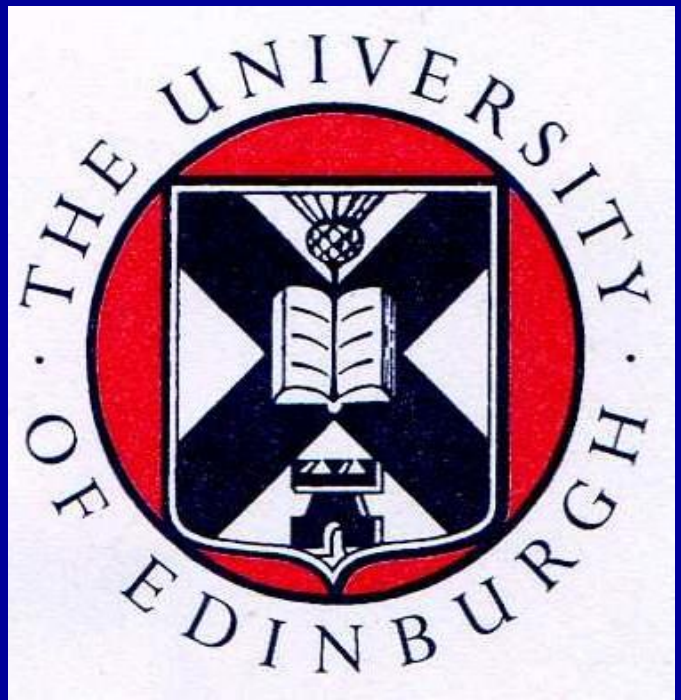
History of Anaesthesia

Lecture for DHMSA 2023

Alistair McKenzie FRCA



Greece c.380 BCE *Corpus Hippocraticum*

- Mention of pain and analgesics, including opium extracts
- In particular, opium poppy referred to as “sleep inducing”
- BUT pain relief not considered at all when referring to operative intervention

A.D. 30 *De Re Medicina*

- A. Cornelius CELSUS
- Recommended opium and mandragora for pain relief
- Suggested use of opium before surgery
- First classical medical work to be printed (1478): 8 books

77 *De Materia Medica* (8 books)

- Pedanius DIOSCORIDES
- Coined the word *anaesthesia*
- Chap 76 of 4th book: mandragora for anaesthesia before surgery

Arabic version:
Topkapi Museum, Istanbul

c.280 China: *The Records of the 3 Kingdoms* – by Chen Shou

- Book of Wei: Vol 29 has notes on Hua Tuo
- Surgeon(?immigrant) who used *mafeisan* “cannabis boiling powder” in wine before operating
- Hua Tuo was killed in AD 207 & his own book destroyed

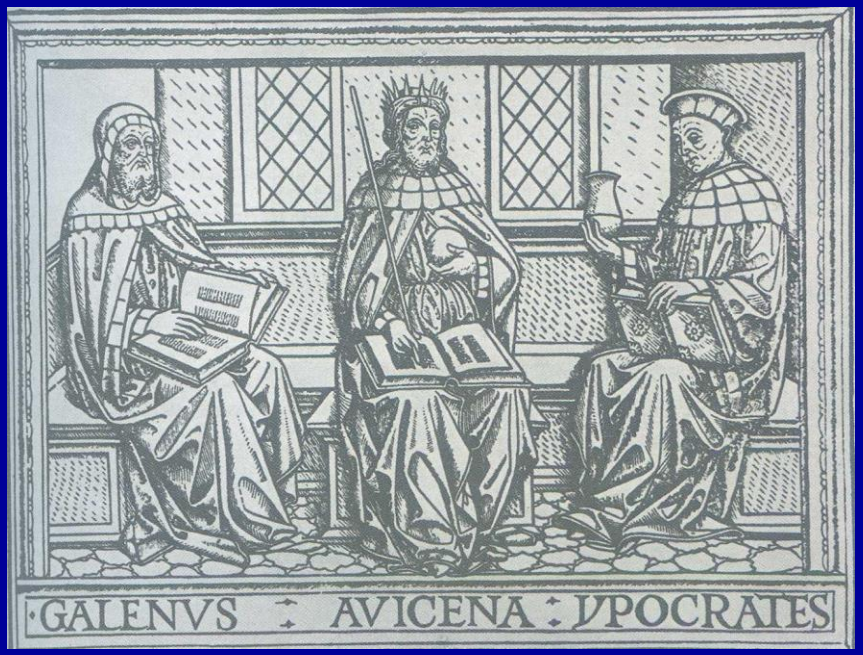
Huo Tuo

c.850 Bald's Leechbook

- Also known as *Medicinale Anglicum*
- Old English word 'laece' refers to any healer – so 'leech' is old-fashioned word for physician
- Remedies listed for many pains

1010 *Canon Medicinae*

- AVICENNA
- Vol 5 re Pain: informs various ‘mukhaddar’ (anaesthetics) which can be used before surgery: mandragora, opium, henbane



Latin translation
15th C. woodcut

1200 *Antidotarium Nicolai*

- Produced in Salerno Medical School – collection of recipes fm antiquity & early medieval authors
- Mentions *Spongia somnifera*
  - papavaris, mandragora – dried up
  - when wish to use: moisten with hot water & apply to patient's nostrils → sleep
- This could *not* induce GA by inhalation
- But perhaps admin as a drink

Britain early 1300s

- Dwale = “a drink to make a man sleep whilst men cut him”
- In late medieval English manuscripts – Cambridge University Library

- INGEDIENTS
- Alcohol
- Bile
- Hemlock
- Bryony -*cf* mandrake
- Lettuce
- Opium
- Henbane
- vinegar

1540 “sweet oil of vitriol” prepared

- 1526 Paracelsus appntd Chair of Med & Chem in Basel (born near Zurich, school in Austria, grad Dr Univ of Ferrara)
- Burned the works of Galen, Avicenna & others
- Stated scientific method
- Migratory! In Wittenberg 1540 + Valerius Cordus prep sweet oil of vitriol named ether 200 yrs later

Theophrastus Bombastus von Hohenheim

1660 demo that air necessary for animal life

- Robert Boyle in Oxford – a member of the “Invisible College”
- *New Expts physico-mech touching the Spring of the Air & its effects …*
- Also 1st gas law

1661 *De Nivis Usu Medico*

- Thomas Bartholin in Copenhagen – discoverer of lymphatic system
- In his 1661 book Chap xxii is on use of snow before incision for refrigeration anaesthesia

1662 report of intravenous inj

- *The Usefulness of Natural Philosophy and Sequels to Spring of the Air*
- In ‘Works of Robert Boyle’ Vol 3
- Description of 1656 inj of opium in alcohol by team of Christopher Wren, Boyle & soe into vein of a large dog

Improved use of opium

- 1680 T Sydenham intro tincture of opium (laudanum) into England
- But physicians also inflicted pain –to relieve evil humours
- Pain valued as sign of patient's vitality – 'physical suffering inevitable'

1775 a *component* of air sustained life in a mouse

- Joseph Priestley at Bowood (nr Calne)
- *Expts & obs on different kinds of air Vol II*
- He had prepared the “dephlogisticated air” in 1774 – then visited Lavoisier in Paris & told him his method

1775

- Carl W Scheele at Uppsala: *Chemische Abhandlung von der Luft und dem Feuer*
- He had discovered “fire air” in 1771
- T Bergman did not pen his introduction to the book until 1777 !

1777 translation into English

- *Chemical Obs & Expts on Air and Fire*
- Scheele noted that in Sept 1774 he had sent a letter to Lavoisier (describing his 1771 discovery)

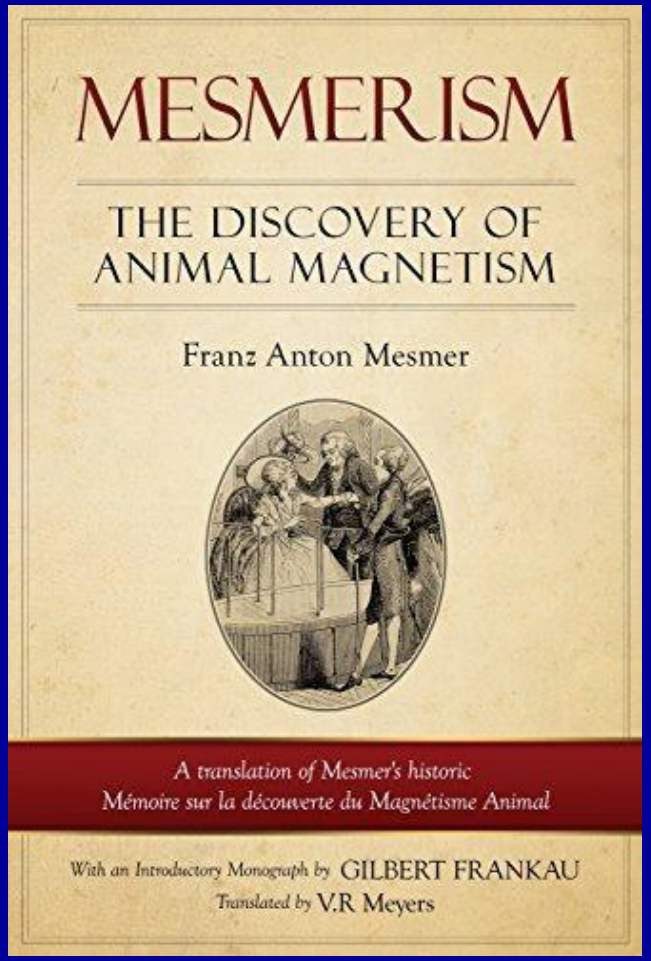
1777 Lavoisier cashes in

- *Exp sur la resp des animaux….Alterations qu'eprouve l'air respire*
- Named the gas "principe oxigen"
- Did not acknowledge either Scheele or Priestley

Antoine Lavoisier with his wife

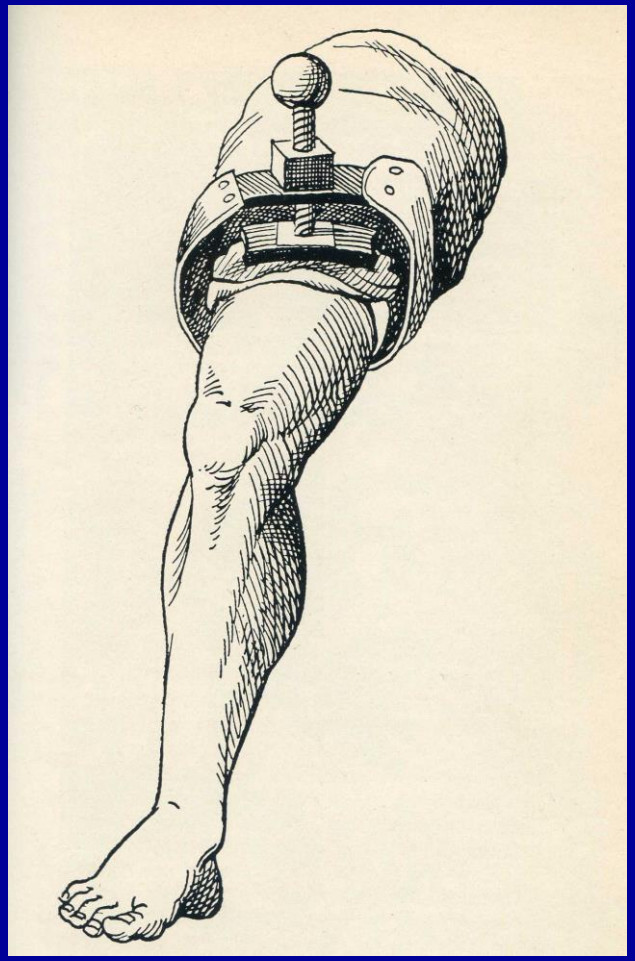
1779 mesmerism

- Franz Anton Mesmer in Vienna and Paris
- *Memoire sur la decouverte du magnetisme animal*



1784 J Moore's compression of nerves

- *A method of preventing or diminishing pain in several ops of surgery*
- Clamp screwed down on limb, compressed main nerves
- Used at St George's Hospital, London by John Hunter, but never became popular



1800 nitrous oxide

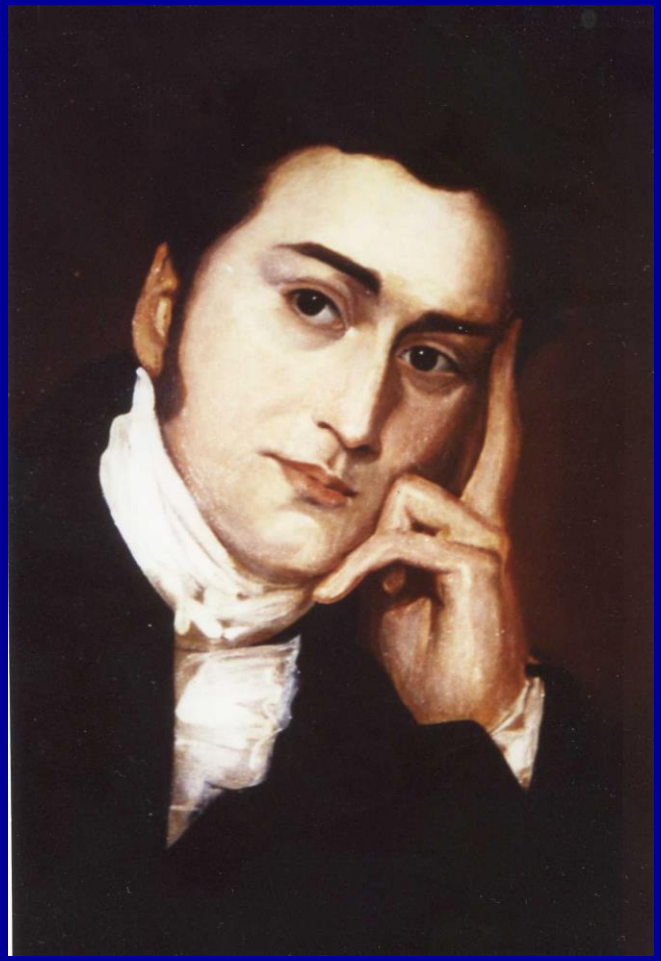
- Humphry Davy at Bristol
- *Researches, Chem & Philosoph; Chiefly Concerning Nitrous Oxide*
- Suggested N_2O might be used to relieve pain of surgical ops

Isolation of morphine

- 1803 FWA Serturner, Paderborn pharmacist
- 1816 published
- Use of pure alkaloid instead of crude prep soon spread through medical world

Hickman in Ludlow, 1821

- Experimented on animals under the influence of CO_2



A

LETTER

ON

SUSPENDED ANIMATION,

CONTAINING

EXPERIMENTS

Shewing that it may be safely employed during

OPERATIONS ON ANIMALS,

With the View of ascertaining

ITS PROBABLE UTILITY IN SURGICAL OPERATIONS ON THE

Human Subject,

Addressed to

T. A. KNIGHT, ESQ. OF DOWNTON CASTLE,
Herefordshire,

ONE OF THE PRESIDENTS OF THE ROYAL SOCIETY,

[redacted]

BY DR. H. HICKMAN,
OF SHIFFNAL;

Member of the Royal Medical Societies of Edinburgh, and of the Royal College of Surgeons, London.

IRONBRIDGE: Printed at the Office of W. Smith.
1824.

1829: A treatise on Poisons

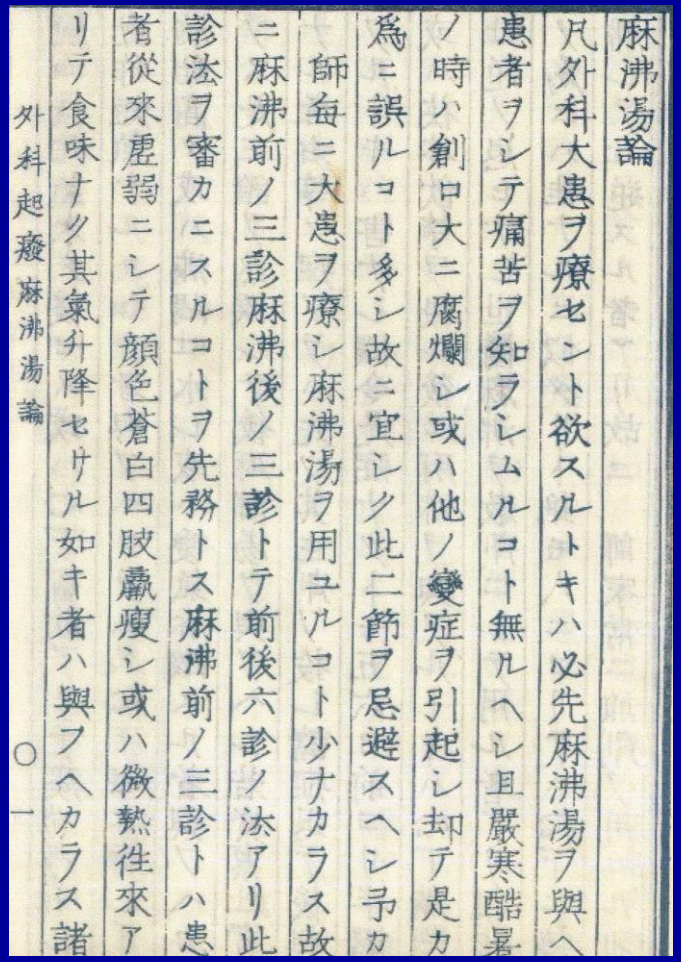
- Sir Robert Christison, Chair of Medical Jurisprudence, Edinburgh
- 4 editions: 1829-45

Christison's Treatise

- Opium
- Hyoscyamus
- Atropine
- Nitrous oxide
- Ether
- Curare

1839 anaesthesia for surgery in Japan

- Gendai Kamada: pupil of Sheishu Hanaoka
- *Mafutsuto-Ron* – gave dosage & method of using ‘Mafutsuto’
- Omitted composition (? for secrecy); main ingredient = Datura


麻沸湯論

凡外科大患ヲ療セント欲スルトキハ必先麻沸湯ヲ與ヘ
患者ヲシテ痛苦ヲ知ラシムルコト無ルヘシ且嚴寒酷暑
ノ時ハ創口大ニ腐爛シ或ハ他ノ變症ヲ引起シ却テ是カ
爲ニ誤ルコト多シ故ニ宜シク此二節ヲ忌避スヘシ予カ
師毎ニ大患ヲ療シ麻沸湯ヲ用ユルコト少ナカラス故
ニ麻沸前ノ三診麻沸後ノ三診トテ前後六診ノ法アリ此
診法ヲ審カニスルコトヲ先務トス麻沸前ノ三診トハ患
者從來虛弱ニシテ顏色蒼白四肢羸瘦シ或ハ微熱往來ア
リテ食味ナク其氣升降セサル如キ者ハ與フヘカラス諸

外科起廢麻沸湯論　〇一

Amputation

- The world was not yet prepared for pain relief
  - Surgery rudimentary, & it was not generally considered that pain should be avoided
  - Religious belief that pain provided a means of atonement (pain = approp punishment)

1843 hypnotic methods

- John Elliotson published book
- *Numerous cases of surgical ops without pain in the mesmeric state; with remarks*
  - *Upon the opposition of many members of the Royal Medical & Chirurgical Society*

Used the word “anaesthesia” on page 65

1843 hypnotic methods

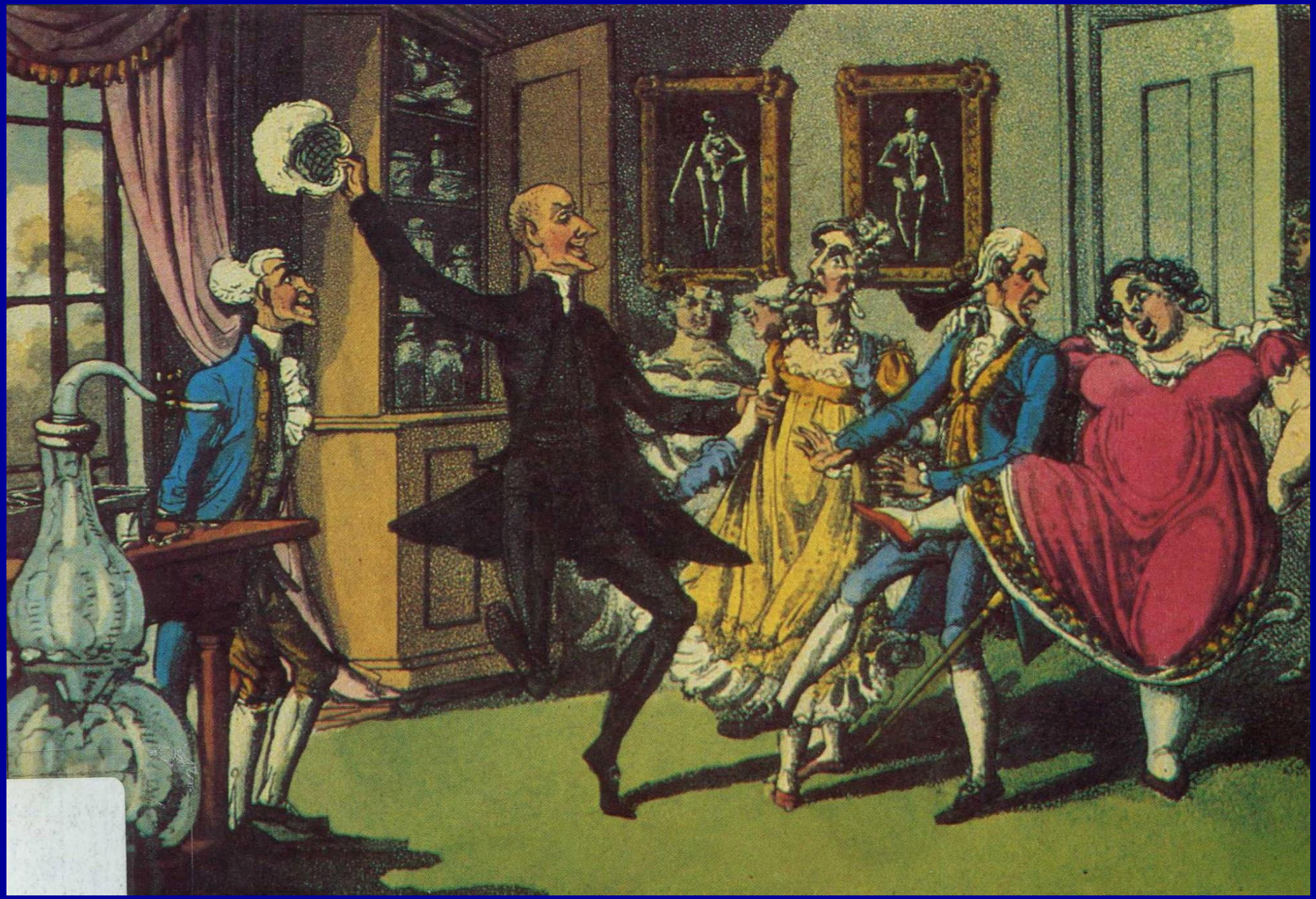
- James Braid: Edinburgh trained → Manchester
- *Neurypnology, or the Rationale of Nervous Sleep considered in relation with Animal Magnetism*
- Showed that “mesmeric influence” is entirely subjective – nil substance passes fm the operator to the patient
- Attrib trance to power of suggestion – called it *hypnosis*

1845 hypnotic method in India

- James Esdaile: MD $_{\text{Edinburgh}}$ $\rightarrow$ appntd Assistant Surgeon East India Company 1831
- Self-taught mesmerism
- Recorded 100s of painless ops (scrotal tumours due to filariasis) at Hooghly Hospital, Calcutta
- Published *Mesmerism in India and its practical application in surgery and medicine*

Anaesthetic agents – abused before the discovery of anaesthesia

- Nitrous oxide
  - Prep by J Priestley 1774
  - Ix by Humphry Davy 1795
  - Davy discov analgesic properties 1800
- Ether
  - “sweet oil of vitriol” prep by Valerius Cordus (and Paracelsus) 1540
  - Ix by M Faraday 1818 – noted narcotic action



1820 Illustration of nitrous oxide used for exhilaration in *Dr Syntax*, London

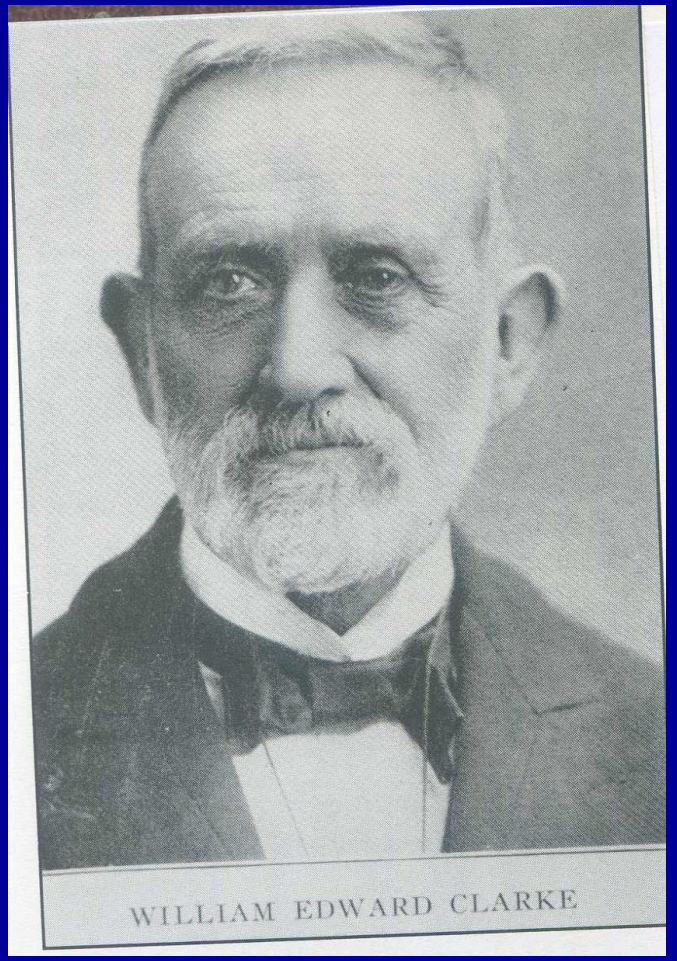
Ether frolics: popular in USA from 1839

By 1840 foundations of anaesthesia already laid

- PHYSIOLOGY and DRUGS
- Circulation of blood
- Role of oxygen
- Herbal based anaesth
- Morphine
- Nitrous oxide
- Ether

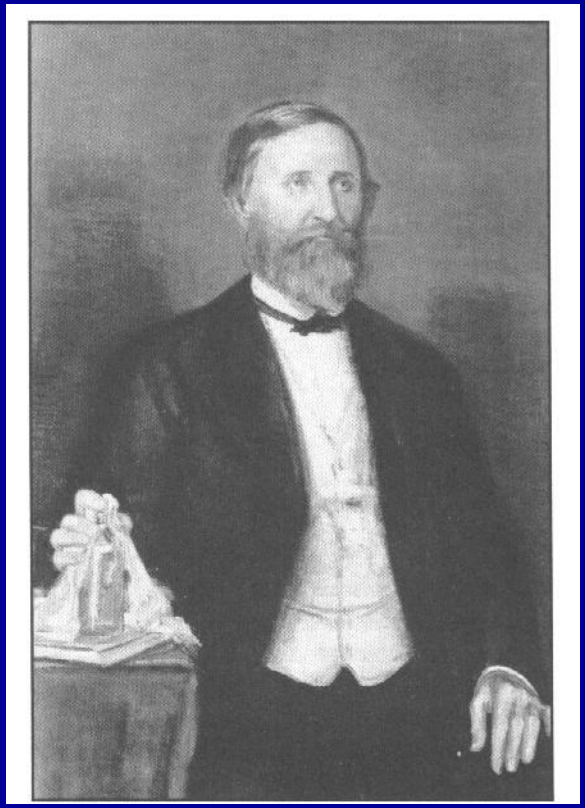
Jan 1842 “almost news”

- Med Student entertain by inhalation of ether
- In Rochester NY Miss Hobbie was given ether by Clarke to enable extraction of a diseased tooth by dentist Elijah Pope
- Not published!



30 March 1842 “almost news”

- GP in Jefferson, GA freq inhaled ether & noticed it nullified pain of knocks
- Gave ether fm a towel to James Venable & then excised a cyst on back of neck
- Didn’t publish!



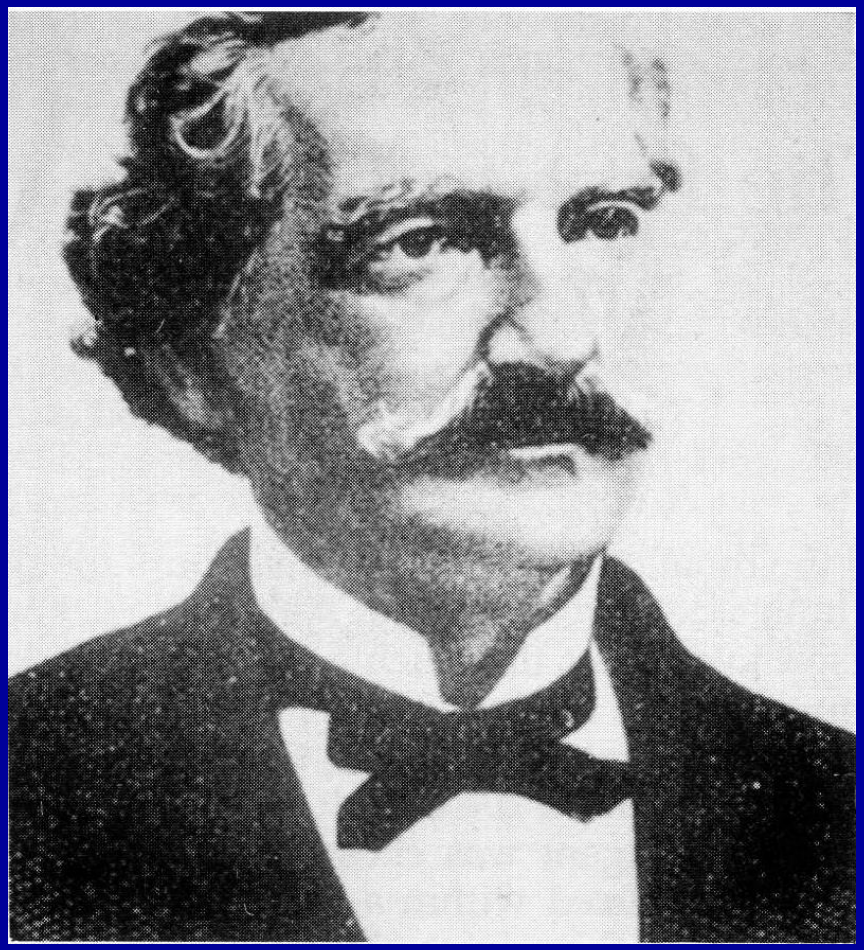
Crawford W Long

Nitrous oxide in autumn 1844

- Horace Wells: dentist in Hartford CT
- Had the idea of relieving pain of surgery by inhal of exhilarating gas
- Under influence of N_2O he had his own tooth extracted by John Riggs – feeling no pain
- Proceeded to using N_2O on 12 – 15 patients

Horace Wells: dentist

Nitrous oxide N_2O in Dec 1844

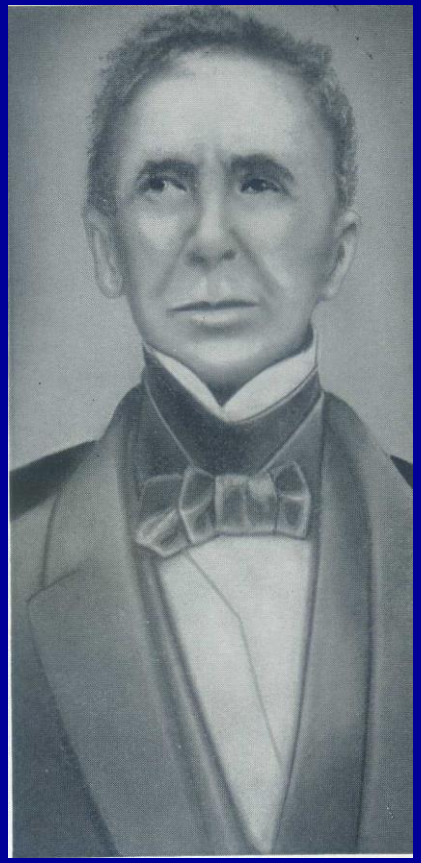


Gardner Q Colton: lecturer in chemistry

- 10 Dec: Colton gave public exhibition of exhilarating gas in Hartford
- 11 Dec: private exhib to Wells
- Some historians believe this led to Wells first trying it

Expts and failed demo Jan 1845

- Wm Morton intro Wells to JC Warren at MGH in Boston – invitation to demonstrate
- Volunteer student for tooth extractn under N_2O – cried out!



JC Warren, Prof of Anatomy & Surgery, MGH, Boston

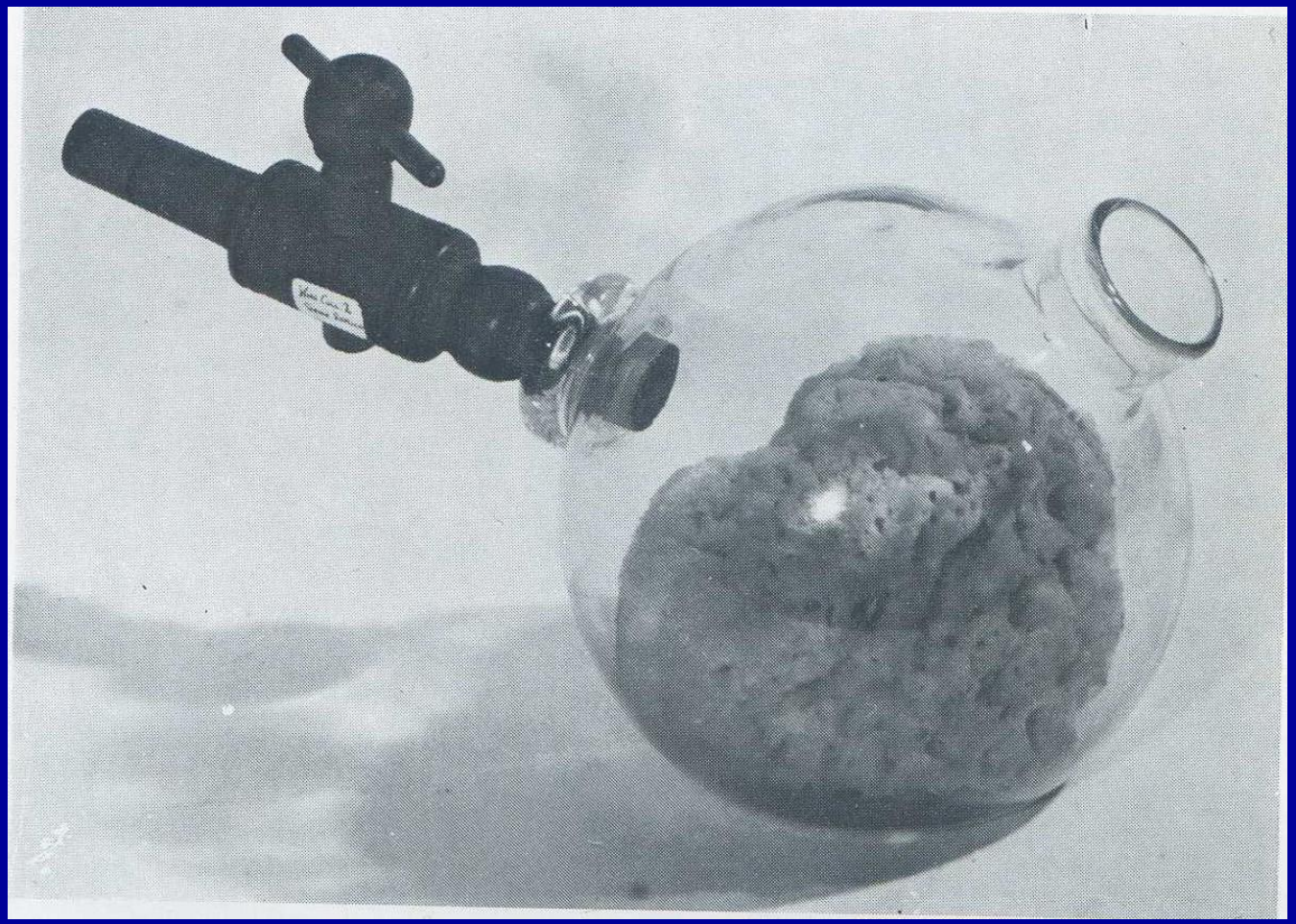
Liaison: chemist & clinician

Charles T Jackson: chemist
(previously physician)

William T G Morton: dentist

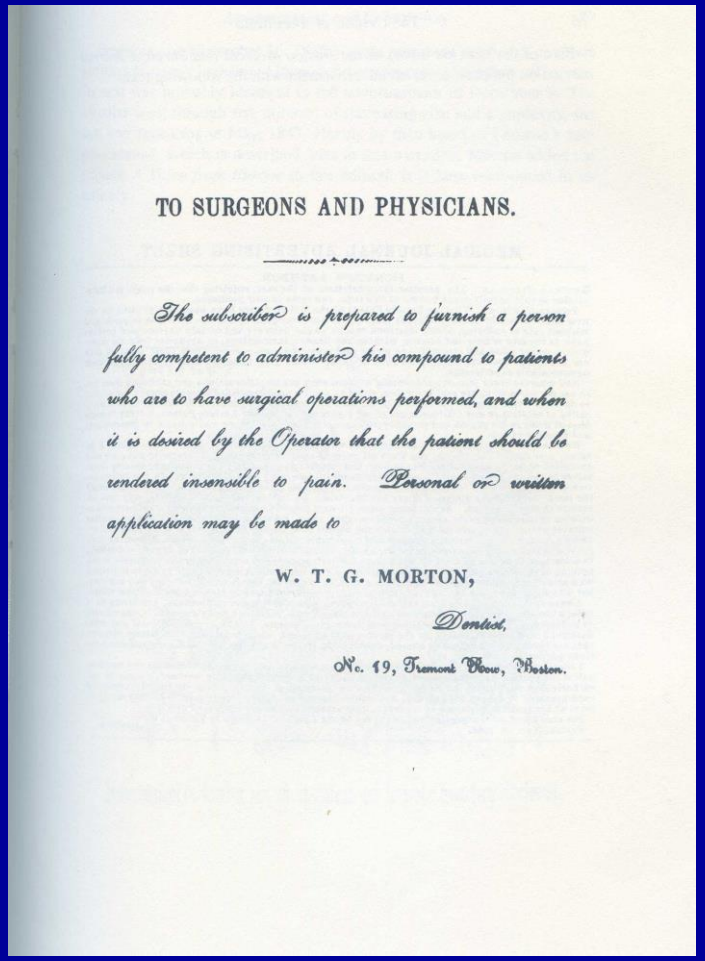
First public demonstration of ether: 16th October 1846

Morton's Inhaler



1846 Morton's announcements

- Notice circulated to physicians on 20th November 1846



TO SURGEONS AND PHYSICIANS.

The subscriber is prepared to furnish a person fully competent to administer his compound to patients who are to have surgical operations performed, and when it is desired by the Operator that the patient should be rendered insensible to pain. Personal or written application may be made to

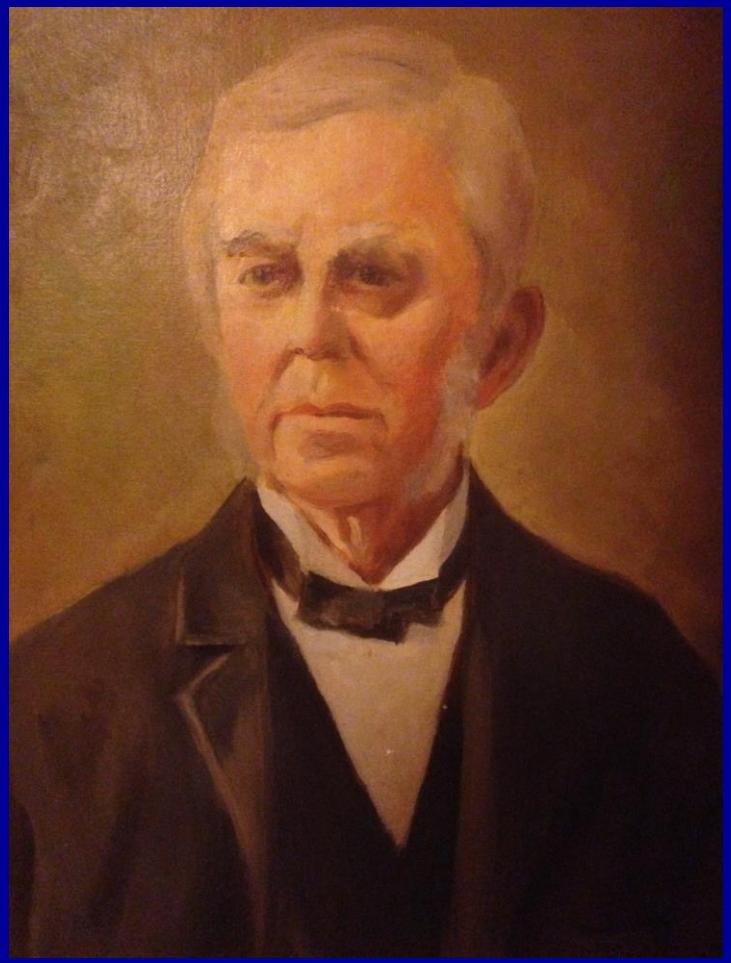
W. T. G. MORTON,

Dentist,

No. 19, Tremont Row, Boston.

The name “Anaesthesia”

- Oliver Wendell Holmes – respected Harvard physician & poet
- Suggested the name “anaesthesia” which was accepted



Dispute: who to credit the discovery of surgical anaesthesia?

- Horace Wells
- Charles Jackson
- William Morton

News of anaesthesia brought by steamship across Atlantic Ocean

- 11 Dec 1846 in Paris
- American Dr Willis Fisher admin ether for surgeon de Lamballe to remove lesion from lip of Pierre Dihet
- Not published until Feb 1847

A J de Lamballe

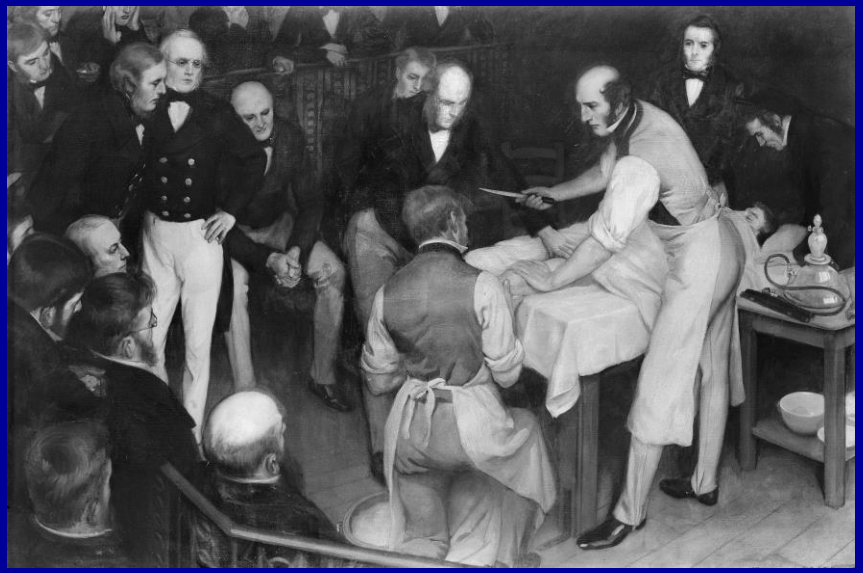
News brought by letters on steamship across Atlantic Ocean

- 19 Dec 1846 London
- Dentist J Robinson admin ether to Miss Lonsdale & extracted molar tooth: success
- Further trials – Prof of Surgery UL, Robert Liston invited
- Liston was impressed – led to modification of inhaler by P Squire

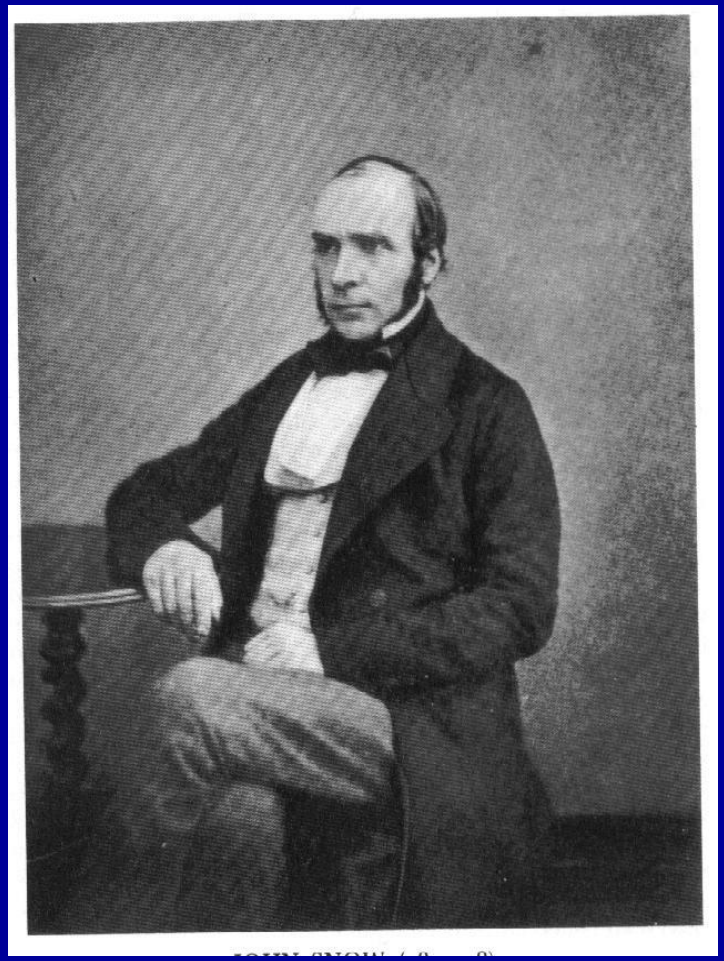
James Robinson

Publicity

- 21 Dec 1846 UCH
- Ether admin by Wm Squire to F Churchill, who had amputation thru thigh by R Liston

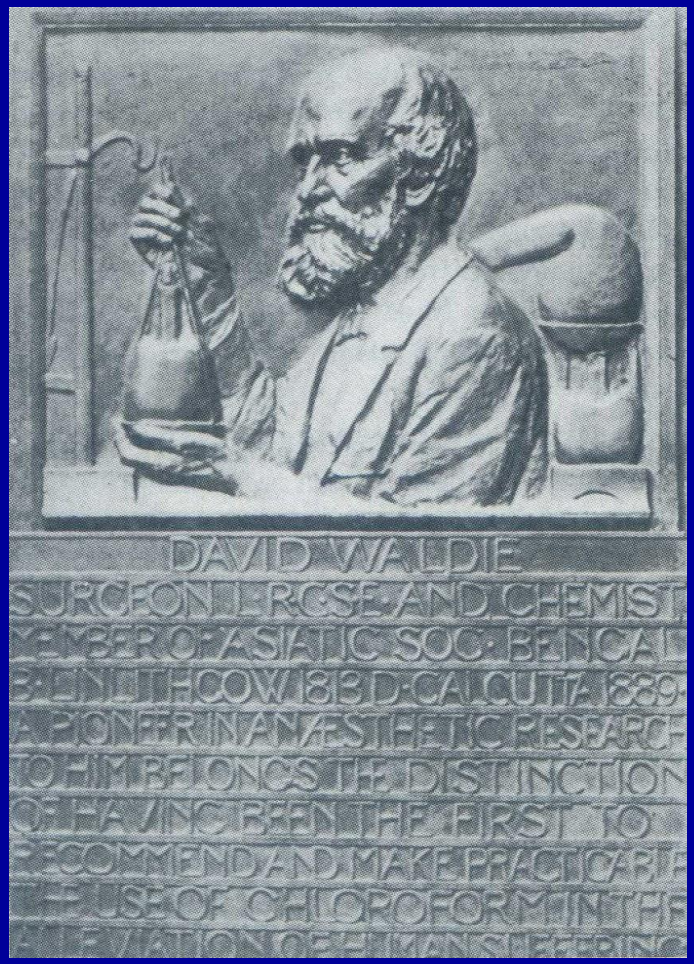


John Snow on ether

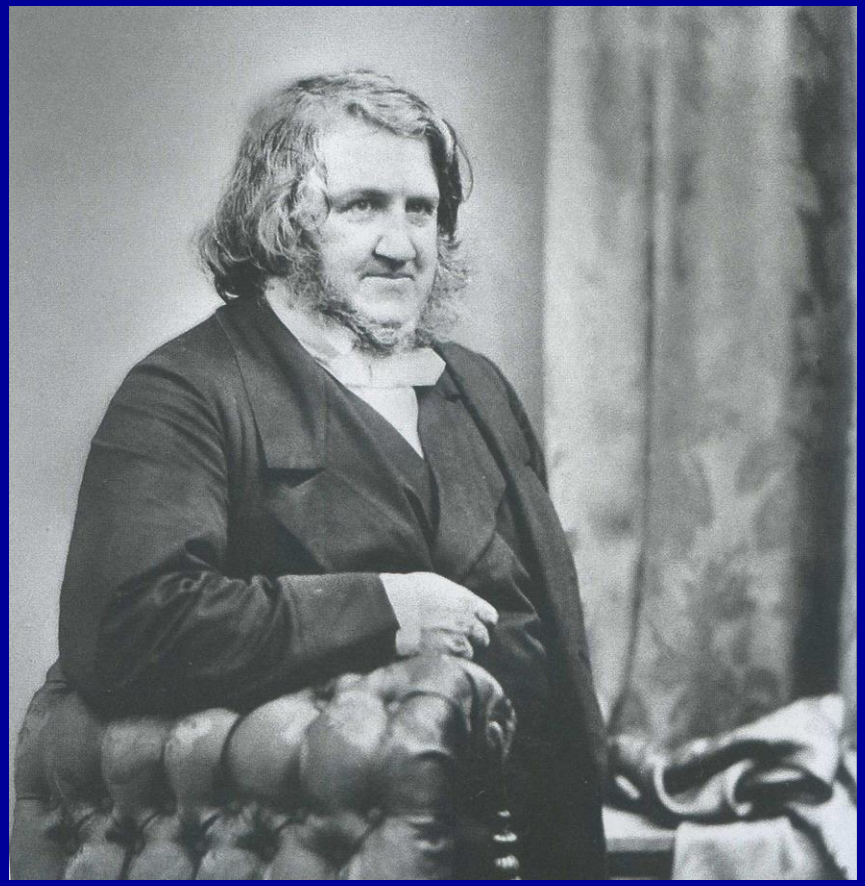


- 1847 five stages of etherization
- Emphasised record-keeping
- 1848 observed patient's pulse characteristics under anaesthesia

Liaison: chemist & clinician



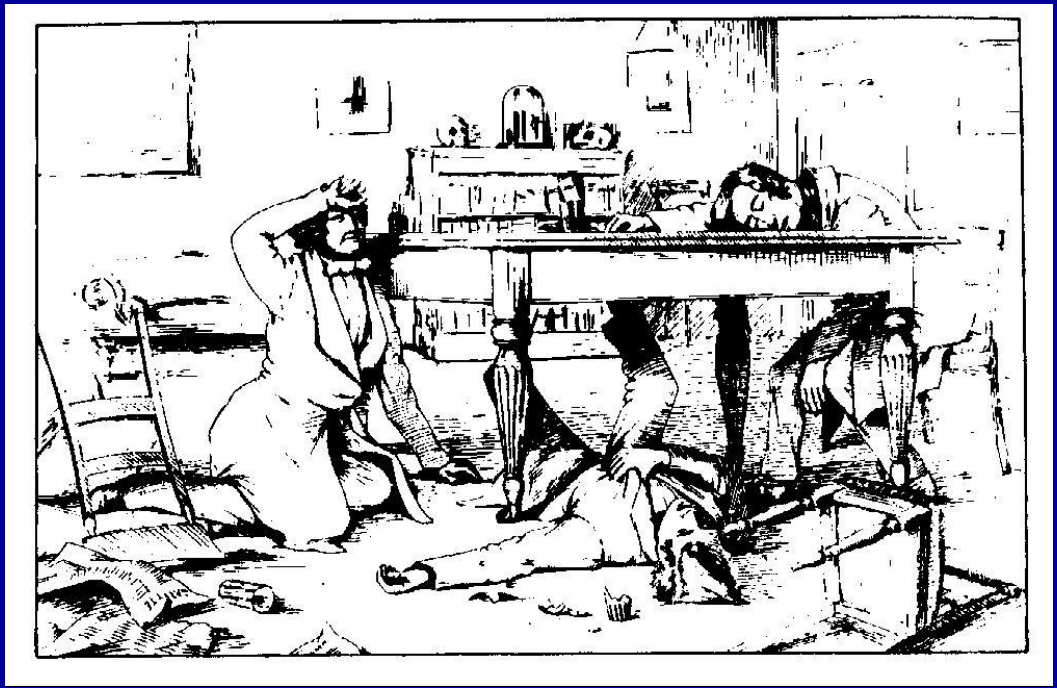
David Waldie: chemist



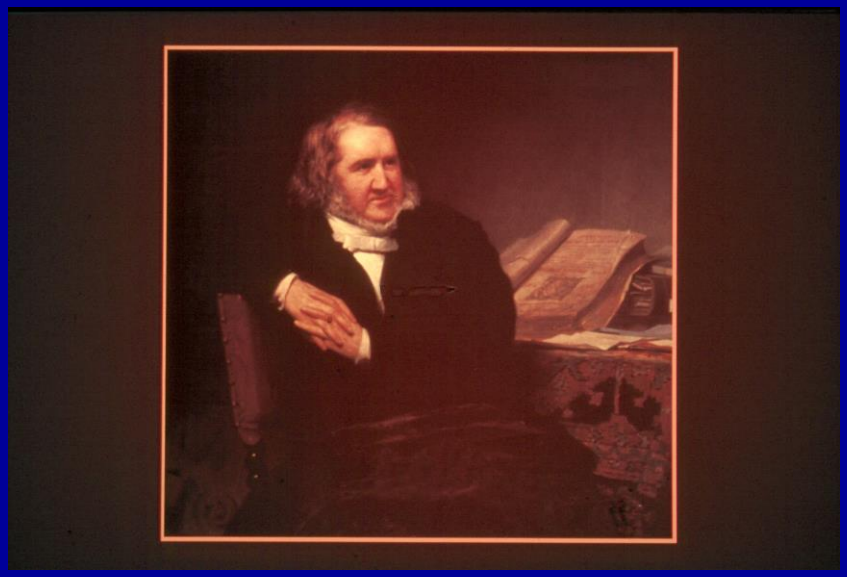
James Young Simpson: obstetrician

4 November 1847

- JY Simpson encounters chloroform



James Y Simpson on chloroform

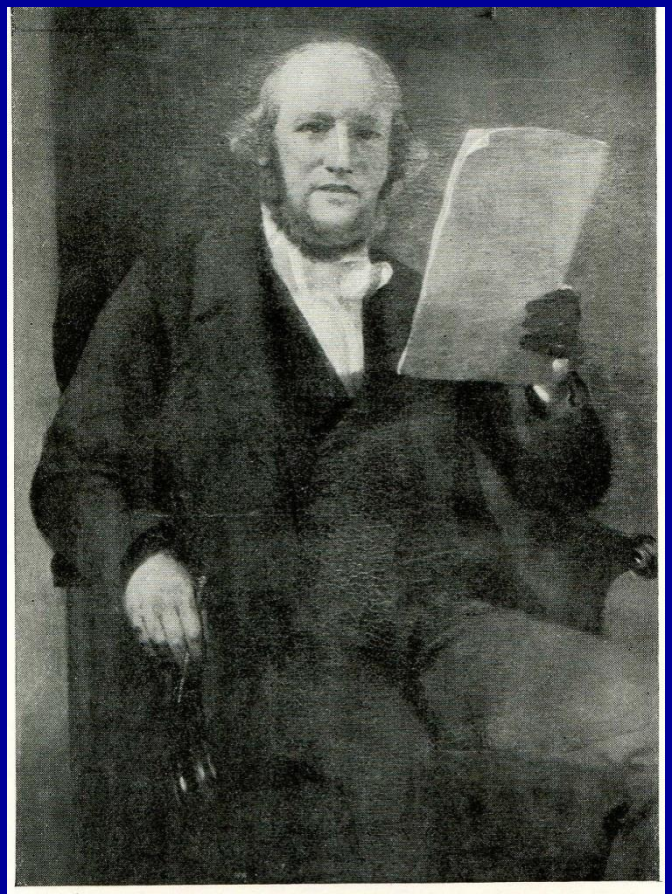


- Championed chloroform and its use in obstetrics
- Instigated Scottish view that patient's respiration was the only worthwhile guide

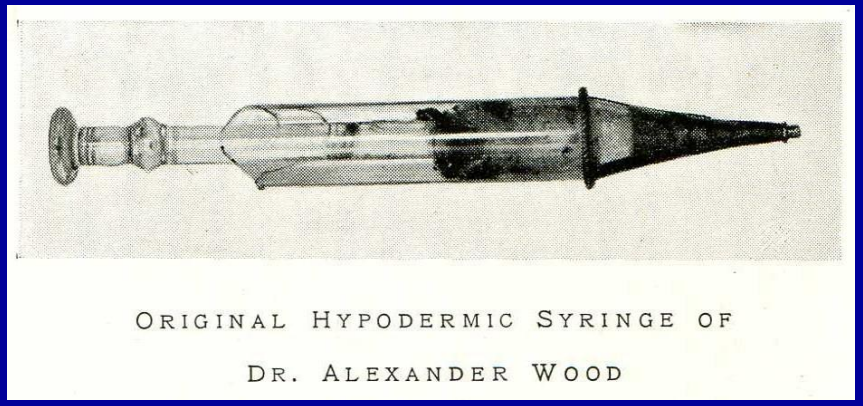
Death under chloroform

- 28 Jan 1848 in Newcastle upon Tyne
- Hannah Greener died under chloroform admin for removal of R great toenail
- JYS insisted she died fm suffocation by brandy, not $CHCl_3$
- Despite further such deaths JYS promoted $CHCl_3$ for the rest of his life

1853 Alexander Wood: hypodermic syringe and needle



ALEXANDER WOOD *(secundus)* (1817–1884)
(Original in the Royal College of Physicians, Edinburgh)



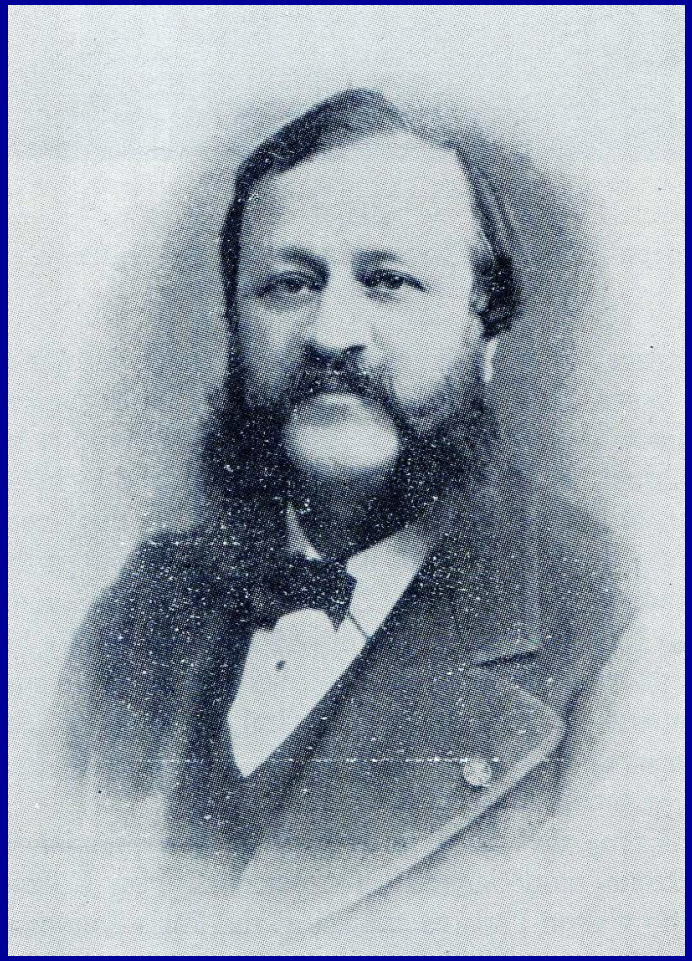
ORIGINAL HYPODERMIC SYRINGE OF
DR. ALEXANDER WOOD

British use of chloroform in the Crimean War 1853-56

- Dr John Hall cautioned against the use of chloroform in the severely wounded, because he believed pain was a powerful stimulant to the body & important for survival
- Duncan & Flockhart chemist shop (Edinburgh) became a major exporter
- Although some army surgeons followed Hall's advice, many (especially Scots trained in the Simpson method) simply continued $CHCl_3$

Nitrous oxide (1863-67)

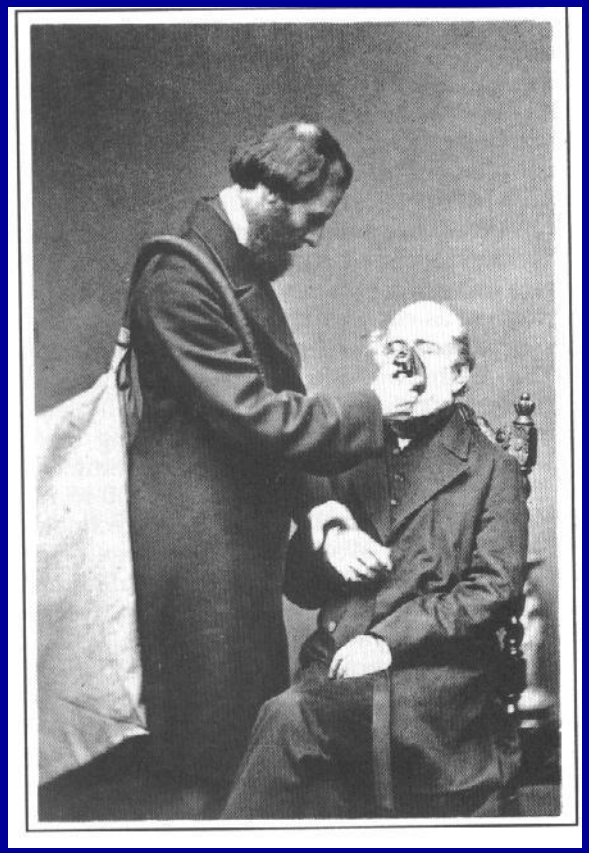
- 1863 Colton estab the Colton Dental Assoc in NY – popular N_2O for extraction of teeth
- 1867 Colton exhibited N_2O in Paris – intro to TW Evans, American dentist working in Paris



Thomas W Evans

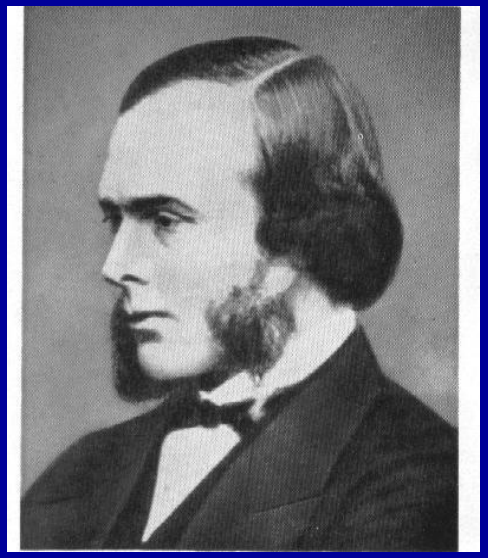
Nitrous oxide: England

- 1868 Evans demo N2O in London (Sprague apparatus & Colton bags), witnessed by J Clover
- Clover substituted his own $CHCl_3$ sack
- 1869 C Fox instigated cylinders of liquid N_2O by Coxeter & Son



Joseph Clover

Up to early 20th century, monitoring neglected

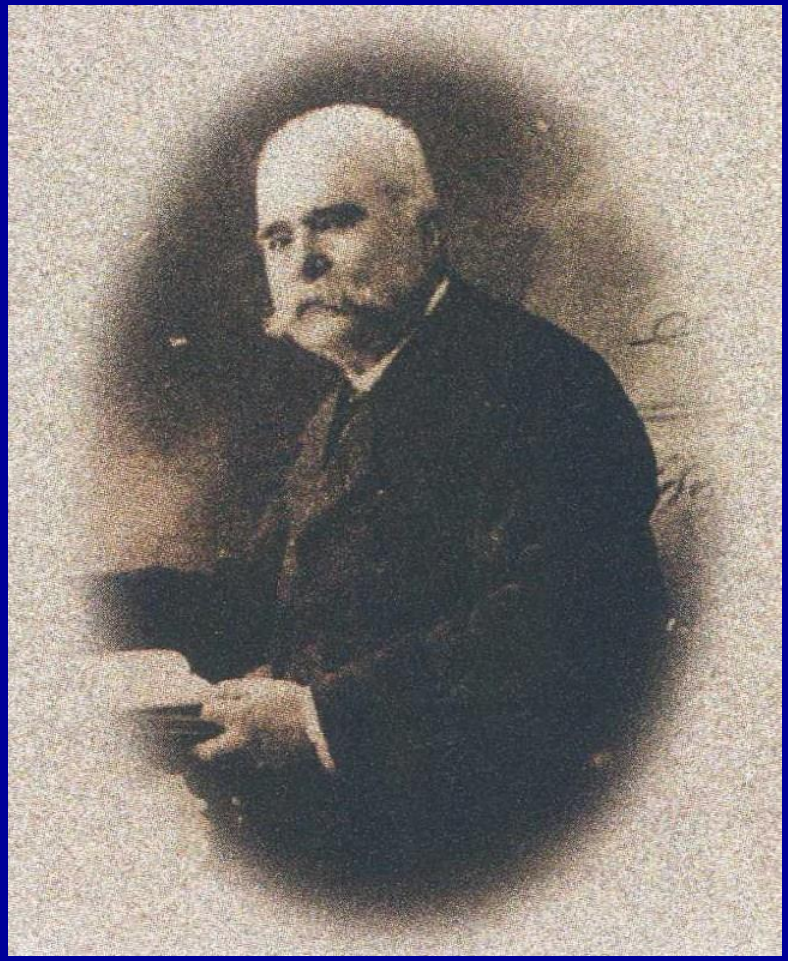


Joseph Lister felt that the giving of anaesthesia was a menial task

- Anaesthesia was delegated to the most junior staff
- No monitoring *equipment* used
- Yet apparatus already existed

Intravenous anaesthesia
Chloral hydrate CCl_3-$CH(OH)_2$

- 1872 P C Oré surgeon in Bordeaux gave chloral hydrate IV for sedation (cases of convulsions)
- 1874 he found in Tx tetanus that it allowed minor surgery
- Technique taken up, but waned ? due to toxicity reports



Pierre Cyprien Oré

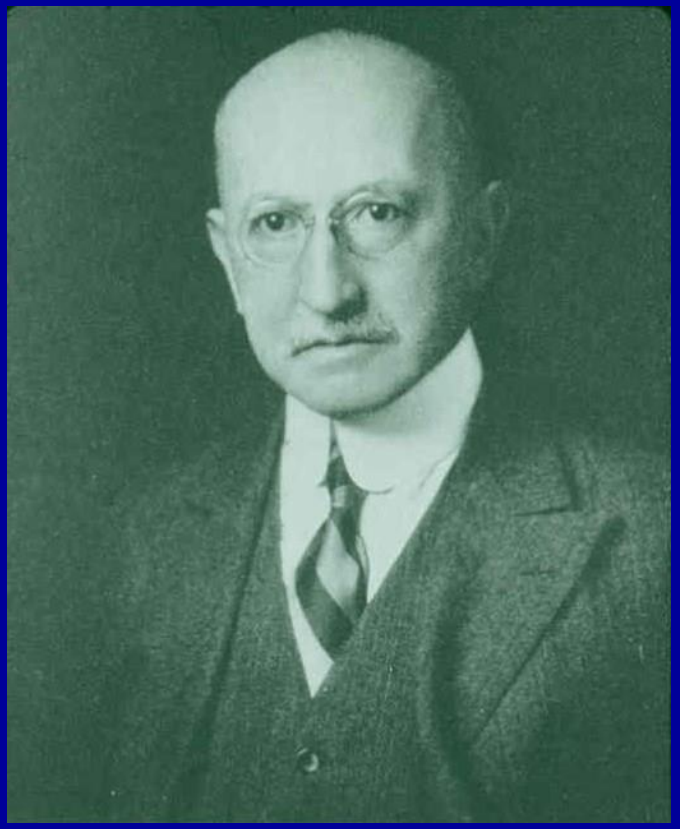
Local anaesthesia

1884 Vienna

- Sigmund Freud lecturer neurology
- *Uber Coca* on possible use of cocaine in Tx of neuro/psychiatric conditions
- Invited trainee ophthalmologist to participate in expts on the drug
- Freud then on temporary absence from Vienna

Successful use of cocaine for eye surgery

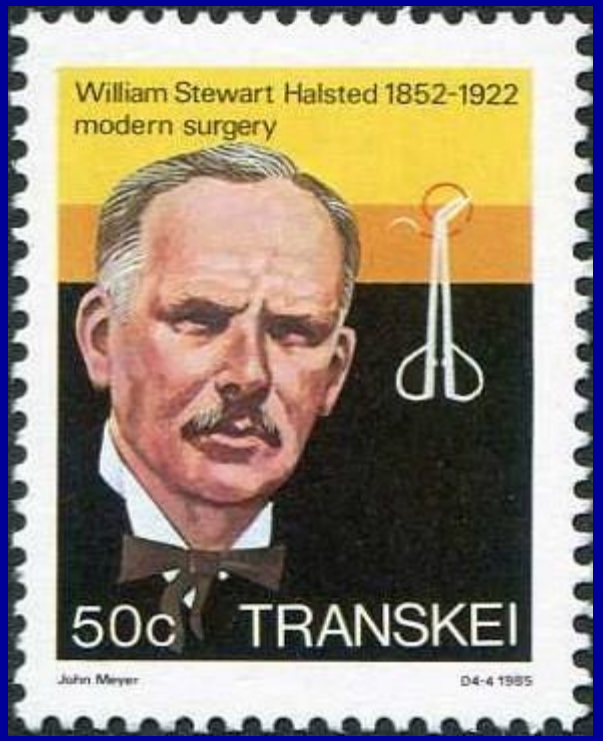
- When Koller realised cocaine numbed the tongue, it dawned on him that here might be the LA he sought!
- Successfully tested on eyes
- 15/9/84 reported to German Ophthalm Soc in Heidelberg



Carl Koller (1857-1944)

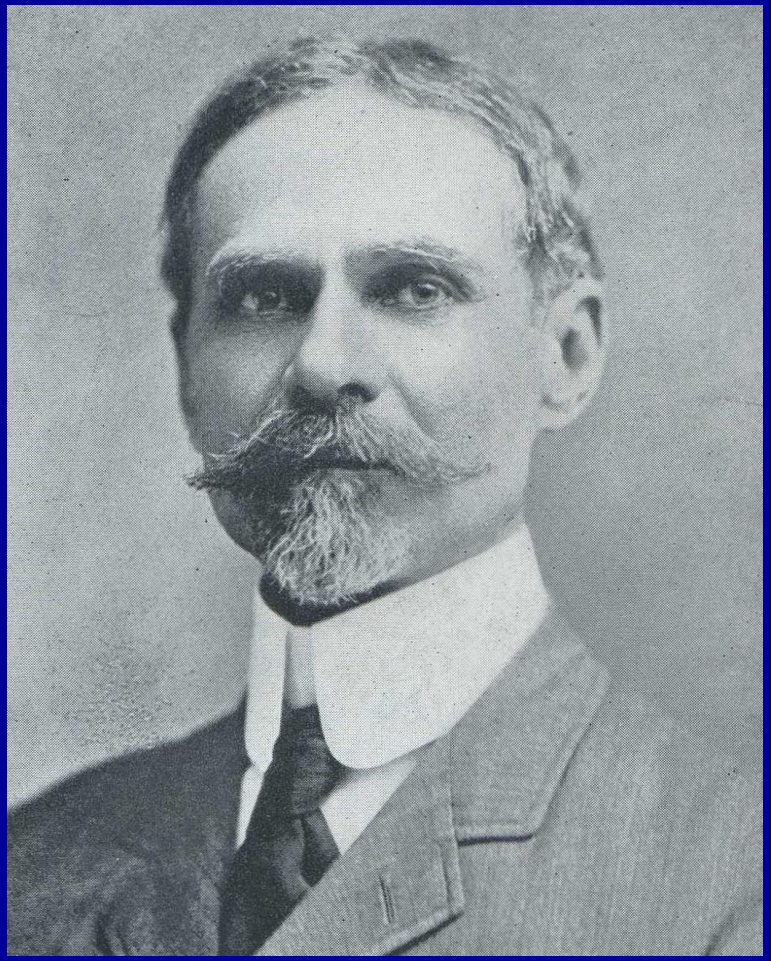
Blocks

- 1884 New York:
  WS Halsted & RJ Hall
- Exptd on themselves
- Blocked supraorbital, infraorbital, inf dental, ulnar & musculocut N
- Letter to *NYMedJ*
  6th Dec 1884



Prolonging the block

- 1885 the neurologist JL Corning applied Esmarch bandage proximally, immed after inj cocaine around nerve



Spinal

- 1891 Lumbar puncture standardised as a clinical procedure by HI Quincke of Kiel
- 1895 accidental piercing of dura (dog) by JL Corning
- 1898 deliberate spinal for surgery using 3ml 0.5% cocaine: A Bier assisted by A Hildebrandt
- 1899 T Tuffier use for intractable pain & surgery

Spinals in USA

- 1899 Tait & Caglieri
- 1900 Rudolph Matas
- Matas also added morphine to cocaine

Spinal in obstetrics

- 1900 Oskar Kreis was first to try intradural spinal block in labour
- Six cases
- Cocaine used

724 Centralblatt für Gynäkologie. No. 28.

(Aus der Frauenklinik in Basel.)

II. Über Medullarnarkose bei Gebärenden.

Von

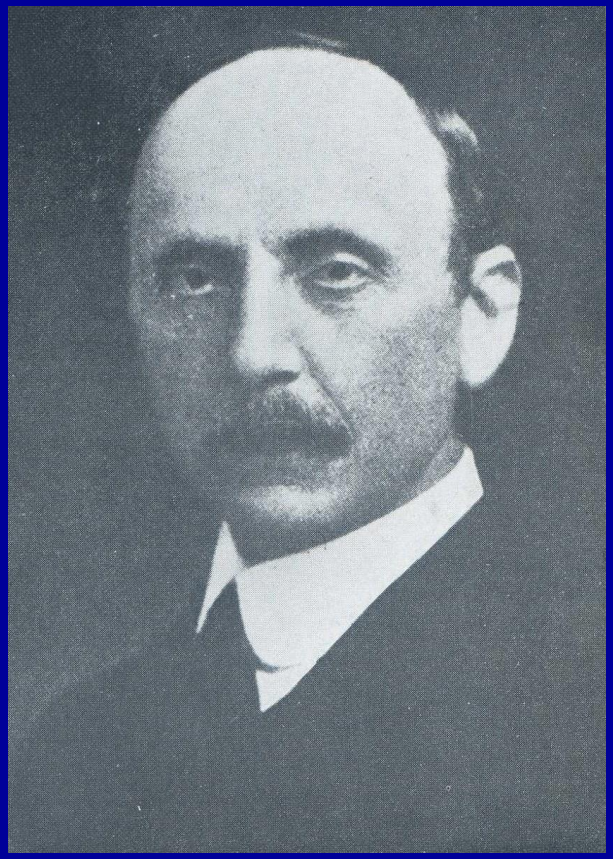
Oskar Kreis,

Assistenzarzt der geburtshilflichen Abtheilung.

ADVANCES IN GA

1893: Hewitt intermittent flow

- Apparatus for mixing a set % of O_2 into a flow of nitrous oxide
- Used for dental anaesthesia
- Featured a demand valve, i.e. the flow was intermittent

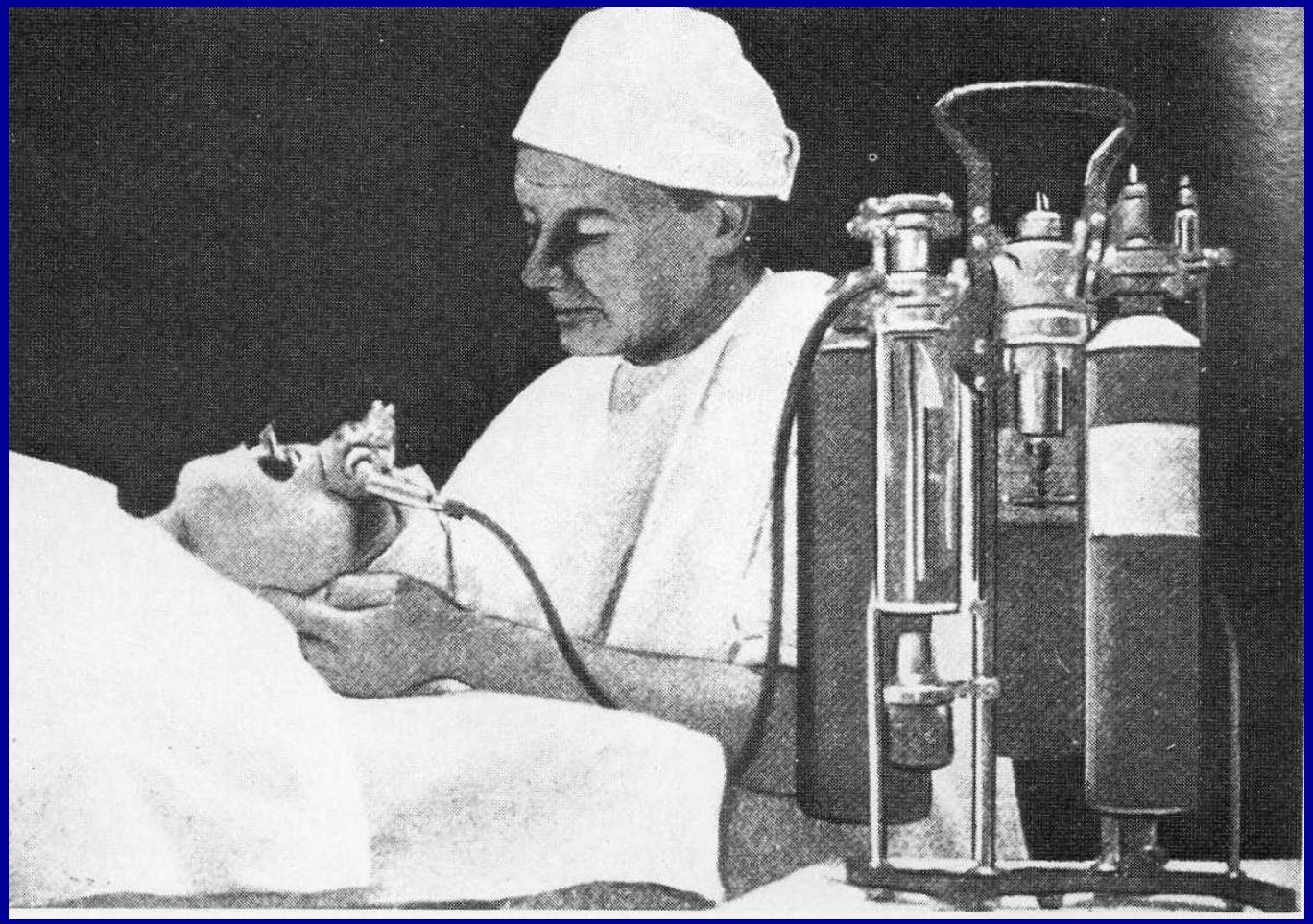


Frederick Hewitt: lecturer on anaesthesia, London Hospital

Continuous flow anaesthesia machines

- In the early 1900s innovations in Germany and USA introduced the first continuous gas flow apparatuses – oxygen mixed with anaesthetic
- Culminated at New York City with James T Gwathmey's machine, which incorporated a 'bubble bottle' for visible measurement of gas flow

Gwathmey machine 1914



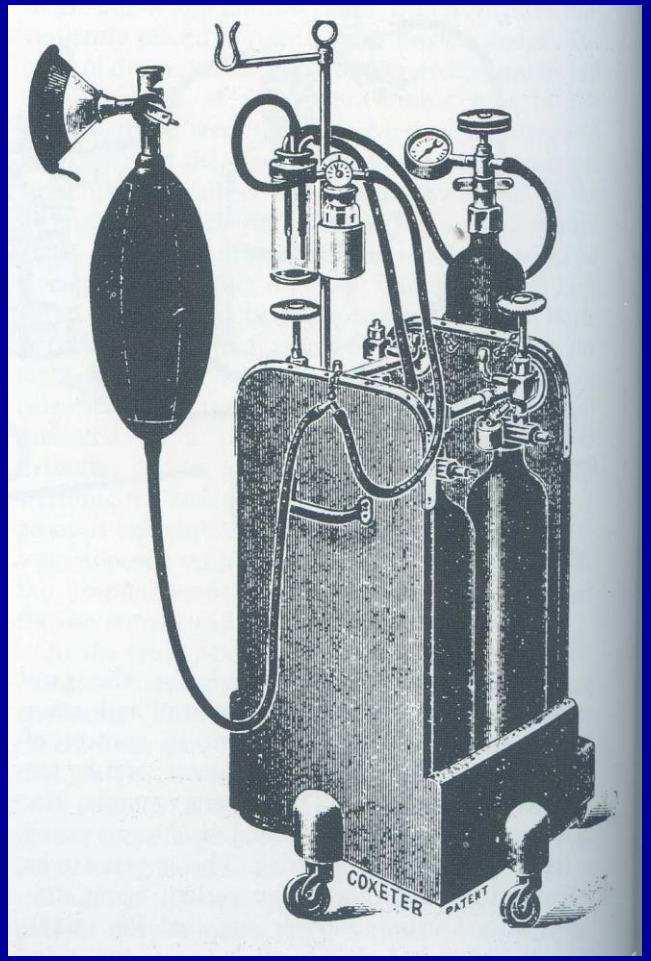
HEG Boyle

- From 1914 Capt Boyle at RAMC in London used Gwathmey machine on military casualties
- He found problems with the apparatus and designed his own machine in 1917 (built by Coxeters), also making use of Marshall's modifications
- Thereafter in Britain subsequent generations of anaesthetic machines were called "Boyle's"

‘Cocky’ Boyle

Boyle's early hospital model

- Anaesthetic gas mixture passed from water sight-feed flow meter thru narrow rubber tubing to a reservoir bag, connected to face-piece by a 3-way stop-cock



1917

ADVANCES POST WW1 TO END WW2

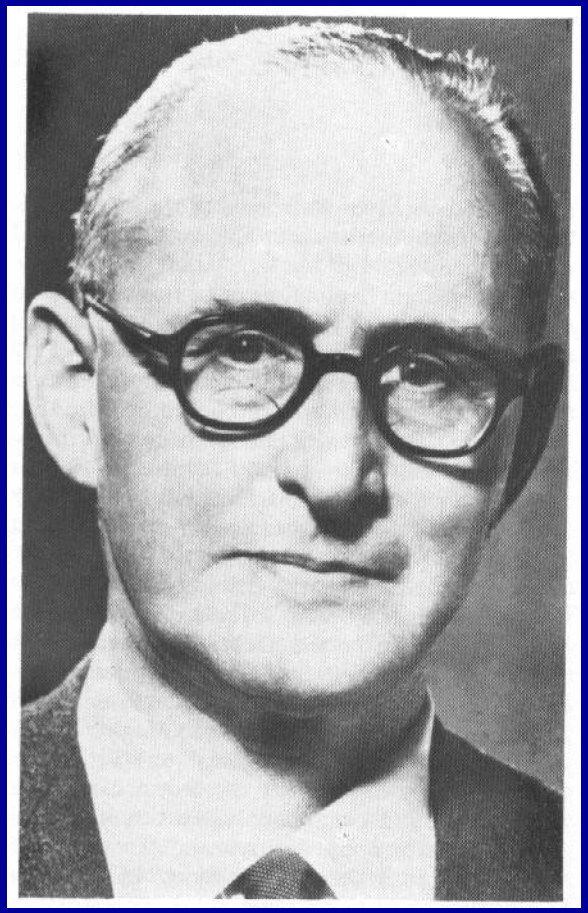
- General anaesthesia
  - Innovation in breathing apparatus & machines
  - New agents
  - Standards
- Regional anaesthesia
  - Lumbar epidurals

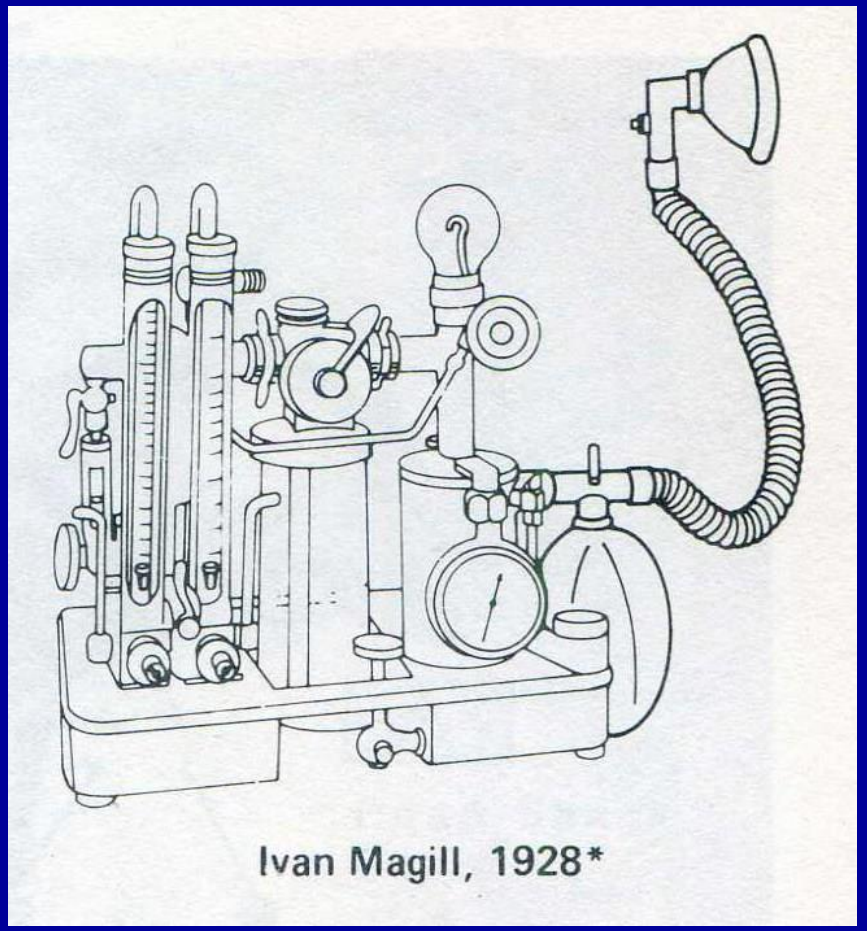
ADVANCES IN GA

breathing apparatus

- 1919 Ivan Magill reqd to anaesthetise for reconstructive ops on face & jaw of wounded soldiers
- Surgeon Harold Gillies at Queens Hosp in Sidcup, Kent
- Magill & ES Rowbotham devised tracheal insufflation of warm ether: by catheter (gum-elastic) passed thru the nose; used laryngo-scope & forceps to guide it thru the larynx
- This progressed to endotracheal tube (wide-bore, rubber)

Magill attachment



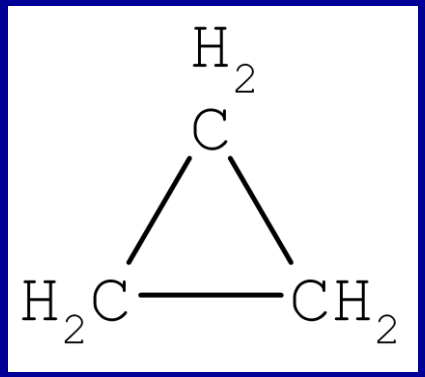


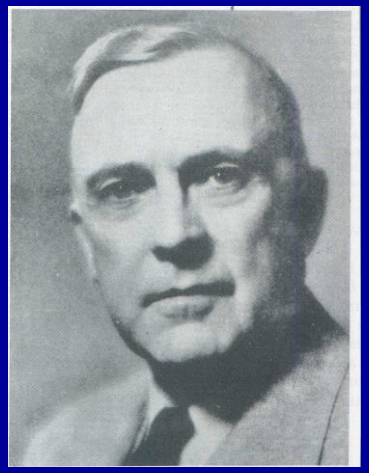
Ivan Magill, 1928*

New inhal anaes agents

Cyclopropane

- 1929 chemist Lucas & pharmacologist Prof V Henderson (Toronto) reported anaesthetic effect on animals & on themselves
- 1933 Prof R Waters anaesthetist at Madison popularised

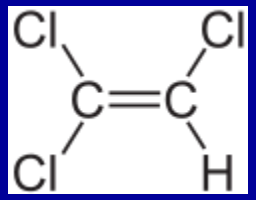




R Waters

Trilene

- 1933 DE Jackson, Prof Pharmacology Cincinnati anaes dogs
- 1935 C Striker publish clin use: 304 patients
- 1941 popularized in London by CL Hewer



C Langton Hewer

Problems with anaesthetic agents

- Slow induction & recovery
- Postop nausea
- Flammability
- Liver damage
- Dysrhythmias
- Toxic products with soda-lime

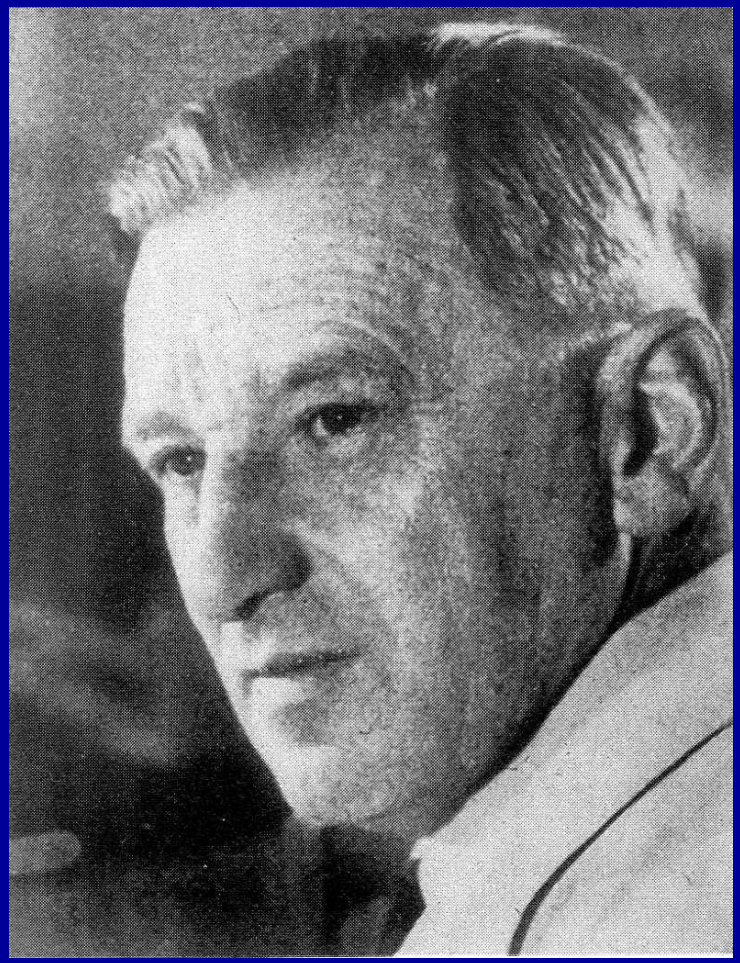
Intravenous anaesthetics

Somnifene: 1st IV barbiturate

- 1920 Daniel Bardet physician in Paris prelim paper: IV adjuvant in anaesthesia
- 1924 Fredet & Perlis (Paris): IV anaesthetic

- Combination of diethyl barbituric acid + diallylbarbituric acid

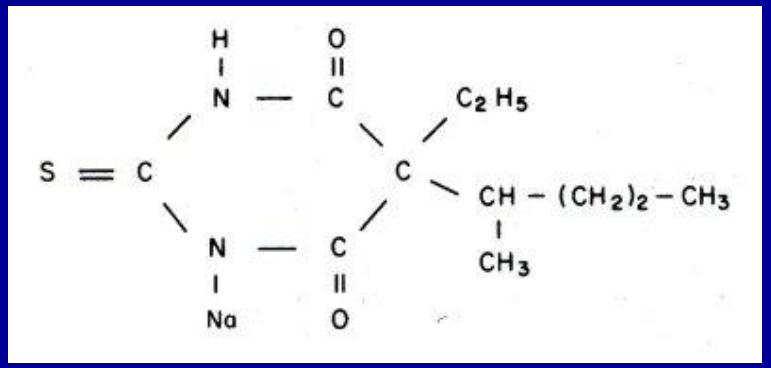
Hexobarbitone 1932

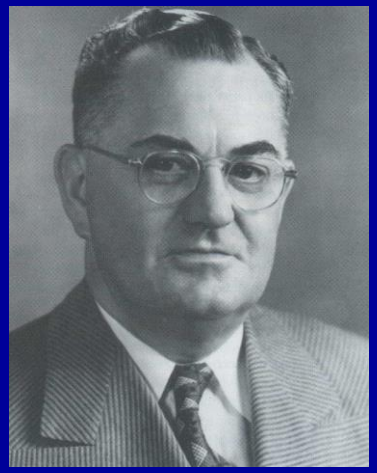


Helmut Weese

Thiopentone

- 1932 synth by Tabern & Volwiller (Abbott Labs, Chicago)
- 1934 clin trials
  - R Waters (Madison)
  - J Lundy (Mayo Clinic)
- Popularised by JS Lundy





John S Lundy

Thiopentone a milestone

- Initially sole agent
- Facilitated IV induction – with maintenance by inhal agents: this became the norm in adults
- Thiopentone remained most popular IV induction agent in the world for 50 years

STANDARDS

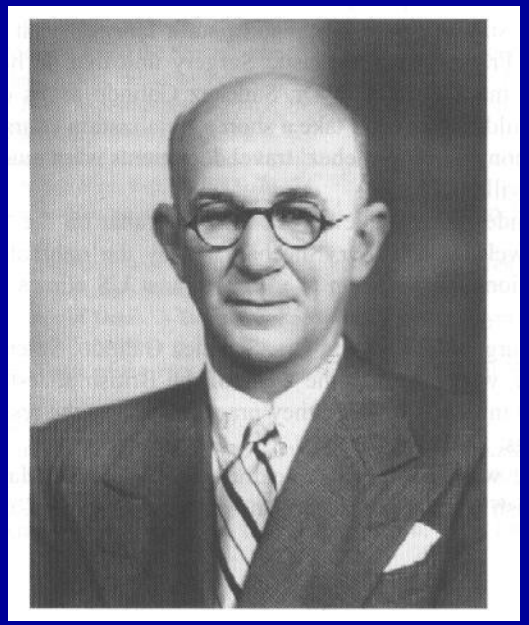
- 1933 first university chair of anaesthesia created at University of Wisconsin in Madison, USA
- Ralph Waters appointed

Diploma in Anaesthetics

- AAGBI (founded 1932) negotiated successfully with RCSEng to provide examination for Diploma in Anaesthetics
- First exam held November 1935
- All candidates were reqd to be graduates in medicine & surgery

First chair of anaesthesia in UK

- 1937 University of Oxford through benefaction of Lord Nuffield
- Robert R Macintosh appointed



Prof RR Macintosh

MUSCLE RELAXANTS

Curare

1942 1st use of Intocostrin in anaesthesia

- Lewis Wright (Squibb) sugg Intocostrin to Harold Griffith at Montreal
- 23 Jan 1942 Griffith & E Johnson at Homeopathic Hospital used Intocostrin **deliberately** to give relax during surgery under cyclopropane anaesthesia
- Published July 1942

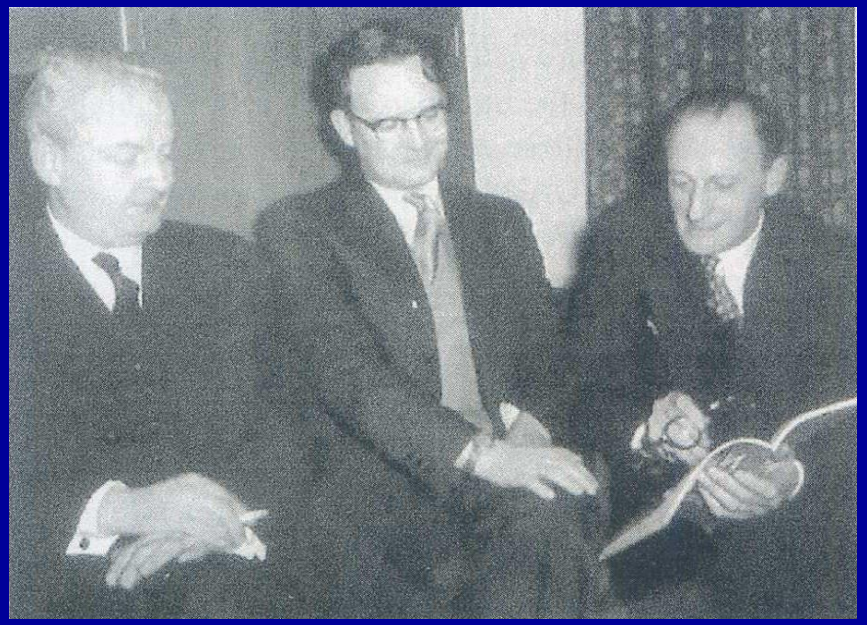
IMPROVEMENTS IN SAFETY

1948 start of NHS (5 July)

- From 1947 the AAGBI negotiated for status of anaesthetists in the forthcoming NHS
- Collaborated with RCSEng – new Faculty of Anaesth formed in 1948
- Secured equal Consultant status – subject to upgrade of DA to two-part exam: 1st in Nov 1948

GENERAL ANAESTHESIA
Halothane

- 1956 following animal studies, clin trials led by anaesthetist M Johnstone at MRI
- The first (inhalation) ‘designer anaesthetic’
- $K_{bl/gas}$ 2.4 – rel quick induction,MAC 0.75%



M Johnstone anaesthetist

C Suckling chemist

J Raventos, pharmacologist

Halothane a milestone

- A great advance!
- 1957 Fluotec vaporizer introduced
- Advantages
  - Potent & non-irritant → rapid, smooth inductn
  - Non-flammable/explosive → allowing diathermy
  - Minimal side effects
  - Relatively rapid recovery

Newer inhalation anaes agents

- Mid-1980s studies showed association (rare) between halothane & hepatitis
- Superseded by enflurane & isoflurane
- Halothane discontinued in UK 2013
- Sevoflurane, after ‘put on hold’ in 1970s, was relaunched in Japan in 1990s and by the millennium was popular worldwide

Newer intravenous anaesthetic agents

- Propofol, a reformulation of disoprofol in a soybean oil emulsion from 1984, was popularized from 1985
- Propofol superseded thiopentone as the most popular IV induction agent in the world
- Also given by infusion for TIVA

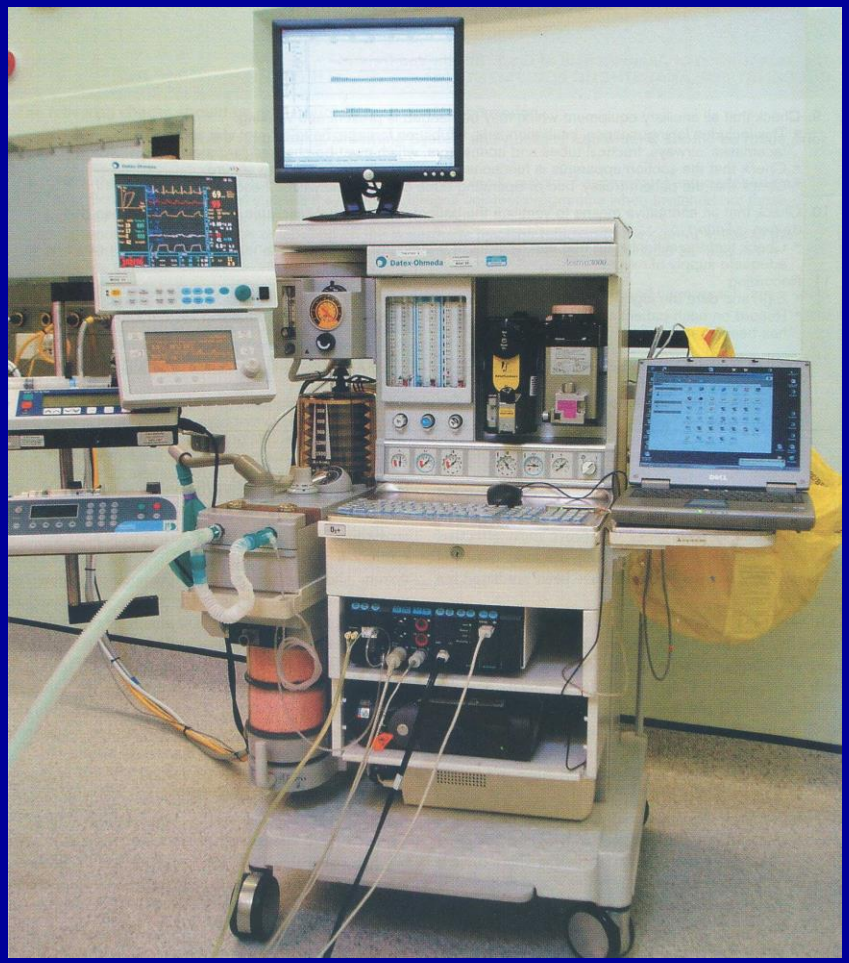
FURTHER IMPROVEMENTS IN SAFETY

MONITORING

- the developments in monitoring techniques have probably made the greatest contribution to the safety of the patient under anaesthesia:
  - 1979 Dinamap
  - After 1983 Pulse Oximetry
  - After 1986 accurate Capnography

Reduction of Equipment Hazards

- 1955-2005 progressive standards for anaesthetic machines, eliminating hazards of misconnection
- Modern machine cannot deliver< 20% oxygen



Datex-Ohmeda Aestiva 5 (2005)

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