A Synopsis of Anæsthesia

FOURTH EDITION

J. Alfred Lee

M.R.C.S., L.R.C.P., M.M.S.A., F.F.A.R.C.S., D.A.

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A SYNOPSIS OF ANÆSTHESIA

BY

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TO MY WIFE

"Eternal vigilance is the price of safety."

"Relief from pain is purchased always at a price. The price in both morbidity and mortality does not greatly differ whatever the agent or agents used."—R. M. WATERS.

"The duty of the anæsthetist towards his patient is to take care."

"While the anæsthetist's chief function is to prevent and alleviate pain, his primary responsibility is to maintain respiration."

Primum non nocere—"First of all, do no harm."

PREFACE TO THE FOURTH EDITION

In the wide field of Anæsthesia it is astonishing what changes in theory and practice can take place in the brief space of five years. Such changes have called for a major revision of this small book in order to bring it reasonably up to date.

This edition differs from the previous one in having many new figures, and my thanks are due to the various manufacturers for lending blocks.

A very complete revision has been carried out, and the alterations and additions are so extensive, involving almost every page, that it is not possible to give them in detail here. Two new chapters have also been added : one on the phenothiazine derivatives, and the other on induced hypothermia. There is a new section dealing with halothane (fluothane).

The author has consulted many papers in the anæsthetic and general surgical and medical literature, and references are given for most of the new work mentioned. He would also like to express his debt to the authors of the many text-books to which he has referred.

As the academic demands on the young anæsthetist become greater, his need for consulting original texts and articles increases. It is hoped that the new edition of this small book will serve as a stimulant to wider reading and will help to recapitulate knowledge gained in a broader field.

This short introduction suffices, I hope, to explain the nature of the book to which it stands preface. There remains only the pleasant duty of thanking the publishers for their constant help, consideration, and co-operation.

January, 1959. J. ALFRED LEE.

FROM THE PREFACE TO THE FIRST EDITION

This book is not designed to take the place of the larger text-books of anæsthesia and analgesia. It is a summary of current teaching and practice, and it is hoped that it will serve the student, the resident anæsthetist, the practitioner, and the candidate studying for the Diploma in Anæsthetics as a ready source of reference and a quick means of revision.

January, 1947. J. ALFRED LEE.

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A SYNOPSIS OF ANÆSTHESIA

CHAPTER I

NOTES ON THE HISTORY OF ANÆSTHESIA

Joseph Black (1728–1799).—The discoverer of carbon dioxide or "fixed air". Born at Bordeaux, France, of Irish-Scottish parentage and educated at Belfast and at the Universities of Edinburgh and Glasgow. Became Professor of Anatomy and Lecturer in Chemistry in the University of Glasgow, and later Lecturer in Chemistry in Edinburgh. Was all this time a practising physician. In 1754 described "fixed air", as he called carbon dioxide, and described its method of identification by lime water. He proved that the gas produced in respiration, during the fermentation of wine (this had been described by von Helmont), during combustion of charcoal in air, and that liberated from chalk by heat and acids was one and the same. He showed it to be toxic to animals and that it can be absorbed by alkalis, facts made use of by anæsthetists to-day.

Joseph Priestley (1733–1804).—The discoverer of oxygen in 1771 and of nitrous oxide in 1772. He was also the first to describe fluorine, sulphur dioxide, and methane.

Born in Yorkshire, and became a Unitarian minister. After an interregnum as secretary to Lord Shelburn, returned to take charge of a church in Birmingham. Here he became intimate with Erasmus Darwin, James Watt, and Wm. Murdock, the inventor of gas lighting. Because of his advanced political views and his sympathies with the French Revolution, his house was beaten up by the mob and he was forced to flee the country. In 1794 he emigrated to Pennsylvania, where, in addition to carrying on with his scientific studies, he was a farmer. He died at the age of 70.

Humphrey Davy (1778–1829).—Born in Cornwall, the son of a wood carver. Became apprenticed to J. B. Borlace, surgeon, of Penzance. At the age of 17 he experimented with nitrous oxide and the effects of its inhalation. In 1798 Davy became superintendent of Thomas Beddoes's Pneumatic Institute in Clifton, Bristol, and in the following year published his book *Researches, Chemical and Philosophical; Chiefly Concerning Nitrous Oxide.* In this, Davy suggested that nitrous oxide inhalations might be used to relieve the pain of surgical operations. A nitrous-oxide container was made by James Watt in 1799 to assist this research. In later life, Davy became famous. He invented the miner's safety lamp, was created a baronet, and was elected President of the Royal Society in 1820.

Michael Faraday (1791–1867).—Said to be the first man to note the narcotic effects of ether vapour, but this is doubtful.* Born at Newington Butts, of poor parents, he became a paper boy and later graduated to book-binding, during which occupation he made his first contact with chemical literature. Deciding to become a chemist, he obtained the post of laboratory assistant to Humphrey Davy at the Royal Institution in 1813, and a little later accompanied him on an extensive tour in Europe. Became Director of Laboratory of Royal Institution in 1825. His great ability soon threatened to rival that of his master, who became jealous. Later Faraday, too, achieved world-wide fame. Fullerian Professor of Chemistry, 1833. Discovered benzene. His observations on ether were published in 1818 in *The Quarterly Journal of Science and Arts.*

Henry Hill Hickman (1800–1830).—Medical education received in Edinburgh. He settled in practice in Ludlow. While doing a locum at Shifnal, in Shropshire, his interest in gas therapy was aroused, as the village was the birthplace of Thomas Beddoes. Familiarizing himself with the pioneer work of Davy, Priestley, and Faraday, Hickman returned to Ludlow and commenced experiments on animals. He was able to perform surgical operations painlessly on them, by causing them to inhale carbon dioxide. This was the first work on surgical anæsthesia induced by inhaling a gas. His results were published in a paper, "A Letter on Suspended Animation", in 1824, but attracted no attention from scientific men in England. Even Sir Humphrey Davy, who was approached by Hickman's friend, T. A. Knight, F.R.S., showed no interest. Charles X of France was appealed to in 1828, and the French Academy of Medicine agreed to investigate Hickman's results, but nothing came of the matter. Baron Larrey, one of Napoleon's surgeons, however, gave Hickman some encouragement. Hickman died prematurely, aged 29, and was buried in Bromfield churchyard.

Horace Wells (1815–1848).—In 1844, Gardner Q. Colton, a travelling lecturer in chemistry, gave a demonstration of the effects of inhaling nitrous oxide at Hartford, Connecticut. Horace Wells, a local dentist, was present and noticed that a young shop assistant while under the influence of the gas, banged his shin and made it bleed, but stated that he experienced no pain. Wells persuaded Colton to try the gas during a dental extraction, and on the following day, Dec. 11, 1844, the experiment was carried out with Colton as anæsthetist, Riggs as dentist, and Wells as patient. It was a big success. "A new era in tooth pulling", according to Wells. Wells learnt from Colton the method of manufacture of nitrous oxide and used it in his dental practice. Later in the year he went to Boston to interest a larger audience in his discovery. He demonstrated the method to the students of Harvard Medical School, but the patient complained of pain : the affair was a fiasco and Wells was hissed out of the room as a fraud. He returned to Hartford and continued to use the gas, but the introduction

* Davison, M. H. Armstrong, *Brit. J. Anæs.*, 1957, **29**, 575.

of ether gradually ousted the use of nitrous oxide. Wells gave up dentistry, travelled round the country with a troop of performing canaries, and was incarcerated in jail after bespattering a New York prostitute with sulphuric acid. He committed suicide.

Colton reintroduced the use of nitrous oxide in dentistry in 1863, at New Haven.

William Thomas Green Morton (1819–1868).—Morton deserves the chief credit for the introduction of ether as an anæsthetic agent, although W. E. Clark, of Rochester, New York, gave ether for a dental extraction in 1842, and Crawford Williamson Long (1815–1878) removed a tumour from the neck of J. M. Venable quite painlessly, in Jefferson County, Georgia, a few months after Clark's experiment. By the time (1849) that Long reported his work, Morton's fame was well established.

Morton, born at Charlton, Worcester County, Massachusetts, was a dentist who became a student, and later a partner of Wells, at Hartford. He separated from Wells and, becoming a medical student in Boston, was present when Wells failed to satisfy the audience as to the efficiency of nitrous oxide. Charles A. Jackson, one of Morton's lecturers at Harvard, suggested that ether could be used as a surface analgesic in dentistry. Morton, however, went further; he experimented on dogs to find out the effect of giving ether vapour by inhalation. Impressed with the results, he gave the vapour to Eben Frost for the removal of a tooth on Sept. 30, 1846. The operation was painless. After gaining further experience, and while still a medical student, Morton gave a demonstration at the Massachusetts General Hospital on Oct. 16, 1846, when Dr. J. C. Warren removed a tumour from the jaw of his patient, Gilbert Abbott, without producing any pain. This success gained him the support of Warren and also of Jacob Bigelow, Professor of Materia Medica. Much wrangling occurred between Morton and Jackson as to who should be given credit for the discovery. Morton three times petitioned the U.S. Congress, and even obtained an interview with the President, but he was never in his lifetime officially recognized as the pioneer of ether anæsthesia. Time later vindicated his claim. He spent his later years farming, and died of cerebral hæmorrhage, a disappointed man. His agent, which he tried to patent under the name Letheon, became widely used. It was given in London and Paris in 1846. Robert Liston was the first surgeon to operate under ether in England; this was at University College Hospital on Dec. 21, 1846, using Squire's inhaler.

The name anæsthesia was suggested by Oliver Wendell Holmes, but had been used by Plato in 400 B.C. to denote absence of feelings in a philosophical sense and also by Dioscorides in the first century A.D. to denote absence of physical sensation (Armstrong Davison).

Ether became known in England through a letter written by Henry Bigelow, Jacob's son, to his friend, Dr. Boott, who gave the first ether anæsthetic, a dental case, two days before Liston's first use of it. Malgaigne was first man to use ether in France, on Jan. 12, 1847.

John Snow (1813–1858).—After Morton, the first whole-time anæsthetist. Starting his medical studies in Newcastle, at the age of 14, as apprentice to Mr. William Hardcastle, Snow worked at the Newcastle Infirmary and became interested in a cholera epidemic at Killingworth Colliery. In later years he proved that cholera is a water-borne disease, when he ordered the removal of the Broad Street pump handle in 1854 in London and so terminated a cholera epidemic. In 1833 he left Newcastle and in 1836 he migrated to London and attended lectures at the Hunter School of Anatomy in Great Windmill Street, and also at Westminster Hospital. He became M.D., London, in 1844, and was appointed lecturer (1844–1849) in Forensic Medicine at the Aldersgate School of Medicine. Snow took an active part in the discussions of the Westminster Medical Society, eventually becoming its President in 1855. In 1841 he read before it a paper on resuscitation of newborn children. He became interested in ether soon after its introduction and quickly perceived that the common method of administration was faulty. To overcome this he invented an ether inhaler. He was appointed anæsthetist to Out-patients at St. George's Hospital, and in 1847 was promoted to the In-patient appointment. He also worked with Robert Liston at University College hospital. His health was poor and he suffered from phthisis and from nephritis, being treated for the kidney disease by Richard Bright. For many years he was a vegetarian and temperance advocate. He experimented with many substances to see if they possessed anæsthetic properties, trying many of them on himself.

Snow rapidly became the leading anæsthetist in London and wrote a book in 1847, *On the Inhalation of Ether*. He did much useful work on the physiology of anæsthesia, and described five stages or degrees of anæsthesia. He later abandoned ether for chloroform, but was familiar with the dangers of the newer drug, believing it to cause primary cardiac failure consequent on the use of too strong a vapour. To overcome this danger he invented a percentage chloroform inhaler. He gave over 4000 chloroform anæsthetics without a death. In 1853 Snow originated the method of "chloroform *à la reine*", when he acted as anæsthetist at the birth of Queen Victoria's eighth child, Prince Leopold. He gave his royal patient 15-minim doses intermittently on a handkerchief, the administration lasting 53 minutes: it met with the Queen's warm approval. Snow introduced amylene as an inhalation anæsthetic in 1856. His income never exceeded £1000 per annum although during the last 10 years of his life he gave an average of 450 anæsthetics a year. His last work, *On Chloroform and Other Anæsthetics*, was published posthumously. Snow's grave in Brompton Cemetery was restored in 1938 by anæsthetists from Britain and the United States. Benjamin Ward Richardson's epitaph reads: "In Brompton Cemetery there was laid to rest, at the age of forty-five, John Snow (1813–1858), exemplary citizen and useful physician. He demonstrated that cholera is communicated by contaminated water; and he made the art of anæsthesia a science."

James Young Simpson (1811–1870).—Born at Bathgate, near Edinburgh. Qualified 1830; M.D., 1832. Elected to Chair of Midwifery at Edinburgh, 1840, spending £500 on canvassing, etc. Started university career in atmosphere of hostility from his colleagues, but his ability as a lecturer soon attracted large classes of students. Four years later was earning £4000 per annum. A later discovery was that of hæmostasis by acupressure. Created baronet, 1866. A memorial bust was erected in Westminster Abbey. Introduced chloroform into surgical practice in 1847. This drug was independently discovered by von Liebig, Soubeiran, and Guthrie in 1831. Dumas gave it its name and wrote the first full description of its physical and chemical properties. The old name was perchloride of formyl. Chloric ether is a solution of chloroform in alcohol. Flourens, in 1847, showed that on inhalation its vapour had anæsthetic powers on animals.

Waldie, 1813–1889, a Liverpool chemist, suggested that Simpson should try the effects of the inhalation of chloroform vapour to relieve the pains of labour. Simpson experimented on himself and his assistants, Mathews Duncan and George Keith, on Nov. 4, and four days later it was first used clinically and a report was read to the Edinburgh Medical and Chirurgical Society on Nov. 10. Although Simpson was the first obstetrician to employ ether (January, 1847), he held that chloroform has the following advantages over ether: (1) Action more rapid, complete, and persistent. (2) Smaller quantity required. (3) Pleasanter. (4) Cheaper. Chloroform was first given in London at St. Bartholomew's Hospital on Nov. 20, 1847.

Joseph T. Clover (1825–1882).—After the death of Snow, Clover became the leading scientific anæsthetic investigator and practical anæsthetist. He was born in Aylesham, Norfolk, and was educated in Norwich. Became R.M.O. at University College Hospital and took F.R.C.S. in 1850. He was the pioneer of the art of completely and immediately removing from the urinary bladder the calculus fragments produced by lithotrity. Worked as general practitioner in London, later specializing in anæsthetics. Was appointed to staff of University College and Westminster Hospitals. In 1862 he invented a chloroform inhaler which enabled percentage mixtures of chloroform and air to be accurately measured and administered. It took the form of a large bag, slung over the back of the anæsthetist, and it contained 4½ per cent of chloroform vapour in air. Realizing the dangers of chloroform, Clover set to work to make the administration of ether more simple and easy. This he did by inducing anæsthesia with nitrous oxide, later adding ether to the gas. Was co-opted on to Committee of Royal Medical and Chirurgical Society which advised the use of a mixture of chloroform and ether, because of the danger of chloroform alone (1864). In 1877 he described his portable regulating ether inhaler which did much to make ether more popular at the expense of chloroform. Another of Clover's achievements was his teaching that ether could be safely given over long periods with anæsthesia carried to adequate depth. He was Lecturer on Anæsthetics at University College Hospital.

Sir Frederick Hewitt (1857–1916).—Educated at Merchant Taylors' School, Christ's College, Cambridge, and St. George's Hospital, London, where he was a distinguished student. Became an anæsthetist as defective eyesight prevented his becoming a consulting physician, and was appointed to Charing Cross Hospital in this capacity in 1884, the National Dental Hospital in 1885, and the London Hospital in 1886. In 1902 became physician anæsthetist to his old teaching hospital, St. George's. He emphasized that nitrous-oxide anæsthesia is possible without asphyxia and that chloroform is specially dangerous during induction. Hewitt modified Junker's chloroform bottle and redesigned Clover's inhaler, enlarging the bore of the central tube (as suggested by Wilson Smith in 1901) and arranging for its rotation within the ether reservoir. He devised a dental prop and also an airway (1908), and wrote a popular text-book (1893) on anæsthesia (*Anæsthetics and their Administration*), the fifth edition of which appeared in 1922. He strongly advocated better teaching of anæsthetics to medical students. Hewitt invented the first practical machine for giving nitrous-oxide and oxygen in fixed proportions in 1887 and the years following. In 1911 he was knighted. Administered an anæsthetic to Edward VII for his appendix operation in 1902.*

IMPORTANT DATES IN THE HISTORY OF ANÆSTHESIA

1516. Curare, South American arrow poison, described by Peter Martyr Angherius.
1540. Valerius Cordus (1515–1544) synthesized sweet vitriol (ether), possibly aided by Paracelsus (1493–1541).
1628. Wm. Harvey (1578–1657) described the circulation of the blood.
1656. First intravenous injection of a drug (tincture of opium) into an animal (a dog) by Sir Christopher Wren and Robert Boyle.
1660. Boyle enunciated his law of the relationship of the volume and pressure of a gas.
1665. Richard Lower (1631–1691) transfused blood from one animal to another.
1754. Carbon dioxide discovered by Von Helmont and isolated by Black.
1771. Discovery of oxygen by Priestley and Scheele, independently.
1772. Priestley discovered nitrous oxide.
1787. Charles's law, showing relationship of volume to temperature of a gas.
1788. Chas. Kite of Gravesend used first endotracheal tube.
1792. Frobenius, a German, named sweet vitriol 'ether'.
1800. Discovery of analgesic properties of nitrous oxide by Davy.
1806. Isolation of morphine from opium by Sertürner (1743–1841).
1807. Baron Larrey performed painless amputations, using ice, on the battlefield.
1816. René Laënnec (1781–1826) invented stethoscope.

* *See* Edwards, George, *Ann. R. Coll. Surg.*, 1951, **8**, 3.

1818. Faraday is said to have discovered narcotic action of ether vapour.
1822. Magendie proved that while anterior spinal roots are motor, posterior roots are sensory.
1824. Hickman carried out operations on animals under carbon dioxide, with freedom from pain.
1825. Chas. Waterton (1782–1865) published his *Wanderings in South America*, which contained an account of the actions of curare.
1831. Chloroform discovered independently by von Liebig, Guthrie, and Soubeiran.
Atropine prepared from *Atropa belladonna*, by Mein and by Geiger and Hesse.
1832. Thomas Aitchison Latta used intravenous saline in the treatment of circulatory collapse in cholera (not in surgical shock).
1834. Alex. Dumas (1800–1884) described chemical composition of, and gave name to, chloroform.
1842. Ether given by W. E. Clark and by Crawford W. Long in the U.S.
Flourens first isolated respiratory centre in medulla.
1844. Horace Wells introduced nitrous oxide inhalation to produce anæsthesia during dental extraction.
Francis Rynd of Dublin invented hyperdermic trocar.
1846. Wm. T. G. Morton successfully demonstrated the anæsthetic properties of ether, Oct. 16. The word "anæsthesia" was suggested by Oliver Wendell Holmes for Morton's "etherisation".
First surgical operation performed in England under ether anæsthesia by Robert Liston, Dec. 21.
1847. Flourens described anæsthetic properties of chloroform and ethyl chloride vapour in animals.
James Y. Simpson introduced chloroform into clinical work, to ease pains of labour.
John Snow published his book, *On the Inhalation of Ether*.
Deaths from ether reported from Grantham and Colchester.
1848. Hannah Greener, aged 15, died from chloroform, administered by Dr. Meggison, Jan. 28—the first recorded case—at Winlayton, Co. Durham.
Heyfelder first used ethyl chloride in humans.
1851. Pravaz of Lyons, invented hypodermic syringe.
1853. John Snow gave chloroform analgesia to Queen Victoria at birth of Prince Leopold, hence "chloroform *à la reine*".
Invention of hypodermic syringe and needle by Alexander Wood, of Edinburgh, to enable morphine to be deposited at the actual seat of pain, or near the nerves supplying the painful area.
1854. Wm. Gairdner, of Glasgow, differentiated between post-operative pneumonia and pulmonary collapse, the latter due to bronchial obstruction.
1855. Gaedicke, of Germany, isolated cocaine from coca plant.
1858. Publication of John Snow's book, *On Chloroform and Other Anæsthetics*.
1860. Nieman purified the alkaloid which Gaedicke had isolated from coca leaves. He named it cocaine.

Important Dates, *continued.*

1862. Thos. Skinner, a Liverpool obstetrician, introduced his domette-covered, wire-framed mask, frequently imitated since (e.g., by Carl Schimmelbusch, of Berlin, in 1890).
Clover's chloroform inhaler.
George Harley introduced his A.C.E. mixture (alcohol, 1 part; chloroform, 2 parts; ether, 3 parts).

1863. Colton popularized the use of nitrous oxide in dentistry, neglected since Wells's discovery.

1864. Report of Chloroform Committee of Royal Medical and Chirurgical Society, which confirmed chloroform's position as first favourite.

1867. Introduction by F. E. Junker, a German surgeon on the staff of the Samaritan Free Hospital, London, of his chloroform inhaler, originally designed for use with bichloride of methylene (CH_2Cl_2), a drug first used clinically in this same year by Sir Spencer Wells and Benjamin Ward Richardson.

1868. Edmund Andrews combined oxygen with nitrous oxide.
T. W. Evans, an American dentist working in Paris, who had learnt about N_2O administration from Colton, introduced it to London dentists. Later in the same year, N_2O was supplied in cylinders in compressed form commercially, five years before U.S. manufacturers put it on the market. Supplies of nitrous oxide may well have been obtainable in London in 1856.
Nasal N_2O inhaler used (independently) by Clover and Coleman.

1871. Trendelenburg gave anæsthetics via a tracheotomy wound.
Hyoscine isolated.
Mason invented his gag. Modified by Fergusson three years later.

1872. Antisalivary effects of atropine described by Heidenhain.
In England, use of ether became much more frequent following the visit of B. Joy Jeffries, an ophthalmic surgeon of Boston, Mass., U.S.A. He 'sold' the American method of ether administration to British surgeons and anæsthetists, a method involving forcing ether on to the patient who was, if necessary, held down during induction. Previously in Britain, chloroform was used almost exclusively.
Oré produced general anæsthesia with intravenous chloral hydrate.
Clover introduced his nitrous-oxide–ether sequence at B.M.A. Annual Meeting at Norwich.

1877. Clover introduced his portable regulating ether inhaler.
Forné, a French naval surgeon, gave chloral hydrate to produce sleep before chloroform anæsthesia.

1878. Macewen introduced intratracheal intubation by mouth.

1880. Klikovich used nitrous oxide to ease labour pains.
Frederick Trendelenburg, professor of surgery at Rostock (afterwards at Bonn and Leipzig), introduced the head-down tilt with pelvic elevation, for abdominal surgery.

1882. Synthesis of cyclopropane by v. Freund.
Cervello introduced paraldehyde into medicine.

1884. Koller demonstrated local analgesic properties of cocaine on the cornea, at the suggestion of Freud, at Ophthalmological Congress at Heidelberg.
Wm. Stewart Halsted and Hall, in New York, did the first nerve-block with cocaine : the nerve, the mandibular.
J. L. Corning produced analgesia by the accidental subarachnoid injection of cocaine.

1887. Sir Frederick Hewitt invented the first practical gas and oxygen machine.

1888. First Hyderabad Chloroform Commission.

1889. Second Hyderabad Chloroform Commission. Reports stated that chloroform is never a primary cardiac depressant. This is now known to be untrue.

1891. Lumbar puncture demonstrated to be a practical clinical procedure by Quincke.
Giesel isolated tropococaine, the first alternative to the toxic cocaine.

1892. Schleich introduced infiltration analgesia.

1893. London Society of Anæsthetists founded.

1894. E. A. Codman and Harvey Cushing advocated use of anæsthetic record charts. Later, 1901, blood-pressure readings, taken with a Riva-Rocci instrument, were added to these charts.

1895. First direct-vision laryngoscope devised by Kirstein.

1897. Braun added adrenaline to cocaine solution to prolong its effect and retard its absorption.

1899. August Bier induced first successful clinical spinal analgesic.
Tuffier developed and popularized spinal analgesia.

1900. Schneiderlein combined scopolamine and morphine in psychiatry.
Landsteiner of the Univ. of Vienna described ABO blood groups.

1901. Extradural caudal block introduced by Sicard and Cathelin, both of Paris, independently.
Hewitt described his modification of Clover's portable regulating ether inhaler, using wider-bore tubes.

1903. Barbitone (veronal) synthesized by Emil Fischer and v. Mering. This was the first barbiturate.

1904. Fourneau synthesized stovaine.
Procaine synthesized by Einhorn, and used by Braun the next year.

1905. The first society of anæsthetists founded in the U.S. by G. A. F. Erdmann, The Long Island Society of Anæsthetists.

1907. Barker made use of the curves of the vertebral column in spinal analgesia and introduced hyperbaric solutions.
Chevalier Jackson described his work on laryngoscopy.

1908. Hewitt introduced his pharyngeal airway.
Massive collapse of the lungs described by Wm. Pasteur.

1909. Bier described intravenous procaine local analgesia.
Meltzer and Auer used intratracheal insufflation anæsthesia in animals.
Burkhardt used intravenous ether.

1910. Elsberg applied Meltzer and Auer's technique to man.
E. I. McKesson introduced the first intermittent-flow gas and oxygen machine, with percentage calibration of the two gases.

Important Dates, *continued.*

1911. Goodman Levy proved that chloroform can cause death (from ventricular fibrillation) in light anæsthesia.
Phenobarbitone (luminal) synthesized.

1912. Boothby and Cotton introduced a sight feed gas and oxygen flow-meter.
Kelly was first to use insufflation intratracheal anæsthesia in England.
A. Läwen used curare to produce relaxation.

1913. Danis was first to describe transacral analgesia.
Gwathmey introduced rectal oil-ether.

1914. Hustin, of Belgium, was first to use citrate in blood transfusion.
Gwathmey's *Anæsthesia* published.

1915. Use of carbon dioxide absorption in animals by Dennis Jackson, of Cincinnati.

1916. Shipway introduced his warm ether apparatus.

1917. Edmund Boyle described his portable N_2O, and O_2 apparatus; the chloroform bottle was added in 1920.
Avertin described by Eicholtz and used clinically by Butzengeiger in 1926.

1920. Guedel's first paper on signs of anæsthesia.
Magill and Rowbotham developed endotracheal anæsthesia.

1921. Extradural analgesia described by Pagés, of Spain.
Carbon dioxide became common in anæsthetic practice, following the work of Henderson and Haldane.

1922. *Current Researches in Anæsthesia and Analgesia* appeared of August.
Goodman Levy's *Chloroform Anæsthesia* published.
First Meeting of Section of Anæsthesia at Annual Meeting in B.M.A.

1923. Ethylene introduced by Luckhardt.
Carbon dioxide absorption used in man, by Waters.
British Journal of Anæsthesia appeared.

1927. Pitkin introduced spinocain and popularized spinal analgesia.
Ocherblad and Dillon used ephedrine in spinal analgesia.
Pernocton used in Germany by R. Bumm.

1928. Introduction of circle method of carbon dioxide absorption, by Brian Sword.
Lucus and Henderson proved that cyclopropane had anæsthetic properties.
I. A. Magill introduced blind nasal intubation.

1929. Sodium amytal used by Zerfas, the first use of rapidly acting barbiturates in anæsthesia, given into a vein.

1930. Waters introduced cyclopropane into clinical practice.
Nembutal and percaine described.
Leake and Chen discovered anæsthetic properties of divinyl ether.

1931. Dogliotti re-introduced extradural analgesia, in Italy.

1932. Weese, Scharpff and Rheinoff were the first to use hexobarbitone (evipan).