmingham in 1948—one of the earliest academic anesthesia departments in the southeastern U.S. 5 illus., 44 refs.


Thompson GE. Mesmer, Mozart and music in anesthesiology. ASA Newsletter 59(9):15-17, 1995. Dr. Thompson was a Wood Library-Museum of Anesthesiology Fellow in 1989 and in this article describes his research into Mesmer (who commissioned Mozart's first opera) and his legacy. 2 illus., 9 refs.


Continued on Page 19
The Thermo Etherizer:
Pioneering Works of a Spanish Surgeon

Servicio de Anestesiología y Reanimación, Hospital General de Galicia-Clinico Universitario
C/Galeras s/n; 15705-Santiago (La Coruña), Spain

Introduction

The idea of warming ether prior to its administration began in the early days of surgical anesthesia. In 1847, Snow’s device included a mechanism to avoid the excessive cooling of ether by the quick evaporation of the anesthetic. Some years later, in 1876, the English gynecologist, Lawson Tait, presented a mechanism for warming ether. One year later Joseph Clover included a device in his anesthetic equipment that prevented the excessive cooling of ether. In this century, the principle of warming ether was practiced by Gwathmey (1914), Shipway (1916) and Bernard Pinson and Stanley Rawson Wilson (1921).

At the end of the 19th century, the Spanish surgeon Antonio Morales Pérez (1848-1930), Chairman of Surgery of the University of Barcelona, began experimenting with hot ether, first in dogs and later in humans. During his professional life he preferred hot ether, using a method that he called “Thermo etherization.” He and his students performed about 10,000 etherizations using this method with no mortalities. This paper presents the clinical experience of this Spanish surgeon and his collaborators who were pioneers of this method of administering inhalation anesthesia.

During the final years of last century, anesthetic techniques changed dramatically in Spain. At that time chloroform was the dominant anesthetic, and ether had been almost completely forgotten by the end of 1847. Nevertheless, with the introduction of Lister’s antisepptic techniques, the situation changed abruptly since surgeons now dared to operate deep in body cavities. Chloroform general anesthesia resulted in many accidents, threatening the life of the patient and distracting the attention of the surgeon. This led many surgeons to question the safety of chloroform and to begin operating under ether anesthesia, a more manageable and convenient anesthetic, which also was a better muscle relaxant.

Dr. Antonio Morales [Figure 1] was one of the Spanish surgeons who returned to the use of ether anesthesia at this time. He had used ether only once during the first years of his professional life (1873-1886), operating under chloroform anesthesia for the remainder of his practice. As complications developed with chloroform anesthesia, he decided to try ether anesthesia.

Dr. Morales conducted a series of experiments in more than fifty dogs at the School of Medicine of Barcelona in 1886, in which he compared the effects of ether, chloroform and methyl dichloride. He counted the number of animals who died of syncope when he deepened chloroform and methyl dichloride anesthesia, a phenomenon which did not occur with ether. Also, during deep stages of ether anesthesia the animals were easily resuscitated with oxygen. In another series of experiments he observed that he could induce deep anesthesia with hot ether, with very quick recovery after the administration of oxygen.

Based on these animal experiments, he tested thermo etherization in a patient in 1887. For the administration of hot ether he made a device which he later modified several times. The apparatus had a cylindrical container of brass and an alcohol
ether in some of his private practice patients, after he left the University.

During the year 1887 he collected data on 174 subjects and by 1919 he had data on 8,945 patients successfully anesthetized using hot ether. Later, he used hot ether in some of his private practice patients, after he left the University.

It appears that Dr. Morales had few problems with thermo etherization. The major difficulties pertained to the apparatus, especially the thermo part, which underwent several modifications to avoid rupture. He did publish one case study of an equipment rupture in the operating room with hot ether, but the patient suffered no serious injuries. He decreased the risk of rupture by warming the ether in a distant place.

Despite the wide experience of this Spanish surgeon with thermo etherization, there were no mortalities attributed to ether. Only in a few instances did he see adverse reactions such as signs of respiratory paralysis, difficulties in anesthetizing alcoholics and complications with hysterical and epileptic patients. He recommended his technique for any patient, except those with acute diseases of the respiratory system. In one of his papers he stated: "I have performed every kind of operation in patients of all ages and in all the regions that enter the surgical field, finding no more contraindications that the ones I stated."2

According to Dr. Morales, patients with severe trauma and hypothermia were a major indication for thermo etherization. He anesthetized these patients while he also warmed them using hot ether, increasing the temperature of the waterbath up to 41 °C. He also used the effect of warming the patient as an index of the physiologic fitness of patients before surgery. If he was unable to increase a patient's temperature with a waterbath of 41 °C, he desisted from operating, considering it likely that a fatal outcome would occur.

The rationale for administering warm ether was that heat favored the evaporation of the anesthetic, with a boiling point around 35 °C, and also that heat diminished ether's toxicity. He found a lower incidence of complications, including airway spasms, decreased pre- and post-operative vomiting, shock and hyperthermia. He recommended that the usual temperature of the waterbath should not exceed 40 °C. He began most operations at 36 °C and decreased the temperature in patients with fever, or increased the temperature in hypothermic patients.

The apparatus of Dr. Morales had a certain similarity with that of the gynecologist of Birmingham, Robert Lawson Tait (1845-1899). Dr. Morales was familiar with that apparatus. In March, 1892, another disciple, Dr. Alfredo Diaz de Liano, made important modifications to Dr. Morales' apparatus, replacing the Richardson bellows and the waterbath with electric batteries as the source of driving and thermal energy. The apparatus of Dr. Diaz de Liano had two portable:

**Figure 3. Electro thermo etherizer by Hartmann.**

Continued on Next Page
Etherizer. . . Continued from Page 15

boxes; one of them had a battery and the other had an engine or dynamo which impelled air into a small bottle of ether. A heat generating device (probably an electric resistor) raised the temperature up to 41° to warm the ether vapor. A long metallic tube carried the vapor to a metallic face mask. Several wires connected the battery with the contents of a second box. Modifying the intensity of the electric current controlled the temperature of the flow and the speed of air that carried the anesthetic vapors. For ten years the apparatus, the "electro thermo etherizer," was used only by Dr. Díaz de Liano who administered more than 1,000 etherizations with his apparatus in the Hospital of the Holy Cross in Barcelona. It was later used by Dr. Morales in 1903.

In 1914, Dr. Morales began using a new electro thermo etherizer made by Hartmann in Germany [Figure 3], which drew electricity from the main current rather than from batteries. This apparatus had two ventilators that warmed and sent a flow of air to a flask with ether. From this flask, air with hot ether was passed to a tube and face mask. There was a thermometer in the tube and a tap for controlling the flow of ether, with two knobs to control the temperature and the flow of air.

References
18. Mur Estana, A. La Termostenización como nuevo método de anestesia según el procedimiento del Dr. Díaz de Lizano, de Barcelona. La Oto-Bino Laringología Española. Revista de Especialidades, 1898-1899; 1:54-56.

WLM History Review:
Spirts of Anesthesia

SUBJECT: Nurse Anesthetists

The history of nurse anesthesia began soon after the successful use of ether as an anesthetic. The ability to safely anesthetize patients increased the amount and scope of surgery in the late nineteenth century. A group of skilled healthcare professionals were needed to anesthetize patients, and nurses, not physicians, were trained and asked by surgeons to assume responsibilities for anesthesia delivery.

Books
* Bankert M. Watchful Care: A History of America's Nurse Anesthetists. New York: Continuum, 1989. (A discussion of the economic and political forces that helped create, shape, and motivate the specialty of nurse anesthesia.)

Journals
* Calverley RD. St. René: The Patron Saint of Anaesthetists and a Patron Saint of Canada. Can Anaesth Soc J 1980;27:74-77. (This fascinating article tells the story of two American nurse anesthetists who were responsible for the association between st. René and anesthesiology.)


* Masters FL, Skidmore MV, Thibodeau BL. U.S. Army/Texas Wesleyan University program in anesthesia nursing. J Am Assoc Nurse Anesth 1991;59:480-481. (The important role nurse anesthetists played in military conflicts is discussed. Special educational programs designed by and for the Army are included.)

* Loan or photocopy available from WLM. Compiled by Fred J. Spielman, M.D.; Edited by Donald Caton, M.D.
Research and Clinician Thomas Nunneley (1809-1870)

This name is probably unfamiliar to the reader, but the following paper by Dr. K. Budd of Bradford, England, explains that this surgical ophthalmologist was also a physiologist interested in investigating potential anesthetic compounds, as well as being a teacher and Medical School administrator—no mean accomplishments. We are indebted to Dr. Budd and the Editor of the Proceedings of the History of Anaesthesia Society 15:9-15, 1994, for their kind permissions to reprint this article.

Research into Anaesthesia by a Surgeon—Thomas Nunneley of Leeds

Dr K Budd
Consultant in Pain Management and Anaesthesia, Bradford

"The hunt for new anaesthetic agents, which began almost as soon as the use of sulphuric ether was well established, covered a wide field." Barbara Duncan, 1947

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

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

In addition to his surgical commitment, Nunneley was actively involved with the Leeds Medical School. He had been appointed to the Council in 1835 and, in addition to teaching, was researching and publishing in the areas of toxicology and ophthalmic anatomy and physiology. It was during this time that he began a major work on researches into potential anaesthetic substances. The fruits of this work appeared both as a book, and in 1849 in the Transactions of the Provincial Medical and Surgical Association, the forerunner of the British Medical Journal. In the foreword to the work, Nunneley states his reasons for investigation:

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

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

Investigation of potential anaesthetic agents

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

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

These were to be administered by five different routes:

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

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

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

In addition to the 363 descriptions of experiments continued on next page.
Nunneley. . . Continued from Page 17

ments and their findings, together with 56 post-mortems, Nunneley also performed some studies on human subjects:

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

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

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

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

In the conclusions to his study, Nunneley writes:

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

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

Sound advice

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

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

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

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

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

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

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

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

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

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

Attainments, personality and controversy

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

He was twice President of the Leeds School of Medicine and, in 1864, was elected as one of the honorary surgeons of the Leeds General Infirmary. For many years he was an active member of the Leeds Philosophical and Literary Society and had been for three years a Liberal member of Leeds Town Council. Not all was sweetness and light, however, for being known as 'a man of strong feeling, somewhat impetuous in action and of great decision of character; the straightforward, uncompromising manner in which he promulgated his opinions may not always have been palatable to those who held opposite views.'

He was openly criticised by his fellow surgeons for 'operating upon a case thought unsuitable by themselves and whom Nunneley had reported cured but was dead within twelve months.'

In *Infirmiry Weekly Board*, 19 January, 1855 Even the year before his death, Nunneley took on the great Lord Lister in the pages of the *British Medical Journal* over the antiseptic system of the latter. Nunneley's 'without it many cases are as good as those of my colleagues with it' was silenced with Lister's broadside 'that he [Nunneley] should dogmatically oppose a treatment which he so little understands and which, by his own admission, he has never tried, is a matter of small moment.'

The following year, Nunneley was dead, but with almost his last breath he was exchanging blows in print with an Infirmary colleague over a question of statistics. As ever, his opponent had the final word: 'by what arithmetical process Mr Nunneley arrives at such conclusions, I am at a loss to divine, unless he prefers that backward reckoning by which 'Lord Dundreary' counts his fingers and makes them number eleven.'

For all his faults, Thomas Nunneley was a man of enterprise, energy and vision in many aspects of life. Unfortunately, his enterprise in anaesthetic research appeared to make no great steps forward. Few contemporary anaesthetists are aware of Thomas Nunneley or what he achieved; but then this could be said of so many.

References

3. Nunneley T. On anaesthesia and anaesthetic substances generally. *Transactions of the Provincial Medical and Surgical Association* 1849; 167-381.
5. Turnbull L. *Artificial Anaesthesia*. 1877; p.228.
Cyanosis... Continued from Page 9

expected to be accompanied by cyanosis until a general practitioner dental anaesthetist, Dr Tom, of Cheltenham, in an influential paper published in 1956, described his technique which was 'revolutionary' in that it postulated using a high percentage of oxygen (20%) with nitrous oxide. It is startling to realise that it is now perfectly possible for a well-taught and well-supervised trainee to spend a subsequent clinical lifetime without ever seeing a single instance of anaesthetic-induced cyanosis. With careful practice, the blue of cyanosis could be as archaic a condition as the green of chlorosis had become fifty years ago.

Summary

By a simple change of nomenclature in the 1830s, when Snow was a student, cyanosis as we understand it today, became a new concept. Its predecessor, lividity, was a fearsome condition, generally terminal. Growing understanding of the physiology of cyanosis, and experience of managing it in relation to anaesthesia, dispelled those fears. Putting it another way, familiarity bred contempt, so that when nitrous oxide was reintroduced in the 1860s, although there were further expressions of alarm about the cyanosis that inevitably came with it, notably from Clover and Benjamin Ward Richardson, these were not sufficient to prevent cyanosis from becoming, for many years, a tolerated concomitant of general anaesthesia.

Literature... Continued from Page 13

Describes the life and medical career of Heywood (1823-1893). 3 illus., 15 refs.


Brief obituary. 1 portrait.


Brief obituary of the Danish anaesthesiologist (1923-1995), author of more than 100 scientific papers. 1 illus.


One of the originators (with R. Melzack) of this pain theory describes its history and current status. 84 refs.


This entry in the journal's "Cover Note" series describes an inhaler dating from 1950 and probably used for short surgical procedures. The identity of White is unknown. 1 illus., 4 refs.


Describes two of Magill's laryngoscopes. 1 illus., 3 refs.

References


10. Ibid 12.

11. Ibid 12.


Reviews primarily nineteenth-century examples. 29 refs.


Brief obituary.
Paul Klemperer Research Fellowship in History of Medicine

The New York Academy of Medicine offers each year the Paul Klemperer Fellowship to support historical research in residence in the collections of the Academy Library. The Historical Collections Department contains 49,000 volumes in the history of medicine and related disciplines. Primary source materials include over 2,000 manuscripts, most notably the Edwin Smith Surgical Papyrus.

The Klemperer Fellowship provides a stipend of up to $5,000 travel, lodging and incidental expenses for a flexible period of time between June 1 and December 31. In addition to completing research in the Library, the Fellow will be expected to present a seminar at the Academy and present a final report of the project.

Applicants should send a curriculum vitae, a project proposal (not to exceed five pages) and a budget prior to March 1 of the year concerned. Candidates will be informed of the results by May 1 of that year. Applications should be sent to: Historical Collections Department, New York Academy of Medicine Library, 1216 Fifth Avenue, New York, NY 10029.

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International Anesthesia Meeting in Spain

To celebrate the 150th anniversary of the first clinical use of ether in Spain (1847), the Chairman of the organizing and scientific committees, Dr. J. Alvarez, announces that from October 2-4, 1997, an international meeting, The Anesthesiology's Way, From XIXth to XXIst, will be held in Santiago de Compostela in the Palace of Congressos y Exposiciones de Santiago.

The topics for the scientific program are: "Progress in Cardiovascular Anesthesia"; "Trends in Ventilation"; "Milestones in the History of Anesthesia"; and "Perspectives in Inhalation Anesthesia".

Papers will be welcomed on any of these subjects and abstract forms with instructions will be available in the autumn.

Special social events are being planned which will highlight the "Santiago Way," which many pilgrims have travelled each year since medieval times.

For further information, and to receive abstract forms, please contact:

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