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HISTORY OF ANAESTHESIA SOCIETY

PROCEEDINGS OF THE

ANNUAL SCIENTIFIC MEETING

25th – 26th JUNE 2025

HELD IN THE

PRINCESS ROYAL GALLERY

NATIONAL MUSEUM OF THE ROYAL NAVY

PORTSMOUTH HISTORIC DOCKYARD

VOLUME 57

While the manuscripts have been edited for style and presentation, the opinions and/or facts as stated are entirely the authors' own.

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Papers and Abstracts:

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HAS 2025 Scientific Programme

(Speakers denoted by asterisk *)

Wednesday 25th June 2025

0830 – 0855 Registration / tea and coffee

0855 – 0900 President's welcome and opening remarks
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0905 – 1020: Session 1: Chair: Dr John Pring

0905– 0930 Leeches – the sucking edge of medicine
*Christine Ball**

0930 – 0955 The changing fortunes of nitrous oxide
Deborah Roy, Tuhin Roy*

0955 – 1020 Hull or high water: Frank Eve's rocking method of artificial respiration and the Royal Navy
*Peter Featherstone**

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*Myles Woodman**

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Nav-Preet Kaur, Mei Lan Hoe*

1135 – 1200 From gallop to gasp: How horses helped humans breathe easier – The evolution of High-Flow Nasal Oxygen Therapy
*Charmaine Almeida**

1200 – 1225 Early Warning Scores – a narrative review
*Andrew Burch**

1225 – 1315: Lunch

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1315 – 1340 The original pain consultant: A glance at Mother Nature's historic contributions to pain relief
*Rhiannon Wilton **

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*Ana Nomani**

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Rachel Wood*

1430 – 1455 Continental European contributions to early "modern" anaesthesia apparatus in Britain and Canada
*Connor Brenna, Wulf Strätling**

1455 – 1520: Tea / Coffee

1520 – 1635: Session 4: Chair: Dr Duncan Mitchell

1520 – 1545 Breast surgery without anaesthesia in the early 19th century, with accounts by patients and relatives
*Declan Warde**

1545 – 1610 General-Practitioner anaesthetists in the UK
*Alistair McKenzie**

1610 – 1635 The DA(RCP&S) 1953-79: "Given away with a packet of cigarettes"?
*Tony Wildsmith**

1645 – 1745: HAS Annual General Meeting

1900 – 2300: President's Reception and Conference Dinner
Nelson Room, Royal Maritime Hotel, Portsmouth

Thursday 26th June 2025

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*Aliya Ahmed**

0925 – 0950 Evolution from pain services to fellowship program (1979-2025): The LMIC experience
Gauhar Afshan, Salman Saleem, Asif Gul Kayani, Khalid Basheer, Amjad Iqbal*

0950 – 1015 Da Costa's syndrome
*Fabrizio Casale**

1015 – 1040: Tea/ Coffee

1040 – 1155: Session 6: Chair: Dr Declan Warde

1040 – 1105 The Jewish medical community in Berlin before the Shoah - Dr Ernst Silberstein (Silten) (1866-1943) and a thriving, international epicentre of modern oxygen-therapy and anaesthesia-related technology
*Wulf Strätling**

1105 – 1130 Did carnations lead to the creation of the Mayo Clinic Department of Anesthesiology and perhaps the specialty of anesthesiology?
*Doug Bacon**

1130 – 1155 How the ISHAs and their Proceedings evolved
*David Wilkinson**

1205-1235: Guest lecture: Introduced by Dr Peter Featherstone

1205 – 1235 Royal Marines collection
James Daly, Principal Curator for the National Museum of the Royal Navy

About the speaker: James Daly joined the National Museum of the Royal Navy in January 2025. He previously worked for Portsmouth City Council, including at the D-Day Story Museum. He is the author of four books on military history, including on the experiences of Portsmouth people in the First and Second World Wars and airborne warfare between D-Day and the Battle of Arnhem. He is an Associate Fellow of the Royal Historical Society and an Associate of the Museums Association.

1240-1245: Closing remarks: Peter Featherstone

Future Meetings

HAS ANNUAL MEETING, 20th - 21st May 2026, Lincoln, UK

The conference and AGM are being held at the Lincoln Hotel, Eastgate, Lincoln LN2 IPN.
The Conference will be held on the Wednesday morning and afternoon and on the Thursday morning. The AGM will be held on the Wednesday afternoon. The President's Reception and Annual Dinner on 20th May is also at the Lincoln Hotel, which is situated in the historic centre of the city, directly opposite the cathedral.

History of Anaesthesia Society
Council Membership October 2025

Officers:

President	Peter Featherstone	2024 - 2027
Immediate Past President	Adrian Kuipers	2024 - 2026
Treasurer & Membership Secretary	Duncan Mitchell	2022 - 2028
Secretary	Kenneth MacLeod	2022 - 2026
Secretary Elect	Anna Maria Rollin	2025-2026
Editor	Doug Bacon	2023 -
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Data Protection Officer	Ann Ferguson	2024 -
Elected Members:	Rajinder Mirakhur	2018-2021, 2024-2026
	Declan Warde	2022 - 2025 - 2027
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- Dr David Wilkinson
- Dr Neil Adams
- Dr Peter Featherstone
- Brigadier Ivan Houghton
- Prof Roger Maltby
- Dr Ian McLellan
- Dr John Pring
- Prof Tony Wildsmith
- Mrs Patricia Willis

David Zuck Memorial Prize 2025

Adjudication Committee:
Professor Douglas R. Bacon (Chair)
Neil Adams
Alistair McKenzie
John Pring
Marten Van Wijhe

The Zuck Prize was awarded to: Rajesh Haridas and Laurence Mather, for their paper “First British and Irish Press report of Surgical Etherization,” published in Anesthesia and Analgesia in October 2024.

Death of Members

Deaths as reported at the 2025 AGM, and since, were:

John Powell

Bob Marchant

Alan MacDonald

John A.H. Davies

Anthony P. Adams

Roger Maltby

Gordon Paterson

List of Delegates

Neil Adams
Gauhar Afshan
Aliya Ahmed
Amna Ahmed
Charmaine Almeida
Doug Bacon
Christine Ball
Dawnya Behiyat
Julie Bourne
Alistair Brown
Andrew Burch
Jennifer Caddy
Fabrizio Casale
Michael Cowen
Peter Featherstone
Paul Goulden
Danielle Huckle
Nav-Preet Kaur
Sally Kelway
Richard Knight
Adrian Kuipers
Richard Laishley
Ronald Lo
Andrew Lovegrove
Umanga Luintel
Ken MacLeod
Alistair McKenzie
Rajinder Mirakhur
Duncan Mitchell
Ana Nomani
Abina O'Callaghan
Adrian Padfield
Chris Pickles
Janet Pickles
John Pring
Anna-Maria Rollin
Deborah Roy
Tuhin Roy
Wulf Strätling
Erin Taylor
Philip Taylor
Marten van Wijhe
Declan Warde
Tony Wildsmith
David Wilkinson
Trish Willis
Rhiannon Wilton
Rachel Wood
Myles Woodman

Leeches – *the Sucking Edge of Medicine*

Dr Christine M Ball, Adjunct clinical associate professor, Monash University, Melbourne.

The humble medical leech (Hirudo medicinalis) is an ancient medical therapy, a curiosity we associate with old pharmacy jars and ignorant physicians. But leeches, despite being a listed endangered species, are survivors. They are still of relevance in modern medical practice and have potential for even more applications in the future. And while they may seem a world away from anaesthesia, they cannot be ignored by us as their anticoagulant properties are of value in modern operating theatres when heparin is contraindicated.

Leeches were believed by ancient civilizations to draw evil humours from the body, relieving pain and restoring balance. They gained even greater popularity in the Renaissance when surgeons and apothecaries applied them for everything from infectious diseases to mental illnesses. A thriving leech trade resulted which only waned during the latter part of the 19th century. But just as interest in direct leech application waned, scientific studies into leech extracts intensified. The active ingredient, hirudin, was isolated in 1904. In the same year, the German pharmaceutical company Sachsse & Co. of Leipzig began manufacturing hirudin, the first pharmacological anticoagulant, in commercial quantities. Their product was used primarily by animal research laboratories, but potential clinical uses gradually emerged.

Obstetricians were among the first to experiment with hirudin, postulating that eclampsia was a thrombotic disease. Hirudin was added to stored blood in early blood banks until it became clear that sodium citrate produced superior results. Early researchers creating renal dialysis machines also utilized hirudin. The discovery of heparin in 1916 saw many experimental scientists switch from hirudin to heparin to avoid the growing anxiety about hirudin toxicity.

Despite this, research into hirudin continued and in 1957, hirudin was isolated in pure crystalline form. Advances in genetic engineering have allowed many cooperative teams to study cloning and gene expression for hirudin. Recombinant hirudin (r-hirudin) can now be produced in several biologic systems and is the subject of much contemporary research. It is also finding a place in clinical medicine, particularly in patients with a history of heparin-induced thrombocytopenia.

The endangered medicinal leech is also having a resurgence. Leeches were listed as approved medical devices by the US Food and Drug Administration (FDA) in 2004 and are being used once again by surgeons, particularly where venous congestion is threatening graft tissue.

The Changing Fortunes of Nitrous Oxide

Deborah Roy, RN MBA, and Tuhin Roy, MD PhD
Department of Anesthesiology and Perioperative Medicine
Mayo Clinic, Rochester, MN, USA

The origins of nitrous oxide as an anesthetic can be arguably traced to the seminal work on gases and respiration conducted by the Oxford virtuosi, led by Robert Boyle (1627-1691). Their methodical investigations led to the development of pneumatic medicine, the idea that gases could be used for therapeutic purposes. The subsequent discovery of nitrous oxide by Joseph Priestley (1733-1804) in 1772 set in motion a series of events that led to its clinical use as a volatile anesthetic that has remained in use until the present day.

Thomas Beddoes (1754-1808), one of the premier advocates of using gases to treat disease, established the Pneumatic Medical Institution in 1798. Although the clinic did not definitively establish a curative role for inhaled agents, physiological alterations including anesthesia were observed. Humphry Davy (1778-1829), hired as superintendent of the Pneumatic Medical Institution, established that nitrous oxide caused analgesia as well as a reversible state of intoxication. Davy's contention that it could be used to facilitate analgesia during minor procedures was not initially acted upon however due to his complex attitudes toward pain relief as a therapeutic target.

Until the 1840s, nitrous oxide was shunned for anesthetic purposes even while it was used for entertainment and treatment of diseases such as asthma, cholera, and hydrophobia. Concerns about its toxic properties and induction of lethargy limited its widespread use in surgical anesthesia in spite of its analgesic benefits.

Dentists were among the first to adopt the use of nitrous oxide for pain relief. Horace Wells, a prominent Boston dentist, began utilizing nitrous oxide for his patients after attending a demonstration by Gardner Quincy Colton (1814-1898). Wells immediately recognized the potential benefit of reversible analgesia and had one of his own teeth extracted under nitrous oxide with positive results.

By the 1860s, improved understanding of the physiological effects of anesthesia and enhanced physiological monitoring pioneered by Joseph Clover (1825-1882) had made inhalational anesthesia more acceptable and inherently safer. Supplemental oxygen subsequently made nitrous oxide administration even safer as pioneered by Edmund Andrews (1824-1904) and later adopted by Frederick Hewitt (1857-1916) in the design of stopcocks and other devices for gas delivery, paving the way for the development of the anesthesia machine. An 1888 report by Dudley Buxton (1855-1931) further supported the safety of nitrous oxide over that of chloroform and ether.

The use of nitrous oxide has been partially supplanted by the development of other more potent inhalational anesthetics, but it remains in use in many areas of the world in part due to its low cost and unique combination of physiological effects. Increasing recognition of its negative environmental effects and biochemical toxicity however have led to its discontinuation in many countries. Sadly, its continued recreational use also continues to take a toll on adolescents and teenagers.
This talk will focus on the historical developments leading to the uptake and decline of nitrous oxide use, current controversies surrounding the clinical relevance of the second gas effect, and its ongoing use in the context of modern alternatives.

Hull or High Water: *Frank Eve's Rocking Method of Artificial Respiration and the Royal Navy*

Dr Peter J Featherstone
Consultant in Intensive Care Medicine and Anaesthesia
Cambridge University Hospitals NHS Foundation Trust
President
History of Anaesthesia Society

By the early 1900s, several methods of artificial respiration employing intermittent compression of the thorax had been described. These included the techniques of Marshall Hall, Henry Silvester, Benjamin Howard, and Edward Schäfer. [1-4] More easily learnt and less exhausting to perform than other techniques, Schäfer's 'prone pressure method' became the dominant technique in English-speaking countries during the first half of the 20th century. [5]

In November 1932, Frank Eve, Consulting Physician at Hull Royal Infirmary, reported a novel method of manual artificial respiration. Eve had stumbled upon his idea 10 months earlier, when asked to see a two-year-old girl with post-diphtheritic paralysis of the diaphragm. Finding the patient propped up in bed, deathly pale and rapidly dying, it occurred to Eve that if a slow seesaw movement were provided, the weight of the girl's abdominal contents might push and pull her diaphragm up and down like a piston. Accordingly, a rocking chair was obtained, and the child tilted through 30 degrees from the horizontal on each side. The technique proved clinically beneficial and was performed continuously by her parents 10–12 times a minute until the diaphragmatic paralysis resolved several days later. Having trialed his technique on a second patient in August 1932, Eve concluded his technique might be applicable to resuscitation after drowning, electric shock and gas poisoning. [6]

Two years later, Surgeon Lieutenant Keevil of the Royal Navy described the successful use of Eve's rocking method in a case of respiratory failure secondary to a ruptured cerebral abscess. Using a service stretcher secured to a trestle, Keevil recorded that breath sounds

could be clearly heard emanating from the patient, which came as a 'striking contrast to the silence which accompanies the Schäfer method'. [7]

The onset of the Second World War brought with it an increased risk of drowning for Naval servicemen. In 1942 Surgeon Lieutenant Gibbens of the Royal Naval Volunteer Reserve reported that many otherwise uninjured men were rescued after only a short immersion at sea, and yet did not survive. Gibbens attributed this failure to the Schäfer method, which he viewed as inefficient, complicated, and tiring, such that it was rarely carried out thoroughly or for long enough. [8] Working with Surgeon Lieutenant de Launay, Gibbens went on to devise several techniques for rapidly instituting Eve's rocking method on board ships. These techniques were officially endorsed by the Navy and propagated in the 1943 publication, First Aid in the Royal Navy. [9]

Eve subsequently helped develop manual methods for rocking victims in small rescue boats, [10] and by 1946 the rocking technique was adopted by the US Coast Guard as complementary to the Schäfer method. Many voluntary organizations, such as Surf Life Saving Australia, also approved its use in the 1940s, teaching it alongside the Schäfer method.

Like other methods of manual artificial respiration, Eve's rocking technique was eventually replaced by mouth-to-mouth respiration in the 1960s.

References

1. Hall M. Asphyxia. Its rationale and its remedy. Lancet 1856; 1:393-394.
2. Silvester H. A new method of resuscitating stillborn children and of restoring people apparently drowned or dead. Brit Med J 1858; 2:576-579.
3. Howard B. Plain rules for restoration of persons apparently dead from drowning, as taught under the auspices of the Metropolitan Board of Health of the City of New York. New York: E. B. Treat and Co. 1869.

4. Schäfer EA. Description of a simple and efficient method of performing artificial respiration in the human subject, especially in cases of drowning, to which is appended instructions for the treatment of the apparently drowned. Med Chir Trans 1904; 87: 609-623.
5. Comroe Jr JH. "…In comes the good air." Pt. I. Rise and fall of the Schäfer method. Am Rev Resp Dis 1979; 119: 803-809.
6. Eve FC. Actuation of the inert diaphragm by a gravity method. Lancet 1932; 2: 995-997.
7. Keevil JJ. Note on the diaphragm gravity method of artificial respiration. J Roy. Nav. Med. Serv 1934; 20: 367.
8. Gibbens GH. Artificial respiration at sea. Brit Med J 1942;2: 751-752
9. First Aid in the Royal Navy. His Majesty's Stationary Office. 1943.
10. Eve FC. Resuscitation in rescue boats. Brit Med J 1945; 1:21-22.

Ebb and Flow: *Innovations and Controversies in the Development of IV Fluid Therapy*

Dr Myles Woodman
Anaesthetics Core Trainee
The Queen Elizabeth Hospital King's Lynn

Introduction

Intravenous (IV) fluids are amongst the most commonly interventions in modern medicine, with over 90% of UK inpatients receiving them at some point in their hospital admission [1]. Yet, despite their ubiquity, IV fluids remain the subject of persistent controversy. When IV fluids were first introduced nearly two centuries ago, they were met with suspicion, scepticism and outright hostility; this treatment we now regard as standard was considered radical, dangerous, and even unethical. Far from being a straightforward scientific progression, the development of IV fluids has reflected moments of desperate experimentation, serendipitous discovery, public and professional backlash, and ongoing controversy.

Early Innovation in Crisis

The origins of IV fluid therapy can be traced to the devastating cholera epidemic of the early 1830s. When Asiatic cholera struck Britain in 1831, the scale and speed of the epidemic were unprecedented, with tens of thousands of lives lost and an alarming mortality rate that often exceeded 50% in some regions. Standard treatments such as bloodletting and calomel were ineffective, fueling a sense of desperation among clinicians [2,3].

Amid the crisis, Dr William O'Shaughnessy, just 22 years old at the time, investigated the chemical pathology of cholera, demonstrating severe depletion of water and salts in the blood and recommending intravenous replacement [4,5]. In 1832, his contemporary Dr Thomas Latta, inspired by O'Shaughnessy's findings, administered the first intravenous saline infusions using a Reed's syringe (originally designed to give enemas), producing rapid but often short-lived improvements in

moribund patients [6,7]. Early reports and detailed descriptions in The Lancet were enthusiastic, describing the treatment as “wonderful and satisfactory”, but outcomes were often poor, with high mortality among severe cases.

The practice soon became contentious; critics highlighted complications such as air embolism and infection, as well as doubts about efficacy and the suitability of infusions for advanced disease [8,9]. IV infusion was perceived as dangerous, radical, even unethical, provoking heated debate both within the medical community and in the wider press. Early practitioners were derided by – as Latta put it - “newspaper scribblers”, who branded them reckless experimenters. The excitement for IV fluids faded almost as quickly as it had arisen: The Lancet published 29 articles on “injections venous, in cholera” in 1831–32, but just two the following year and none after that [10]. As the epidemic waned in 1833, O’Shaughnessy moved to India and started a successful career in civil engineering, his obituary making no mention of his contribution to IV fluids. Latta died the following year of tuberculosis. Without its two main protagonists, IV therapy slipped into obscurity by the mid-1830s.

Why did IV fluids fail to prosper initially? The therapy’s decline has been attributed to several factors: it was most often used in moribund patients, sterile technique was lacking, the solutions were hypotonic, and public perception was often negative. With the end of the pandemic, the clinical need had also diminished. Furthermore, the practice was grounded in an incomplete physiological framework, with little understanding of osmolality, sterility or fluid volume. The rapid disappearance of IV fluids after their initial promise is perhaps a classic example of how crisis can drive - but not necessarily sustain - medical innovation.

Physiological Foundations

New advances in physiology and biochemistry in the late 19th century laid the foundations for a more scientific approach to intravenous fluid therapy. Amongst the earliest and most influential work was that of Friedrich Goltz in the 1860s, whose frog experiments demonstrated that circulatory collapse could result not only from blood loss but also from

profound venodilation and blood sequestration, especially within the abdominal circulation. Goltz's "Klopfversuch", in which mechanical stimulation of the frog's abdomen caused reflex cardiac inhibition and prolonged circulatory failure from venous pooling, illustrated that maintenance of both intravascular volume and vascular tone was vital. These concepts prefigured modern understanding of distributive shock and informed later development of fluid therapy for critical illness [11].

In 1882–83, Sydney Ringer's experiments with isolated frog hearts produced another step forward. Ringer found that hearts contracted best in a 0.75% saline solution but deteriorated if perfused in distilled water. An accidental substitution - his assistant's use of tap water from the New River Water Company rather than distilled water in preparing this "saline" solution - revealed that impurities such as calcium and potassium were essential for cardiac function. Ringer systematically determined optimal concentrations of sodium, potassium, and calcium, leading to his eponymous solution [12-14] - though notably, it was never intended as a routine IV fluid for humans.

The concept of "isotonic" saline emerged, with Hartog Jacob Hamburger's studies (published 1896–1897) showing that 0.9% sodium chloride was "indifferent" to red cells, not causing haemolysis [15]. However, it remains unclear when and how "normal" saline became the standard for clinical use. Early British references to its administration describe solutions with varied composition, and the use of the term "normal saline" seems to have evolved more from convenience and cost.

Expansion in Clinical Use as a Blood Substitute

By the late 19th century, these physiological discoveries fostered renewed interest in IV fluids for a range of clinical scenarios. From the 1880s, IV saline was increasingly used as a practical, cheap and rapid substitute for blood in acute care. In 1881, Bischoff reported success with intra-arterial saline for postpartum haemorrhage [16]. The following year, Egerton Jennings described dramatic recovery following intravenous saline and alcohol in a woman with severe postpartum bleeding: "signs of animation very rapidly appeared - recognition of people present, speech, vision and hearing returned…". Jennings' confidence in the therapy was

such that he developed a portable siphon apparatus for easy use in emergencies, emphasizing that it could be performed by “any careful operator” [17,18]. His optimism was echoed by William Coates, who in 1882 reported two further successful cases using Jennings’ apparatus, describing the procedure as so straightforward it “could have been accomplished single-handed”, and was far more accessible than blood [19]. It is therefore not surprising that IV fluid therapy was propelled into the mainstream by the clinical exigencies of the First World War, with the need to resuscitate large numbers of trauma and shock patients prompting widespread use of crystalloids.

By the early 20th century, clinicians began to challenge the assumption that intravenous saline was harmless. Evans, in 1911, criticized the “utter recklessness” with which saline was sometimes prescribed postoperatively, highlighting cases where unchecked administration led to fatal osmotic disturbances and renal failure, including deaths following several litres of infusion in vulnerable patients [20]. Experimental work by Hort and Penfold reinforced these warnings: they demonstrated that excessive saline caused not only acute complications such as fever, pulmonary oedema and sudden death, but also tissue injury to organs including the liver, heart, and kidneys. They concluded that saline infusion was “not nearly so innocuous a proceeding as is often supposed” [21]. These early critiques clearly anticipated many modern concerns.

Refinements to Crystalloid Composition and Administration

A key advance in perioperative fluid management came from the vascular surgeon Rudolph Matas, who, in 1924, pioneered the use of a continuous intravenous drip for surgical patients . Matas recognized that intermittent boluses or rectal infusions were often insufficient for individuals with poor circulation or compromised nutrition. By recommending a constant, controlled infusion throughout and following surgery, he aimed to better maintain circulatory stability—the first true “IV drip”. Interestingly, Matas preferred to use 5% glucose rather than saline alone, cautioning that excessive saline could contribute to cardiac

and renal complications which had become apparent over the previous decade [22].

Around the same period, attention shifted from the quantity to the composition of IV fluids. Paediatrician Alexis Hartmann had turned his attention to treating children suffering from severe diarrhoeal disease, who frequently developed both dehydration and metabolic acidosis. Hartmann observed that whilst normal saline restored volume, it failed to correct acidosis. Drawing inspiration from Ringer's work, he adapted the solution in 1932 by incorporating sodium lactate - an anion that the body could metabolize to bicarbonate, thus counteracting acidosis [23,24]. This innovation proved especially important for children with significant enteral bicarbonate loss. Hartmann summarized the theoretical and practical advantages of this "balanced" solution - designed to better match plasma electrolyte levels and maintain physiological pH - in a landmark 1934 paper [25].

The Development of Colloid Solutions

In parallel to the growing use of IV crystalloids, the limitations of saline as a sole blood substitute spurred new attempts to replicate plasma's properties. In 1915, gelatin solutions were first trialed for shock and haemorrhage, with initial results from the battlefields in France suggesting superior ability at restoring normotension, and by 1918, William Bayliss had provided a physiological rationale for colloid infusions based on Starling's work on oncotic pressure. Gum acacia and other early colloids were therefore introduced as plasma expanders [26,27]. However, colloids soon proved controversial themselves, with reports of unpredictable adverse reactions, including anaphylaxis and sudden death [28]. The early colloids like gum acacia were thus largely abandoned due to these serious risks, prompting renewed caution and scepticism, reminiscent of the controversies surrounding initial saline use.

Renewed interest in the use of colloids would not come until the outbreak of World War Two with a need for volume expanders in the face of another blood shortage. Further synthetic products were developed for this purpose, such as polyvinylpyrrolidone (Periston) [29], which saw

extensive use in the German Army Medical Services but was eventually abandoned over concerns about carcinogenicity. During the same period, industrial-scale blood fractionation yielded 25% human albumin solutions [30], a far safer alternative, which was first used during the battle of Pearl Harbour.

Crystalloids, Colloids and Controversy

From the 1970s, increasing recognition of the drawbacks associated with both crystalloids and colloids drove ongoing debate over optimal fluid therapy. During the 1970s, new research focused on electrolyte physiology, revealing that large infusions of chloride-rich fluids like normal saline could precipitate hyperchloraemic metabolic acidosis - a disturbance linked to impaired renal function and poorer patient outcomes which had been hinted at by work completed back in the 1910s [31-32]. This led clinicians to reassess the use of saline and spurred renewed interest in balanced electrolyte solutions, such as Hartmann's, which more closely replicate plasma composition and help avoid these complications.

As attention shifted in the 1980s to colloid solutions - then widely promoted for their superior ability to expand intravascular volume - they became a mainstay in trauma, surgical and critical care [33]. However, landmark trials conducted towards the end of the century, including the SAFE, CHEST and 6S studies, overturned established practice by demonstrating that synthetic colloids, particularly hydroxyethyl starch (HES), were associated with higher rates of acute kidney injury, bleeding and mortality in critically ill patients [34,35]. Even albumin, once the gold standard, was called into question due to cost, potential for disease transmission, and uncertain survival benefit [36]. As evidence mounted, regulatory bodies imposed strong warnings and restrictions on colloid use, particularly HES, in the critically ill. These pivotal findings marked a decisive shift back to crystalloids - especially physiologically balanced formulations - for most clinical indications.

Conclusions

From the early experimental therapeutics in cholera patients to the large-scale use of saline in wartime triage, intravenous fluid therapy has repeatedly demonstrated its life-saving potential but also its capacity for harm when misunderstood or misapplied, indeed, up to 20% of serious patient safety incidents in acute UK care still attributed to IV fluid mismanagement [1]. The story of IV fluids exemplifies medicine's ongoing tension between clinical urgency and limited knowledge in the face of physiological complexity.

References

1. Padhi S, Bullock I, Li L, Stroud M. Intravenous fluid therapy for adults in hospital: summary of NICE guidance. British Medical Journal. 2013 Dec 10;347.
2. Howard-Jones N. Cholera therapy in the nineteenth century. Journal of the History of Medicine and Allied Sciences. 1972 Oct 1;27(4):373-95.
3. Venters GA. Leith in the time of cholera – the story of Thomas Latta - Hektoen International [Internet]. Hektoen International - An online medical humanities journal. 2017 [cited 2025 Feb 5]. Available from: https://hekint.org/2017/02/01/leith-in-the-time-of-cholera-the-story-of-thomas-latta/
4. O'Shaughnessy WB. Experiments on the blood in cholera. The Lancet. 1831 Dec 31;17(435):490.
5. O'Shaughnessy WB. Chemical Pathology of Cholera. The Lancet. 1832 May 26; 18(456):225-232
6. Lewins R. Injection of saline solutions in extraordinary quantities into the veins in cases of malignant cholera. The Lancet. 1832 May 26;18(456):243-4.
7. Latta T. No. 3. Letter from Dr. Latta, of Leith, detailing Three Cases, of which one was successful. The Lancet. 1832 Jun 23;18(460):370-3.
8. Latta T. Reply to some objections offered to the practice of venous injections in cholera. The Lancet. 1832 Jul 7;18(462):428-30.

9. Green PH. Discovery of Air in the Heart after Venous Injection. The Lancet. 1832 Jul 7;18(462):440-1
10. Cosnett JE. The origins of intravenous fluid therapy. The Lancet. 1989 Apr 8;333(8641):768-71.\
11. Goltz. Über den Tonus der Gefäße und seine Bedeutung für die Blutbewegung. Archiv für pathologische Anatomie und Physiologie und für klinische Medicin. 1864 May;29(3):394-432.
12. Ringer S. Concerning the influence exerted by each of the constituents of the blood on the contraction of the ventricle. The Journal of physiology. 1882 Aug;3(5-6):380.
13. Ringer S. A further contribution regarding the influence of the different constituents of the blood on the contraction of the heart. The Journal of physiology. 1883 Jan;4(1):29.
14. Ringer S. A third contribution regarding the influence of the inorganic constituents of the blood on the ventricular contraction. The Journal of Physiology. 1883 Aug;4(2-3):222.
15. Hamburger HJ. A Discourse on permeability in physiology and pathology. The Lancet. 1921 Nov 19;198(5125):1039-45.
16. Bischoff JJ. Ein günstig verlaufener fall von intraarterieller Infusion einer alkalischen Kochsalzlösung bei drohendem Verblutungstode. 1881.
17. Jennings CE. The intra-venous injection of fluid for severe hæmorrhage. The Lancet. 1882 Sep 16;120(3081):436-7.
18. Jennings CE. The intra-venous injection of fluid for severe hæmorrhage. The Lancet. 1883 Feb 10;121(3102):228-9.
19. Coates WM. Two cases of intra-arterial injection of fluids for severe hæmorrhage. The Lancet. 1882 Dec 30;120(3096):1110-2.
20. Evans GH. The abuse of normal salt solution. Journal of the American Medical Association. 1911 Dec 30;57(27):2126-7.
21. Hort EC, Penfold WJ. The dangers of saline injections. British Medical Journal. 1911 Dec 12;2(2659):1589.
22. Matas R. The continued intravenous “Drip”: with remarks on the value of continued gastric drainage and irrigation by nasal intubation with a gastroduodenal tube (Jutte) in surgical practice. Annals of surgery. 1924 May;79(5):643.

23. Hartmann AF, Senn MJ. studies in the metabolism of sodium R-lactate. I. Response of normal human subjects to the intravenous injection of sodium R-lactate. The Journal of Clinical Investigation. 1932 Mar 1;11(2):327-35.
24. Hartmann AF, Senn MJ. Studies in the metabolism of sodium r-lactate. II. Response of human subjects with acidosis to the intravenous injection of sodium r-lactate. The Journal of Clinical Investigation. 1932 Mar 1;11(2):337-44.
25. Hartmann AF. Theory and practice of parenteral fluid administration. Journal of the American Medical Association. 1934 Nov 3;103(18):1349-54.
26. Bayliss WM. Intravenous injection in wound shock: Abstract of the Oliver-Sharpey Lectures delivered before the Royal College of Physicians on April 30th and May 2nd, 1918. British Medical Journal. 1918 May 5;1(2994):553.
27. Hogan JJ. The intravenous use of colloidal (gelatin) solutions in shock. Journal of the American Medical Association. 1915 Feb 27;64(9):721-6.
28. Lee RV. Sudden death in two patients following intravenous injections of acacia. Journal of the American Medical Association. 1922 Aug 26;79(9):726-8.
29. Hecht G, Weese H. Periston, ein neuer Blutflüssigkeitsersatz. Münch. med. Wschr.. 1943;90:11.
30. Cohn EJ, Strong LE, Hughes WL, Mulford DJ, Ashworth JN, Melin ME, Taylor HL. Preparation and Properties of Serum and Plasma Proteins. IV. A System for the Separation into Fractions of the Protein and Lipoprotein Components of Biological Tissues and Fluids. Journal of the American Chemical Society. 1946 Mar;68(3):459-75
31. Wakim KG. Normal 0.9% Salt Solution Is Neither Normal Nor Physiological. Journal of the American Medical Association. 1970 Nov 30;214(9):1710.
32. Stewart PA. Modern quantitative acid–base chemistry. Canadian journal of physiology and pharmacology. 1983 Dec 1;61(12):1444-61.

33. Twigley AJ, Hillman K. The end of the crystalloid era?. Anaesthesia. 1985;40:860-71
34. Velanovich V. Crystalloid versus colloid fluid resuscitation: a meta-analysis of mortality. Surgery. 1989 Jan 1;105(1):65-71.
35. Schierhout G, Roberts I. Fluid resuscitation with colloid or crystalloid solutions in critically ill patients: a systematic review of randomised trials. British Medical Journal. 1998 Mar 28;316(7136):961-4.
36. Cochrane Injuries Group Albumin Reviewers. Human albumin administration in critically ill patients: systematic review of randomized controlled trials. British Medical Journal. 1998 Jul 25:235-40.

The Evolution of Blood Transfusions

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The importance of blood has been long recognized. In ancient medical theory blood was described as one of four vital bodily fluids or "humours". It was believed to be a source of life, temperament and even spirituality. Its association with life and death led to the creation of treatments including blood-letting and transfusion.

The life-saving practice of transfusing blood has evolved from crude early attempts at animal-to-human transfusions to the safe and sophisticated practices of modern-day. I will explore this evolution in this presentation.

In the 17th century, early experimentation with transfusion between animals and humans was shunned by medical practitioners because it was poorly understood and resulted in significant mortality. This gave rise to the ban of blood transfusion practice for nearly 300 years.

However, interest in transfusions persisted and the gained interest again in the 1800s with the transfusion of various liquids as blood substitutes, including beer, urine and milk. In 1818, the first human-to-human transfusion was successful but despite this, the practice remained experimental for several decades.

The breakthrough and widespread acceptance for blood transfusion was gained in the 20th century, with the discovery of ABO blood groups. The 20th century saw the continued advancement of blood transfusion medicine, including the establishment of blood banks. It became a wide-spread, life-saving procedure during war. Developments in blood storage and screening has made transfusion the safe and effective procedure we recognize in modern medicine, and frequently use in our day-to-day practice.

Progress within the field of transfusion medicine continues and likely to see advancements in personalized medicine, lab-grown products and increased use of data to improve transfusion practices. The history of blood transfusion is a testament to the power of scientific innovation and while challenges remain, the future holds immense promise.

From Gallop to Gasp: *How Horses Helped Humans Breathe Easier And the Evolution of High-Flow Nasal Oxygen Therapy*

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High-flow nasal oxygen (HFNO) therapy has transformed respiratory care, offering a non-invasive, patient-centred method for delivering warmed, humidified oxygen at high flow rates. While its widespread clinical use is relatively recent, the technological and conceptual origins of HFNO trace back several decades, influenced by innovations in medical, veterinary, and engineering disciplines. In the 1970s and 1980s, it was recognized that high-flow oxygen delivery without appropriate humidification led to mucosal drying, discomfort, and diminished clinical effectiveness. This realization spurred the development of systems that could properly condition the inspired gases, thus ensuring patient comfort and preventing airway desiccation. A significant milestone occurred in 1985 when the Oxygen Enrichment Company introduced a system that delivered oxygen through an unheated nasal cannula using a heated delivery tube, capable of flow rates exceeding 8L/min. This advancement marked an important step towards achieving proper humidification during high-flow oxygen delivery. Parallel to these developments, innovations in vapour-phase water inhalation therapy led to the creation of the MT-1000 Human Transpirator Respiratory Unit and the ET-1000 Equine Transpirator Respiratory Unit by Transpirator Technologies Inc., designed to manage respiratory conditions like Exercise-Induced Pulmonary Haemorrhage in racehorses. These systems helped establish the clinical benefits of delivering warm, humidified gas to the respiratory tract, laying the groundwork for future HFNO technology. Building on this foundation, in 2000, Vapotherm, a U.S.-based company, revolutionized neonatal care by developing high-flow devices that provided heated, humidified oxygen through small nasal cannulas. These devices served as an alternative to nasal Continuous Positive Airway Pressure for managing conditions such as apnoea of prematurity, respiratory distress syndrome

and as post-extubation support. Vapotherm's innovations in neonatal HFNO provided the foundation for its eventual use in the broader paediatric population, particularly in the treatment of bronchiolitis. A significant milestone in HFNO's evolution occurred with the FLORALI trial (2015), a landmark study comparing HFNO to standard oxygen therapy and non-invasive ventilation in adult patients with acute hypoxaemic respiratory failure. This trial demonstrated HFNO's ability to reduce intubation rates, improve survival, and enhance patient comfort, establishing it as an effective treatment for acute respiratory failure. The global COVID-19 pandemic further accelerated the adoption of HFNO, particularly in settings where mechanical ventilation posed significant risks or were logistically challenging. HFNO proved invaluable for delivering effective oxygenation while avoiding intubation in patients with viral pneumonitis and other forms of non-hypercapnic respiratory failure. Clinical trials and observational studies during the pandemic reinforced HFNO's growing role in managing respiratory conditions like COVID-19 pneumonia. While HFNO has proven beneficial in many clinical scenarios, it is not a universal solution. HFNO's limitations, including oxygen consumption and cost, highlight the importance of clinical judgment and resource management in its use. As such, HFNO should be viewed as a vital component of a comprehensive respiratory management strategy, rather than a panacea for all respiratory challenges.

Early Warning Scores: *A Narrative Review*

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Introduction

It has now been three decades since the first paper describing an Early Warning Score (EWS) was published, marking a pivotal shift in the monitoring of patients. Since then, the EWS has undergone a substantial evolution, culminating in the widespread adoption of the National Early Warning Score 2 (NEWS2) across hospitals in the United Kingdom. Its influence has extended internationally, with adoption in parts of Europe, North America, and Australasia. This article explores the genesis of the EWS and the controversies that surround its use.

Genesis

In the 1980s, increasing awareness of the frequency and potential preventability of in-hospital cardiac arrests led clinicians to investigate the role of vital signs as early indicators of deterioration. In 1995, Lee et al. identified key physiological abnormalities warranting urgent medical attention. Shortly after, in 1997, Morgan et al. introduced the first aggregate scoring system, coining the term "Early Warning Score." By 2001, the concept had gained enough traction for the Department of Health to recommend its implementation, alongside the introduction of critical care outreach teams.

The proliferation of EWS systems nationwide led to a variety of scoring models, each differing in parameters and thresholds. Aggregate scoring systems soon proved superior to single-parameter models in predicting adverse outcomes such as ICU admission and cardiac arrest. A major advancement came in 2010 with the development of VitalpacEWS, which used a large dataset and iterative testing to optimize prediction of in-hospital mortality. This model laid the foundation for NEWS, introduced in 2012, and its refined successor, NEWS2, launched in 2017. Specialized adaptations for paediatric and maternity patients followed, further embedding the system into clinical practice.

Controversy

Despite its widespread adoption, the EWS has not escaped criticism. Detractors expressed concern that reliance on a numerical tool could undermine clinical judgement. Critics argued that the EWS oversimplifies complex patient presentations and that investing in staff training and clinical acumen would be more beneficial. Some feared that the role of Medical Emergency Teams (METs), responding to EWS triggers, could inadvertently deskill ward staff by shifting responsibility away from bedside teams.

The standardization of the EWS nationally was also met with resistance from hospitals that felt a one-size-fits-all approach could not accommodate the nuances of their patient populations nor resource constraints. Concerns were raised about over-triggering, which could result in alert fatigue and resource strain, and under-triggering in certain groups such as patients with spinal cord injuries.

Moreover, the evidence supporting the effectiveness of EWS remains limited. Although intuitively beneficial, robust data proving that the EWS improves outcomes like mortality or ICU admissions is lacking. A Cochrane review highlighted low-certainty evidence regarding the impact of the EWS and METs on key clinical outcomes, largely due to a paucity of high-quality randomized controlled trials.

Conclusion

The Early Warning Score has undergone a remarkable transformation from concept to cornerstone of inpatient care. Despite ongoing debate regarding its efficacy and implementation, the EWS has become a deeply embedded feature of modern healthcare, with further refinement and evolution likely to continue.

The Original Pain Consultant: ***A Glance at Mother Nature's Historic Contributions To Pain Relief***

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"Nature itself is the best physician" – Hippocrates [1]

Introduction

Pain, a universal challenge involving unpleasant sensory and emotional experiences associated with actual or potential tissue damage [2], has long tormented humankind. As such, ancient cultures across the world turned to nature's bounty for answers, seeking solace in minerals, fauna and flora to soothe their ailments. Time then, allowed us to explore these natural concoctions, applying science and philosophy to inspire our current management of pain relief.

In the wake of an opiate crisis, alternative pain relief, sustainability and holistic medicine are just some of the topics entering the forefront of medical news. This essay hopes to provide the reader with a refreshed view of pain relief and its origins in the natural world. It will explore lesser known but vital medical and scientific discoveries underpinning the transformation of natural remedies and tinctures into the modern artform that is, analgesia. Taking focus on electrotherapy, chilli peppers and aloe vera, the aim of this essay is to inspire consideration and highlight the history that integrated naturally originating analgesic material into today's practice, as well as discussing the scientific principles and research underpinning their applications.

Why is alternative pain relief so topical?

From the bark of the white willow to aspirin and the opium poppy to morphine, nature has fame in providing the discipline of medicine with widely used pain-relieving medications. The opium poppy, perhaps the most famous natural source of pain relief has an extensive history,

believed to be first documented on Sumerian clay tablets in c 2000 BC [3]. However, the poppy's gift to abolish pain was laced with side effects and misery; enticing war, overdoses, tolerance and addiction, this two-faced flower is now the subject of great turmoil for many.

Hail, lovely blossom! -- thou can'st ease,
The wretched victims of disease;
Can'st close those weary eyes, in a gentle sleep.
Which never open but to weep;
For, oh! thy potent charm,
Can agonizing pain disarm;
Expel imperious memory from her seat,
And bid the throbbing heart forget to beat.

Ode to the Poppy By Henrietta O'Niell [4]

Here the author romantically considers the poppy's two identities, first celebrating its ability to bestow oblivion and relief of pain and then to condemn its amnesic and life stealing qualities [4].

Pain in humans is almost exclusively inescapable, in 2019 a National Health Service survey suggested prevalence of chronic pain in adults to be around 34% [5]. While in 2020, government statistics from 2017-2018 shows that opioid medications had been prescribed to 5.6 million people in the UK for non-cancer related pain, accounting for 13% of the population [6]. Noticeably, an estimated 560,000 people had received opioid prescriptions lasting longer than 2.5 years[6]. Unnervingly, in 2022, statistics showed that almost half of drug-related deaths involved an opiate [7].

Since the 1800s scientists and physicians have tinkered and manipulated the poppy's original recipe to give us a vast array of opiate medications ranging in potency, side effect profile and effectiveness [3,8]. Some of these, developed in the hope of reducing addiction created worsened epidemics of dependence [8]. Despite the risks associated with prescribing and taking opiate medications, its varying forms remain staple analgesics across the world.

With increased awareness in the general public of the risks and side effects of opiate medications it is not uncommon for physicians to be questioned about opiates or to hear statements such as “I don’t want to become addicted”. So, what can be done about this? As physicians, we have the knowledge to recommend alternate pain solutions, where efficacious; while as researchers, we might direct our exploration of novel drugs to the analgesic properties of various natural sources – as our medical predecessors did with the Torpedo fish.

The fishy origins of electrotherapy

Electrotherapy, the application of electricity to therapeutically modify or stimulate tissue and muscle for the purpose of pain relief [9], has long captured the imagination of the medical world. However, few are privy to the contributions that ancient, rudimentary discoveries had in the invention of this practice. Perhaps the most intriguing of these, is the bioelectric phenomena (electricity actively generated by cells [10]) seen in electric fish – particularly the perplexing torpedo fish, who it appears, founded this intricate relationship between nature, medicine and electricity.

In c. 47AD, Scribonius Largus Designatianus, court physician to the Emperor Claudius, was encouraged by one of Claudius’ Freedmen to prepare a list of prescriptions [11]. Scribonius Largus thus created the famous *Compositiones medicae* - a list of 271 medical recipes and recommendations. In the below translation of instruction 162 [12], reference is made to Anteros, another Roman Freedman who, when walking down the beach, accidentally stood on a stranded electric ray. Anteros, who suffered from gout, experienced immediate pain but later found that his gout had been cured – and thus the electric ray became the foundation of electrotherapy as a medical discipline.

162 *Ad utramlibet podagram torpedinem nigram vivam, cum accesserit dolor, subicere pedibus oportet stantibus in litore non sicco, sed quod alluit mare, donec sentiat torpere pedem totum et tibiam usque ad genua. Hoc et in praesenti tollit dolorem et in futurum remediat. Hoc Anteros Tiberii Caesaris libertus supra hereditates remediatus est.*	162 For either kind of gout, when the pain approaches, one should place a living black electric ray under one's feet, standing on the shore which is not dry, but which the sea washes, until he feels that the entire foot and the shin bone up to the knee is numb. And this removes the pain for the moment and cures it for the future. Anteros, a freedman of Tiberius Caesar, in charge of inheritances, was cured by this.

Figure 1: Recipe 162 of Scribonius Largus Designatianus' *Compositiones medicae*, translation to English by Jocks, I T (2020) [12].

The electric ray mentioned in Scribonius' recipe is thought to reference the torpedo fish, belonging to the Torpedinidae family [12]. This ray benefits from the possession of electric organs which house electrocytes capable of generating discharges up to 200 volts [13]. For reference, modern TENS machines typically run on 9-volt batteries [14]. While Scribonius' recipe is the earliest written record found which references therapeutic use of electric fish for pain, it is thought that their electrifying qualities were understood as far back as the ancient Egyptians, with some references claiming their use of electric catfish to treat arthritis [15] – the below mural from Mastaba of Ti , Saqqara [16], depicts boats sailing over a sea with electric catfish.

Figure 2: Relief from the archaeological site of Mastaba of Ti in Saqqara depicting a range of Nile aquatic life including the Nile Electric Catfish which has been circled for the purpose of this essay [16].

Following Scribonius' observation, and further recommendations for their use to cure headache [17], the significance of electric fish in the management of pain trailed through time to the physicists and physicians of the Age of Enlightenment.

The pioneering work of Luigi Galvani, an Italian Physician of the 1700s, was key in identifying the potential relationship between biological processes and electricity - forging an empirical observation into a core understanding. In 1786, Galvani experimented with frog legs and electricity - of varying forms [18]. Ensuing these experiments Galvani published his essay *De Viribus Electricitatis in Motu Musculari Commentarius* (*Commentary on the Effect of Electricity on Muscular Motion*), concluding the presence of a new 'animal electricity' which differed from the 'natural electricity' seen in electric storms and fish and also separate from the 'artificial electricity' resulting from friction. Perhaps most importantly, Galvani advocated the concept that nerves conducted this 'animal electricity' in the form of 'electric fluid' to muscle. Galvani's experiments fundamentally described the relationship between muscles, nerves and electric stimuli [18]. Together with Victor Albrecht von Haller's research (in the 1740s and 50s), who identified that nerves responded to stimuli, particularly that of a painful nature, and that this stimuli cannot be achieved in the absence of nerves [19] - these great thinkers laid the groundwork for future research.

In the short years proceeding Galvani's experiments, and having watched them first-hand, fascination of the intertwining effects of electricity and nature was inherited by Galvani's nephew, Giovanni Aldini. Aldini – often referred to as the real-life Frankenstein – was so named on account of his own experiments running electric currents through large animals and human bodies, particularly the deceased bodies of prisoners following execution [20]. While his gruesome demonstrations attracted large crowds, they failed in his mission to reanimate the dead and would today be considered exceedingly unethical; however, they demonstrated one important concept… that muscular contraction could be obtained in humans through the application of electrical currents.

Around the same time, great advancements had begun in the manipulation and provision of electricity and energy, with inventions such as Otto Von Guericke's electrostatic generator and Ewald Georg von Kleist's Layden Jar. While not directly impacting electrotherapy, the discoveries of great physicists accelerated physician interest and their ability to provide pain relief through electricity.

In 1799, Alessandro Volta, friendly rival to Luigi Galvani, attempted to disprove Galvani's theory of the existence of 'animal electricity' [18]. In the process he invented and revealed to the world his first electric battery, a device whose structure closely mirrored the electric organ anatomy of the Torpedo fish [16]. While current batteries are much more portable, the stacking of batteries in today's appliances also mimics the Torpedo's anatomy – further knitting together the natural world with the scientific one.

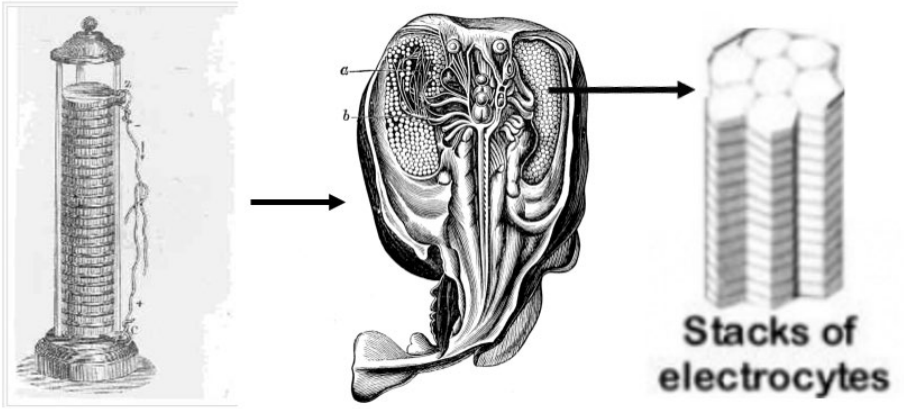

Figure 3: Combination of images highlighting the similarities between Volta's battery and the torpedo fish. Sources from left to right: ETHW's Volta Battery [21], Life in motion lecture [22], Ocean Treasures memorial library [23].

Volta's invention flagged the start of a wave of electrical discoveries and in the years that followed, the medical world found numerous uses of electricity to manage patients' symptoms. Some better founded in evidence than others and some less well seated in morality. In the early 1900's, physicians utilised electrotherapy, later termed electroshock therapy, in the hope of curing mental health ailments. However, the reported misuse of electricity as a therapy at this time, left a dark mark on the discipline and great mistrust in those utilising electrotherapy [24].

It wasn't until 1965 when Melzack and Wall published their paper "Pain Mechanisms: a new theory" detailing their Gate-Control Theory of pain signalling, that electrotherapy was reconsidered in modern medicine.

The concept that stimulated nerves could open or close gates for pain signals seeded electrotherapy with solid underpinning scientific principles [14]. In 1974, Clyde Norman Shealy an American neurosurgeon developed the Transcutaneous Electrical Nerve Stimulation (TENS) device for the purpose of relieving migraine, gout and chronic back pain [14]. Following extremely successful testing, the TENS machine became common place in hospitals across the world and then eventually into the homes of patients and general public. Last year, the global market size for TENS was estimated at over 300 million USD [25], thus proving the ongoing investment in electrotherapy as a pain-relieving alternative.

Additional modern pain relief methods embodying the principles of electrotherapy include Spinal Cord Stimulators and Deep Brain Stimulation. These contribute to the management possibilities for various sources of pain, particularly that of a chronic nature, as well as other conditions such as Parkinson's and epilepsy [26]. Furthermore, the potential of electrotherapy applications within healthcare is vast, for example current research suggests positive outcomes when combined with immunotherapy in the treatment of cancers [27].

These contemporary practices demonstrate the lasting legacy of early bioelectric breakthroughs and offers opportunity for this essay to reinforce appreciation of the torpedo and other electric fish in catalysing, not only our understanding of the therapeutic potential of electricity, but also the prevailing, global impact electricity continues to provide.

When life gives you chillies… make a cream

Chilli peppers, berry-fruit plants of the *Capsicum* genus are peppers native to South America (especially modern-day Peru, Bolivia and Mexico) as well as the Amazon basin [28]. Alongside being one of the most consumed condiments in the world (second only to salt) [29], the use of capsicum as a therapeutic agent has indigenous roots in the Americas and has survived an estimated 6000 years to be used in modern day for effective pain relief.

The earliest known archaeological samples of chilli were found in the Coxcatlán Cave in the Tehuacán Valley of Mexico, modern analysis estimated those samples to date from approximately 8000 years ago [30].

At this time, it is theorised that chillies were gathered from wild plants, with domestication and cultivation thought to begin approximately 6000 years ago.

Figure 4: Image showing the archaeological remains of chilli peppers in Mexico [30].

The above photograph includes the desiccated remains of chilli peppers found in caves in the Vally of Oaxaca in modern Mexico [30]. Analysis of these chillies suggest all to belong to the *Capsicum* genus. With only 2 of the 122 samples dating to 8000 years ago and others dating c. 1000 AD, this highlights the enduring use of chilli peppers across different millennia and civilisations.

New archaeological evidence recovered from Mayan ballcourts (sporting grounds thought to host a football/basketball like tournament) found a number of vase-like pottery items – when analysed, variations of the capsaicin molecule were isolated, highly indicative of the presence of chillies in these vessels [31]. However, there remains speculation regarding the use of these chillies: were they being ground into some spicy drink? Were they being used in spiritual rituals following the ball

games or was their purpose the form of a paste, applied to injury after sporting events.

The importance of chilli peppers in Aztec culture is highlighted in historical documentations. The below drawing is taken from the Florentine Codex book X, composed in the 16th century by Spaniard Explorer Bernardino de Sahagún [32], it contains over 2000 images drawn by native artists, which depict the way of life of the Aztec civilisation.

Figure 5: A tradesman selling chilli peppers outside an Aztec temple [32]

Around the 15th and 16th centuries and following contact with the indigenous peoples of the Americas, Western explorers returned to Europe and dispersed chilli throughout the continent and beyond, to Asia [33]. Chilli easily integrated into modern diets and became staple to many European and Asian recipes. At the same time, herbalists began exploring its heat properties, as well as the medicine uses the Aztecs had suggested (dental problems, ear infections, digestive problems and for types of wounds) [32]. Throughout this time scientific explanation was lacking and the use of chilli in medicine lay more in the foundation of observation and inherited remedies, than in any proven biological process.

In 1876 capsaicin was isolated as the bioactive compound which gives chillies their famously intense heat [29]. In plant matter, capsaicin is at higher concentrations in the tissue surrounding the seeds, with a presumptive role of protecting seed germination from potential ingestion by animals [29].

Following this, mechanistic understanding of the effects of capsaicin, was beginning to form.

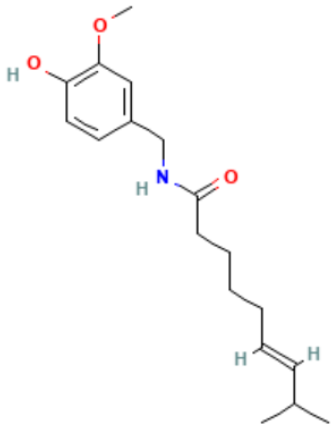

Figure 6: The molecular structure of capsaicin [34]

Capsaicin's structure was first described in 1919 and is a non-polar phenolic compound which is insoluble in water. Its structure makes it particularly absorbent when administered topically or orally [29]. Original research established the excitability of nociceptors in response to capsaicin where calcium ion influx was noted in dorsal root ganglion neurons [35].

Transient receptor potential cation channel subfamily V member 1 (TRPV1) receptors were crucial in identifying the mechanism by which capsaicin provoked pain. Located in nociceptors across the peripheral nervous system, TRPV1 is activated by capsaicin, noxious heat and low pH, recognising stimuli across the skin, joints, muscles and digestive system [36]. In 2000, studies involving mice showed reduction in pain response behaviours to capsaicin where TRPV1 receptors were absent [29].

With capsaicin acting as an agonist of TRPV1 it would be expected that its application would increase pain sensation rather than acting as an analgesic. These studies, while pivotal in illuminating the function of TRPV1 required further development to identify and give substance to the pain model associated with capsaicin. Some evidence exists which describes the role of capsaicin in causing desensitisation of nerves through the depletion of substance P, a neuropeptide in nerve fibres which express TRPV1 receptors and transmit pain signals to the brain [29].

Additionally, capsaicin is thought to play a role in the inhibition of high and low-voltage activated calcium channels, in turn increasing intracellular calcium with activation of calcium-dependent proteins which further lead to the desensitisation of TRPV1 [29]. As such, capsaicin, especially when applied topically, increases the sensation of pain in the first instance before causing desensitisation, making it particularly useful in the management of chronic pain. Capsaicin and TRPV1 have additionally unlocked potential within healthcare research to further develop and test new TRPV1 antagonists [29] with the hope of developing novel pain relief medications with small side effect profiles.

Finally, it is little known that preparations of capsaicin, where appropriate, can be prescribed. Capsaicin creams are typically available as 0.025% or 0.075% strength preparations, patches are also available. In the UK, prescribing advice can be found on the BNF which lists the possible indications: localised neuropathic pain, post-herpetic neuralgia and symptomatic relief for osteoarthritis [37]. Additional indications require supervised use and expert advice.

While much of our scientific understanding of capsaicin and its impact on the nervous system at a cellular level has materialised in the last few centuries, our knowledge of its pain-relieving properties is rooted in indigenous knowledge. Capsaicin is truly proof of the enduring relationship between nature, historic tradition and modern exploration, and perhaps has a great deal more to teach us.

Aloe, Aloe… a time-honoured panacea

Perhaps the most well-known of the three topics discussed in this paper, *Aloe barbadensis* Miller, better known as *Aloe vera,* is a plant whose medicinal properties extend multiple traditional healing practices, from China and India to West Indies and Japan [38]. *Aloe*, derived from the Arabic ‘alloeh’ translates to the English ‘shining bitter substance’ with *vera*, in Latin, meaning ‘true’ [39]. *Aloe vera* is a perennial succulent traditionally located in hot, dry areas of the Middle East of Asia, Southern Mediterranean, Canary Islands and North Africa.

The extent of the presence of *Aloe vera* in ancient history remains somewhat unclear, shrouded in mystery and mythology. A simple internet

search of *Aloe'*s presence in history will fill screens with Ancient Egyptian carvings and stories of Queen Nefertiti and Cleopatra's famous beauty routines comprising of *Aloe* [38], however little scientific proof or documentation was found that could validate these stories as true, with many sources/websites being sellers of *Aloe vera* products.

Pliny the Elder of Ancient Rome, released his Naturalis Historia in c 77AD. The encyclopaedia, comprising of thirty-seven volumes, detailed knowledge on an array of topics relating to the natural world [40]. Among them he comprehensively described the use and benefits of *Aloe* as perceived in the Roman era.

Writing "It [*Aloe*] is employed for numerous purposes, but principally as a purgative…., in cases of derangement of the stomach, it is administered two or three times a day. As a purgative it is mostly taken in doses of three drachmæ". Outside its laxative effects, Pliny describes further uses of *Aloe* and with regard to its pain-relieving properties "applied to the temples and forehead with rose oil and vinegar, or used as an infusion, in a more diluted form, it allays head-ache" [40].

The oldest known illustration of *Aloe vera* is taken from Dioscorides' Codex Aniciae julianae (see below):

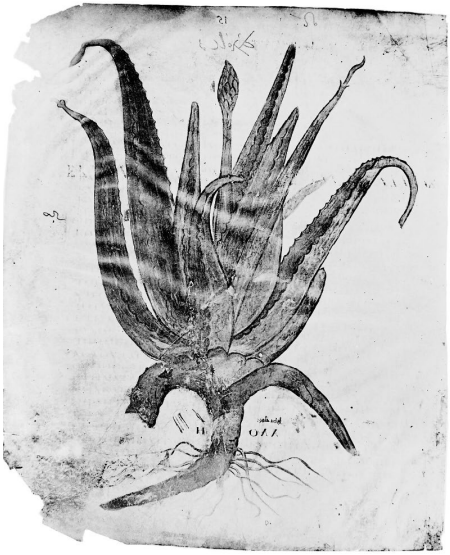

Figure 7: *Aloe vera* taken from Dioscorides' Aniciae julianae Codex [41].

Dioscorides was a Sicilian Surgeon who accompanied Roman armies, recording various flora and gaining fame in the pharmacognosy world for much of the 1st century AD [42]. In Goodyer's translation to English, reference is made to Dioscorides' knowledge of *Aloe* "conglutinating of wounds", "cleansing the stomach" and "curing jaundice" [43]. Additionally, aloe was proposed particularly for healing genital sores.

Following scientific exploration of the multitude of properties possess by aloe species, *Aloe vera* is considered the most potent and commercially important. From aloe vera, over 75 compounds have been identified that provide its anticancer, anti-inflammatory, antioxidant, analgesic and antidiabetic (to name a few) effects [44]. In modern times, development of safer laxatives and other medicines made many older uses of *Aloe* redundant. However, it has remained an indispensable medicinal product in the cabinets of many homes – particularly for its relieving effects of burns and sunburn.

The analgesic properties of *Aloe vera* are not fully understood, but are generally attributed to a range of compounds including anthraquinones and enzymes.

Aloe-emodin, another constituent of *Aloe* is shown to inhibit inducible nitric oxide synthase (iNOS) and thus nitric oxide (NO) production [44]. In the short term, NO production is useful, contributing to diverse cellular functions including vasodilation, neurotransmission and immune response. However dysregulated iNOS and resulting high concentration of NO can be detrimental and have been observed in processes including septic shock, cancers and pain [45]. The inhibition of iNOS by aloe-emodin could be key in treating numerous diseases including pain.

Aloe vera also contains the compounds aloin A and aloin B. These anthraquinones, present in the gel of *Aloe vera*, are strong antimicrobial compounds [44]. They too have shown the inhibition of iNOS and thus reduced NO following lipopolysaccharide induction in the presence of gram-negative bacteria [45].

Much like the willow tree, *Aloe vera* also contains traces of salicylic acid [44]. Being the famed component of willow bark that led to the production of aspirin, salicylic acid irreversibly binds to COX-1 and COX-2

[46], preventing conversion of arachidonic acid to prostaglandin and thromboxane precursors. Prostaglandins are key in the mediation of pain and inflammatory processes. While aspirin is more commonly used for its anti-thrombotic effects over its pain-relieving qualities, should the same be said for *Aloe vera*?

Despite aloe-emodin and aloin being the most researched aloe specific compound, most research emphasises their antimicrobial and anti-inflammatory process. Further detailed research is required to understand the pain signalling pathways aloe vera interrupt, the role that aloe-emodin and aloin contribute to this and the clinical implications it possesses.

So, what are the clinical studies showing?

In 2017, Nimma *et al's* cross-sectional randomized interventional study concluded reduced pain in individuals post tooth-extraction when using *Aloe vera gel* compared to those using regular analgesia (of undisclosed type) [47]. In 2016, Fallari *et al* showed reduced swelling and postoperative pain following use of *Aloe vera* mouth wash post-pulpotomy [48]. While in 2014, Rahmani *et al* found reduced chronic pain from anal fissures alongside reduced haemorrhage and increase wound healing [49].

In 2023 a review into the potential of medicinal plants to treat burns and sunburn was completed [50]. When discussing *Aloe vera* it was noted that multiple studies had found aloe vera to have increase wound healing when compared to the standard treatment of 1% silver sulfadiazine (SSD) cream. Khorasani *et al* published statistically significant results confirming the mean times to complete wound healing were 15.9 (+/- 2) days and 18.73 (+/- 2.65) days respectively for *Aloe vera* cream versus 1% SSD cream [51]. Meanwhile, a second study showed wound epithelialisation time was 11 (+/- 4.18) days in *Aloe* gel versus 24.24 (+/- 11.16) days for 1% SSD cream [52]. This study also concluded that time to complete pain relief was much improved at 21 days with *Aloe vera* gel, compared to 26 days when managed with 1% SSD cream. In common practice the purpose of SSD cream is largely attributed to its anti-microbial properties, however with the multi-purpose analgesic, anti-microbial and anti-

inflammatory attributes of *Aloe vera*, should we be investigating aloe as a potential replacement in the treatment of burns?

Many potential uses of *Aloe vera* are yet to be fully explored, newer studies are investigating the use of *Aloe* as a topical agent to aid pain relief and healing of radiation burns following radiotherapy [53]. Often pain relief and anti-inflammation go hand-in-hand, with *Aloe vera* containing many compounds of an anti-inflammatory nature, it is difficult to pinpoint the extent of aloe's analgesic profile or whether analgesia is attributed to a reduction in swelling and inflammatory processes. Either way, further, larger clinical studies are required alongside better understanding of the many qualities possessed by *Aloe vera* in order to establish, definitively, its continued presence in modern medicine and ability to treat a plethora of pain related conditions. In moving toward more holistic healthcare, *Aloe vera* in its current over-the-counter form offers an accessible and affordable pain relief for many.

A Natural Conclusion

The natural history of analgesia celebrates a rich tapestry of human curiosity and admiration for the natural world. Alongside our scientific persistence, a close relationship has formed between nature and healing. Early civilisations, which laid the groundwork for recent discoveries are much to be thanked; their documentation, stories and archaeological clues have pointed modern practice in the right directions – not only for analgesics but in all areas of medicine.

The natural sources of pain relief discussed in this essay range in their applications, strengths and scientific journey. Electrotherapy, now an established pain relief technique found in hospitals and homes across the world, has evidence in the gate-control theory. Although widely accepted, the concept of gate-control still remains a theory awaiting scientific proof, and further research is required to establish the range of conditions for which electrotherapy could be useful. *Capsicum* peppers and the capsaicin it contains has led to discoveries of the functions of certain nociceptors and the chemical pathways in which they are involved. A historic plant whose warming compounds remains prescribable by today's doctors, also requires additional clinical studies to compare its

efficacy with common pain relief techniques. And finally, *Aloe vera,* whose soothing gel has been used for millennia to treat a range of conditions, remains the primary source of liberation for the pain of sunburn in modern day. Its properties are vast with huge potential in the fields of diabetes and cancer research – but its analgesic effects requires further investigation and categorisation.

While we have come a long way in adapting rudimentary remedies to evidence-based medicines, the journey to alleviate the mistakes of our past is ongoing. As we continue to tackle the consequences of addictive pain relief, we must let the lessons of history aid in balancing our desire for advancement with our respect for nature's gifts. The World Health Organization estimates that 80% of the world's population uses herbal medicine for some aspect of daily health [54]. With holistic medicine gaining traction in modern day (an estimated global market size of 70.5 billion USD [55]), it is clear that nature and natural resources will remain key in the development of new medicines and progressing the ongoing mission to alleviate pain across the globe.

References

1. Neuburger, M. "An Historical Survey of the Concept of Nature from a Medical Viewpoint" 1944, Isis 35(1):16–28
2. The British Pain Society. What is pain? [Internet]. 2025. [Cited 01/02/2025]. Available from: https://www.britishpainsociety.org/about/what-is-pain/
3. Norn S, Kruse PR, Kruse E. Opiumsvalmuen og morfin gennem tiderne [History of opium poppy and morphine]. Dan Medicinhist Arbog. 2005;33:171-84. Danish. PMID: 17152761. Available at: https://pubmed.ncbi.nlm.nih.gov/17152761/
4. O'Niell, H. 1792. Ode to the Poppy. In Smith, C. Desmond (1792). Lines 26-33. Available to view at: https://allpoetry.com/poem/8574257-Ode-To-The-Poppy-by-Henrietta-O-Neill.
5. NHS Digital. *Health survey for England 2017*. [Internet]. 2019 NHS Digital. [cited 01/02/2025]. Available at: https://digital.nhs.uk

6. United Kingdom. Public Health England. Prescribed Medicines Review: Summary. [Internet] 2020. (Cited 01/02/2025). Available at: https://www.gov.uk/government/publications/prescribed-medicines-review-report/prescribed-medicines-review-summary#contents
7. Office for National Statistics. Deaths related to drug poisoning in England and Wales: 2022 registrations. [Internet]. 2023 (Cited 01/02/2025). Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsrelatedtodrugpoisoninginenglandandwales/2022registrations
8. Crime Museum. History of Heroin. [Internet]. 2025. (Cited 02/02/2025). Available from: https://www.crimemuseum.org/crime-library/drugs/history-of-heroin/
9. Küçükdeveci, A. Rehabilitation interventions in osteoarthritis, Best Pract Res Clin Rheumatol 2023, 37(2). https://doi.org/10.1016/j.berh.2023.101846.
10. Adams DS. What Is Bioelectricity? Bioelectricity. 2019 Mar 1;1(1):3-4. doi: 10.1089/bioe.2019.0005. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC8370266/
11. Hornblower, S. Spawforth, A. Eidinow, E. *The Oxford Companion to Classical Civilization*. 2014 September 11. OUP Oxford. p352. ISBN 978-0-19-101676-9.
12. Jocks, I T. Scribonius Largus' Compounding of Drugs (Compositiones medicamentorum): introduction, translation, and medico historical comments Vol 2. [PhD thesis on the Internet] University of Glasgow; 2020. (Cited 02/02/2025) 2:106. Available at: https://theses.gla.ac.uk/82178/14/2020jocksphdvol2.pdf
13. Tsoucalas, G. Karamanou, M. Lymperi , M. Gennimata, V. Androutsos ,G. 'The "torpedo" effect in medicine'. Int. Marit. Health, 2014 June 30. 65(2), 65–67. doi:10.5603/imh.2014.0015.
14. TENSunits.com. A Brief History of Electrotherapy & Its Uses for Pain Relief [Internet] 2025. (Cited 02/02/2025). Available at: https://tensunits.com/blogs/blog/history-of-electrotherapy-for-pain-relief

15. ScotsCat.com. Malapterurus electricus. 2007 April. Factsheet 130. (Cited 02/02/2025). Available at: https://www.scotcat.com/factsheets/malapterurus_electricus.htm
16. Zubairi, R. The Shocking Medical History of Electric Fish. [Internet] The Long Now Foundation. 2023 April 5. (Cited 02/02/2025). Available at: https://longnow.org/ideas/the-shocking-medical-history-of-electric-fish/
17. Jocks, I T. Scribonius Largus' Compounding of Drugs (Compositiones medicamentorum): introduction, translation, and medico historical comments Vol 2. [PhD thesis on the Internet] University of Glasgow; 2020. (Cited 02/02/2025) 2: 33-34. Available at: https://theses.gla.ac.uk/82178/14/2020jocksphdvol2.pdf
18. Dibner, B.. "Luigi Galvani." *Encyclopedia Britannica*, 2024 November 30. (Cited 02/02/2025). Available at: https://www.britannica.com/biography/Luigi-Galvani.
19. Olson K. History of Pain: A Brief Overview of the 17th and 18th Centuries. Pract Pain Manag. 2013;13(6).
20. Serena, K. Meet Dr. Giovanni Aldini — The Man Whose Experiments Inspired 'Frankenstein'. All That's Interesting. 2017 December18. (Cited: 02/202/2025). Aavailable at: https://allthatsinteresting.com/giovanni-aldini-frankenstein
21. Engineering and Technology History Wiki. Milestones:Volta's Electrical Battery Invention, 1799. 1999. (Cited 02/02/2025) Available at: https://ethw.org/Milestones:Volta's_Electrical_Battery_Invention,_1799
22. Wikisource contributors. Life in Motion/Lecture VI [Internet]. Wikisource ; 2019 Sep 29, (cited 02/02/2025). Available from: https://en.wikisource.org/w/index.php?title=Life_in_Motion/Lecture_VI&oldid=9624836.
23. Ocean Treasure Memorial Library. Marbles Electric Ray. Image 47. 2022. (Cited 02/02/2025). Aavailable at: https://otlibrary.com/marbled-torpedo-ray/
24. NeuroLaunch. Electrotherapy: A Comprehensive Guide to Electrical Stimulation in Medical Treatment. [Internet] 2024 Oct 1. (Cited

02/02/2025). Available from: https://neurolaunch.com/what-is-electro-therapy/
25. Grand View Research. Transcutaneous Electrical Nerve Stimulation Market Size, Share & Trends Analysis Report By Product (Portable, Table Top), By Application (Chronic Pain, Acute Pain), By End-use, And Region Forecasts, 2024 – 2030. [Internet] (Cited 02/02/2025). Report ID: GVR-4-68039-920-2. Available from: https://www.grandviewresearch.com/industry-analysis/transcutaneous-electrical-nerve-stimulation-market-report
26. Sironi V. Origin and evolution of deep brain stimulation. Front Integr Neurosci. 2011 Aug 18;5:42. doi: 10.3389/fnint.2011.00042.
27. Das R, Langou S, Le T, Prasad P, Lin F, Nguyen TD. Electrical Stimulation for Immune Modulation in Cancer Treatments. Front Bioeng Biotechnol. 2022 Jan 11;9:795300. doi: 10.3389/fbioe.2021.795300.
28. Gómez-García, J. Chili Pepper's Fiery History: The Berry That Conquered the World. [Internet] 2024 Dec 11. (Cited 03/02/2025). Available from: https://www.thecollector.com/history-chili-peppers-berry-world/
29. Fattori, V. Hohmann, M. Rossaneis, A. Pinho-Ribeiro, F. Verri, W. Capsaicin: Current Understanding of Its Mechanisms and Therapy of Pain and Other Pre-Clinical and Clinical Uses. Molecules. 2016 Jun 28 21(7):844. doi: 10.3390/molecules21070844.
30. Perry, L. Flannery, K. Precolumbian use of chili peppers in the Valley of Oaxaca, Mexico, 2007 July 17. Proc. Natl. Acad. Sci. U.S.A. 104 (29) 11905-11909, https://doi.org/10.1073/pnas.0704936104
31. Powis, T. Murrieta, E. Lesure, R. Bravo, R. Grivetti, L. Kucera, H. Gaikwad, N. Prehispanic Use of Chili Peppers in Chiapas, Mexico. 2013 November 13. https://doi.org/10.1371/journal.pone.0079013
32. Heinrich, M. Mexican Herbal Medicines. [Internet] Mexicolore. (Cited 03/02/2025) Available at: https://www.mexicolore.co.uk/aztecs/health/mexican-herbal-medicines
33. Tastes of History. A Brief History of Food: Chilli Peppers. [Internet] 2020 June 20. (Cited 03/02/2025). Available at: https://www.tastesofhistory.co.uk/post/a-brief-history-of-foods-chilli-peppers

34. National Center for Biotechnology Information PubChem Compound Database; CID=1548943. (Cited 03/02/2025). Available from: https://pubchem.ncbi.nlm.nih.gov/compound/1548943.
35. Wood, J, Winter, J. James, I. Rang, H. Yeats, J. Bevan, S. Capsaicin-induced ion fluxes in dorsal root ganglion cells in culture. J. Neurosci. 1988;8:3208–3220. doi: 10.1523/JNEUROSCI.08-09-03208.1988
36. Rosenbaum, T. Simon, S. TRPV1 Receptors and Signal Transduction. In: Liedtke WB, Heller S, editors. TRP Ion Channel Function in Sensory Transduction and Cellular Signaling Cascades. Boca Raton (FL): CRC Press/Taylor & Francis; 2007. Chapter 5. (Cited 03/02/2025) Available from: https://www.ncbi.nlm.nih.gov/books/NBK5260/
37. National Institute for Health and Care Excellence. Capsaicin. British National Formulary. 2025. (Cited 03/02/2025). Available at: https://bnf.nice.org.uk/drugs/capsaicin/
38. Karkala Manvitha, Bhushan Bidya. Aloe vera: a wonder plant its history, cultivation and medicinal uses. J Pharmacogn Phytochem 2014;2(5):85-88.
39. Kaur, S. Bains, K. Aloe Barbadensis Miller (Aloe Vera): Pharmacological activities and clinical evidence for disease prevention, International Journal for Vitamin and Nutrition Research, vol. 94, no. 3–4, pp. 308–321, Jun. 2024, doi: 10.1024/0300-9831/a000797.
40. Bostock, J. The Natural History. Pliny the Elder. (Cited 04/02/2025). Available at: https://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.02.0137%3Abook%3D27%3Achapter%3D5.
41. Wellcome Collection. M0006098: Aloe, from Dioscorides: Juliana Anicia Codex. 1939. (Cited 04/02/2025). Available at: https://wellcomecollection.org/works/ceu2rxs6
42. Crosswhite, F. Crosswhite, C. Aloe vera, Plant Symbolism and the Threshing Floor: Light, Life and Good in Our Heritage. 1984. (Cited 04/02/2025). Available at: https://repository.arizona.edu/bitstream/handle/10150/552247/dp_06_01-043-050.pdf?sequence=1
43. Gunther, R. The Greek Herbal of Dioscorides. 1934. Oxford University Press. Oxford.

44. Sánchez M, González-Burgos E, Iglesias I, Gómez-Serranillos MP. Pharmacological Update Properties of *Aloe Vera* and its Major Active Constituents. Molecules. 2020 Mar 13;25(6):1324. doi: 10.3390/molecules25061324.
45. Cinelli, M. Do, H. Miley, G. Silverman, R. Inducible nitric oxide synthase: Regulation, structure, and inhibition. Med Res Rev. 2020 Jan;40(1):158-189. doi: 10.1002/med.21599.
46. Drugbank Online. Salicylic acid. [Internet]. 2025 February 05. (Cited 04/02/2025). Available at: https://go.drugbank.com/drugs/DB00936
47. Nimma V.L., Talla H.V., Bairi J.K., Gopaldas M., Bathula H., Vangdoth S. Holistic healing through herbs: Effectiveness of Aloe vera on post extraction socket healing. J. Clin. Diagn. Res. 2017;11:83–86. doi: 10.7860/JCDR/2017/21331.9627.
48. Fallahi H.R., Hamadzade H., Nezhad A.M., Zandian D., Taghizadeh M. Effect of Aloe vera mouthwash on postoperative complications after impacted third molar surgery: A randomized, double-blind clinical trial. J. Oral Maxillofac. Surg. Med. Path. 2016;28:392–396. doi: 10.1016/j.ajoms.2016.05.011.
49. Rahmani N., Khademloo M., Vosoughi K., Assadpour S. Effects of Aloe vera cream on chronic anal fissure pain, wound healing and hemorrhaging upon defection: A prospective double blind clinical trial. Eur. Rev. Med. Pharmacol. Sci. 2014;18:1078–1084.
50. Skowrońska W, Bazylko A. The Potential of Medicinal Plants and Natural Products in the Treatment of Burns and Sunburn-A Review. Pharmaceutics. 2023 Feb 13;15(2):633. doi: 10.3390/pharmaceutics15020633.
51. Khorasani G., Hosseinimehr S.J., Azadbakht M., Zamani A., Mahdavi M.R. Aloe versus Silver Sulfadiazine Creams for Second-Degree Burns: A Randomized Controlled Study. Surg. Today. 2009;39:587–591. doi: 10.1007/s00595-008-3944-y.
52. Shahzad M.N., Ahmed N. Effectiveness of Aloe Vera Gel Compared with 1% Silver Sulphadiazine Cream as Burn Wound Dressing in Second Degree Burns. J. Pak. Med. Assoc. 2010;63:225–230

53. Haddad P, Amouzgar-Hashemi F, Samsami S, Chinichian S, Oghabian MA. Aloe vera for prevention of radiation-induced dermatitis: a self-controlled clinical trial. Curr Oncol. 2013 Aug;20(4):e345-8. doi: 10.3747/co.20.1356.
54. Parveen, A. Parveen, B. Parveen, R. Ahmad, S. Challenges and guidelines for clinical trial of herbal drugs. Journal of Pharmacy and Bioallied Sciences 7(4):329-333, 2015 December. DOI: 10.4103/0975-7406.168035
55. Grand View Research. Herbal Medicine Market Size, Share & Trends Analysis Report By Intervention (Ayurveda, Traditional Chinese Medicine), By Product Form (Tablet/Capsules, Powder), By Source, By Distribution Channel, By Region, And Segment Forecasts, 2024 – 2030 [Internet] (Cited 04/02/2025) . Report ID: GVR-4-68040-293-0. Available from: https://www.grandviewresearch.com/industry-analysis/herbal-medicine-market-report

History of End-of-Life Care – *Via International Lens*

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But what if no cure was possible and the end of life was inevitable?

End of life care has undergone significant transformation across cultures and centuries, reflecting broader shifts in medical practice, societal values, financial constraints and religious beliefs.

This historical overview traces the evolution of end-of-life care from its inception, where death was often ritualized and care provided by family and community, to the institutionalized and medicalized approaches of the modern era. A few of interesting examples include, the Benguet tribe blindfold the dead, make them sit up straight on a chair and place it on the main entrance whereas the Tingian tribe where the dead are dressed in their best garments, made to sit on chair and sometimes place a lit cigarette between the lips.

A modern death ritual involves launching cremated remains into outer space. The first space burial took place in the year 1992 when a Pegasus rocket launched the ashes of 24 people into outer space. The rise of palliative care in the late 20th century marked a pivotal shift toward holistic care, however hospice care goes back to mid 1800. The aim was to provide patient centred models that prioritize comfort, dignity, and quality of life in the final stages. Before the 20th century, most people died at home, with family members providing care and support. The development of new medical treatments and technologies in the 20th century led to a greater emphasis on hospital-based care. The history of end-of-life care in the ICU involves a shift from prioritizing life-sustaining technology to recognizing the importance of comfort, dignity, and shared decision-making. Early ICUs focused on technologically advanced life support, but over time, ethical and practical considerations led to the development of palliative care protocols and a more holistic approach to end-of-life care in the ICU.

Over time, concerns arose about the impersonal nature of hospital care at the end of life and the lack of patient-centeredness. Hospice care, as we know it today, developed significantly in the 1960s, largely due to the

work of Cicely Saunders, who established the first modern hospice, St. Christopher's Hospice in London and is undoubtedly considered the pioneer in end-of-life care around the world.

In 1843, as a young widower and bereaved mother, Mme Jeanne Garnier, along with others in a similar situation, founded the Dames de Calaire in Lyon, France, to provide care for the dying. Between 1874 and 1899, her influence led to the introduction of six more establishments in Paris and New York. 36 years later the idea spread to Ireland when it was adopted by The Irish Sisters of Charity who opened Our Lady's Hospice in Dublin. Shortly after, it spread to England when they opened St. Joseph's Hospice in Hackney, London.

Dame Cicely Saunders founded St Christopher's House in 1967 in London. She went on to study philosophy, politics and economy, followed by nursing and eventually medicine. The Second World War broke out and, she decided to abandon her studies and train as a nurse. She was forced to quit her job due to back problems and return to her degree. After graduating, she decided to become a medical social worker at St Thomas' Hospital in London. Her keen interest in palliative care and pain control developed early hence she started to plan a dedicated centre for hospice care. David Tasma was a Polish migrant who was receiving treatment for an incurable cancer at St Thomas'. She would visit David regularly and it was during those conversations that the idea of hospice came about in this modern sense. After David died, Cicely continued as a social worker for years. Cicely became a medical student at the age of 33. After qualifying as a physician in the late 1950s, instead of following the tried and tested path into one of London's teaching hospitals, she took a position at St Joseph's Hospice in Hackney, one of the first hospices in the UK. So, Cicely secured a research grant to develop studies at the hospice focusing on pain management. Her research showed the potential of the sisters' approach to care but highlighted that it needed to be underpinned by science and research. In the early 1960s, after a few years working at St Joseph's, Cicely started planning a hospice under her own leadership. This was the beginning of the modern 'hospice movement'. Cicely opened St Christopher's Hospice in 1967. By the late 1960s Cicely was widely known and respected in the field of end-of-life care. Her reputation resulted in a lot of attention when St Christopher's opened; the appetite to see this new form of hospice was so great that the first visits took place before any patients were even there. She chose to open the hospice as an independent charity, separate from the NHS. At the time St Christopher's was established, government policy around end-of-life care was practically non-existent. Cicely served as the Medical Director, Chairman and

Founder/President of St Christopher's Hospice for 34 years. In 2002, in her early eighties, Cicely set up The Cicely Saunders Foundation (now Cicely Saunders International). Cicely developed breast cancer but continued to work, even from her deathbed. She died at St Christopher's on 14 July 2005.

In 1963 Saunders introduced the concept of hospice care to the US at Yale University (National Hospice and Palliative Care Organization. She gave a talk at Yale University and she talked about what specialized care for the dying could look like, 1960s saw the work of Elisabeth Kübler-Ross, an American psychiatrist, challenge the attitudes of the medical community towards end-of-life experience and care. Dr. Kübler-Ross's 1969 book "On Death and Dying" is still required reading in many healthcare disciplines. The book outlines the five stages that dying patients' experience: denial, anger, bargaining, depression and acceptance. In 1972, Dr. Elisabeth Kubler-Ross testified before the US Senate Special Committee on Aging about the right to die with dignity. This included the right to make decisions about one's end-of-life care and to die at home. In 1974 first hospice established in the US. Palliative care eventually began to catch hold in hospitals across the United States. Between 2000 and 2011, the prevalence of palliative care in U.S. hospitals with 50 or more beds has increased more than 157%.

The term "palliative care" was first used in 1974 by Dr. Balfour Mount, a surgical oncologist at the Royal Victoria Hospital and McGill University in Montreal. In 1973, in response to the work being done by Dr. Kübler-Ross and Dr. Saunders, McGill's Dr. Mount visited St. Christopher's. In 1974, he became the founding director of the Royal Victoria Hospital Palliative Care Unit. He coined the term "palliative care" to distinguish this emerging field of medicine from hospice care. He had heard of St. Christopher's Hospice in London through the Elizabeth Kubler-Ross book, "On Death and Dying". Palliative care the etymology of the word was perfect. It means "to improve the quality of". He ran it by Cicely and Robert Twycross in the UK and neither of them were impressed. So, he got particular pleasure when, a few years later, the Royal College of London and Edinburgh chose the term "Palliative Medicine" as its new specialty.

In the early 1970s, three major providers accounted for most hospice services in Australia: the Little Company of Mary; Sisters of Charity; and the Deaconess Society. The leadership shown internationally by people such as Vittorio Ventafridda (Italy), Cecily Saunders (England) and Balfour Mount (Canada) led to an undeniable shift in care for people with advanced illness.

In 1965 the Calvary Hospice in Gangneung City was run by Sisters of the Little Company of Mary who came from Australia in 1964. The first physician to introduce hospice care in South Korea was Kyung-Shik Lee, a haemato-oncology specialist who was an assistant professor in internal medicine at the Catholic University of Korea School of Medicine in 1981. Most of the academic focus in the early 1980s was on prolonging the life span of patients, and thus hospice care was not a widely discussed topic. A department dedicated to hospice care centered on the nursing staff was established at Seoul St. Mary's Hospital, and began operation in March 1987.

The concept of end-of-life care as part of the health-care system is relatively new in India, having been introduced in the 1980s. The first hospice in India was established in 1986 in Mumbai. In 2016, there were over 900 palliative care centres in India, accessible to <1% of the Indian population.

The beginnings of palliative care services in Latin America can be traced back to the 1980s, when teams from Colombia and Argentina started implementing inpatient and outpatient services, respectively. The World Health Organization's Cancer Pain Relief strategy played a crucial role in promoting palliative care principles and practices. Despite progress, palliative care is still not available to a large enough number of patients in the region.

In Africa pain relief medication, especially opioids, is often unavailable or inaccessible due to cost, strict regulations, and limited availability of trained healthcare professionals. In many African health care systems, the concept of opiophobia, or a fear of opioids, is prevalent. In some cases, misunderstanding and the fear of addiction have led healthcare workers to provide restricted treatment, leaving in patients in unnecessary pain at the end of life. Dr. Anne Merriman, founder of Hospice Africa, played a pivotal role in introducing and advocating for palliative care in Uganda and other African countries, focusing on pain relief and improving the quality of life for those with HIV/AIDS.

PALLIATIVE SEDATION IN THE DISCUSSION OF END-OF-LIFE CARE

Opium, willow bark, and cannabis were used for pain relief, dating back centuries. Paracelsus introduced laudanum, a tincture of opium, in the 16th century. Morphine was isolated from opium in the early 1800s, revolutionizing pain treatment. In 1853 the invention of the hypodermic syringe, by Alexander Wood and Charles Pravaz, allowed for the

subcutaneous administration of morphine, revolutionizing pain management. The 19th century saw the introduction of ether and chloroform as anaesthetics for surgery. Herbert Snow, a surgeon, developed the Brompton cocktail, an analgesic mixture that included morphine and other drugs, which later became a part of the modern hospice movement.

Pain treatment was mostly reactive, focused on acute medical or surgical issues. Terminally ill patients often received minimal pain relief due to fear of opioid addiction, stigma around death and dying or lack of medical training in palliative principles. The second half of the 20th century saw the rise of palliative care as a distinct field, with a focus on managing pain and other symptoms associated with serious illnesses. Dame Cicely Saunders founded St. Christopher's Hospice, which became a model for modern hospices by combining compassionate care with pain and symptom management and research. The concept of total pain was introduced, physical, emotional, social, and spiritual suffering. Emphasis on regular, scheduled opioid use (e.g., morphine) rather than as-needed dosing. Multidisciplinary approach gained ground, including nursing, social work, chaplaincy, and pharmacology. WHO developed the analgesic ladder in 1986, providing a stepwise approach to pain management, starting with non-opioids and progressing to stronger opioids as needed. Modern palliative care emphasizes a patient-centred approach, acknowledging pain as a subjective experience and tailoring treatment to individual needs and preferences. Today, palliative care utilizes a range of interventions, including pharmacological and non-pharmacological approaches, to address pain and other symptoms, such as psychological support and advanced care planning. Despite advancements, challenges remain in pain management, including the need to address stigma associated with palliative care and the potential for opioid-related issues. There is growing emphasis on individualized pain management, neuropathic pain control, use of adjuvant medications (antidepressants, anticonvulsants), non-pharmacological approaches (e.g., mindfulness, massage, TENS), expansion into non-cancer diagnoses: heart failure, COPD, dementia, renal failure, etc. and opioid crisis sparks debates on balancing adequate pain relief versus opioid misuse.

In conclusion, end-of-life care started as rituals. People died due to lack of medical inventions and technology. This led to emphasis on prolonging life with advancement of medicine. As the advancement of medical research, medicines, equipment and technology, it was understood that there is need to shift the focus from prolonging life to dignified death. A medical revolution had been erupting in various parts of the world which

did not interlink until late, and still several parts of the world continue to be alien to the concept. The idea of end-of-life still was only limited to hospice centres and palliative medicine which gradually penetrated into critical care medicine as the advancement of medical technology. Understanding the historical context of end-of-life care illuminates the ongoing challenges and ethical imperatives in delivering compassionate care at life's end.

A Brief History of Simulation in Anaesthesia

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Nowadays simulation is a commonplace teaching method across many medical specialties, but this hasn't always been the case. We will consider simulation in the context of delivering anaesthesia and the training of anaesthetists, including the origins of simulation in the aviation industry and the development of mannikins over time. We will look at various models and mannikins including mechanical task trainers, Laerdel's Resusci Anne, and computer-controlled mannikins such as Sim One.

Sim One is considered to be one of the first computer-controlled patient simulators and in 1969 was certainly one of the most complex computer-mannikin interfaces that had been seen. It earned itself a small report in November 1970's National Geographic publication, under the title 'The Patient That Always Comes Back'.

Additionally, we will explore how these mannikins have contributed to the development of training, especially for the management of high-risk, low-frequency incidents, where the anaesthetist is expected to manage what might be a once-in-a-career situation confidently and competently.

The links between aviation and anaesthesia have long been established, given the similarities in their need for stringent safety protocols to attempt to avoid such infrequent but significant incidents. We will therefore also look at a 'flight simulator for anaesthetic training', developed by Howard Schwid, as well as the most famous flight simulator device, the Link Trainer.

Reappraising the Advent of Early "Modern" Anaesthesia Apparatus in Britain and Canada

- Continental European Contributions and the Role of Richard Jacobson (1877 – 1957)

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Introduction

Recent scholarship has challenged traditional accounts on the history of the anaesthetic gas machine, which are dominated by UK-centric narratives. Based on recent archival research and comparative historiography, the authors re-appraised the introduction of the first recognizably "modern" anaesthetic gas machines to Britain and Canada. This paper summarizes a full version of this work, which provides a more detailed and comprehensive overview of the topic and its findings.[1] In the same context, related aspects of the life of Richard Jacobson (1877 – 1957) were explored: Jacobson was an employee of the Germany-based Dräger Company (est. 1889), who contributed significantly to the spread of resuscitation, rescue, and anaesthesia technology from continental Europe to Britain and its former colonies.

Ultimately, our findings contribute to a growing recognition that the core of modern anaesthetic practice is not the product of any one

source of innovation. Rather, it is founded on reciprocal interactions which took place across many nations and disciplines. Re-discovering these interactions generates unique opportunities for further historical analysis.

The First Recognisably "Modern" Anaesthesia Gas Machines in Britain

The anaesthesia gas machine is a central element of practice, allowing precise and tailored delivery of anaesthetic agents, as well as mechanical ventilation and advanced monitoring. Prior historiography has often celebrated the "Boyle Machine" (1917) as the first modern anaesthetic gas machine in the UK.[2–8] However, recognizably modern apparatus were introduced to most other regions in the world, including central Europe, the USA, and Japan between 1900 and 1905.[1,9] Appearing over a decade later, the Boyle Machine would therefore have been a belated outlier in the international historical record, rather than the groundbreaking and technologically innovative achievement as which it was long portrayed thereafter.[2,10–13]

The Boyle Machine's design was attributed to the British anaesthetist Henry Boyle (1875 – 1941) and first came out in 1917. The apparatus was capable of the type of continuous-flow administration that modern devices characteristically are. It subsequently cemented its place in historical accounts—even though, until well after WW II (1939 – 1945), the device appears to have been less popular in British clinical practice than the basic blow-over systems which were famously classified in 1954[14] by the likewise British physicist William W. Mapleson (1926 – 2018).[15] Moreover, the novelty of "modern" anaesthesia technology cannot be ascribed to Boyle's machine either, as all of its elements and components are clearly borrowed from earlier apparatus that were designed, widely marketed, and introduced into clinical practice in central Europe[9,16–18] and the USA over the preceding decade.[5,17–20] Earlier research has even implicated Boyle and his device in plagiarism to the detriment of his US-influenced British compatriot Geoffrey Marshall (1887 – 1982).[5,13]

Hence, the above constellation of facts merited a detailed investigation of whether—with its later-celebrated Boyle machine—Britain and its Empire were really lagging behind other regions of the world, or whether they were equally embedded within the shared international chronologies, causalities, and contexts, which have been

confirmed elsewhere.[21] Drawing on archival research and comparative historiography, we began with reappraising the advent of modern anaesthesia apparatus in the UK. Our findings confirmed that—just like in all the other, comparable regions—this advent preceded the domestic Boyle Machine by more than a decade.[1]

For example, the internationally influential Roth-Dräger anaesthesia apparatus (Germany, 1902), alongside other recognizably modern technology for anaesthesia-related practices, are reliably confirmed to have been by c. 1903 – 1905 successfully introduced and widely marketed across continental Europe, the USA, and even as far afield as Japan and East Asia.[16] Investigating the same period and technological capabilities in Britain, we identified several sources illustrating the use of this same Roth-Dräger apparatus in the UK—and the wider British Empire—since the period of 1904 – 1908 (a decade before the Boyle Machine).[1] The sources identified included articles in scientific journals, academic meeting proceedings, and a patent drawing illustrating a gas pressure reducing valve designed by Dräger to suit Imperial-standard gas appliances.[1] We also identified marketing advertisements for Dräger products (including resuscitation and rescue equipment) in the UK, which had been prepared and distributed by one Richard Jacobson since as early as c. 1903 – 1907.[1]

Richard Jacobson

In order to further elucidate the introduction of Dräger equipment to the UK, we compiled a literary portraiture of Richard Jacobson (1877 – 1957),[1] who was in the company's employ from between c. 1903[22] and c. 1907[23] until c. 1934.[24] Over three decades, Jacobson served as a sales representative importing Dräger devices into the UK—first as the head of Dräger's London-based subsidiary (British Draegerworks Limited, London), and then as head of Dräger's General Agency in Vienna.[1] Being Jewish, he was forced out of his position after the rise of the National Socialists' dictatorship to power in Germany and Austria (1933). Narrowly escaping the Holocaust, he ultimately fled to the USA, where he died two decades later in 1957.[1]

While our research initially focused on anaesthesia apparatus which Jacobson marketed in the UK prior to the development of the Boyle Machine, it also uncovered his interesting contributions to occupational health: critical of the standards of healthcare provision and workplace

safety, Jacobson marketed Dräger's broad range of rescue products—self-contained respirators, emergency ventilators, and resuscitation devices—in Britain and across its empire (Figure 1).[1]

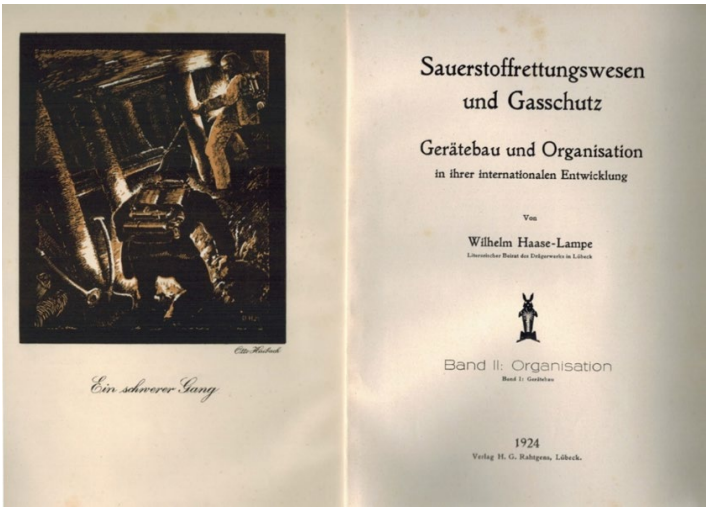
Figure 1: Photograph of the Dräger Company booth at the World Mining Exhibition, London-Olympia, in July 1908. The younger gentleman on the left is believed to be Richard Jacobson (1877 – 1957). Reproduced with permission from the Dräger Archives.

The market segment for these devices expanded rapidly, notably after two devastating mining disasters in Courrières France (1906-Mar) and the "Hamstead-Pit" in England (1908-Mar).[25]

Dräger Rescue Devices in Canada

We traced our portraiture of Jacobson to the first evidence of recognizably modern anaesthesia gas machines in Canada, where Dräger appears to have also entered the market first with this line of rescue and resuscitation technology.[1]

Newspaper archives frequently describe the use of Dräger devices, for example in the aftermath a fire at the Acadia Coal Company's mine in Stellartan, Nova Scotia (1910),[26,27] and other mining complications.[28] Surviving Dräger sources likewise provide ample evidence of the distribution of rescue devices in Canada. For example, an extensive three-

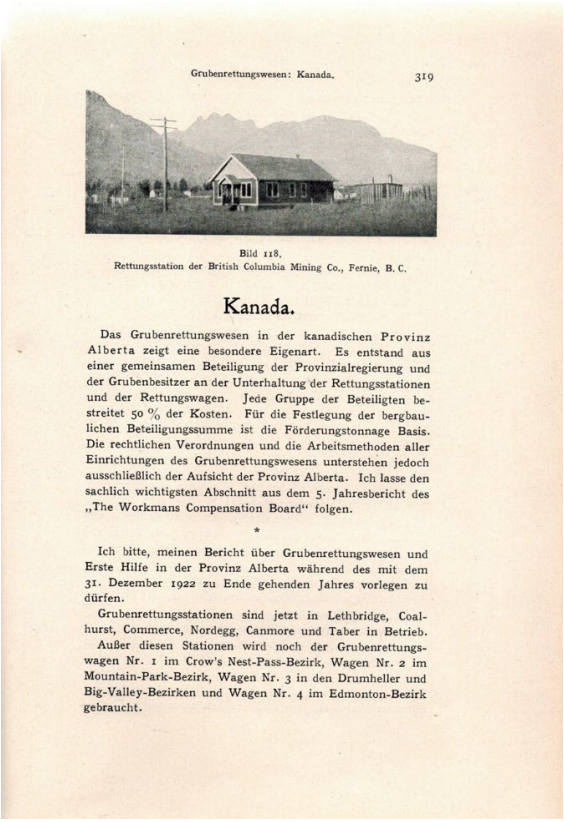


volume "Textbook of Mining-Rescue" (Figure 2), commissioned by Dräger, lists multiple rescue apparatus stations in Canada, which were mostly equipped with Dräger equipment.[29]

Figure 2: Front page of a monography penned by J.W. Haase-Lampe29 and detailing the international contributions of the Dräger Company to mining rescue. Reproduced with permission from the Dräger Archives.

This can be cross-referenced and independently confirmed with Canadian sources from c. 1907 – 1911, which describe Dräger "apparatus stations" established in the Canadian provinces of Alberta and Nova Scotia.[30–32]

It is evident that the firm had co-developed and promoted many collaborative partnerships with typically close-knit mining communities, even in remote and rural settings. For example, in Southern Alberta alone Dräger had (by 1922) established rescue stations in the cities of Lethbridge, Canmore, Taber, Coalhurst, Nordegg, and the former village of Commerce ("Coalgate" c. 1912 – 1913; dissolved in 1926 following the closure of the Chinook coal mine).[29] Efforts to establish mobile rapid response units are documented in the Edmonton Region, Drumheller, Crowsnest Pass, Big Valley, and the now-abandoned mining town of Mountain Park.[29] Dräger sources also describe these mining rescue operations in Alberta as having arisen from the joint participation of provincial governments and mine owners, each party contributing half of the costs required to maintain equipment and vehicles (Figure 3).



Grubenrettungswesen: Kanada. 319

Bild 118.
Rettungsstation der British Columbia Mining Co., Fernie, B. C.

Kanada.

Das Grubenrettungswesen in der kanadischen Provinz Alberta zeigt eine besondere Eigenart. Es entstand aus einer gemeinsamen Beteiligung der Provinzialregierung und der Grubenbesitzer an der Unterhaltung der Rettungsstationen und der Rettungswagen. Jede Gruppe der Beteiligten bestreitet 50 % der Kosten. Für die Festlegung der bergbaulichen Beteiligungssumme ist die Förderungstonnage Basis. Die rechtlichen Verordnungen und die Arbeitsmethoden aller Einrichtungen des Grubenrettungswesens unterstehen jedoch ausschließlich der Aufsicht der Provinz Alberta. Ich lasse den sachlich wichtigsten Abschnitt aus dem 5. Jahresbericht des „The Workmans Compensation Board" folgen.

*

Ich bitte, meinen Bericht über Grubenrettungswesen und Erste Hilfe in der Provinz Alberta während des mit dem 31. Dezember 1922 zu Ende gehenden Jahres vorlegen zu dürfen.

Grubenrettungsstationen sind jetzt in Lethbridge, Coalhurst, Commerce, Nordegg, Canmore und Taber in Betrieb.

Außer diesen Stationen wird noch der Grubenrettungswagen Nr. 1 im Crow's Nest-Pass-Bezirk, Wagen Nr. 2 im Mountain-Park-Bezirk, Wagen Nr. 3 in den Drumheller und Big-Valley-Bezirken und Wagen Nr. 4 im Edmonton-Bezirk gebraucht.

Figure 3: A German-language account on Dräger's mining rescue operations in Canada (Haase-Lampe, 1924).29 Reproduced with permission from the Dräger

Institutions in the province of British Columbia followed suit around the same time, developing what were often referred to as "Draeger-Stations".[29] An example of one of these rescue stations, maintained by the British Columbia Mining Co. in Fernie, British Columbia, is illustrated against the backdrop of the encircling Rocky Mountains in Figure 4. Further images from the Dräger archive illustrate plans for the Mine Rescue Station in Nanaimo, British Columbia (c. 1922 – 1924; (Figure 5) and the constructed station (Figure 6).

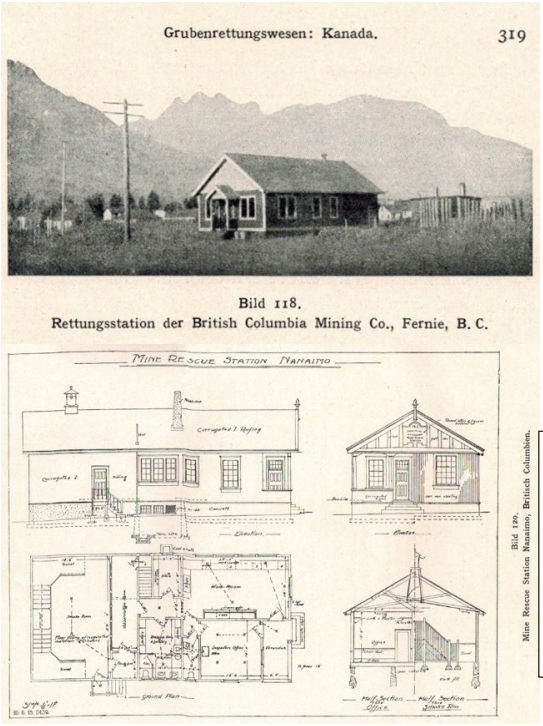


Figure 4: A Dräger rescue station operated by the British Columbia Mining Co. in Fernie, British Columbia (c. 1922 – 1924).29 Reproduced with permission from the Dräger Archives.

Figure 5: Blueprints for the Dräger rescue station developed in Nanaimo, British Columbia (c. 1922 – 1924).29 Reproduced with permission from the Dräger Archives.

Figure 6: A Dräger rescue station based on the schematics in Figure 4 and operated in Nanaimo, British Columbia (c. 1922 – 1924).29 Reproduced with permission from the Dräger Archives.

Early Modern Anaesthesia Technology in Canada

In Canada, recognizably modern anaesthesia technology appears not to have been introduced via the British "motherland", as one might

expect. Instead, our findings suggest that contemporary anaesthesia technology from Dräger and wider continental Europe mostly reached Canada—likewise since the early 1900s and before the Boyle machine—via indirect routes.[1] These technologies likely either percolated through the neighbouring USA and discourse with leading pioneers of anaesthesia technology there, for example James T. Gwathmey (1862 – 1944) and his wider circle, or—by way of the francophone Canadian provinces—from France.

Sporadic findings suggest that the same mechanism of early anaesthesia apparatus introduction—via influences from continental Europe or the USA, rather than from Britain—may have also occurred in other regions of the British empire (e.g., South Africa).[33]

Conclusions

Our investigations[1] highlight the significant influence of innovations arising from continental Europe—and, not least, from the Dräger Company. They illustrate and further confirm the rapid spread of rescue equipment as a conduit, by which wider innovative technology spread (equally rapidly) around the world. The distribution of this equipment was closely followed by recognizably modern anaesthesia apparatus. These apparatus were introduced to central Europe, the USA, Japan, and indeed also Britain and the wider British Empire since between 1900 – 1905.[9]

Our findings concerning Britain and Canada are also consistent with more recent research, which already cast serious doubt on the rather unilateralist and embellished claims concerning the Boyle Machine.[9] They argue, instead, in favour of acknowledging international and trans-disciplinarily *shared heritage* in the history of anaesthesia.

Acknowledgements

We gratefully acknowledge the Dräger Company for granting copyright permissions to evaluate and reproduce data stored in their respective archives for this work.

References

1. Brenna CTA, Strätling MWM. The Advent of Modern Anesthesia Apparatus in Britain and Canada: A Reevaluation of Shared Heritage. *A&A Practice* 2025;19:e01953.

2. Sinclair CM, Thadsad MK, Barker I. Modern anaesthetic machines. *Continuing Education in Anaesthesia, Critical Care and Pain* 2006;6:75–8.

3. Robinson DH, Toledo AH. Historical development of modern anesthesia. *J Invest Surg* 2012;25:141–9.

4. Patil VP, Shetmahajan MG, Divatia JV. The Modern Integrated Anaesthesia Workstation. *Indian J Anaesth* 2013;57:446–54.

5. Gurudatt C. The Basic Anaesthesia Machine. *Indian J Anaesth* 2013;57:438–45.

6. Metcalfe NH. The effect of the First World War (1914-1918) on the development of British anaesthesia. *Eur J Anaesthesiol* 2007;24:649–57.

7. Wilkinson DJ. Evolution of the anaesthetic machine. *Current Anaesthesia & Critical Care* 1991;2:51–6.

8. Thomas K. *The development of anesthetic apparatus. A history based on the Charles King Collection of the Association of Anaesthetists of Great Britain and Ireland*. Blackwell Scientific Publications, 1975.

9. Strätling MWM, Bause G. The history of modern anesthesia technology - A critical reappraisal (Part X) Reappraising the advent of modern anesthesia apparatus in the USA (c. 1900-1930) and the roles of anesthetists in technological innovation: Leading, being led, or reciprocal partnership? *Proceedings of the 10th International Symposium on the History of Anesthesia* 2023:99–145.

10. Record N, Beecroft C. Principles of the anaesthetic machine. *Anaesthesia & Intensive Care Medicine* 2022;23:1–5.

11. Subrahmanyam M, Mohan S. Safety Features in Anaesthesia Machine. *Indian Journal of Anaesthesia* 2013;57:472.

12. Rodger D. Fundamentals of the Anaesthetic Machine. In: Rodger D, Henshaw K, Rawling P, Miller S, eds. *Fundamentals of Operating Department Practice*. 2nd ed. Cambridge: Cambridge University Press, 2022:204–17.

13. Metcalfe NH. Sir Geoffrey Marshall (1887-1982): respiratory physician, catalyst for anaesthesia development, doctor to both Prime Minster and King, and World War I Barge Commander. *J Med Biogr* 2011;19:10–4.

14. Mapleson WW. The elimination of rebreathing in various semi-closed anaesthetic systems. *Br J Anaesth* 1954;26:323–32.

15. Hunter JM, Hemmings HC. The many contributions of WW Mapleson to the British Journal of Anaesthesia. *Br J Anaesth* 2019;122:159–62.

16. Strätling MWM. The history of modern anesthesia technology - A critical reappraisal (Part V) The clinical introduction of the Roth-Dräger anesthesia apparatus to the United States (c. 1903 - 1907) and early interactions with James Tayloe Gwathmey (1862-1944) and Richard von Foregger (1872-1960). *Proceedings of the 10th International Symposium on the History of Anesthesia* 2023:255–309.

17. Romero-Ávila P, Márquez-Espinós C, Cabrera Afonso JR. Historical development of the anesthetic machine: from Morton to the integration of the mechanical ventilator. *Braz J Anesthesiol* 2021;71:148–61.

18. Thompson PW, Wilkinson DJ. Development of anaesthetic machines. *Br J Anaesth* 1985;57:640–8.

19. Strätling MWM. The history of modern anesthesia technology – a critical reappraisal (Part VIII) The origin of the Cotton-Boothby apparatus (USA, c. 1911 - 1912) and its international backgrounds (c. 1900-1913) - re-connecting shared heritage. *Proceedings of the 10th International Symposium on the History of Anesthesia* 2023:73–98.

20. King A. The history and development of anaesthetic apparatus. *British medical journal* 1946;2:536–9.

21. Strätling MWM. The history of modern anesthesia technology - a critical reappraisal (Part VI) Re-discovering important examples of long-disavowed collaborations, interactions, and reciprocity between continental European and Anglo-American pioneers before World War I (1914-1918). *Proceedings of the 10th International Symposium on the History of Anesthesia* 2023:216–54.

22. Dräger Archiv, Bestand BÄD V (Übersee); Unter-Bestand V / 7.2.3a. England und Ireland, Richard Jacobsen, 1903-1912 [Archive Files: correspondence, contracts].

23. Dräger Archiv, Bestand BÄD IX/9 [Persönlichkeiten im DW (alphabetisch)], Unter-Bestand IX/9.22 Richard Jacobsen, London 1906-1923 [Archive Files: correspondence, contracts].

24. Kamp M. Personal communication: February 7, 2020. Ongoing research project: Biography Dr Otto Heinrich Dräger (1898 - 1986) (Neumann & Kamp Historische Projekte, Widenmayerstraße 49, D - 80538 München).

25. Jacobson R. Meine Erfahrungen im Sauerstoff-Rettungswesen Englands. *Draeger-Hefte* 1917;61/63:561–6.

26. Anonymous. N. S. Colliery Threatened By Serious Fire. *The Standard* 1910:Volume 1, No. 299. p. 1.

27. Anonymous. Fire and Marine Notes. *The Monetary Times* 1910;44:1338.

28. Anonymous. The Eight Men Who Were Entombed in Cape Breton Mine Are Dead. *The Evening Times and Star* 1911:Volume VI, No. 79, 6.

29. Haase-Lampe J. Handbuch für das Grubenrettungswesen (international) – Sauerstoffrettungswesen und Gasschutz, Gerätebau und Organisation in ihrer internationale Entwicklung [Handbook of Mining Rescue (international) – Oxygen-rescue and gas-protection – Apparatus development and logistics (Textbook in three volumes: 1924-1929; commissioned by the Draeger Company)]. Lübeck, Germany: H.G. Rathgens, 1924.

30. Anonymous. Verdict in Bellevue Mine Disaster Case. *Edmonton Bulletin* 1911:Volume V, No. 564. p. 4.

31. Gray FW. Breathing Apparatus for Rescue Work in Coal Mines. *The Canadian Mining Journal* 1907;28:77–9.

32. Anonymous. Around The Collieries. *The Maritime Mining Record* 1908;11:19.

33. Daneel P. Local Anaesthesia in General Surgery. *The South African Medical Record* 1911;8:99.

Breast surgery without anaesthesia in the early 19th century, with accounts by patients and relatives

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The idea of surgery without anaesthesia is unthinkable nowadays, but for centuries it was the norm. Medical historians regularly discuss anaesthetic and surgical advances and those who introduced them, but far less has been said or written about the patient's experience of illness and surgery in times past. What follows are four cases of patient accounts of preanaesthetic surgery.

Frances 'Fanny' Burney (1752 – 1840)

The best-known account of being subjected to an operation in the pre-anaesthesia era is that of the English novelist Frances or 'Fanny' Burney [1,2]. Born in King's Lynn, Norfolk in 1752, she married Alexandre d'Arblay, former adjutant-general to the Marquis de Lafayette, 41 years later. The family was in France when the Napoleonic wars resumed in 1802 and lived there for the following ten years.

At age 58 years, Burney felt pain and hardness in her right breast. Initially reluctant to seek medical advice, she ultimately relented and was prescribed conservative treatment. However, she was later informed by her doctors, who included two of the leading French surgeons of the day, Barons Antoine Dubois and Dominique Jean Larrey, that there was no alternative to surgery if there was to be any hope of saving her life. On September 30th 1811, she underwent, in her Paris home and without the benefit of anaesthesia, what was referred to at the time as an amputation of the affected breast. So horrific did Burney find her experience of surgery that it was almost six months before she felt she could revisit it to inform her family in England of what had occurred – she did so in a letter of almost 6000 words to her sister Esther with the title Account from Paris of a Terrible Operation [1].

The following brief extract is representative of what Burney wrote: 'Yet—when the dreadful steel was plunged into the breast—cutting through veins—arteries—flesh—nerves—I needed no injunctions not to restrain my cries. I began a scream that lasted unintermittingly during the whole time of the incision—and I almost marvel that it rings not in my Ears still! so excruciating was the agony. When the wound was made, and the instrument was withdrawn, the pain seemed undiminished, for the air that suddenly rushed into those delicate parts felt like a mass of minute but sharp and forked poniards, that were tearing the edges of the wound—but when again I felt the instrument—describing a curve—cutting against the grain, if I may so say, while the flesh resisted in a manner so forcible as to oppose and tire the hand of the operator, who was forced to change from the right to the left—then, indeed, I thought I must have expired' [1].

Fanny Burney survived the operation and in fact lived for almost another 29 years.

Abigail 'Nabby' Adams Smith (1765 – 1813)

Just nine days after Fanny Burney's surgery, Abigail, known as 'Nabby' Adams Smith, daughter of John Adams, the second president of the United States of America, underwent a similar operation, also without the benefit of anaesthesia, at the Adams family home in Quincy, Massachusetts, USA [2].

In May 1810, aged 44 years, she had discovered a lump, also in her right breast. She was seen by various doctors and was treated with plasters, and later cicuta or water hemlock, pills. In September 1811, Nabby consulted, by letter, her father's friend and fellow signatory of the American Declaration of Independence Dr Benjamin Rush, who had graduated from the University of Edinburgh, Scotland in 1768. Rush replied, not to her, but to the former president, strongly recommending surgery. He wrote 'The pain of the operation is much less than her fears represent it to be – I repeat again – let there be no delay in flying to the knife. Her time of life calls for expedition in this business, for tumors such

as hers tend much more rapidly to cancers after 45, than in more early life' [3].

The surgery was performed by John Warren, father of John Collins Warren of future Ether Dome fame. John Adams wrote a few days later to Rush:

> *'On Tuesday the eight of October, a day memorable in my little annals, the operation was performed in the presence of two Dr Warrens, Dr Welsh and Dr Holbrook, by Dr Warren Senior. The operation was twenty five Minutes in performing, and the dressing an hour longer. The surgeons all agree that in no instance did they ever witness a patient of more Intrepidity than she exhibited through the whole Transaction. They all affirm that the morbid substance is totally eradicated and nothing left but Flesh perfectly sound. They all agree that the probability of Compleat and ultimate success is as great as in any instance that has fallen under their Experience' [4].*

Similarly Nabby's mother, also Abigail, related some details of the operation to her son and of course Nabby's brother, John Quincy Adams (1767 – 1848), who would later become sixth USA president. She wrote 'She supported herself through it with calmness and fortitude & bears with much patience, all the consequences of weakness and confinement, and loss of the use of the Arm, as any Heroine – She is doing well and recovering as fast as could be expected, after an operation in which the whole breast was taken off – the wound is entirely healed, and every affected part was removed, so that we have every prospect of her perfect recovery to Health and Usefulness again' [5].

Unfortunately, the cancer returned in early 1813 and Nabby died in August of that year.

Susanna Dillwyn Emlen (1769 – 1819)

Susanna Dillwyn Emlen was born into a prominent New Jersey Quaker family in 1769 - her mother died within a month of her birth. She was raised by an aunt after her father William Dillwyn moved to England when she was aged five and remarried – Dillwyn Street in the town of Ipswich, Suffolk was later named after him in recognition of his work as a slavery abolitionist.

In late 1813, also at age 44 years, Emlen found a lump in her left breast. Like Burney and Smith, and despite her brother-in-law, Dr Philip Syng Physick being a prominent surgeon, she was slow to seek advice. She wrote 'I knew Dr Physick's preference of a surgical operation in such cases, and I had not yet suffered enough to endure the thought of so terrible a measure' [6].

After trying various remedies, Emlen finally consulted Physick in April 1814, four or more months after discovering her tumour – three other surgeons also examined her and found that her lump, 'had extended under the left arm and contaminated the gland there'. [7] All agreed that an operation was required. While Emlen pondered her options, the surgeons prescribed a strict regime with to diet, evacuation by bleeding or other means and confinement to a recumbent posture. A number of leeches were applied to the affected part and it was soon blistered and then dressed with mercurial ointment. These traditional treatments were understood to prepare the tumour for easier excision.

Emlen took some time to consent to surgery, it was eventually performed by Physick at her home in June 1814. A nurse put a handkerchief over her head hoping it might save her the sight of the preparations. While a local family physician supported her arm and an aunt her head, the operation proceeded. She later wrote 'My suffering was severe beyond expression, my whole being seemed absorbed in pain - the tumour was taken out in 25 minutes but it was an hour before I was in bed'. It was fourteen hours before she became 'easy enough' to sleep. [7]. Her initial recovery went so well that two weeks after the operation she was able to ride for half a mile but the disease eventually recurred

during a visit she made to her father in England, during autumn 1819; *she died in November of that year back home in New Jersey.*

Catherine Coulson (c. 1768 – 1802)

The three cases referred to above have all previously been described in the medical history literature. The fourth and last in this paper, the only one in which the surgery took place in the United Kingdom, to the best of this writer's knowledge, has not.

In 1802, one Thomas Coulson who at that time was living and working in Plymouth, England wrote almost 600 words concerning the final illness and death from breast cancer, aged 33 years or so, of his wife Catherine. The original handwritten piece survives and is currently held, as part of the Coulson Family Papers, at Kresen Kernow ('Cornwall Centre'), the official archive for Cornwall, UK. [8]

Coulson began by reporting that his late wife had died on March 9th 1802. She had been 'afflicted above two years with a scirrhous in her right brest' (sic) [8]. In early 1801 the breast began to pain her, leeches were applied several times without benefit, and the lump increased in size. The couple travelled to London, over 200 miles from Plymouth, to seek the opinion of the surgeon and future president of the Royal College of Surgeons, Henry Cline (1750 – 1827). After examining Catherine Coulson's breast and making enquiries as to her general health, Cline expressed the view that an operation would be useless as 'the glands were affected beyond the reach of the knife' [8]. He prescribed unspecified medicine and gave dietary advice, and expressed a hope that the disease process might remain in a torpid state for several years.

However, after returning to southwest England, his patient's condition declined and she underwent breast surgery without anaesthesia in late 1801 or early 1802, almost certainly in Penzance, Cornwall. Coulson wrote 'the operation was performed by Mr Borlase, Dr Luke, Mr Berriman. She sat in a chair and tho it was 3 quarter of an hour in hand never issued a groan' [8]. Catherine's wound initially healed well but her right arm soon began to swell and 'notwithstanding the use of

leaches (sic) and foments as well, it became enormously large. The weight of the arm opened the cicatrix, a violent blackness arose in the arm and discharged a quantity of humour (sic)' [8]. On an unspecified date in February 1802 a vein burst in the cicatrix with major blood loss which 'caused her so low that she gradually sunk under it….' [8].

John Bingham Borlase, apparently the lead surgeon for Mrs Coulson's operation, was born near Penzance in 1753. It was to him that Humphry Davy (1778 – 1829) had been apprenticed before leaving Cornwall to work in Thomas Beddoes' Pneumatic Institution in Bristol. More relevant to this paper, perhaps, is the fact that he and his patient Catherine Coulson were brother and sister.

Thomas Coulson, master painter at the naval dockyard in Plymouth, was born one mile outside Penzance in 1767. He and Catherine Borlase had married in 1791, he outlived her by 43 years. The couple's youngest son, William, was born in late 1801, by which time his mother clearly already had breast cancer. He was apprenticed in his youth to William Berriman, became a prominent London surgeon and it was he who operated on the two patients anaesthetised by John Snow (1813 – 1858) during a visit made by him (Snow) to Cornwall in 1856 [9].

Discussion

The four breast operations outlined were all carried out on middle or upper class women and it is probably more likely that their correspondence, rather than that of others less privileged, would be preserved. It is clear that each of them also had the connections to obtain expert surgical opinion and, it can be assumed, better access than most to the resources required to temporarily turn kitchens or bedrooms into operating theatres, also family members or friends into nurses and so on. It has frequently been reported that attempts over the centuries to alleviate the pain of surgical operations often involved the use of alcohol, herbal mixtures containing opium alkaloids or hypnotism. Fanny Burney wrote, in the spring 1812 letter to her sister, that one of the assistant surgeons gave her some wine cordial to drink prior to her operation [1].

Susanna Emlen was administered laudanum (opium in alcohol), both pre- and postoperatively [10]. However, there is no mention of either alcohol or analgesia in the available information regarding Nabby Smith's or Caterine Coulson's surgeries and no suggestion at all of the use of hypnotism or mesmerism where any of the four women were concerned. In conclusion, these accounts, by the patients themselves or close relatives, provide not only a remarkable insight into the horrific experiences of some women suffering from breast cancer in the early nineteenth century but also 'shine a light' on their truly remarkable fortitude.

References

1. Original letter available at https://archives.nypl.org./brg/1931#c223378 (last accessed 19 August 2025).
2. Jimenez RE. "A monument to suffering and to patience": The harrowing journey of Nabby Adams through breast cancer. Journal of Medical Biography 2023; 31: 133-142.
3. From Benjamin Rush to John Adams, 20 September 1811. Founders Online National Archives, (last accessed 19 August 2025). https://founders.archives.gov.documents/Adams/99-02-02-5687
4. From John Adams to Benjamin Rush, 13 October 1811. Founders Online National Archives, (last accessed 19 August 2025). https://founders.archives.gov.documents/Adams/99-02-02-5695
5. From Abigail Smith Adams to John Quincy Adams, 17 November 1811. Founders Online National Archives, (last accessed 19 August 2025). https://founders.archives.gov.documents/Adams/99-03-02-2061
6. Aronowitz RA. Unnatural History: Breast Cancer and American Society. Cambridge: Cambridge University Press, 2007, p. 25.
7. Ibid., p. 27.

8. From the Collections at Kresen Kernow, Coulson Family Papers. X696/363.

9. Warde D. December 1856 – Snow comes to Cornwall. The History of Anaesthesia Society Proceedings 2015; 48: 20-28.

General- Practitioner anaesthetists in the UK

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In the UK after the advent of general anaesthesia in December 1846, doctors who took on the administration of anaesthetics did so as part of their general practice. For the first three decades there were very few full-time anaesthetists, notably John Snow followed by Joseph Clover. Although hospitals were used, it was common for anaesthesia and surgery to occur in patients homes and also hotel rooms – as evidenced by the list of venues provided in John Snow's casebooks.[1] The larger cities had teaching hospitals where, by the end of the Victorian era, specialist anaesthetists had been appointed. For example, J Frederick W Silk was appointed to Guy's Hospital, London; he founded the Society of Anaesthetists based in London in 1893[.2] However, general practitioners still commonly gave anaesthetics in the houses of the upper- class patients.

In the Edwardian era there was still prejudice against hospitals by the middle and upper classes, who regarded these as for the sick poor only. But there then arose a great expansion in nursing homes and cottage hospitals – well built and with good medical facilities.[3] Nevertheless, surgeon John H Watson reported in 1933 that in the Burnley area of Lancashire, operations on private patients were commonly performed in private houses until the end of the First World War, less frequently in the 1920s, and by the 1930s mainly for emergencies.[4] Domiciliary obstetrics continued much longer. In 1930 house surgeons were required to administer 12 anaesthetics for emergency cases under supervision[5] and so, on entering general practice, were considered competent in anaesthesia.

At this time, there was a clear contrast between rural and urban anaesthetic practice. In the country regions the vast majority of doctors administering anaesthetics did so as part of their general practice. They

were paid poorly for this service, only general practitioner rates. The appointment as 'Visiting Anaesthetist' at a provincial hospital was honorary – unpaid for general ward patients, paid poorly by the surgeon for fee paying patients.[6] The repercussions of poor pay were recalled by W Stanley Sykes in Vol 1 of his Essays on the First Hundred Years of Anaesthesia. He was called one night as a general practitioner to give an anaesthetic for a confinement, which meant two or three hours off his night's sleep for a fee of 21shillings. 'Gas and oxygen' would have cost more than the fee, so he gave chloroform for a forceps delivery. The patient died a few days later from delayed chloroform poisoning – the only case he ever saw. He reflected that totally unnecessary deaths were caused by cheese-paring financial considerations.[7] In 1932 the Association of Anaesthetists of Great Britain and Ireland (AAGBI) was founded. Ordinary membership was initially restricted to anaesthetists with teaching hospital appointments and capped at 150. This excluded a huge number of doctors who acted as anaesthetists.[8]

Zebulon Mennell, Senior Anaesthetist and Lecturer on Anaesthetics at St Thomas's Hospital, published an article aimed at general practitioners in 1933 on his modified Junker bottle for maternity analgesia. In this he stated "Under existing circumstances in this country, there is no question that chloroform is the only satisfactory anaesthetic for general use in maternity work".[9]

Surgeon John H Watson recorded (1933) that for elective operations, the preparation of the private house and scheduling of the attending medical staff was the responsibility of the patient's general practitioner. He noted that the surgeon was responsible for providing a portable operating table and surgical instruments while the anaesthetist was responsible for providing his own apparatus. In the case of emergency operations, Watson described how a bedroom and bathroom could be expeditiously set up.[4] He opined that practically any emergency procedure could be undertaken with a team of five: (1) the surgeon, (2) surgeon's assistant, (3) good surgical nurse, (4) good general nurse, (5) anaesthetist, unless the operation was to be done under local

or spinal anaesthesia.[4] The implication that if the surgeon was prepared to perform spinal anaesthesia himself, there was no need for an anaesthetist, reveals the thinking of the time.

In 1934 Dr Dulcie Helen Lukis was awarded the Sir Charles Hastings Prize by the British Medical Association for her essay titled "Problems of Anaesthesia in General Practice" and this was published as a book the following year.[10] She was a general practitioner in Malden, near Kingston upon Thames, and had been appointed Honorary Anaesthetist to the South London Hospital, Clinical Assistant to the ENT Department, Queen's Hospital for Children, and Medical Officer for Kingston Victoria Hospital. She noted that the average general-practitioner anaesthetist might not be required to anaesthetise for weeks on end and then be called to give a series. Her estimate was that if he did not hold an anaesthetic appointment, he would probably give only 250 anaesthetics per year, at least 150 being dental gases, minor operations and chloroform à la reine, probably 50 per cent of the remainder being emergencies. The call for emergency anaesthesia could mean most undesirable conditions and circumstances without time for adequate preparation. She declared that the badly shocked accident case, the almost moribund post-partum haemorrhage, and the emergency tracheotomy were more frequently encountered by the general practitioner than by the specialist.[10]

In a two-part article in Volume 13 of the British Journal of Anaesthesia (first part in the October 1935 issue) Stanley Sykes lamented on the plight of the general-practitioner anaesthetist. He noted that the 'visiting anaesthetists' (all of whom were part-time general practitioners) were so badly paid that they could not see patients pre- and post-operatively. He pointed out that the poor state of affairs for doctors interested in anaesthesia precluded advancement of knowledge and skills in the subject.[11]

In November 1935 came the first sitting for the Diploma in Anaesthetics (DA), under the wing of the Conjoint Examining Board of the Royal College of Physicians of London and the Royal College of Surgeons

of England. But it was not until 1943 that the Council of the AAGBI voted in favour of Ordinary Membership for holders of the DA.[12] General practitioners continued to act as anaesthetists.

Through July to November 1937 the British Medical Journal featured a series of articles on anaesthesia in general practice. Although the first one was by Helen Lukis[13], the remainder were written by full time anaesthetists and experts. Between 1902 and 1946 six British anaesthetic textbooks had 'general practitioner' or 'practitioner' in the title, the last being the second edition of that by James Ross Mackenzie.[14]

In 1948 John Gillies, head of the Department of Anaesthetics at the Royal Infirmary of Edinburgh (and at that time President of the AAGBI), published a survey on the use of chloroform. He found that 94% of general practitioners in Scotland chose chloroform for their domiciliary obstetrics, yet in hospital practice this had been superseded by ether. Gillies pointed out the need for trainees to be taught the use of chloroform to prepare them for general practice.[15]

After the installation of the Faculty of Anaesthetists in 1948 and the implementation of the Fellowship examination in 1953, the compulsory supervision of a certain number of anaesthetics by house surgeons had fallen away. So, doctors entering general practice might have had no experience of anaesthesia whatsoever.[16] But initially there were simply not enough Fellows to cope with the surgical workload. In reviewing Stuart Cullen's book titled "Anaesthesia in General Practice" in 1954, Professor William Mushin in Cardiff commented: "It is very likely that in the future more anaesthetic work in this country will have to be done by general practitioners". Mushin recommended the book for general practitioners studying for the DA.[17]

As late as 1956 only about 40% of the membership of the AAGBI practised anaesthesia predominantly; the other 60% did mainly general practice.[18] The proportion of members predominantly engaged in anaesthesia rose quite dramatically in the next few years.

One area in which anaesthesia by general practitioners continued through the 1960s was obstetrics. This was particularly so in rural locations. In a survey of domiciliary obstetric practice in 1965, Dr Rutter noted that chloroform by rag and bottle was still advocated by senior general practitioners, and that according to the maternal mortality reports of 1952-54, 1955-57 and 1958-60, there were still deaths of mothers under chloroform in the home. Noting that some obstetric flying squads did not provide anaesthetic help, he opined that because the need for anaesthesia in domiciliary obstetrics was so infrequent, the general practitioners could not get sufficient anaesthetic experience. He concluded "that the home is the place not for enthusiastic amateurs in anaesthesia but only those whose skill is continually being tested in hospital. The home, however, does present problems of its own – the open fire, the high bed, the confined space and the lack of adequate washing facilities." He called for adequate consultant cover and equipment from the hospital service.[19]

In an article on inhalational anaesthesia for general practitioners in 1966, Professor JP Payne (working at the Royal College of Surgeons of England) noted that the general practitioner may be called upon in an emergency to give an anaesthetic in difficult situations. He thought that it was therefore essential for the practitioner to acquire skill in the use of the simple open-mask techniques.[20]

Some insight into the anaesthetic practice of general practitioners is provided by their own publications in The Practitioner. One such in July 1972 was written by Dr Eric Bloomfield, who held the D Obst.RCOG but not the DA, although he was a member of the Society for the Advancement of Anaesthesia in Dentistry (SAAD). Bloomfield stated that for many years he had given dental anaesthetics in local practitioners' dental surgeries: using IV diazepam and pethilorfan with an added titratable dose of methohexitone. He went to describe his method of anaesthesia for vasectomies at the St James Health Centre in Walthamstow, London. At the onset of the procedure, he gave a 'cocktail' of 0.3 – 0.6 mg of atropine, 100mg of pethilorfan and 10 mg of diazepam

in a 10 ml syringe by slow IV injection. The needle was left in the vein (antecubital fossa) and a 10 ml syringe of 2% methohexitone was attached via a plastic tube; after an initial dose of 60-80 mg, the syringe was kept attached for further intermittent doses of 10-20 mg.[21] A contemporary specialist anaesthetist could have criticised him as the 6th edition of the popular textbook A Synopsis of Anaesthesia (published four years earlier) stated that 1% (not 2%) methohexitone was commonly used, and noted that intra-arterial injection of 2% methohexitone was as dangerous as thiopentone.[22]

In the June 1973 issue Dr Dewi Morgan, who also held the D Obst.RCOG but not the DA, published an article titled 'The General Practitioner Hospital'. Therein he lamented on the heyday of the cottage hospital at Walton-on-Thames, Surrey in the 1950s: although most general anaesthetics were administered by two of the general practitioners, they were helped out by many as "most of them could give gas, oxygen and ether". He noted that such 'occasional anaesthetists' were "frowned upon nowadays by the experts". Morgan then expressed the views of the modern-day surgeons (1970s) as follows.23 "They feel that a full-time anaesthetist capable of carrying out all the modern resuscitative procedures should be available to them and that there should be resident staff to deal with emergencies such as haemorrhage and cardiac arrest. In addition they point out that their lists are almost clear and that there is little need to continue operating in small outlying units. It is also pointed out that such units are uneconomical so far as surgical procedures are concerned." Morgan then stated the case for the continuation of surgical treatment by "good selection of cases". He opined that the cottage hospital offered the following advantages:[23]

- Patients preferred the intimate atmosphere
- Patients were given a greater sense of individuality
- The family doctor got more job satisfaction
- The generalist was enabled to contribute information omitted from the letter of referral, and to answer patients' queries of a confidential nature.

In the same issue of The Practitioner (June 1973) Dr Paul Barclay, who held the DA, published an article titled 'The General-Practitioner Anaesthetist'. Besides his general practice in Norfolk, he became anaesthetist for Cromer Hospital in 1947 and saw the continuing change introduced by the NHS. He was able to take on the general anaesthetics of his own patients and thought that they were no longer fearful of 'going under' because they knew the anaesthetist. He suggested that that the general practitioner's intimate knowledge his own patient was of great value to the administration of anaesthesia, providing "the ability to interpret certain indefinable qualities of vitality and spirit". To him the clinical involvement of the general practitioner before and after the anaesthetic was very rewarding. He recalled that in 1967 visiting surgeons had discovered the potential of the hospital to reduce their waiting lists and so introduced more and longer operating sessions. Looking to the future he noted that with likely service expansion, there was the threat that anaesthetics would have its own department. He stated that his general practice work could not be reduced, whilst his anaesthetic sessions could; and he believed that below an indefinable minimum amount of anaesthetics work could prove inadequate for maintenance of a reliable standard – something he hoped he would never be faced with.[24]

In 1974 Eric Wilkes, Professor of Community Care and General Practice at Sheffield University, published on 'Anaesthetics and the general practitioner', based on a paper he had read to the Faculty of Anaesthetists at the Royal College of Surgeons in June 1973. He noted that "the occasional anaesthetist ……. has few friends now" and that the specialty of anaesthetics had now grown to provide at a district general hospital approximately one consultant anaesthetist to every 41000 people, the best ratio of all the specialties. This was "associated with a massive but undocumented decline in the number of general practitioners who give anaesthetics".[25] Wilkes led three surveys as follows.

(1) In a North Midlands city (? Sheffield): of nearly 250 doctors on its executive council list, only 17 (7%) gave anaesthetics - just 3 of these 17 held the DA.

(2) In peripheral towns of the region, 38 part-time general-practitioner clinical assistants in anaesthetics (only three holding the DA) did 77 anaesthetic sessions/week (mainly surgical, dental, and gynaecology). Their contribution equated to anaesthetising 325 patients per week (15000 per year).

(3) Holders of the DA. Through 1962-1970 the DA was obtained by 2062 doctors. Of these more than 50% were abroad or not listed in the Medical Directory, and 25% were employed in hospital but not in general practice. This left about 450 who were circularised, and 263 replied – revealing 138 general practitioners doing part-time anaesthetics. Again, their anaesthetic sessions were mainly surgical, dental, and gynaecology. Their anaesthetic workload was about 830 patients per week (about 40000 patients per year).[25]

Articles on anaesthesia ceased in The Practitioner after 1980, an indication that this was no longer considered an area in which general practitioners should be involved. Figures from the 1987 Confidential Enquiry into Perioperative Deaths (CEPOD) Report reveal the decline in use of general-practitioner anaesthetists in the Thames Hospitals to just 0.4%.[26]

A few general practitioners continued to act as anaesthetists, particularly in private practice, into the 1990s. A Department of Health enquiry into general anaesthesia in outpatient dental practice led to the Poswillo Report of 1990. One of its important proposals was that that doctors and dentists administering general anaesthesia or sedation should have postgraduate training; those with knowledge and experience should be allowed to continue, provided they could satisfy the College of Anaesthetists of their competence, with periodic reassessment.[27] Further, in 1998 the General Dental Council issued new ethical guidelines limiting the administration of general anaesthesia to medically qualified specialist anaesthetists.[28]

Certainly, regarding hospital practice, credit is due to the general-practitioner anaesthetists who provided a valuable service at a time when the surgical services could not have coped without them.

References

1. Ellis RH (Ed.). The Case Books of Dr. John Snow. London: Wellcome Institute for the History of Medicine, 1994.
2. Correspondent. J Frederick William Silk, MD. British Journal of Anaesthesia 1926-27; 4: 178-81.
3. Emrys-Roberts M. The Cottage Hospitals 1859-1990. Motcombe, Dorset: Tern Publications, 1991.
4. Watson JH. Operations in private houses. The Practitioner 1933; 130: 274-85.
5. Moir E. Correspondence. British Journal of Anaesthesia 1930-31; 8: 79.
6. Boulton TB. The Association of Anaesthetists of Great Britain and Ireland 1932 – 1992 and The Development of the Specialty of Anaesthesia. London: AAGBI, 1999; 9.
7. Sykes WS. Essays on the First Hundred Years of Anaesthesia. Volume 1. Edinburgh: E&S Livingstone Ltd., 1960; 115.
8. Boulton TB. The Association of Anaesthetists of Great Britain and Ireland 1932 – 1992 and The Development of the Specialty of Anaesthesia. London: AAGBI, 1999; 24-25.
9. Mennel Z. Modified Junker bottle for maternity analgesia. The Practitioner 1933; 130: 519.
10. Lukis DH. Problems of Anaesthesia in General Practice. London: Hodder & Stoughton, 1935; 2-7.
11. Sykes WS. Anaesthesia, its present and future. British Journal of Anaesthesia 1935; 13: 28-32 and 41-53.
12. Boulton TB. The Association of Anaesthetists of Great Britain and Ireland 1932 – 1992 and The Development of the Specialty of Anaesthesia. London: AAGBI, 1999; 79.

13. Lukis DH. Choice of Anaesthetic in General Practice. British Medical Journal 1937; 2: 126-28.
14. Mackenzie JR. Practical Anaesthetics for students, hospital residents and practitioners. (Second Edn.) London: Baillière, Tindall & Cox, 1946.
15. Gillies J. Analyses of replies to a questionnaire on the use of chloroform at the present time. Anaesthesia 1948; 3: 45-52.
16. Boulton TB. The Association of Anaesthetists of Great Britain and Ireland 1932 – 1992 and The Development of the Specialty of Anaesthesia. London: AAGBI, 1999; 131.
17. Mushin WW. Book Review. Anaesthesia in General Practice. British Medical Journal 1954; 2: 1275.
18. Boulton TB. The Association of Anaesthetists of Great Britain and Ireland 1932 – 1992 and The Development of the Specialty of Anaesthesia. London: AAGBI, 1999; 136, 203, 206.
19. Rutter PEH. Anaesthesia in domiciliary midwifery. J. Coll Gen Practit 1965; 10: 45-50.
20. Payne JP. Current Therapeutics: CCXXL. Inhalational Anaesthesia. The Practitioner 1966; 166: 721-29.
21. Bloomfield E. Vasectomy and IV anaesthesia in a health centre. The Practitioner 1972; 209: 76-78.
22. Lee JA, Atkinson RS. A Synopsis of Anaesthesia (6th Edn). Bristol: John Wright and Sons Ltd., 1968; 288-89.
23. Morgan D. The General Practitioner Hospital. The Practitioner 1973; 210: 739-42.
24. Barclay PS. The General-Practitioner Anaesthetist. The Practitioner 1973; 210: 753-8.
25. Wilkes E. Anaesthetics and the general practitioner. Journal of the Royal College of General Practitioners 1974; 24: 413-15.
26. Buck N, Devlin HB, Lunn J. The Report of a Confidential Enquiry into Perioperative Deaths. London: Nuffield Provincial Hospitals Trust, 1987; 63.

27. Poswillo DE. Chairman. Report of an Expert Working Party. General Anaesthesia, Sedation and Resuscitation in Dentistry. London: Standing Dental Advisory Committee Department of Health, 1990.
28. Strunin L. President's Statement. Royal College of Anaesthetists Newsletter 1999; 44 (January): 1-3.

The DA(RCP&S) 1953-79:
"Given away with a packet of cigarettes"?

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A previous presentation (Cirencester meeting, 2022) described the origins, implementation and working of the DA from 1935 until 1953, a key time being 1948. In a move to ensure that specialist anaesthetists would be eligible for consultant appointments in the new NHS, the diploma became a two-part examination set (nominally at least) at fellowship standard. The Faculty of Anaesthetists was instituted at the same time, but the definitive fellowship (FFARCS) was awarded only by election. However, the two-part DA examination proved to be unsatisfactory, and in 1952 it was agreed that a new examination, leading to the FFARCS, would be introduced. Half the Board of Faculty thought that the DA should be abolished, but it continued (albeit at a lower standard because it was no longer the 'definitive' qualification) in 1953 for two reasons:

1. Clinical services in the UK were still very dependent on the contribution of GP anaesthetists and its was accepted that the DA would provide useful 'screening' of suitability for the role.

2. DA examination fees made a significant contribution to the income of the Conjoint (RCP/RCS) Board (CB) which administered the examination, and the implication is that maintaining this income would keep the new Faculty in favour with two Royal Colleges.

Informally it was agreed that the DA would revert to its previous arrangements, particularly that its examiners would all be anaesthetists. Unfortunately, the CB's formal recommendation was that a physician and surgeon would be members of a group of four examiners, this meaning that the 20-minute oral component would comprise only 10 minutes on anaesthesia and five each on medicine and surgery, inadequate for each really. This change, and others, did not become known to the Board of Faculty until they had been approved by both College Councils, and it is hard to resist the feeling that the new Faculty had been put firmly 'in its place'. Unsurprisingly this brought about a complete breakdown in communication between the Faculty and the CB that lasted for a decade. Although the anaesthetist examiners were eminent members of the specialty there was resistance to formal input from any anaesthetic organisation so the DA was run literally 'in isolation'.

The same was true, in varying degrees, of other CB diplomas and applied even to the LRCP/MRCS, their basic medical qualification. Ultimately two factors were to bring the Board down:

1. The first was change in attitudes to post-graduate training and examination driven by the huge expansion in medical knowledge after the Second World War, and more specifically the view that assessment should be integrated with education. Arguably the 'Todd' Report of 1968 was the most important of the outside influences which put pressure on the CB, and 'Todd' had selected the DA for particular criticism.

2. The second problem was overload, overload of the CB's workings and its members. They were a group of nine, a lay Secretary and eight College Fellows, each of the latter, including both Presidents, also having other responsibilities. They had become responsible for a basic medical qualification, 14 specialist postgraduate diplomas

and the administration of all aspects of a large, decaying building (in Queen Square, London) known as Examinations Hall.

Dealing with the building and the academic criticism led to distraction from oversight of the various examinations, but the CB (particularly the RCP representatives) continued to resist change, and the Faculty did not achieve formal input to the DA until 1972. Full control was achieved in 1980, but only because the costs of Examination Hall forced the CB's hand and its demise became inevitable. Having achieved control the Faculty began a process of examination restructuring, the result being that after fighting the CB for many years the Board of Faculty fought one another for three years! Inevitably a compromise, the result was the (unloved?) three-part fellowship, introduced in 1985, with the DA (now 'DAEng') awarded on passing the Part 1 examination, completing 12 months of approved training and, of course, paying the fee, not that many did! So, 1984 saw the end of the DA as a free-standing qualification and, after another decade, the unpopularity of the three-part examination led to reversion to two parts with the DA (DA'UK' after separation from the RCS) finally consigned to history.

Acute pain service in Pakistan:
Development, Challenges and Milestones

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Acute pain management continues to be a challenge despite advancement in the field, and is often inadequately treated, leading to patient anxiety and distress. The importance of formal acute pain services (APS) in improving acute postoperative pain management has been recognized for many decades and since the 1980s, these services have been established in most major hospitals of the developed world. However, in many low-middle income countries, APSs are yet to be established or are functional only in major tertiary care centers. In Pakistan, formal APS was first established in 2001 at Aga Khan University Hospital, Karachi, and functioned as an anaesthesiologist-based model comprising of two consultants and a rotating resident. In 2002 APS team was successful in getting financial approval for a pain nurse.

Challenges faced

- Lack of knowledge among physicians, nurses and patients
- Lack of funds and resources (PCA pumps, etc.)
- Lack of expertise in regional anaesthetic techniques and nerve blocks
- Drug availability issues
- Lack of trained anaesthesiologists and nurses

Achievements by APS

- Standardization of pain assessment method and documentation
- Introduction of new modalities like patient-controlled analgesia (PCA)
- Early detection and management of complications
- Publication of guidelines for nurses for PCA and epidural infusions
- Education of medical and nursing staff on the wards
- Regular audits to improve service provision and quality indicators

By 2010: There were 4 approved positions for pain nurses providing 24-hour dedicated cover for acute pain. Nurses conducted regular teaching sessions for ward-nurses to establish a hub-and-spoke model for acute pain cover throughout the hospital.

Training sessions to expand services: APS team at Aga Khan University Hospital conducted several acute pain courses and workshops for anaesthesiologists and nurses of other tertiary care hospitals of the region, often travelling to other cities to conduct teaching sessions. We were able to obtain funds for these activities through International Association for the Study of Pain (IASP) grants. Acute pain services have now been established in many major tertiary care centers of the region.

Status in 2025: There are five dedicated and trained pain consultants, four pain-nurses, two pain fellows, and two rotating residents, ensuring 24-hour comprehensive APS cover. Additionally, there is availability of several PCA pumps and ultrasound machines and improved drug availability enabling successful implementation of the required pain management strategies.

Evolution from Pain Services to Fellowship Program (1979-2025):
The LMIC Experience.

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The evolution of pain medicine in Pakistan represents a groundbreaking journey from the inception of pain services to the establishment a College of Physicians and Surgeons Pakistan (CPSP) accredited Pain Fellowship program. This journey highlights the anaesthesia faculty's commitment to promoting pain medicine in low- and middle-income countries (LMIC). This abstract provides an overview of the service evolution, the challenges encountered, and the significant milestones achieved toward academic excellence and improved patient care.

The initiative began with the visionary leadership of Brig (R) M. Salim, a pioneering figure, who identified a significant gap in pain medicine in Pakistan. In 1979, he established the country's first pain clinic at the Army Medical College, Rawalpindi. This was soon followed by similar services in various Combined Military Hospitals (CMH) supported by Maj Gen (R) Amjad Iqbal and Brig Asif Kayani (R). Between 1979 -1997, pain services outside of military hospitals were virtually non-existent in both public and private healthcare institutions across Pakistan. Aga Khan University (AKU), the country's first private international medical university established in 1985, stepped forward to address this critical gap in health care. The Department of Anaesthesia at AKU led the way by establishing the first formal chronic pain service which included an outpatient pain clinic and in-patient consultations in 1998. Dr. Gauhar

Afshan played a leading role in this initiative after receiving specialized training at the Pain Management Centre, Queen's Medical University, Nottingham, UK in 1998. This was followed by the establishment of pain clinics in Lahore by Dr. Khalid Basheer in 1998, and at Holy Family Hospital, Rawalpindi by Dr. Salman Saleem in 1999. After 2000, the number of pain clinics began to grow steadily across the country, and today, most major teaching hospitals offer outpatient pain clinics. However, until 2001, there was no structured acute pain management service in Pakistan. Recognizing this critical gap, AKU took the lead and established the country's first formal acute pain service in 2001.

Recognizing the urgent need for specialized training in this field, AKU also launched its first pain medicine fellowship program in 2005. In the same year, an MSc in Pain Medicine program was also started by Brig (R) M. Salim at Riphah International University, Islamabad, further reflecting national efforts to formalize pain education. Building on these developments, the faculty sought to further institutionalize Pain Medicine in Pakistan by developing a formal Pain Fellowship program under the College of Physicians and Surgeons Pakistan (CPSP). The establishment of the CPSP Pain Fellowship program involved comprehensive curriculum development and delivery, and upgrading of training infrastructure to fulfil both academic and clinical training requirements. Key milestones included the formulation of competency-based learning objectives, the incorporation of multidisciplinary clinical rotations, and the integration of research and scholarship as core components of the program. These advancements played a pivotal role in strengthening pain management in Pakistan by offering a structured, academic pathway for training the next generation of pain medicine specialists.

Da Costa's Syndrome

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Anaesthetists are familiar with the Da Costa syndrome, also known as 'Soldier's heart', after cardiac irregularities which were first noticed in the American Civil War, then in the Boer War, causing soldiers to be declared unfit and therefore discharged and pensioned off.

This problem was investigated at the Mount Vernon Hospital in Highgate, by James Mackenzie and Thomas Lewis, who had an interest in heart function. At the onset of World War I, the problem increased so the investigation and proposed treatment moved to the Colchester Military Hospital, where Sobroan Barracks was taken over and became the Colchester Military Heart Hospital.

Professors Albutt and Osler, as well as Mackenzie and Lewis and later American physicians became involved in the research. The result was differentiating functional effects on the heart i.e. valvular disease, from a normal heart effected by stress. The latter responded to exercise and gradual rehabilitation.

The end result was that a useful system of assessment was developed, which was originally used for pensions with the Admiralty and then by the Pensions Ministry. Similar post-traumatic ailments arose following Railway accidents and later motor car accidents.

Dr. Ernst Silten (Silberstein) (1866-1943) and the Jewish Medical Community in Berlin Before the Shoah: *a Thriving, International Epicentre of Modern Oxygen Therapy and Anaesthesia-Related Technology (c. 1890s-1930s)*

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Introduction

It is well known that since c. 1902 collaborations involving the Dräger Company (est. 1889, Lübeck, Germany) were internationally leading innovators of anaesthesia-related technology. It is much less known that after the rise of the Nazi-Dictatorship in Germany (1933-1945) this network was adversely affected by the regime's toxic ideologies and criminality, even before WW II and the Holocaust had begun. Until this time most of the (inter)national relations of the Dräger-led conglomerate were managed by two Jewish-owned subsidiaries: the fate and international relevance of the German-British businessman Richard Jacobson (1877 – 1957) was reported recently.[1] In this paper details are presented on a second key-player, his wider background and context in Berlin, and their importance for international anaesthesia, oxygen therapy and related medical technology.

Ernst Silberstein-Silten: *early biography and historical context*

Dr. Ernst Silten (1866-1943)[2-7] was born as Ernst Silberstein into a Jewish family in the Prussian city of in Königsberg, Germany (now: Kaliningrad, Russia). He studied chemistry and pharmacology, initially in Berlin. Around 1894 he transferred to Rostock. There he obtained around

1896 a PhD (Dr. phil.)[8], mentored by the internationally prominent Karl Arnold August Michaelis (1847-1916), who held a professorship for chemistry and pharmacology at Rostock University (1890 – 1916).[9] Silberstein then spent several years as an apprentice, before he bought his own pharmacy in 1899 [*"Kaiser–Friedrich-Apotheke"* (Emperor Fredrick Pharmacy), (est. 1888, Karlstraße 21, Berlin-Mitte; today: Galenus-Apotheke, Reinhardtstraße 5)].[6,7]

Figure 1: Portrait Photograph (1935) of Dr. Ernst Silten (Dräger Archiv, Lübeck).

In 1900 he married Marta Friedberg (1877-1943)[10], likewise a member of the Jewish community and soon they had two sons: Heinz (later Henry) (1901-1953) and Dr. Fritz Silten (1904-1980).[3]

Silberstein immediately began to diversify his business – initially by combining it with a specialist pharmaceutical factory and workshop: His *"Sauerstoff-Centrale Berlin, Dr. Ernst Silberstein"* mainly produced and marketed compressed oxygen (in German: "Sauerstoff") and devices for its therapeutic application. He initially supplied hospitals in and around Berlin. The motives for this diversification lay partially in his earlier interests.[6,7] At least as important, however, were the opportunities offered to him by the very location of his new firm, in the very heart of a growing metropolis and in the neighbourhood of its already then world-famous Charité University Hospital.

Figure 2: Sauerstoff-Centrale and Kaiser Friedrich Pharmacy, Berlin. Marketing Pamphlet [Oxygen- and inhalation therapy]. Berlin, Germany, c. 1906.[6] (Dräger Archiv, Lübeck).

Sauerstoff-Centrale
für alle medicinischen u. Rettungszwecke

Kaiser Friedrich-Apotheke
Dr. Ernst Silberstein
Berlin NW. 6. + Karlstrasse 20a

Sauerstoff-Inhalationen

bei
Asthma
Keuchhusten
Herz-, Lungen- u.
Blut-Krankheiten

in Verbindung u. A.
mit Mentholöl
Cypressenöl
Kreosot
Fichtennadelöl

Die umstehenden Apparate Nr. 3 und 4 sind in ca. 400 Fällen im Jahre 1905 leihweise abgegeben und zum grossen Teile mit sehr guten Erfolgen angewendet worden. U. A. wurden die Apparate verordnet:

Wirkl. Geh. Rat Exc. von Bergmann	Professor A. Fraenkel	Dr. Josephsohn
Geh. Med.-Rat Dr. von Leyden	Professor Rosin	Dr. Wolff
Geh. Med.-Rat Prof. Dr. Hoffa	Professor Krause	Dr. Thalheim
Geh. Med.-Rat Heubner	San.-Rat Dr. Riedel	Dr. Loewenthal
Geh. Med.-Rat Senator	San.-Rat Dr. Schlesinger	Dr. Zoelzer
Geh. Med.-Rat Prof. Goldscheider	San.-Rat Dr. Benda	Dr. Kirchhoff
Geh. San.-Rat Dr. Blumenthal	Dr. Heubach	Dr. Mannheim
Geh. San.-Rat Dr. Hoffmeier	Dr. Levi	Dr. Katzenstein

und viele Andere.

Auf telephonische Bestellung wird Sauerstoff nebst Inhalations-Apparat umgehend zugesendet. — Fernsprecher Amt III, Nr. 1020.

Around the time Ernst Silberstein arrived in Berlin, Germany and its new capital (since 1870) saw a period of peace, growth and prosperity. It lasted a - previously unprecedented - entire generation. The economy expanded massively. In the field of medicine and related research Berlin rapidly became a hotbed for international progress ("Berliner Medizin").[6] Its probably most prominent centre of excellence and pioneers were the above-mentioned Charité Hospital (est. 1710-1727), alongside Robert Koch (1843-1910) and Rudolf Virchow (1821-1902).[6]

An early specialist treatment centre for oxygen- and inhalation Therapy and pneumatic medicine

Around the late 18th century Berlin was already at the international forefront of emerging techniques of "*pneumatic medicine"* and *"oxygen therapy"*.[11] By c. 1782 an early specialist treatment centre had been established at the Charité. In keeping with Berlin-Brandenburg's longstanding Huguenot connections to France (since c. 1685-1700) it was an international joint venture: the main promotors on the German side were the royal physician Christian Gottlieb Selle (1748-1800), King

Frederick the Great of Prussia (1712-1786), his brother Prince Heinrich (1726-1802), and the Huguenot Berlin chemist Franz Carl Achard (1754-1821). In France their best-known contact identified so far was the polymath and encyclopaedist Jean le Rond D'Alembert (1717-1783), a friend of the Prussian philosopher-king.[11] In terms of wider international and historical contexts this episode is important, as the German-French cooperation *predates* the *"Pneumatic Institute for inhalation gas therapy"* (Bristol, UK, c. 1798 – 1802): famously founded by Thomas Beddoes (1760-1808), Humphry Davy (1778-1829) and James Watt (1736-1819), it is often claimed to have been the "first" such specialist centre ever founded.[11]

At the time Paris was an epicentre of the European "enlightenment". Contemporaneous French contributions and publications in the field of oxygen therapy and pneumatic medicine are numerous.[11-13] Berlin, by comparison, was then still a relative "backwater". Hence, it seems probable that even *before* the centre at the Charité comparable institutions existed elsewhere, which have not been explicitly reported as such in subsequent historiography.

Moreover, from the late 1850s to the 1880s one of the internationally most prominent pioneers of "pneumatic medicine" was likewise based in Berlin: Louis Waldenburg (1837-1881), who authored influential publications, textbooks and designed apparatus.[14]
Related public-health-achievements promptly found their way into the very fabric of the city - and into its population's sense of identity: quickly ballooning from a medium-sized town into a genuine metropolis, Berlin retained to this day a generous layout, spacious parks and lush forests, pleasantly situated in a network of lakes, canals and rivers. Those help to absorb the dirt and noise of industry and traffic and preserve a high quality of life. In recognition, both the city's unofficial "anthem", alongside one of its favourite beverages, celebrate what became known since the early 1900s as the *proverbially* fresh and healthy "Berlin Air" ("Die Berliner Luft-Luft-Luft").

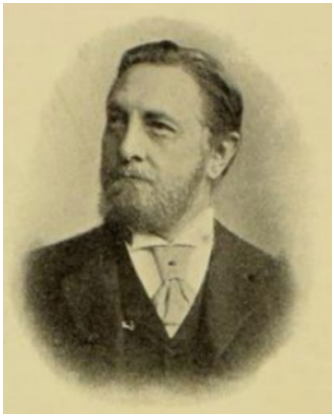
The advent of "modern" oxygen therapy: *well before WW I (1914-1918) and Britain's John Scott Haldane !*

Following a gradual, international and multifactorial demise of "early" oxygen therapy over the 19th century, between the 1890s and early 1900s numerous members and institutions of Berlin's then thriving Jewish Community played prominent roles in facilitating an early and important "breakthrough" of recognizably "modern" and efficient inhaled oxygen therapy. [11,12,15-18]

Yet again, this probably began at the Charité, where Ernst von Leyden (1832-1910) had become its first Jewish professor and chair of Medicine in 1876. His main specialty was pulmonology, which he furthered by promoting public health, prevention and treatment (e.g., TBC), not least in specialist hospitals for lung diseases, inhalation therapy and balneology. He also became publicly recognized, not least as personal physician to e.g. the German chancellor Otto von Bismarck (1815-1898). Alongside his disciple Max Hugo Michaelis (1869-1933)[12,16,19] (apparently not related with Silberstein's above mentor in Rostock), von Leyden is credited in Germany and central Europe with having subsequently (c. 1890s-1900s) "re-established" oxygen therapy -- increasingly on a recognizably "modern" footing.[11,15,16]

Trained and mentored by von Leyden (since 1891), Michaelis obtained his PhD in 1893 and rose through the hierarchy at the Charité. His early involvement with oxygen therapy was matched by his special interest in cardiology and tuberculosis. He gained associate professorship ("Habilitation") around 1898[19,20] and then switched to the Jewish Hospital in Berlin (est. 1756).[21] Supported by a network of clinical colleagues and allied authors[22-31] he transformed the institution into Europe's probably leading centre in the field.

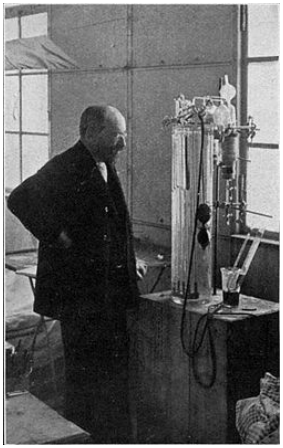
Figure 3 & 4: Ernst von Leyden (1832-1910) (left; c. 1900)[19] and Max Hugo Michaelis (1869-1933) (right; c. 1900)[19] – two early, Berlin-based pioneers of recognizably "modern" oxygen therapy (c. 1890s – early 1900s).



The internationally influential physiologists Nathan Zuntz (1847 - 1920) and his disciple Adolf Loewy (alternative spelling: Löwy; 1862 – 1937) completed the team with ground-breaking research in the fields of respiration, metabolism and high altitude medicine.[32-36] They became important, pioneering mentors to the famous British physiologist John Scott Haldane (1860 – 1936) and his subsequent circle in Britain and the USA.[18]

Apart from closely cooperating with numerous other international colleagues (which included several joint high-altitude expeditions)[18,35], Zuntz and Loewy also acknowledged - in a 500 pages textbook on the topic (1906)[35] - their own forbearers with a detailed, 33-page historical account. Even most of their methods, apparatus and results were already comparable with those of colleagues, who subsequently followed in their footsteps – most famously during an Anglo-American expedition to Pikes Peak[18] [Colorado, USA (1911)]: It was *later* (revealingly: mostly after WW II) claimed to have been the - allegedly - *"most important high-altitude expedition in the early 20th century".*[37]

Figure 5 & 6: Nathan Zuntz (1847 - 1920) (left) and Adolf Loewy (1862 – 1937) (right), conducting physiologic experiments in high-altitude environments, c. 1905.[35]



Apart from promoting inhaled oxygen therapy since around the 1890s, Michaelis began designing devices for this purpose.

Figure 7: Marketing pamphlet (undated, c. 1901) of the "Sauerstoff-Fabrik Berlin, G.m.b.H." for the Wohlgemuth chloroform-oxygen anaesthesia apparatus (since c. 1900 / 1901) (left) and Max Michaelis oxygen inhalation apparatus (since 1890s) (right). (Dräger Archiv, Lübeck).

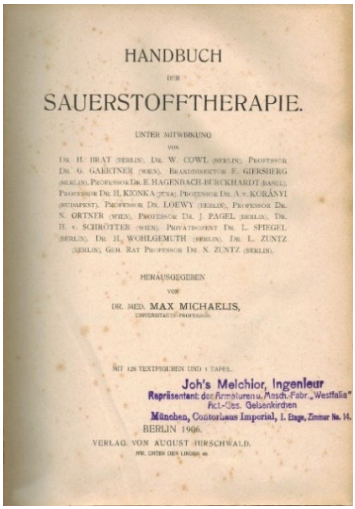

Sauerstoff-Fabrik Berlin, G. m. b. H.

Berlin N., Tegeler Strasse 15.

Auszeichnungen:

He also edited and co-authored a remarkably comprehensive and internationally influential textbook on the topic: The "Handbuch der Sauerstofftherapie" ("Handbook of Oxygen Therapy"). It appeared in 1906 and was dedicated by Michaelis and his colleagues to von Leyden.

Figure 8: Front page of Michaelis's 550-page "Handbook of Oxygen Therapy" (1906).[15]


HANDBUCH

DER

SAUERSTOFFTHERAPIE.

UNTER MITWIRKUNG

VON

HERAUSGEGEBEN

VON

DR. MED. MAX MICHAELIS,

MIT 128 TEXTFIGUREN UND 1 TAFEL.

Joh's Melchior, Ingenieur
Repräsentant der Armaturen u. Masch.-Fabr. „Westfalia"
Fil.-Ges. Gelsenkirchen
München, Cottorlaus Imperial, I. Etage, Zimmer No. 14.

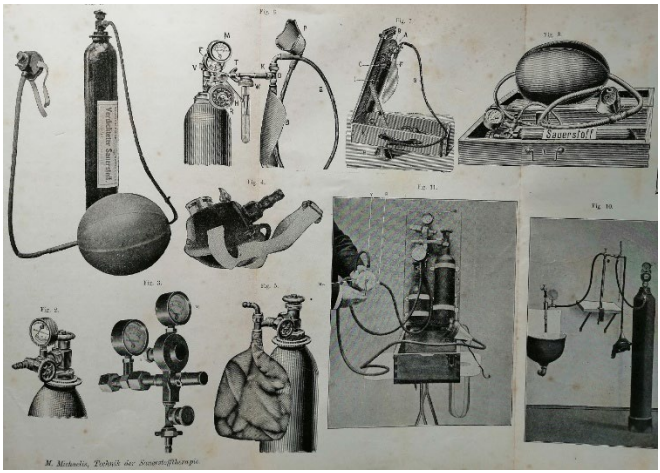
BERLIN 1906.

VERLAG VON AUGUST HIRSCHWALD.

Hence, *both* Michaelis's internationally influential textbook *and* his related apparatus predate by more than a decade *matching* WW I - treatment reports and devices[38-40], for which Britain's Haldane was only much later (likewise since after WW II)[41] graced with the - demonstrably incorrect[18] - titles "founder", or "father" of oxygen therapy.

Figure 9 -13: A "genealogy" of apparatus (1901 – 1906 – 1916 – 1918), which illustrate the advent of recognizably "modern" oxygen therapy (c. 1890s-1900s) – well *before* WW I (1914-1918) and the involvement of J. S. Haldane.[42]

Figure 9: A page with illustrations of contemporary apparatus from Max Michaelis's prominent German-language textbook on oxygen-therapy (1906).[15]



The illustrations date from a transitional phase, when the previous, basic technology was increasingly replaced with the incoming technology of highly compressed gases and its

recognizably *modern* appliances. *Defining* features of the *outgoing* technology (since around the early to mid-1800s) had been cast-iron cylinders, moderate gas compression, basic (mostly open-close) valves, intermittent gas supply, rebreathing bags [Figure 7 (above): Michaelis apparatus] and mostly thermolytic (i.e., chemically often contaminated) gas production-processes. Important *innovations of the new technology* were steel cylinders, much higher levels of gas compression (more economical), reliable pressure reducers and manometers, continuous, reliably controlled, and mostly oxygen-enriched gas supply, precision dosimetry, and cleaner and more economical gas-production processes.[42]

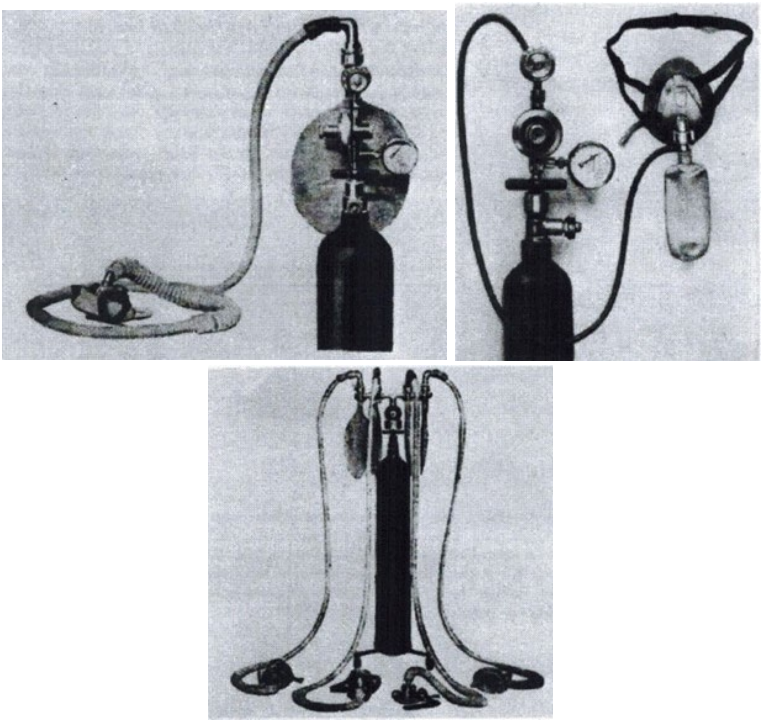
The relevant chapter in Michaelis's textbook acknowledges and illustrates the technological progress. The leading role and contributions of Dräger and their temporary cooperation partner, the Berliner Sauerstoff-Fabrik G.m.b.H., are explicitly noted.[15] The European oxygen-therapy devices depicted on either end of the top row (Max Michaelis & Berliner Sauerstoff-Fabrik G.m.b.H.; c. 1900) use a mix of incoming and outgoing design principles ("Hybrid" apparatus) (i.e., no, or basic pressure reducers; rebreathing bags for intermittent oxygen-supply). Most other devices and appliances shown already represent the more advanced, or modern technology: the Dräger Sauerstoffkoffer [Oxygen Trunk] (top row: third from left) and the Dräger inhalation device next to it (top row: second from left) were both marketed since c. 1902. The same applies for the Brat Apparatus [c. 1905; bottom row: second from right)].[42] Similarly, publications on oxygen for treating gas victims across continental Europe also predate the supposedly "first" publication by Haldane.

Figure 10: Oxygen-inhalation of gas-victims in a German WW I field hospital (autumn 1916). The relevant publication predates Haldane's alleged "first" publication on the matter. More importantly, it acknowledges that by that time *"the therapeutic properties of pure oxygen in gas-intoxications had been common knowledge for decades".*[42]

Bild 14. Sauerstoff-Inhalation Gaserkrankter in einem Feldlazarett.

Sauerstoff-Inhalation im Felde.

Figure 11-13: The earliest devices, which were used by Haldane for oxygen-inhalation of gas-victims during WW I (c. 1917, left; c. 1918 / 1919, center and right) [Manufacturer: Siebe Gorman, London, UK]. Technologically and clinically, they are copies of apparatus, which had been introduced across continental Europe since c. 1900.[18,42]



Chemistry, pharmacology, toxicology, health-and-safety & resuscitation

A leading promotor of related research in the fields of chemistry, pharmacology, toxicology and (also preventative) health-and-safety technology was the still existing AGFA-company[17,43] ("Aktiengesellschaft für Anilinfabrikation"). Co-founded (c. 1850-1873) by Paul Felix Abraham Mendelssohn Bartholdy (1841-1880), it was originally based in Berlin-Rummelsburg.[17] The Mendelssohn dynasty were not only bankers but gradually acquired a large industrial conglomerate. With medicine and the evolving discipline of anaesthesia they shared an emphasis on risk

awareness and enlightened ethics. These were also reflected in their "trademark": The watchful crane, who reassuringly *stands guard* ("Ich Wach") over his flock -- according to legend with a stone clenched in one raised claw. It would drop with a splash into shallow waters, if his alertness were to slip - and hence prevent him from falling asleep on a job, on which the safety and welfare of others depend.[44,45]

Figure 14 & 15: Paul Felix Abraham Mendelssohn Bartholdy (1841-1880) (left) and the coat of arms of the Mendelssohn dynasty (right): It bears their safety-conscious motto "Ich Wach" ("I stand guard").

In keeping with their complex responsibilities, one of the leading medical employees of AGFA, Dr Heinrich Brat (1867-1908), became an important pioneer in the anaesthesia-related fields of pharmacology and toxicology, health and safety, oxygen therapy, ventilation and resuscitation and even anaesthesia apparatus.[17] His two most innovative contributions were the "Brat apparatus" for oxygen therapy and resuscitation of pre-WW I "gas victims" (mostly industrial or domestic gas accidents) (c. 1905 / 1906) and a machine for artificial ventilation and anaesthesia (c. 1908). Both were soon modified in technologically more sophisticated and commercially more successful Dräger developments.[17,27-31]

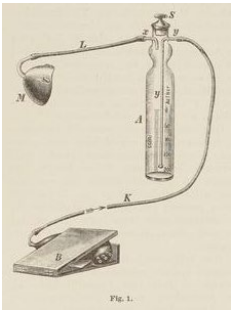
Figure 16: Dr. Heinrich Brat (1867-1909) – a forgotten Berlin pioneer of oxygen therapy, ventilation and anaesthesia technology.

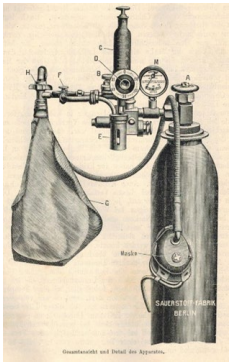
Contributions to the advent of ”modern” anaesthesia technology (c. 1894-1910)

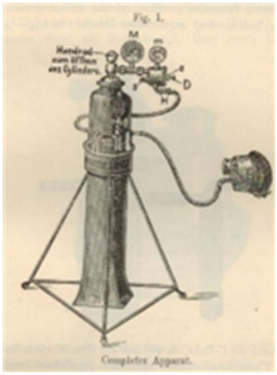
Almost from the very beginning Michaelis and his cluster made a deliberate point of encouraging surgeons to utilize the re-emerging therapy for anaesthesia and perioperative care: around 1894 Michaelis himself suggested a *blow-over* apparatus for ether anaesthesia[46] - a “bubble through”, or “sight-feed” technique, which had been used for much wider therapeutic and laboratory purposes since centuries before [e.g. the Woulff bottle, named after the Irish-American Peter Woulff (1727-1803), who published his “invention” in 1767].[47] Alongside Michaelis and Loewy the surgeon Heinz Wohlgemuth (1863-1936) likewise worked at the Jewish Hospital. Michaels prompted him to develop an early apparatus for chloroform-oxygen anaesthesia (c. 1899-1901).[16,48-51] It is widely considered the perhaps earliest “modern” anaesthesia apparatus, courtesy of the *defining signature-components* of routine oxygen supplementation, cylinders, specialist technology for compressed gases, dosimetry and respiratory support.[52] It was immediately - at least - *noted* in the USA[53] and exported as far afield as Japan.[54] Just another year later (1901/1902) it inspired the development of the much more successful Roth-Dräger apparatus (c. 1902).[16,50,53]

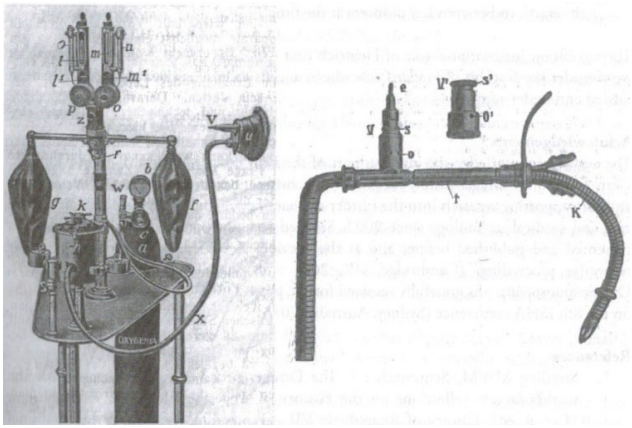
Figure 17 - 22: Noteworthy contributions of the circle around Max Michaelis, the Jewish Hospital and the Beliner Sauerstofffabrik to the field of anaesthesia and progressively “modern” anaesthesia technology (in chronological order).
Top: Michaelis blow-over apparatus for ether anaesthesia (1894).[46]

Centre: Two early versions of Heinz Wohlgemuth's apparatus for chloroform-oxygen anaesthesia (from c. 1900 / 1901 until c. 1911).[48,49] Bottom: Heinrich Brat apparatus for anaesthesia and artificial ventilation via endotracheal intubation (c. 1908).[17]









Unsurprisingly, Michaelis invited all colleagues mentioned above to contribute to his landmark textbook.

How Brat and the Berlin-based team around Michaelis and v. Leyden came tantalizingly close to solving the enigma of CO_2-physiology – and pioneered one of its most common clinical uses…

Brat's internationally influential apparatus for oxygen inhalation, resuscitation and artificial ventilation (c. 1905 / 1906)[17,59] also became a - nowadays under-recognized - pioneer in the field of the then most longstanding and controversial enigma of respiratory and anaesthesia-related physiology: the complexities, risks -and potential opportunities of the effects of carbon dioxide.

The design of Brat's apparatus[29] was based on empirical experiences and research with oxygen supplementation and ventilation in resuscitation, notably in industrial settings. Carbon gases and - chiefly - increased CO_2-levels had been long recognized as prognostically important factors.[30,31,55] Even a stimulating effect of CO_2 on the respiratory centre of the brain was at this time already postulated[55], but remained subject to controversial, mostly theory-based speculation without convincing proof. Unsurprisingly, many of the contemporary assumptions and theories are from today's perspective obsolete. They were mostly corrected by US-led research and developments since the late 1910s and the 1920s. Still, soon after its release Brat's apparatus had shown significant improvements of oxygen resuscitation via "artificial ventilation" (rather than just passively supplementing O_2). For this it was praised and supported by von Leyden, Michaelis and others.[55] The device delivered "alternating" artificial ventilation: Its positive pressure inspiration was driven by the decompressed oxygen. The negative-pressure (passive) expiration was additionally aided by suction.[17,29,59] The latter was generated by an injector. For practicality reasons this was *mostly* likewise driven by another compressed gas – carbon dioxide. In this process, CO_2 was added

to the gas mix, additionally stimulating the respiratory drive and hence adding another contributor to a better outcome - although this was then not fully understood. Technologically and physiologically, however, Brats' apparatus and technique then de facto already used – irrespective of their different (and now partially obsolete) rationales – the very same method and design, which was subsequently established (since around the mid-1920s) in the US-led developments on "carbon dioxide stimulation".

Berlin's continued contributions to the carbon-dioxide developments in the 1920s – an update on recent findings

Over the following two decades the Berlin cluster continued to exercise significant influence on developments in the field: an important breakthrough was later famously attributed to a cooperation between the US-physiologists Yandell Henderson (1873–1944) and Howard Haggard (1891–1959), who had turned for technological support to the then most innovative apparatus developer in America – Richard von 1960). Based on experiments which probably commenced around 1917, their joint apparatus for *adding* CO_2 to the gas flow - to stimulate the spontaneous breathing of anaesthetised patients - came out around 1925 ("Henderson-Coburn Carbon Dioxide Outfit", Foregger Inc., New York, USA).[56-58]

Close and regular discourse and cooperation between the involved *physiologists* on all related questions was long known – mostly with colleagues in the three leading European centres of the time: Copenhagen, Vienna and the Berlin-based team led by Zuntz and Loewy.[18,59]

On the *technological* side, a close trans-Atlantic cooperation also existed: throughout his career Foregger is known to have entertained friendly interaction and close cooperations with Dräger in Germany. Around the 1920s this helped him to upgrade and modernize his entire product range – e.g., with more advanced specialist components for highly compressed gases[42,53], and high precision dosimetry (in his case: water depressions flowmeters, or "Aquameters").[60] Unsurprisingly, it is

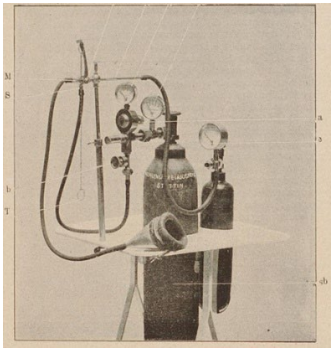
now proven that Foregger's *Henderson-Coburn Carbon Dioxide Outfit* was in fact also a *genuine collaboration* of him with the German circle around Dräger in Lübeck and – by then – Dr Ernst Silten in Berlin: for the US-apparatus the technologically decisive component was sourced by Foregger from the German market leader. Dräger and most of their medical cooperation partners in Europe had until this time been deeply skeptical about deliberate CO_2-stimulation. It is known that it was particularly Dräger's main marketing-partner Ernst Silten in Berlin, who lobbied around the same time his allies in the field of engineering and clinical medicine to more actively engage with the mostly US-led trend - and to broaden the product range accordingly.[42,59,61] Hence, when Henderson-Coburn-Foregger came out with their device (c. 1925), Dräger-Silten & Co. acknowledged their rationales[62,63], developed their own, slightly more sophisticated and safer device[59,60] and released it in various modifications around the same time.[64-66]

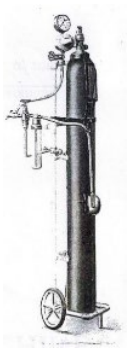
Figure 23 -31: A genealogy of early apparatus, which pioneered the support of artificial ventilation by stimulation of the brain's respiratory centre with carbon-dioxide.
Top row: Brat's apparatus for oxygen inhalation, resuscitation and artificial ventilation: Apparatus and schematics (Sauerstoff-Fabrik Berlin, Germany, c. 1905 / 1906). Note the smaller gas cylinder for CO_2-supplementation.
Centre row: The Henderson-Coburn-Foregger(-Dräger) "Carbon Dioxide Outfit for post-operative CO_2-inhalation" (Foregger Co., Inc., N.Y., USA, c. 1925).

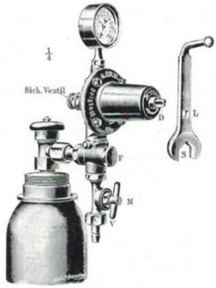
- **Left:** entire apparatus, with dosimetry (centre-left) [initially a "Henderson Bottle" (bubbler), then a Foregger-developed "inside (water depression) flowmeter"] and a pressure reducing valve on top (c. 1925).
- **Centre:** Enlarged detail of the pressure reducing valve of the same US-apparatus.
- **Right:** Dräger's "CO_2-Automat" (since c. 1899), which was used here to facilitate controlled CO_2- supplementation.

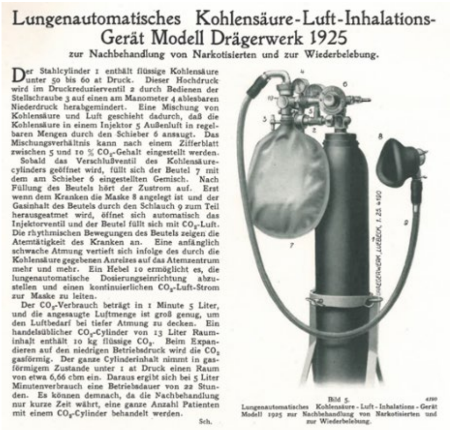
Bottom row: Dräger's matching developments for the contemporary German market (likewise c. 1925)

- **Left:** Apparatus for CO_2-inhalation in anaesthesia [Carbon Dioxide-air inhalation device Model Drägerwerk 1925 for post-operative treatment in anaesthesia and resuscitation under pressure-controlled respiration].
- **Centre:** Public announcement of the German company's major shift of physiologic stance in favour of the new doctrine of stimulating respiration in anaesthesia and resuscitation by supplementing CO_2.
- **Right:** Enlarged detail of the newly developed pressure reducer and injector for Dräger's above apparatus for CO_2-inhalation in anaesthesia – here used in Dräger's Oxygen-Carbon Dioxide Trunk for CO_2-inhalation in resuscitation (c. 1924/1925).









Lungenautomatisches Kohlensäure-Luft-Inhalations-Gerät Modell Drägerwerk 1925

zur Nachbehandlung von Narkotisierten und zur Wiederbelebung.

Der Stahlcylinder 1 enthält flüssige Kohlensäure unter 50 bis 60 at Druck. Dieser Hochdruck wird im Druckreduzierventil 2 durch Bedienen der Stellschraube 3 auf einen am Manometer 4 ablesbaren Niederdruck herabgemindert. Eine Mischung von Kohlensäure und Luft geschieht dadurch, daß die Kohlensäure in einem Injektor 5 Außenluft in regelbaren Mengen durch den Schieber 6 ansaugt. Das Mischungsverhältnis kann nach einem Zifferblatt zwischen 5 und 10 % CO_2-Gehalt eingestellt werden.

Sobald das Verschlußventil des Kohlensäurecylinders geöffnet wird, füllt sich der Beutel 7 mit dem am Schieber 6 eingestellten Gemisch. Nach Füllung des Beutels hört der Zustrom auf. Erst wenn dem Kranken die Maske 8 angelegt ist und der Gasinhalt des Beutels durch den Schlauch 9 zum Teil herausgeatmet wird, öffnet sich automatisch das Injektorventil und der Beutel füllt sich mit CO_2-Luft. Die rhythmischen Bewegungen des Beutels zeigen die Atemtätigkeit des Kranken an. Eine anfänglich schwache Atmung vertieft sich infolge des durch die Kohlensäure gegebenen Anreizes auf das Atemzentrum mehr und mehr. Ein Hebel 10 ermöglicht es, die lungenautomatische Dosierungseinrichtung abzustellen und einen kontinuierlichen CO_2-Luft-Strom zur Maske zu leiten.

Der CO_2-Verbrauch beträgt in 1 Minute 5 Liter, und die angesaugte Luftmenge ist groß genug, um den Luftbedarf bei tiefer Atmung zu decken. Ein handelsüblicher CO_2-Cylinder von 13 Liter Rauminhalt enthält 10 kg flüssige CO_2. Beim Expandieren auf den niedrigen Betriebsdruck wird die CO_2 gasförmig. Der ganze Cylinderinhalt nimmt in gasförmigem Zustande unter 1 at Druck einen Raum von etwa 6,66 cbm ein. Daraus ergibt sich bei 5 Liter Minutenverbrauch eine Betriebsdauer von 22 Stunden. Es können demnach, da die Nachbehandlung nur kurze Zeit währt, eine ganze Anzahl Patienten mit einem CO_2-Cylinder behandelt werden.

Sch.

Bild 5. 4190

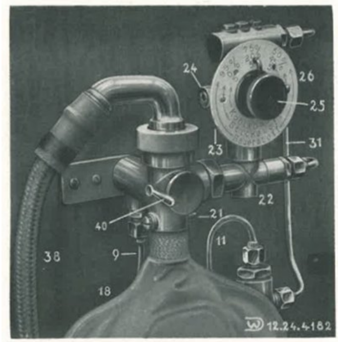
Lungenautomatisches Kohlensäure-Luft-Inhalations-Gerät Modell 1925 zur Nachbehandlung von Narkotisierten und zur Wiederbelebung.

Draeger-Hefte

Periodische Mitteilungen des Drägerwerkes, Lübeck.

Januar/Februar 1925 | Nummer 100

Grundsätzliche Umstellung der inhalatorischen Wiederbelebungsverfahren.



The Berlin Oxygen Factory (Sauerstoff-Fabrik Berlin)

Between the 1890s and mid-1900s the Berlin-based cluster around Max Michaelis, von Leyden, Brat and others mostly cooperated with one company, which supplied their gases and built their devices: The "Sauerstoff-Fabrik Berlin" [Tegeler Strasse 15, Berlin N 39 (Moabit /

Wedding)].[11,15,16,67-69] Founded in 1889 by the chemist Dr. (Rudolf) Theodor Elkan[69] (born: c. 1861)[70], the firm claimed to have been the first oxygen "factory" in Germany.[69] It soon became one of central Europe's most prominent providers of compressed gases for medical purposes (esp. oxygen and nitrous-oxide) and the devices required.[15] A marketing pamphlet from c. 1910 illustrates a wide product range, which mostly targeted the markets in the German and Austro-Hungarian Empires.[68]

Over the first two decades of its existence the firm successfully managed two technological transitions. These revolutionized oxygen *production* and therefore contributed decisively to lay the foundations of modern oxygen therapy.[71]

Initially, Elkan's factory still used traditional "chemical"[69], or "thermolytic" methods. These had dominated the production of oxygen and other medical gases since the 18th century: chemicals were heated, the released gases were purified and stored in either gasometers, breathing bags, or (since the c. 1820s/1830s) increasingly in metal cylinders.[47,71] Requiring large amounts of chemicals and fuel, the method was costly and inefficient. The produced gas was often contaminated, resulting in - at best - unpleasant smells, at worst toxic side-effects.[71] Apparently, public concerns (probably about odors released in the atmosphere, transport requirements and explosion risks) meant that Elkan had to build his factory outside the city.[69]

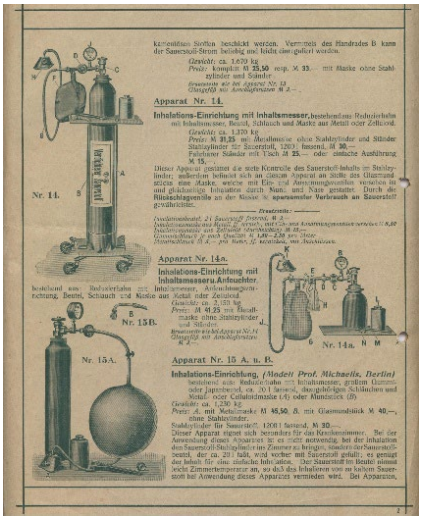
Soon afterwards Elkan switched to what the firm later called the "electrolytic method":[69] The *Brin process* (patented 1885) facilitated improved mass-production of oxygen. It had been invented by the French brothers and chemists Arthur and Leon Quentin Brin. To promote their invention internationally, they founded a firm in Britain - *Brin's Oxygen Company Ltd.* (est. c. 1885 / 1886). It was later renamed the *British Oxygen Company* (BOC) and is today part of the international Linde Group.[60,71]

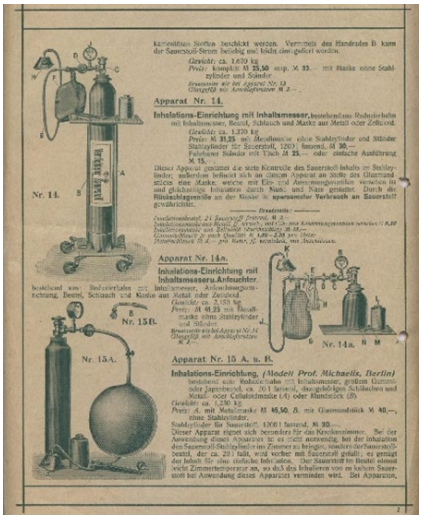
In the *early* 1900s the Sauerstoff-Fabrik was involved in a series of accidents (gas explosions), which were reported in Britain, Germany, and France. Around this time, it still used the Brin process. The accidents

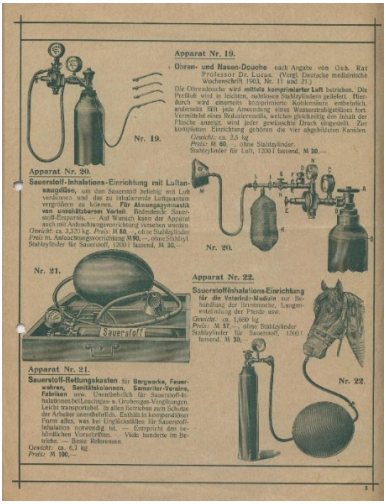
contributed to an about 10-year delay of the international introduction of modern technology for nitrous oxide-oxygen anaesthesia.[72]

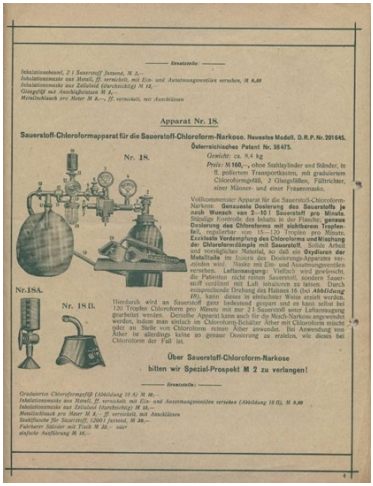
Since around the mid-1900s to early 1910s, the Brin process was in turn rendered obsolete by what the Berlin firm called the “physikalisches Verfahren” - the German-French invented Linde-Claude processes, which are still used today.[60,71] Contemporary German-American interactions[73] suggest that the transitions carried out in Berlin probably served as a template, or inspiration, on which - not much later - two prominent US-industrialists and their firms emulated their own modernization and restructuring of the entire sector: Albert Charles Clark (1868-1927) [A.C. Clark & Co (est. c. 1895, Chicago, Ill., USA)] and Graham Warren Clarke (1857-1943), alongside his network of companies, which clustered around the Ohio Chemical & Manufacturing Company (est. c. 1884-1910, Cleveland, Ohio). From c. 1910 onwards they both became hugely influential pioneers of modern “gas-anaesthesia” in the USA.[73]

Figure 32-34: Selected illustrations from a marketing pamphlet of the Sauerstoff-Fabrik Berlin (c. 1910).









Around 1900 the Sauerstoff-Fabrik as taken over by Dr. phil. Ludwig Michaelis[70] (*04.09.1869).[74,76] The firm is likewise on record as a Jewish-owned business, whose owners were dispossessed during the Nazi Dictatorship.[74] Ludwig Michaelis died around this time. His family later pursued redress. Most details of their personal tragedy, however, appear - so far - to be either unresearched, or lost altogether to the chaos and criminal injustice of the time.[74]

Just like Dräger[42,60] and many other pioneers of the time, Ludwig Michaelis pursued the opportunities of modern gas-technology not only in medicine, but also in much wider industry: Around 1908[75] he founded the *"Autogen" Werke für autogene Schweißmethoden G.m.b.H.,* a specialist for blowtorches and other devices for metal-working with ultra-high temperatures. Around 1915 this firm became the nucleus of the *Autogen-Gasaccumulatoren-Aktien Gesellschaft* (AGA), which became by 1919 a major manufacturer in Germany for automobiles and trucks (Berlin-Lichtenberg, Herzbergstraße 82 –86).[76]

The little which is known about Dr. Ludwig Michaelis does not suggest that he was related to Silberstein-Silten's mentor in Rostock. There may, however, have been a closer connection between him and his *clinical* main collaborator, the above mentioned Leyden-disciple and textbook author Max Hugo Michaelis: Set aside their matching surnames, interests and well recorded cooperation in the field of oxygen therapy and

related apparatus in Berlin, a Max Michaelis is also on record as the minority business partner in Ludwig's Autogen Weke.[75] However, there are several individuals identifiable around the time, who went by the name Max Michaelis, who shared broadly matching biographical details, and who were mostly German Jews caught up in the Shoah: the most plausible, likewise Berlin-based alternative identified so far could e.g. have been Max Israel Michaelis [born: 23rd February 1867 in Usch (Posen) / Ujście], who was on record as a businessman in Berlin-Charlottenburg (Sybelstraße 25; previously: Fritschestraße 70) around 1936-1939. Tragically, he died by suicide in Berlin (13th September 1940), to "escape" even worse - deportation and genocide.[77] Otherwise, also his story has - so far - been lost.

Notable contributions to rescue medicine

Set aside the above devices for oxygen therapy, resuscitation, and anaesthesia, the Berlin Sauerstoff-Fabrik co-developed one of the earliest recognizably "modern" self-contained respirators for fire-brigades and mining rescues services: the "Giersberg Respirator" (first version c. 1899). Its main inventor was the chief of the professional Berlin Fire Brigade
("Branddirektor", served 1893-1905), Erich Giersberg (1854-1905).[78,79]

An extensive, well referenced and illustrated publication of him certainly ranks among the best and most comprehensive, predominantly practice-oriented accounts on the international development of respirator technology until that date.[80] Sadly for him, his landmark publication only appeared posthumously in Max Michaelis's 1906-textbook, with the editor paying a touching tribute to him and his work in the foreword. Giersberg's widely recognized competence and devices contributed to important further developments by two likewise German competitors: Georg Albrech Meyer (1862-1937) [Shamrock Apparatus (development c. 1897-1903); Westfalia Co., Gelsenkirchen] and Dräger (since c. 1903). The latter two succeeded around 1904-1906 in making respirator technology physiologically and technologically "fit for purpose" – and internationally successful: Their new apparatus promptly rose to global prominence

(Courrires Mining Disaster, 1906). Yet again, this was about a decade *before* WW I (1914-1918) allegedly became the decisive "catalyst" for life-saving progress in this field.[18]

It has likewise been proven that Britain's Haldane, who was later unilaterally credited with this progress, had been decisively influenced by both these German initiatives, well before his own contributions in the field became (inter)nationally relevant (since c. 1912).[18]

Most recently, extensive research has been commenced by this author to further cross-reference, objectivate and adequately re-contextualize these long-disavowed, international and trans-disciplinary interactions and cooperations. An obvious question arising is whether and to what extent *disavowed reciprocity* can also be "rediscovered" on the base of contemporary *British evidence* – and not least in the extensive personal material surviving of Haldane himself.

One of the first, provisional findings uncovered is the photograph below: it was *believed* to show John Scott Haldane around 1906, *"wearing a diving suit in the company of a German soldier"*.[81]

The presumed soldier, however, appears to be a senior officer of the Berlin fire brigade – and is therefore almost certainly Ernst Giersberg. He wears a quite "diagnostic" uniform (gala-, or dress-version for official, or ceremonial purposes): it had been introduced by Giersberg himself around 1901 to mark the 50th anniversary of the foundation of the Berlin fire brigade. It featured a blue jacket with a single row of buttons, red rims and margins ("Biese"), black trousers and – as the only "royal" fire brigade in Prussia – the emblem of the crown on a "classical" Prussian helmet ("Pickelhaube").[79,82]

Figure 35: The British physiologist John Scott Haldane (1860 – 1936) (left), apparently testing a new device for fire brigades in the presences of an unidentified, senior officer of the Berlin fire brigade (right). The latter would *very* probably have been Erich Giersberg (1854-1905). The photograph would most plausibly have been taken in Berlin, Germany, around 1905. (Reproduced with the kind permission of the National Galleries of Scotland).[81]

Unfortunately it has not been possible to trace a photograph of Giersberg from around the time of his death. The closest one available so far shows him in profile and dates from 1902. A full beard further complicates identification. It is known, however, that the last years of Giersberg's life were marred by chronic pulmonary disease, attributed to a severe inhalation trauma suffered in 1897.[79]

Hence, the progression of his condition would probably have required inhalation therapy. Both explain why he would have shaved off most of his beard (to improve the fitting of facemasks), why he would have gained weight (owing to reduced exercise tolerance) and why he may have aged prematurely, prior to his sudden and early death at the age of just 51 years. Active involvement in respirator development and testing would likewise have mandated to have at least his chin clean-shaven.

From the picture alone the apparatus cannot be unequivocally identified, either:

However, it is plausible to assume that Haldane would have tested here - in the presence of the inventor himself - one of Giersberg's apparatus. Indeed, it is known that at a major firefighting exercise in

Berlin in 1905 a new device was tested. In combination with a conventional (self-contained) respirator, it featured a suit, which allowed (via a long hose) for the fire fighter to be remotely sprayed with water, so that he could be cooled and prevented from catching fire himself. Indeed, the apparatus and suit Haldane is wearing in the British photograph appears to be such a “Brandtaucher“ (”Fire Diver“) apparatus. It also explains, why this gear was later erroneously believed to be diving equipment.

Hence, the above photograph, which survived among Haldane’s own possessions in Britain, illustrates that between c. 1901 and 1905 Haldane *must* have entertained quite close contacts to (at least) the Berlin fire brigade – and therefore quite inevitably also to the wider Berlin cluster around Giersberg, the Sauerstoff-Fabrik and Michaelis. Otherwise they would hardly have invited him to attend exercises in person and test their devices himself.

Seen in combination with the earlier evidence, this also proves that Haldane was then in close contact *with all leading German pioneers* in the field of respirator technology - well before most of his own research and developments, or the technology rising to even higher public acclaim during WW I.

Figure 36 - 37: The chief of the Berlin fire brigade, Erich Giersberg (1854-1905), in a photograph from c. 1902 (left) (Reproduced with the kind permission of the Berlin Fire Brigade). Astonishingly, the unidentified gentleman standing behind him, wearing a top hat, likewise looks very much like Haldane.
The ”Fire Diver“ apparatus in a test (right). The fire-exercise buildings of the Berlin fire brigade are seen in the background.[83] The above British photograph of Haldane and the fire officer (Figure 35) was most probably taken on this occasion in 1905.

Other notable names in the international history of rescue medicine, who were either Berlin-based, or had strong and longstanding connections to the capital were Prof. Dr. George Meyer (1860-1923)[84], who mostly worked in the civilian sector, and Friedrich von Esmarch (1823-1908), who is famously considered as one of the “fathers” of “military medicine”.

Berlin: the "cradle" of Dräger's internationally influential medical technology

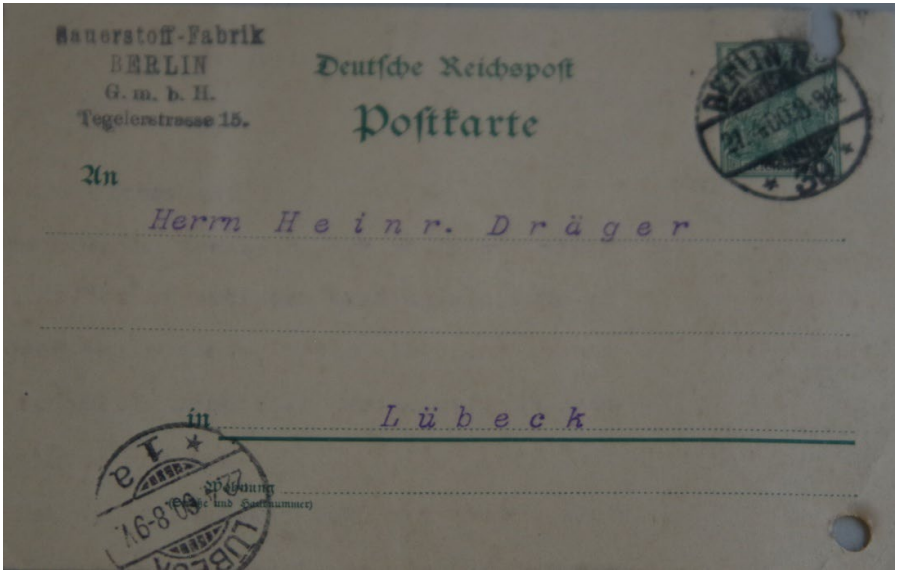
Around the same time that Max and Ludwig Michaelis intensified cooperation with Giersberg and Wohlgemuth (both c. 1899/1900), the Dräger company also joined the network. It saw Dräger's pressure reducing valves and other appliances for compressed gases making their debuts in medical devices. Since around 1900 / 1901 the Sauerstoff-Fabrik's above Giersberg respirator, its Wohlgemuth anaesthesia apparatus, and some of Max Michaelis's own oxygen therapy devices were equipped with - and technologically improved by - Dräger components.

Even the probably earliest correspondence between both firms, which commenced this episode, survives to this day in the Dräger archives in Lübeck, Germany. It is a humble, type-written postcard, dated 21st April 1900, signed by Dr. Ludwig Michaelis, and apparently written after he had obtained Dräger marketing pamphlets, which had piqued his interest. Hence, the Sauerstoff-Fabrik requested potentially suitable devices for its own purposes, namely Dräger's "Bierdruckautomat" (a pressure reducing valve), the "Finimeter" (a manometric volumeter) and the "Oxygenautomat" [a miniaturized, combined pressure reducer with manometer, primarily for relatively small (portable) and low-flow oxygen devices, or medical apparatus] to be delivered for tests, alongside some further information.

The cooperation was initially short-lived and ill-fated. It ended in acrimony, with Dräger accusing Michaelis of trying to usurp one of their patents, primarily for the Giersberg apparatus. A short, bruising lawsuit ensued, which Dräger won.[61] The firm then famously began to develop and market its own rescue- and medical devices, including the Roth-Dräger anaesthesia apparatus (since c. 1901-1902).

Figure 38 -39:

The probably first direct business contact between the Sauerstoff-Fabrik and Dräger (April 1900; Dräger Archiv). It also marks Dräger's debut in the field of medical apparatus.



Sauerstoff-Fabrik
BERLIN
G. m. b. H.
Tegelerstrasse 15.

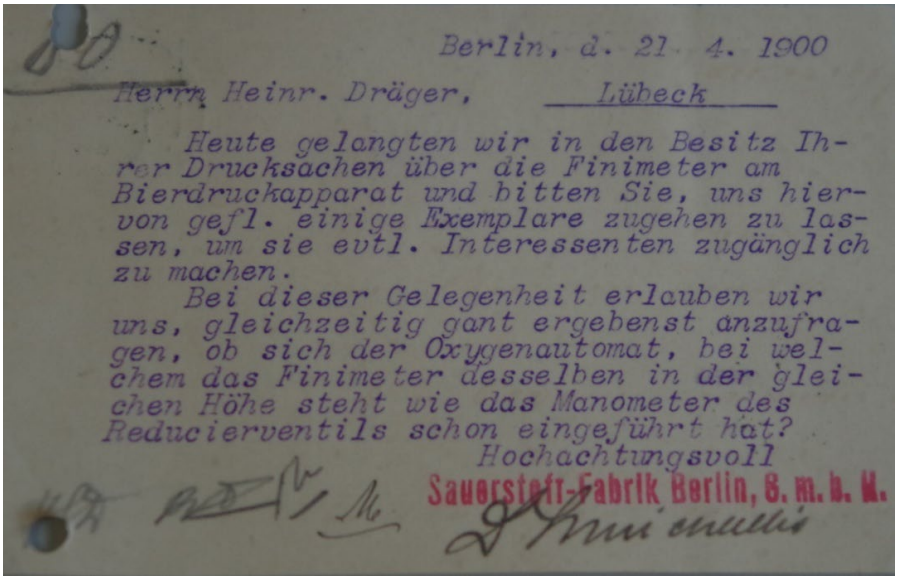
Deutsche Reichspost

Postkarte

An

Herrn Heinr. Dräger

in Lübeck



Berlin, d. 21. 4. 1900

Herrn Heinr. Dräger, Lübeck

Heute gelangten wir in den Besitz Ihrer Drucksachen über die Finimeter am Bierdruckapparat und bitten Sie, uns hiervon gefl. einige Exemplare zugehen zu lassen, um sie evtl. Interessenten zugänglich zu machen.

Bei dieser Gelegenheit erlauben wir uns, gleichzeitig gant ergebenst anzufragen, ob sich der Oxygenautomat, bei welchem das Finimeter desselben in der gleichen Höhe steht wie das Manometer des Reducierventils schon eingeführt hat?

Hochachtungsvoll

Sauerstoff-Fabrik Berlin, G. m. b. H.

By c. 1910 some cooperation between both firms may have resumed, with probable Dräger appliances occasionally present again in Sauerstoff-Fabrik apparatus.[68] This is also consistent with Ludwig Michaelis's above, rapidly expanding outbranching into the field of autogen- and wider metal working-technology (since 1908). There his and Dräger's paths would also have crossed frequently.

By 1910, however, the Sauerstoff-Fabrik had begun to lose its former market leadership. In the field of economical *gas production*, the international markets were soon dominated by the (initially Germany- and France-based) multi-national conglomerates behind the Linde-Claude processes, i.e., *Linde* (est. 1879) and *Air Liquide* (est. 1902) respectively. In the field of *therapeutic apparatus*, Dräger's innovative gas-appliances laid the base for them likewise assuming an internationally leading role.

The Silberstein-Siltens and Drägers:
Close business-partners and friends

Following Dräger's spectacular falling-out with the nationally leading specialist in the German capital, the longstanding, close cooperation (c. 1903-1938) and lifelong friendship (c. 1903-1943) between the Drägers and the Silberstein-Siltens was established:
In the fields of oxygen therapy and wider medical technology both were then the "new kids on the block". Their collaboration empowered both to "get a foot into the door".

In his autobiography (1914)[85] the founder of the Dräger Company, Johann Heinrich Dräger (1847-1917) recognized Silberstein's importance with the following description (translated):

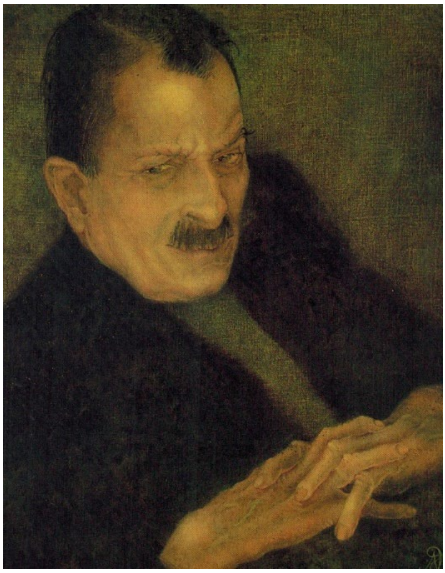
> *"In 1903 we got our representative in Berlin, Dr Silberstein. It was at the time still difficult, even in big Berlin, to identify a knowledgeable and competent person, who had already grasped the future therapeutic and industrial importance of compressed oxygen. Following lengthy enquiries, I learnt that the "Emperor Frederick Pharmacy", Karl Street, Berlin was marketing compressed oxygen. I went straight there.*

Its owner, Dr Ernst Silberstein, received me in his office and was initially quite reserved. Soon, however, he invited me (or I suggested to him, I no longer recall precisely) into his private apartment and both of us warmed towards one another during the conversation. We realised that we were intellectually on equal footing and this recognition generated reciprocal sympathy and respect. We parted on that day with the shared knowledge that in terms of business we were meant for one another. And this initial feeling has never let us down. Us and Dr. Ernst Silberstein have since that time always stood by one another, in joy and sorrow, and became much more than mere business-friends. Over the years we did not only exchange goods and money, but also huge amounts of ideas and intellectual property."

Another touching testament to the lasting and close friendship between both families are two surviving portraits of Silberstein-Silten, which were painted by Heinrich Dräger's daughter Anna Dräger-Mühlenpfordt (1887-1984).[86]

With the longstanding business-friend of three generations of her family and his wife, Anna Dräger shared a deep love for the fine arts. She herself became an accomplished artist. Many of the early Dräger-Silberstein catalogues were adorned with her creations.[87]
Together with her husband, the academic and architect Carl Mühlenpfordt (1878-1944), she had also been openly critical of Adolf Hitler and his Nazi Party. In consequence, they were likewise subject to reprisals after the Nazi-dictatorship had been established in Germany (1933-1945).[86]

Figure 40: Portrait of Dr Ernst Silten (1866-1943) by Anna Dräger-Mühlenpfordt (1887-1984) [Oil on canvas, c. 1937; based on a coal-on paper sketch from c. 1928].[86] [Anna Dräger-Mühlenpfordt, Bildnis Dr. Ernst Silten, 1937. Reproduced with the kind permission of the Lübecker Museen, Museum Behnhaus Drägerhaus. © Rechtsnachfolger der Künstlerin].



Noteworthy examples of Dräger-Silten achievements in the field of international anaesthesia technology

Their rapid, subsequent success shows that their joint venture paid off -- for both partners.

- Dräger was soon likewise on friendly terms with the eminent physiologists Zuntz and Loewy. These led to internationally consequential co-operations, notably in the fields of specialist (mostly: high-altitude) respirator technology, oxygen resuscitation and positive-pressure ventilation ("Pulmotor" device, c. 1908)].[18,59]

- Since around 1904-1905 a veritable Dräger-Silberstein/Silten "brand" is recorded in national *and i*nternational marketing literature. Silberstein/Silten is usually designated as Dräger's main and specialist partner for marketing *medical* apparatus. This persisted until far into the 1930s.[53] Silberstein-marketed Roth-Dräger and related apparatus paved the way for a wider international introduction of recognizably "modern" anaesthesia-related technology - e.g., in Europe and the USA[53], in Britain, Canada and the wider British Empire[1], and even as far afield as Japan and East Asia.[54,88]

- In the USA Silberstein took over the activities, which Dräger's market representative for France and South-West Europe, Dr. Ernest Guglielminetti (1862-1943), had temporarily pursued on the medical sector (c. 1903-1907).[18] The Dräger-Silberstein cooperation also predates the establishment of Dräger's own US-subsidiary (The Draeger Oxygen Apparatus Co., est. 1907). Its remit were mostly industrial products (e.g., metal working, mining, carbonated beverages), including respirators and rescue technology. Around the mid-1910s this subsidiary became instrumental in initializing and coordinating marketing and cooperation on the emerging US-market for anaesthesia apparatus - most notably with the fledgeling company (est. 1914) of the Dräger-ally Foregger. By the mid to late 1920s, with an ever-increasing Dräger-Foregger cooperation in fields like carbon-dioxide stimulation (above), and closed-circuit carbon-dioxide absorption (below), Silten appears to have been mostly in charge again, even seeing off an attempt of Foregger to replace him as the sole distributer for Dräger's medical apparatus in the USA.[42,53]

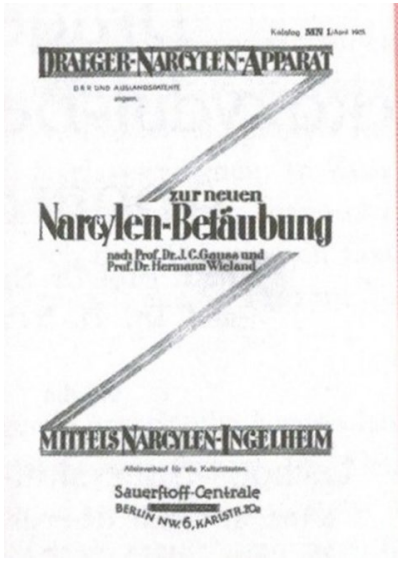
In consequence, Silten arguably played a key-role in facilitating the *international* clinical and economic success of several anaesthetic

landmark-developments:

- One example with a legacy until today was the first market introduction of apparatus with closed-circuit carbon-dioxide absorption [i.e., the Dräger Acetylene-apparatus (Gauss-Wieland, c. 1925) and the Sudeck-Schmidt-Apparatus for nitrous oxide-oxygen (+/- ether) anaesthesia (Modell A, c. 1928)]. In the USA these were subsequently acknowledged and replicated by Foregger – initially in a cooperation (c. 1928/1929) between himself and the anaesthetists Thomas J. Collier (1875-1952). Just a year later their apparatus was brazenly plagiarized by their compatriot Brian Collins Sword (1889-1956).[47]

- Silten is also believed to be the first provider of centralised fresh-gas supply and gas-scavenging systems for hospitals in Germany & in the Netherlands (since c. 1927-1931).[16] Internationally this project was probably (co-)triggered by a Dräger-cooperation with a Japanese partner in the *industrial* sector.[89] In the *clinical* sector related US-German interactions are likewise on record.[16]

Figure 41 -43: Three examples of product catalogues of the Dräger-Silberstein/Silten alliance. They represent significant contributions to the advent of recognizably “modern” anaesthesia-related technology over the first three decades of the 20th century (Dräger Archiv, Lübeck).
Top (left): Front page of a catalogue for the USA and Britain (1907).
Top (right): Marketing catalogue for the Dräger “Narcylen”-Apparatus (Gaus-Wieland) (1926).
Bottom: Marketing catalogue for the Dräger Sudeck-Schmidt apparatus (Modell A) (1928).



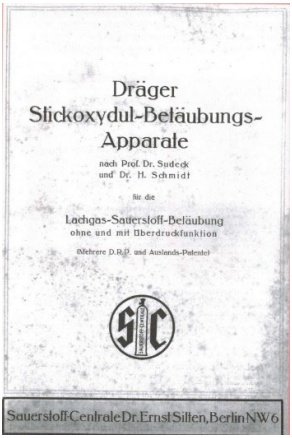
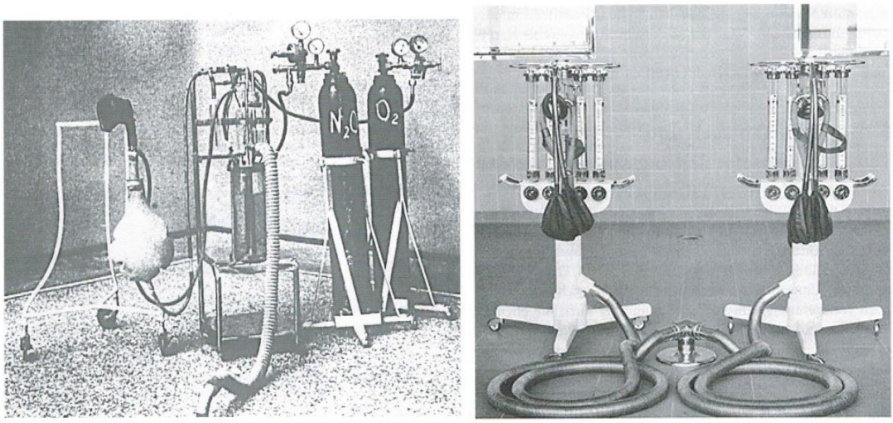


Figure 44-45: Two early examples of centralized gas-management in contemporary European anesthesia.[16,89]
Left: An early Dräger nitrous oxide-oxygen apparatus with carbon dioxide absorption, gas cylinders (likewise with Dräger pressure reducers and manometers), and gas-scavenging with floor piping (Leiden, The Netherlands, c. 1927).[16]
Right: Another example of a gas-scavenging connection to floor piping (Freiburg University Hospital, Germany, c. 1931). The related technological solutions for this newly built hospital are known to have been marketed and provided by Silten, likewise since c. 1927.[16,89]



Re-discovering an internationally embedded Dräger-Silten conglomerate

Around the end of WW I the Silbersteins changed their surname to Silten, hoping this would reduce exposure to anti-Semitic resentment, which the family and its companies encountered increasingly, not only in Germany.[2-6]

During the crisis-ridden years around WW I and throughout most of the 1920s, the Dräger-Silten conglomerate, economically struggling like almost everybody else, is now also known to have entered several strategic alliances in Germany and abroad.[1,42,53,54,88]
Set aside Dräger's and Silten's original "mother-companies" in Germany, stakeholders identified so far were e.g. Dräger's other subsidiaries in the

USA [Draeger Oxygen Apparatus Company (c. 1907-1918)][53] and Britain [British Draegerworks Ltd., London, c. 1903-1914)][1], their Vienna-based "General Agency", serving mostly Eastern Europe, but also reaching out as far as East Asia[1,88], Ernest Guglielminetti in France, Italy and Switzerland[18], a Dutch international marketing company (c. 1920s; NV Technisch Handelsbureau (NVTH), The Hague, Netherlands)[42,88], the Auer-Gesellschaft [also known as Deutsche Gasglühlicht AG (DEGEA), est. 1892][53,61] and the Kawasaki conglomerate (est. 1878) in Japan (c. mid-1920s-1940s).[88]

In the field of anaesthesia-related technology cooperations existed with the US-American Foregger Company [est. 1914, New York; close personal friendships and repeated collaborations (1907-1960s)][42,53,60] and with the by then likewise Berlin-based Haertel KG (Klopstockstr. 57, Berlin NW 23, Germany; previously Breslau) [e.g., around 1926 on the influential Tiegel-Henle anaesthesia apparatus (c. 1910-1930)].[16]
Silten's own "core business" by that time consisted of at least three firms:

- His original pharmacy ("Kaiser–Friedrich-Apotheke", est. 1888, acquired c. 1899; Karlstraße 21, Berlin-Mitte),
- his oxygen-production and inhalation-apparatus company [est. c. 1900 as "Sauerstoff-Centrale Berlin, Dr. Ernst Silberstein" (since c. 1919 renamed Silten)],
- and his chemical and pharmaceutical manufacturing and marketing business ["Dr. Ernst Silten Fabrik chem. Pharmac. Präparate - Fabrikation chemisch-pharmazeutischer Präparate (est. c. 1919)].[2,6,89]

Astonishingly, more recent findings suggest that this already impressive list must most likely include several other companies, whose close national and international connections to primarily Silten (and indirectly also to Dräger) have previously been under-recognized:

- The Inhabad-Gesellschaft M.B.H. [est. c. 1900-1910; dissolved c. 1967] was likewise a Berlin-based and apparently Jewish-owned company in the sector of medical technology.[90] Throughout its existence the firm was *outwardly* a fierce (inter)national Dräger competitor. Behind the scenes, however, contemporary sources illustrate increasing technical co-operation with Dräger (since the mid-1910s) and an apparent (part-)takeover (early 1920s -c.1938), when Inhabad even moved in next door to Silten.
- The Medicinisches Waarenhaus Actien-Gesellschaft [sic] (est. 1894) was at the time among the largest specialist "department stores" for medical equipment in continental Europe. The firm was probably also mostly controlled by Jewish shareholders and likewise had its main base just across the road from Silten [Karlstrasse Nr. 31, Berlin]. It also boasted a large factory with at least eight specialist workshops and another six affiliated outlets across Germany.[60] Catalogues reveal an enormous product-range. They also suggest that Silten-Dräger must have had significant influence and may therefore have been among the major shareholders.
- The US-German "Atmos" Company had been founded by Dräger and their former US-agents around 1918, when WW I forced Dräger to shut down the Draeger Oxygen Apparatus Company in the USA. Since around the early 1920s the "Atmos" trademark was also used by Silten in Germany and Europe for a wide range of medical and non-medical products. Around the early 1930s it eventually replaced the trademark "Sauerstoff-Centrale". The German company exists under the same name to this day.[7]
- C.F. Boehringer & Söhne (est. 1859) (today: Boehringer Ingelheim) – to this day a large multinational conglomerate in the chemical & pharmaceutical industry.[6]
- Silten Ltd. (est. 1930) – Silten's London-based subsidiary for Britain, Australia and the wider British Empire.

The complex and extensive evidence on these international business connections of the Dräger-Silten conglomerate in the inter-War period, and its implications for the history of anaesthesia, requires a detailed presentation. This will be provided separately.

Tragic Endings

After the rise of the NS-dictatorship to power (1933) the Silten family and their companies were increasingly subject to reprisals. Between 1936 and 1938 the regime forced Silten, like other Jewish businessmen in Germany, to sell his firms for well below market value to non-Jewish, German ("Aryan") competitors ("Zwangs Arisierung"; "Forced Aryanization").[5,6,89] The same sad fate befell Ludwig Michaelis's "Sauerstoff-Fabrik Berlin"[67,74] and "Inhabad".[90]

In Silten's case the pharmacy was taken over as a family business and exists to this day.[6] His (inter)national manufacturing and distribution business was taken over in 1938 by the "Atmos Gesellschaft Fritzsching & Co". In the 1940s Atmos moved its headquarters from Berlin to the area of Freiburg, in South-West Germany. From there it continues to internationally market a similar range of specialist products.[7]

In 1938 Silten's wife Marta, his second son Fritz and his family fled to the presumed safety of the Netherlands. Ernst Silten himself, by then well in his 70s, remained in Berlin. Supported by old friends and business partners – including the Drägers – he continued to live in the former family home, above the pharmacy. Despite warnings that he should hide, or flee to avoid deportation, he refused.[2,6,10]

After the Netherlands had been occupied by the German Wehrmacht, the exiled Siltens were all arrested. To escape deportation to Auschwitz, Silten's wife Marta tragically ended her own life on July 7, 1943, in the internment camp Westerbork.[2,6,10]

Fritz and his family were deported to the Theresienstadt Ghetto, where they survived the war.[91,92] After the war the family lived abroad, first in the Netherlands, then in Switzerland. In 1959 their daughter, Ruth Gabriele Sarah Silten (1933-2021) eventually emigrated to the USA and settled in California.[92,93] Alongside two life-affirming volumes of poetry she left

behind two harrowing, autobiographical accounts of having had to live through this appalling period of German history.[94,95] She also donated the Silten's art collection to the *Huntington Library, Arts Collection and Botanical Gardens*, San Marino, Cal., USA. It had mostly been collected by Ernst's wife Marta Friedberg-Silten (1877-1943) and her father. Marta herself was an accomplished pianist and painter. Their collection had somehow remained intact and was returned to the family. In Gabriele's and her family's memory the Silten and Dräger families sponsored a *Silten Prize* for *"pupils and students who do research in local, regional, international or biographical aspects of the history of the Holocaust",* awarded by the historical society Lastoria, Bremen.[96]

Of Silten's eldest son, Heinz (Henry) Silten (1901-1953), little is known. He emigrated and lived overseas since at least the early 1930s. Eventually he ended up in Britain, where he set up his own firm. It specialised in broadly the same type of apparatus as those developed and marketed by his father's conglomerate in Berlin. Many related patents were likewise registered in Britain. The available documentation confirms that "Silten Ltd., of 27 Porchester Terrace, London" [also: "Silten House, Hatfield, Hertfordshire, England"] manufactured inhalers, inhalants and "Silbe Brand" tablets. The firm also distributed these as agents for the British Empire of Ernst Silten's "mother companies" in Berlin.

Since c. 1936 Henry also had an Australian business partner, Leslie Vincent Kay (1902-1976)[97] *"for the registration of a limited liability company in… and …for the continents of Australia and New Zealand".*[98] When the war broke out, Henry Silten was interned on the Isle of Man, where he toiled as a farm labourer. In 1942 he was allowed to return to London, got married and became a British citizen. Around 1946 he is on record with efforts to trace the whereabouts of his brother and his family and assisting them in finding shelter and gradually rebuilding their lives – in Germany, the Netherlands, and Switzerland.[6]

Following his early death in 1952 "Silten Ltd." in London was managed for several years by his younger brother. He had since rebuilt a company in Amsterdam and shuttled regularly between Amsterdam and

London. Around 1963 Fritz sold all companies and retired with his wife to Zürich, Switzerland.[6]

Back in Berlin, just shortly before his family's imprisonment and his wife's suicide, Ernst Silten own story also ended in a profound tragedy: Warned by his housekeeper that his deportation was imminent, Ernst Silten also chose to rather end his own life, on March 5, 1943. He is buried on the Jewish Cemetery in Berlin-Weißensee.[6]

In his efforts to help saving Silten and his family, Otto Heinrich Dräger (1898-1986) had hired a solicitor, Dr Helmut Pfeiffer (1907-1945). By all accounts Pfeiffer was himself a Nazi-sympathizer and was - on one side - well-connected and initially on good terms with the regime.
On the other hand, however, he repeatedly played a dangerous double-game, helping several Jews and other Nazi-victims to evade prosecution and deportation, and flee the country.[99]

Eventually, however, his cover blew, and his luck ran out: Alongside his Croatian fiancée and four Polish clients Pfeiffer was apprehended by the GESTAPO around the end of 1944, when, like Dräger's collaborator Jakobson[1], he tried to flee Germany from occupied Denmark to Sweden. He was imprisoned, possibly tortured.
In the closing days of the war he was brutally murdered by the Nazis in Copenhagen - strangled in his prison cell.[99,100]

As one could probably expect of a person in his position and in these difficult times - an influential industrialist under a brutal dictatorship - it is undisputed and recognized that there was - practically unavoidable - *entanglement* of Otto Heinrich Dräger with the regime.[101-104]
On this occasion, however, it may well have only been the collapse of the Nazi dictatorship, alongside Germany's unconditional surrender in the war, shortly afterwards, which spared him - and potentially his family and aides - a similar fate and tragedy.

Figure 46-47: Portrait photographs of Dr Helmut Pfeiffer (1907-1945)[100] (left) and Otto Heinrich Dräger (1898-1986) (right, 1978).[105]

Conclusions

The tale of Dr. Ernst Silten (Silberstein) (1866-1943) and the Jewish Medical Community in Berlin before the Shoah is a *dark story* from one of the darkest chapters in the history of humankind. "Never again!" and preserving a "culture of remembrance" (in German: "Erinnerungskultur") were for nearly 80 years thereafter a broad consensus. They were - and continue to be - a pledge to continuously strive to heed and learn from the lessons of history - and to prevent a repetition of the catastrophes of dictatorship, oppression, genocide and war.

Currently, however, it is widely and rightly observed that just such a "repetition" could unfold - and could do so in scenarios and constellations, few would ever have thought possible.

The history presented here can therefore serve, first and foremost, as another strong reminder, or as a warning sign - a burning "writing on the wall", or - to use the *proverbial* term from the ancient Hebrew scripts in the Old Testament - a *Mene Mene Tekel Upharsin* מְנֵא מְנֵא תְּקֵל וּפַרְסִין (The Holy Bible, Daniel: 5,25-31).

For our own, narrow niches - the history of anaesthesia, or oxygen therapy - the *facts and evidence* presented *mandate* critical *revisions* of numerous "popular", but rather unilateralist post-WW II narratives. Setting aside that due factual accuracy should be "a given" in academia and in a scientific discipline, we all owe *at least* due recognition to all those victims mentioned – for their astonishing and lasting contributions *to our Shared World – and equally Shared Heritage.*

References:

1. Brenna C. T. A., Strätling M. W. M. The Advent of Modern Anesthesia Apparatus in Britain and Canada: A Re-evaluation of Shared Heritage. A & A Practice 19(5): p e01953, May 2025. DOI: 10.1213/XAA.0000000000001953.
2. Stolpersteine in Berlin [Holocaust Memorial, Website]. Dr Ernst Silten. https://www.stolpersteine-berlin.de/de/reinhardtstr/5/ernst-silten (accessed: May 2025).
3. Geni – Genealogy [Ancestry database]: Ernst Silten (Silberstein) (Last updated: February 26, 2025) https://www.geni.com/people/Ernst-Silten/6000000022192210426 (accessed: May 2025).
4. MyHeritage [Ancestry database] - Biographical Summaries of Notable People: Ernst Silten https://www.myheritage.com (accessed: May 2025).
5. Das Deutsche Apotheken-Museum, Heidelberg: https://www.deutsches-apotheken-museum.de/sammlung/museumsobjekte/neu-im-bestand/erinnerung-an-ernst-silten (accessed: May 2025).
6. Grabow A. Luft zum Atmen – Eine Berliner Apothekengeschichte über mehr als ein Jahrhundert. Vergangenheits-Verlag, Berlin, Germany, 2013.
7. ATMOS Medizin Technik GmbH & Co. KG, Lenzkirch, Germany. Company History. https://atmosmed.com/en/company/history (accessed: May 2025).

8. Silberstein E. Über Organische Phosphroverbindungen: Oxyphosphazo-Verbindungen der aromatischen Reihe. Dissertation (PhD Thesis), Rostock University, Karl Hinstorffs Buchdruckerei, Rostock, Germany, 1896.
9. Universität zu Rostock. Catalogus Professorum Rostochiensium: Michaelis, August, Prof. Dr. phil., 1890-1916; o. Professor der Chemie und Pharmazie: https://purl.uni-rostock.de/cpr/00002390 (accessed: May 2025).
10. Stolpersteine in Berlin [Holocaust Memorial, Website]. Marta Silten geb. Friedberg. https://www.stolpersteine-berlin.de/de/reinhardtstr/5/marta-silten (accessed: May 2025).
11. Stratling M, Heinze H, Schmucker P. Inhaled Oxygen Therapy: a re-assessment. In: Drury PME et al. (edits). The History of Anaesthesia (Proceedings of the Sixth International Symposium on the History of Anaesthesia, Cambridge, UK, 14-17 September 2005). Conservatree, Reading, UK, 2007: 349-355.
12. Kossobutzki C. Die Geschichte der inhalativen Sauerstofftherapie in Deutschland. Medical PhD-Thesis, Lübeck University, 2009.
13. Zimmer M. Histoire de l'anesthésie: Méthodes et techniques au XIXe siècle. EDP Sciences, Les Ulis, France, 2008.
14. Waldenburg L. Die Pneumatische Behandlung der Respirations- und Circulationskrankheiten. Hischwald, Berlin, Germany, 1875. [Private Collection Dr. Stratling, Cardiff, UK].
15. Michaelis M. (ed.). Handbuch der Sauerstofftherapie. Hirschwald, Berlin, Germany, 1906. [Private collection Dr. Stratling, Cardiff, UK].
16. Goerig M, Schulte am Esch J. Die Entwicklung des Narkosewesens in Deutschland von 1890-1930 [The development of anaesthesia in Germany (1890-1930)]. Steintor Verlag, Lübeck, Germany, 2012.
17. Strätling MWM, Niggebrügge S, Niggebrügge C. Dr. Heinrich Brat (1867-1909) – a forgotten German pioneer of international Oxygen therapy, ventilation and anaesthesia technology. In: Cooper MG et al., eds. History of Anaesthesia VIII – Proceedings of the 8th International Symposium on the History of Anaesthesia. Sydney, Australia: Australian Society of Anaesthetists; 2016: 54-64.

18. Strätling MWM. Re-discovering important examples of long-disavowed collaborations, interactions, and reciprocity between continental European and Anglo-American pioneers before World War I (1914-1918): Dr. Ernest Guglielminetti (1862-1943) and his American and multi-national Roth-Dräger connection (c. 1903-1907), specialist respirators (c. 1907), Britain's John Scott Haldane (1860 – 1936) and his European heritage of oxygen therapy, respiratory physiology, and technology (c. 1903 – 1914), and Headbox-anesthesia devices (c. 1904-1914) [The history of modern anesthesia technology – a critical reappraisal (Part VI)]. In: The Japanese Society of Anesthesiologists (ed). Proceedings of the 10th International Symposium on the History of Anesthesia (ISHA 2022: Kobe, Japan, June 16-18, 2022). Kobe, Japan, 2023: 216-254.
19. MyHeritage [Ancestry database]. Prof. Dr. med. Max Michaelis, 1869 – 1933. https://www.myheritage.com/names/max_michaelis (accessed: May 2025). [Early Biography: Pagel J. Biographisches Lexikon hervorragender Ärzte des neunzehnten Jahrhunderts. Urban & Schwarzenberg, Berlin und Wien, 1901: 1134].
20. Geheimes Staatsarchiv Preußischer Kulturbesitz, I. HA Rep. 76, Va Sekt. 2 Tit. IV Nr. 50, Bd. 6: "Habilitation, Vergütung und Dienstverhältnisse der Privatdozenten in der Medizinischen Fakultät der Universität Berlin, Bd. 6. https://archivdatenbank.gsta.spk-berlin.de (accessed: May 2025).
21. Jüdisches Krankenhaus Berlin, Germany: https://www.juedisches-krankenhaus.de/willkommen/geschichte.html (accessed: May 2025).
22. Aron E. Was können wir uns von der Sauerstoff-Therapie versprechen? Dtsch Med Wochenschr, Leipzig und Berlin. 1893; 19: 644-648.
23. Aron E. Über Sauerstoff-Inhalation. Verhandlungen der Berliner medizinischen Gesellschaft (1900-1901). 1902; 32: 283-302. (Part 2: Diskussion). Part 1: 113-126. Ebenso: Berl Klin Wochenschr, 1901; 38: 951-972, (Diskussion), 553;632.

24. Aron E. Die Aussichten der Sauerstoff-Inhalationen nach den neuesten physiologischen Untersuchungen. Dtsch Med Wochenschr, Leipzig und Berlin. 1904; 30: 1957-1960.
25. Aronson. Über Narkosen mit Chloroform-Sauerstoff-Gemisch. Dtsch Med Wochenschr, Leipzig und Berlin. 1901; 27: Verlags-Beilage, 81.
26. Bernstein J. Weitere Versuche über der Sauerstoffzehrung in den Geweben. Verhandungen der Gesellschaft deutscher Naturforscher und Ärzte, 1891. Leipzig, 1892: 148-151.
27. Brat H. Die Sauerstofftherapie in der gewerbehygienischen Praxis. Zeitschr ärztl Fortb, Jena. 1905; 2: 473-475.
28. Brat H. Die Stellung eines Sauerstoffatmungsapparates in der Therapie. Berl klin Wochenschr. 1905; 13: 494-499.
29. Brat H. Sauerstoff-Atmungsapparat. Illustrierte Monatschr ärztl Polytechn, Berlin. 1906; 28: 69-70. https://digital.zbmed.de/pflege/periodical/titleinfo/8341117 (accessed: May 2025).
30. Brat H. Über einen neuen Sauerstoffatmungsapparat. Dtsch Med Wochenschr, Leipzig und Berlin. 1905; 31: 594-596.
31. Brat H: Über Erfolge der Sauerstofftherapie, unter besonderer Berücksichtigung der in den Gewerbebetrieben gewonnenen Erfahrungen bei gewerblichen Vergiftungen. Klin Jahrbuch, Jena. 1905; 14: 531-546.
32. Loewy A. Über die Bindungsverhältnisse des Sauerstoffes im menschlichen Blute. Centralbl Physiol, Leipzig und Wien, Germany / Austria. 1899; 13: 449-454 [On the binding capacities of oxygen in human blood].
33. Loewy A. Über die Wirkung des Sauerstoffs auf die osmotische Spannung des Blutes. Berl Klin Wochenschr. 1903; 11: 23-27 [On the effects of oxygen on the osmotic tension of blood].
34. Loewy A, Zuntz N. Über den Mechanismus der Sauerstoffversorgung des Körpers. Arch Physiol, Leipzig, Germany. 1904; 1: 166-216 [On the mechanism of oxygen-delivery to the body].

35. Zuntz N, Loew A, Müller F, Caspari W. Höhenklima und Bergwanderungen in ihrer Wirkung auf den Menschen – Ergebnisse experimenteller Forschungen im Hochgebirge und Laboratorium, Deutsches Verlagshaus Bong & Co, Berlin & Wien, 1906 (first edition) [High altitude climate and mountaineering – their effects on man – results of experimental research under high-altitude Alpine conditions and in the laboratory] [Extensive Textbook on high altitude medicine and physiology]. [Private collection Dr. Stratling, Cardiff, UK].
36. Zuntz N, Loewy A ed. Lehrbuch der Physiologie des Menschen. F.C.W. Vogel, Leipzig / Germany, 1911 [Textbook of Human Physiology].
37. West, J.B. 100th Anniversary of the Pikes Peak expedition to high altitude. Physiology News. 2011; 84: 48-49.
38. Haldane JS. The therapeutic administration of oxygen; Br Med J. 1917 (February 10): 181-183.
39. Haldane JS. Organism and environment as illustrated by the physiology of breathing, Yale University Press, New Haven, USA, 1917.
40. Haldane JS: Respiration, Yale University Press, New Haven, USA, 1922.
41. Davis RH. Breathing in irrespirable atmospheres. London, UK, Saint Catherine Press Ltd., (undated) c. 1948.
42. Strätling MWM. The friendship between Bernhard Dräger (1870-1928) and Richard von Foregger (1872-1960) and related examples of Anglo-German discourse on anesthesia (c. 1907-1955) [The history of modern anesthesia technology – a critical reappraisal (Part VII)]. In: The Japanese Society of Anesthesiologists (ed). Proceedings of the 10th International Symposium on the History of Anesthesia (ISHA 2022: Kobe, Japan, June 16-18, 2022). Kobe, Japan, 2023: 149-215.
43. Agfa-Gevaert N.V., Mortsel, Belgium: https://www.agfa.com/corporate/about-us/history/ (accessed: May 2025).

44. Panwitz S., Schüring P (ed.). Das Haus des Kranichs - Die Privatbankiers von Mendelssohn & Co. (1795–1938). Hentrich & Hentrich Verlag Berlin Leipzig, Germany, 2018.
45. Mendelssohn Gesellschaft e.V. Die Mendelsohns. https://www.mendelssohn-gesellschaft.de/en/mendelssohns (accessed: May 2025).
46. Michaelis M. Zur Technik der Aethernarkose. Therap. Monatshefte, Verlag von Julius Springer, Berlin, Juli 1894: 339-343.
47. Strätling MWM. The evolution of key components of modern technology – recontextualizing the most notable milestones: Time for a shift of paradigm in the history of anesthesia! [The history of modern anesthesia technology – a critical reappraisal (Part III)]. In: The Japanese Society of Anesthesiologists (ed). Proceedings of the 10th International Symposium on the History of Anesthesia (ISHA 2022: Kobe, Japan, June 16-18, 2022). Kobe, Japan, 2023: 383-406.
48. Wohlgemuth H. Eine neue Chloroform-Sauerstoffnarkose. Arch Klin Chir. 1901; 64: 664-681 [Private Collection Dr. Stratling, Cardiff, UK].
49. Wohlgemuth H. Der Wert des Sauerstoffs in der Chirurgie [The value of Oxygen in surgery]. In: Michaelis M, ed. Handbuch der Sauerstofftherapie [Handbook of Oxygen-Therapy]. Hirschwald, Berlin, Germany, 1906: 482-515.
50. Goerig M., Schaffner E. Heinz Wohlgemuth und Otto Roth: The men behind the technique. In: Schulte am Esch J., Goerig M., ed. The History of Anaesthesia, Proceedings of the 4th International Symposium on the History of Anaesthesia (Hamburg, Germany, 26th – 29th April 1997). Dräger Druck, Lübeck, Germany; 1998: 815-822.
51. Goerig M, Schulte am Esch J. Forgotten Jewish Pioneers of German Anaesthesia. In: Schulte am Esch J., Goerig M (ed). The History of Anaesthesia: Proceedings of the Forth International Symposium on the History of Anaesthesia. Dräger Druck, Lübeck, Germany; 1998: 553-566.

52. Strätling MWM. The history of modern anesthesia technology - A critical reappraisal: Part I: Key criteria of “modern” anesthesia: Technology and professionalism - definitions, backgrounds, and a short introduction to a changing evidence-base. J Anesth Hist. 2020; 6(3): 101-109. https://doi.org/10.1016/j.janh.2020.06.001
53. Strätling MWM. The clinical introduction of the Roth-Dräger anesthesia apparatus to the United States (c. 1903 - 1907) and early interaction with James Tayloe Gwathmey (1862-1944) and Richard von Foregger (1872-1960) [The history of modern anesthesia technology – a critical reappraisal (Part V)]. In: The Japanese Society of Anesthesiologists (ed). Proceedings of the 10th International Symposium on the History of Anesthesia (ISHA 2022: Kobe, Japan, June 16-18, 2022). Kobe, Japan, 2023: 255-309.
54. Makino H, Strätling M.W. Re-assessing the advent of modern anesthesia- and related medical technology in Japan (c. 1900s-1950s) – Time to recognize globally shared heritage! In: The Japanese Society of Anesthesiologists (ed). Proceedings of the 10th International Symposium on the History of Anesthesia (ISHA 2022: Kobe, Japan, June 16-18, 2022). Kobe, Japan, 2023: 58- 68.
55. Brat H., Michaelis M., v. Leyden E. et al. Diskussion (on: Brat H. Über einen neuen Sauerstoffatmungsapparat). Dtsch Med Wochenschr, Leipzig und Berlin. 1905; 31: 521-523.
56. Foregger R. Percentages and true flow of gases for gas-oxygen anesthesia. Anesth Analg. 1927; 6: 225-234.
57. The Foregger Company Inc. The Metric Gas Machine - CO2–absorption [Product catalogue; with an updated history (1st edition: 1926/1927)] New York, 1938 / 1939.The Wood Library-Museum of Anesthesiology. Foregger Company - Company File. Archives. Located at: The Wood Library-Museum of Anesthesiology. Schaumburg, Illinois, USA.
58. Foregger Company Inc. Anesthesia and Oxygen Appliances, Gwathmey Apparatus, Metric Gas Machine (Catalogue 1926), New York, USA, 1926. The Wood Library-Museum of Anesthesiology. Foregger Company - Company File. Archives. Located at: The Wood Library-Museum of Anesthesiology. Schaumburg, Illinois, USA.

59. Niggebrügge C. Die Geschichte der künstlichen Beatmung – Eine Analyse auf Grundlage einer systematischen Auswertung der Bestände des Archivs der Drägerwerk-AG, Lübeck [The history of ventilation - A historic re-evaluation on the base of a systematic analysis of the archives of the firm Dräger Medical, Lübeck, Germany]. Lübeck, Germany: Universität zu Lübeck (Diss Med) [Medical PhD-thesis, Lübeck University]; 2011.
60. Stratling MWM, Bause GS. The Rotameter – unspinning its secrets. A milestone in modern flowmeter technology and its com[plex and controversial history in anesthesia and medicine, engineering, research, and industry [Monography, release pending: 2026].
61. Kamp M. Bernhard Dräger. Erfinder, Unternehmer, Bürger. 1870-1928. Wachholtz Verlag, Kiel / Hamburg, Germany, 2017.
62. Haase-Lampe W. Grundsätzliche Umstellung der inhalativen Wiederbelebungsverfahren [Fundamental change of methods of inhalative resuscitation]. Draeger Hefte. 1925; 100 (Jan./Feb. 1925): 1031-1032.
63. Rosenthal E. Über Sauerstoff-Kohlensäure-Inhalationen bei Kohlenoxyd-Vergiftungen und bei der Narkose. Draeger Hefte. 1925; 100 (Jan./Feb. 1925): 1035 – 1036 [On Oxygen-Carbon Dioxide Inhalation in Carbon-Monoxide intoxication and anesthesia. Annotated report on: Henderson, Haggard, Coburn. The therapeutic use of carbon dioxide after anesthesia and operation. JAMA, 74: 783ff].
64. Schröder H. Lungenautomatischer Sauerstoff-Kohlensäure -Koffer Drägerwerk, Modell 1924 [Oxygen-Carbon Dioxide Trunk Drägerwerk, Modell 1924 for pressure-controlled respiration]. Draeger Hefte. 1925; 100 (Jan./Feb. 1925): 1032-1034.
65. Sch. [sic: Schröder H.]. Lungenautomatisches Kohlensäure-Luft-Inhalationsgerät Modell Drägerwerk 1925 zur Nachbehandlung von Narkotisierten und zur Wiederbelebung [Carbon dioxide-air inhalation device Model Drägerwerk 1925 for post-operative treatment in anesthesia and resuscitation under pressure-controlled respiration]. Draeger Hefte. 1925; 100 (Jan./Feb. 1925): 1035.

66. Dzialoszynski A. Kohlensäure–Inhalation in der Chirurgie. Draeger Hefte. 1928; 123: 146-148.
67. Jüdische Gewerbebetriebe in Berlin, 1930-1945 - Online-Databank. Humboldt-Universität zu Berlin, Institut für Geschichtswissenschaften, Berlin, Germany: Sauerstoff-Fabrik (Chemie und Drogeriewaren): https://www2.hu-berlin.de/djgb/public/en/find (accessed: June 2025).
68. Sauerstoff-Fabrik Berlin G.m.b.H. (ed.). Marketing pamphlet (6 pages). Berlin, Germany, c. 1910 (Private Collection Dr. M.W. Stratling, Cardiff, UK).
69. Sauerstoff-Fabrik Berlin G.m.b.H. – Sauerstoffherstellung [short marketing publication for educational purposes (mostly targeting school graduates and teachers) on the history of the company, its activities and main products]. In: Kongressleitung "Die neuzeitliche deutsche Volksschule" (Hrsg.). Führer durch den Kongress Berlin 1928 [Conference guide]. Cornelius Verlag, Berlin, 1928: 67-68. (Private Collection Dr. M.W. Stratling, Cardiff, UK).
70. Peters A. Dr. Bernhard Dräger (1870 – 1928) als Erfinder: Seine Beiträge zur Weiterentwicklung der Druckgastechnik und deren Bedeutung für die Entwicklung einer modernen medizintechnologischen Verbundforschung [Dr. Bernhard Dräger (1870 – 1928) as an inventor: His contributions to the development of the technology of compressed gases and its transfer into medical engineering]. Lübeck, Germany: Universität zu Lübeck (Diss Med) [Medical PhD-thesis, Lübeck University]; 2007.
71. Stratling M, Heinze H, Schmucker P. Production of Oxygen – From the beginnings (1772) to the Linde-Process (1902). In: Drury PME et al. (edits). The History of Anaesthesia (Proceedings of the Sixth International Symposium on the History of Anaesthesia, Cambridge, UK, 14-17 September 2005). Conservatree, Reading, UK, 2007: 487-493.

72. Strätling MWM. Re-contextualizing the advent of modern technology in nitrous-oxide–oxygen anesthesia (c. 1900 – 1914): New evidence on the German Dräger Company (est. 1889), America's Jay A. Heidbrink (1875-1957), and other examples of under-recognized interactions before World War I (1914-1918) [The history of modern anesthesia technology – a critical reappraisal (Part IX)]. In: The Japanese Society of Anesthesiologists (ed). Proceedings of the 10th International Symposium on the History of Anesthesia (ISHA 2022: Kobe, Japan, June 16-18, 2022). Kobe, Japan, 2023: 420-445.
73. Strätling MWM, Bause GS. Reassessing the advent of modern anesthesia apparatus in the USA (c. 1900-1930) and the roles of anesthetists in technological innovation: Leading, being led, or reciprocal partnership? [The history of modern anesthesia technology – a critical reappraisal (Part X)]. In: The Japanese Society of Anesthesiologists (ed). Proceedings of the 10th International Symposium on the History of Anesthesia (ISHA 2022: Kobe, Japan, June 16-18, 2022). Kobe, Japan, 2023: 99-145.
74. Landesarchiv Berlin. Archivale: Verfahren Ludwig Michaelis (*04.09.1869), verstorben, zuletzt wohnhaft: Berlin-Charlottenburg, Sybelstr. 58, gegen das Deutsche Reich (Wiedergutmachungsverfahren, 1957). https://www.landesarchiv-berlin.findbuch.net/php/main.php#42205265702e203032352d3033x14581 (accessed: May 2025).
75. Anonymous. Mitteilungen. Acetylen in Wissenschaft und Industrie. 1908 (11), Marhold, Halle a.d.S., Germany: 128-129. Internet Archive: https://archive.org/details/bub_gb_IWZDAQAAMAAJ (accessed: June 2025).
76. Kehl B (ed.). Zur Geschichte der Nutzfahrzeuge (Archiv Axel Oskar Mathieu) [On the History of vehicles for commerce and industry; Online Archive Axel Oskar Mathieu]: https://www.archiv-axel-oskar-mathieu.de/pdfs/AGA.pdf (accessed: June 2025).

77. Stolpersteine in Berlin [Holocaust Memorial, Website]. Max Israel Michaelis. https://www.stolpersteine-berlin.de/de/sybelstr/25/michaelis-max-israel (accessed: May 2025).
78. Strätling MWM, Niggebrügge C., Schumacher J. The History of Early Respirators – A systematic re-assessment of the main "technology transfer" that lead to the development of modern anaesthesia technology. In: Helen Askitopoulou et al. (edits.), History of Anaesthesia VII – Proceedings of the 7th International Symposium on the History of Anaesthesia (2009), Crete University Press, Heraklion, 2012: 159 – 180.
79. Berliner Feuerwehr. Geschichte [History of the Berlin Fire Brigade]: Branddirektor Erich Giersberg (1893-1905). https://www.berliner-feuerwehr.de/ueber-uns/historie/leiter-der-berliner-feuerwehr/branddirektor-erich-giersberg-1893-1905/ (accessed: June 2025).
80. Giersberg E. Die praktische Anwendung der Sauerstofftherapie bei dem Bergbau und bei der Feuerwehr. In: Michaelis M. (edit.). Handbuch der Sauerstofftherapie. Hirschwald, Berlin, Germany, 1906: 390 – 390-481 [Use of Oxygen Therapy in the practice of mining and firefighting; with 67 tables and illustrations].
81. National Galleries of Scotland. Historical Photograph (Gelatin silver print; 18.50 x 16.50 cm). Accession number: PGP 160.1. (Current) Title: Dr John Scott Haldane, 1860 – 1936. Physiologist. Wearing a diving suit in the company of a German soldier (estimated c. 1906). https://www.nationalgalleries.org/art-and-artists/42164/dr-john-scott-haldane-1860-%E2%80%93-1936-physiologist-wearing-diving-suit-company-german-soldier (accessed: June 2025).
82. Förderverein Feuerwehrmuseum Berlin e. V. Feuerwehrmuseum Berlin (Illustrations). https://www.feuerwehrmuseum-berlin.de/ (accessed: June 2025).
83. Der Feuertaucher. https://epilog.de/unsere-feuerwehr.berliner-leben.1905 (accessed: June 2025).

84. Haase-Lampe JW. Geheimer Staatsrat Prof. Dr. med. George Meyer (Biographical sketch). In: Haase-Lampe JW. Handbuch für das Grubenrettungswesen (International) – Sauerstoffrettungswesen und Gasschutz (Band I & II), Rathgens, Lübeck, Germany, 1924 and 1929: 679-681.
85. Dräger H. Lebenserinnerungen. Schwenke & Co, Lübeck, Germany, 1954 (1st Edition: 1914).
86. Museum für Kunst- und Kulturgeschichte der Hansestadt Lübeck (ed). Anna Dräger-Mühlenpfordt zum Gedenken – Gemälde-Zeichnungen-Druckgraphik (1908-1980) [Catalogue for exhibitions in Lübeck and Braunschweig, Germany, 1984-1985). Graphische Werkstätten, Lübeck, Germany, 1984.
87. Strätling MWM, Niggebrügge HC, Niggebrügge S. Under-recognized East-West interaction and co-operation in 20th century anesthesia - examples from the Dräger archives: Arts and crafts in marketing, product-design, and engineering and the development from Dräger's Pulmotor (c. 1908), via the Takaoka Respirator (c. 1951-1957), to the international breakthrough of artificial ventilation (c. 1950s-1960s). In: The Japanese Society of Anesthesiologists (ed). Proceedings of the 10th International Symposium on the History of Anesthesia (ISHA 2022: Kobe, Japan, June 16-18, 2022). Kobe, Japan, 2023: 492-503.
88. Strätling MW. Modern anesthesia-related technology in East Asia – re-discovering its early history and wider contexts (c. 1900s-1950s): evidence from the Dräger Archives on interactions between Germany, Japan, and China. In: The Japanese Society of Anesthesiologists (ed). Proceedings of the 10th International Symposium on the History of Anesthesia (ISHA 2022: Kobe, Japan, June 16-18, 2022). Kobe, Japan, 2023: 452-491.
89. Jüdische Gewerbebetriebe in Berlin, 1930-1945 - Online-Datenbank: Dr. Ernst Silten Fabrik chem. Pharmac. Praeparate: https://www2.hu-berlin.de (accessed: June 2025).

90. Bundesarchiv, Koblenz, Germany. Archivsignatur: R 3001/10490, Inhabad-Gesellschaft mbH in Berlin, Okt.-Dez. 1937: https://invenio.bundesarchiv.de/invenio/direktlink/edfb7a98-566b-4a94-9859-d224b8d4e4ef/ ; https://www.deutsche-digitale-bibliothek.de/item/WKR5TXI3WMN6GWNITDX5YAVDROXQS6IS (accessed: June 2025).
91. Stolpersteine in Berlin [Holocaust Memorial, Website].Fritz Silten. https://www.stolpersteine-berlin.de/de/knesebeckstr/28/fritz-silten (accessed: June 2025).
92. Silten Family (Autobiographical sketch: R. Gabriele S. Silten, 17 October 2010). https://www.joodsmonument.nl/en/page/356169/silten-family (accessed: June 2025).
93. Gedenkstättenreferat der Stiftung Topographie des Terrors, zentrale Netzwerkstelle für die bundesrepublikanische Gedenkstättenlandschaft zu den NS-Verbrechen, Berlin, Germany (ed.). Erinnerungsraum für Ruth Gabriele Silten (1933-2021). https://www.gedenkstaettenforum.de/aktuelles/veranstaltungen/details/erinnerungsraum-fuer-ruth-gabriele-silten (accessed: May 2025).
94. Silten RGS. Between Two Worlds: autobiography of a child survivor of the Holocaust. Fithian Press, Santa Barbara, CA , USA, 1995.
95. Silten RGS. Is the War over: Memoir of a Child Survivor of the Holocaust. Fithian Press, McKinleyville, CA, USA, 2004.
96. Gedenkstättenreferat der Stiftung Topographie des Terrors, Berlin. Silten Preis. https://www.gedenkstaettenforum.de/fileadmin/user_upload/Aktuelles/Projekte/2022/PDF/Silten_Preis_Ausschreibung_2022.pdf (accessed: May 2025).
97. Bruce W. Fairhall. The Whole Fairhall Project (Private Ancestry Website, NSW 2530 Australia). https://fairhall.one-name.net/families/fullproject/g0/p176.htm (accessed: May 2025).
98. Science Museum Group Collection, London, UK Silten Limited. https://collection.sciencemuseumgroup.org.uk/people/cp128347/silten-limited (accessed: May 2025).

99. KrejsaS. Spurensuche – Der NS-Anwalt und Judenretter Helmut Pfeiffer. Vergangenheitsverlag, Berlin, Germany, 2011.
100. Bundesarchiv. Porträt Helmut Pfeiffer, Bild 146-2009-0089 / o.Ang. / CC-BY-SA 3.0.
101. Böttcher W. Thoemmes M. Heinrich Dräger -Eine Biographie. Wachholtz Verlag, Neumünster, Germany, 2011.
102. Knoll M. Die Drägerwerke im Dritten Reich. GRIN Verlag, München, Germany, 2004.
103. Romey S. Ein KZ in Wandsbek: Zwangsarbeit im Hamburger Drägerwerk. VSA Verlag, Hamburg, Germany, 2016 [Erweiterte Neuausgabe, 1. Auflage 1994].
104. Kamp M. Biographie Otto Heinrich Dräger (1898-1986). Pending release: 2025-2026.
105. Drägerwerk AG Lübeck (ed.). Heinrich Dräger – 80 Jahre. Graphische Werkstätten, Lübeck, Germany, 1978.

Did carnations lead to the creation of the Mayo Clinic Department of Anesthesiology and perhaps the specialty of anesthesiology?

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History is filled with unique and improbable connections. An observation that ethylene prevented carnation buds from opening in a greenhouse in Chicago may well have led to the recognition and infrastructure of the modern specialty of anesthesiology. One hundred years ago, on April 1, 1924, John Lundy began his work at the Mayo Clinic in Rochester, Minnesota. Over the next thirty-five years, he would be instrumental in the development of intravenous anesthesia, regional anesthesia, fluid therapy, blood banking and, in the 1950s anesthetics for "blue" babies for cardiac catheterization. What were the factors that caused Lundy to leave a thriving private practice in Seattle, Washington and move to Rochester?

The past often contains a prolog to the story at hand. Isabella Herb was a physician anesthetist in the last decade of the 19th century. She was brought to the Mayo Clinic in 1899 to give anesthetics for Dr. Charles Mayo's patients. Dr. Herb was on staff until 1904 when she left Rochester, toured Europe, and then settled in Chicago at Rush medical Center and Presbyterian Hospital. John Lundy would cross paths with her when he attended Rush medical college graduating in 1920. He externed for three years in anesthesia, a division headed by Dr. Herb

In 1922 Drs. Arno B. Luckhardt and J. Bailey Carter began to study ethylene based on the observation that the gas could inhibit carnation buds from opening. Successfully anesthetizing animals, on March 11, 1923 Dr. Herb successfully anesthetized a human patient. Two weeks later it became the preferred anesthetic at Rush. Luckhardt and Baily published their results in the March-April 1923 edition of *Current*

Researches in Anesthesia and Analgesia and presented their work at the June meeting of the Pacific Coast Association of Anesthetists, a meeting Lundy most likely attended.

On February 4, 1924, Lundy had the opportunity to meet Dr. William J. Mayo at the Annual Dinner Meeting of the King County Medical Society. Seated across from Dr. Will, Lundy asked what the Mayo Clinic position was on ethylene anesthesia. Replying that it was not employed at the Clinic a lively discussion ensured which by evening's end resulted in an offer to come to the Mayo Clinic and take over anesthesia. Closing his practice in six weeks and moving across the country, Lundy arrived at the Mayo Clinic. Within five years, Lundy would establish the Anaesthetists Travel Club, an organization critical to the formation of the American Board of Anesthesiology and the recognition of the specialty.

How the ISHAs and their Proceedings evolved

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In the late 1960s and early 1970s there was no formal structure for research and publication of the history of our discipline. Major textbooks often had a chapter relating to history or perhaps the subject was used as an introduction to teaching. Almost all anaesthesia journals published historical papers, but these were written infrequently. Anaesthesia history was focused on local and national contributions and rarely considered parallel international developments; most non-English publications were ignored. There were several published anaesthesia history books, but these were not often read by trainees except around examination times as the Fellowship examination run by the Faculty of Anaesthesia within the Royal College of Surgeons of England retained history as part of its examination curriculum.

In the early 1980s, a young anaesthetist from Ljubljana, now working at the Erasmus University, Rotterdam, Joseph Rupreht, discussed with his professor the idea of holding an International Symposium on the History of Modern Anaesthesia. Professor Wilhelm Erdmann (1940-2020) was enthusiastic, and the 1st ISHA took place in Rotterdam 5-8 May 1982. It was a huge success thanks to the vigorous enthusiasm of Rupreht. 200 registrations were obtained, and 120 papers were read and subsequently published in 1985. Attendees came from over 30 countries across the world and the list of names of those that attended and presented read like a who's-who of anaesthesia greatness.

Honorary Presidents of the Congress were Professor Doreen Mary Elizabeth Vermeulen-Cranch (1915-2011) (the first European professor of anaesthesia in Amsterdam), Sir Robert Reynolds Macintosh (1897-1989) (the first anaesthesia professor at Oxford University), Sir Geoffrey Stephen William Organe (1908-1989) (the first professor of anaesthesia at a London Teaching Hospital, The Westminster) and Hans Franz Edmond

Killian (1892-1982) one of the founders of German anaesthesia). There was an impressive social program including a sightseeing tour of Rotterdam with a harbour tour, a reception and banquet in the Town Hall during which a quartet, including Peter Safar on piano, played Bach and a day trip to Amsterdam with time on the canals, the Rijksmuseum and watching diamond cutting. This programme caused many delegates to agree that it was "the happiest meeting ever".

As a direct consequence of this first International Symposium on the History of Anaesthesia (ISHA), three of the American attendees, Roderick Kerns Calverley, (1938-1995) Selma Harrison Calmes (1940-) and Jacob Mainzer Jr, (1931-2015) decided to work together to create a society to continue to develop anaesthesia history and in 1983 the Anesthesia History Association (www.ahahq.com) held its first meeting and has met regularly ever since. Sadly, they have not published regular Proceedings although the Bulletin published by the Wood Library Museum of Anesthesiology did publish some papers from those meetings and photographs of attendees. Ian Mclellan (1943-) and the author both attended the Rotterdam meeting and talked to Thomas Babbington Boulton (1925-2016) about starting a UK history society. The History of Anaesthesia Society (HAS) was founded in 1984 after a preliminary meeting in Reading and has met regularly ever since. Its Proceedings have been published every year and contain a mass of historical information as well as lists of members and photographs of lecturers.

In the UK, the Association of Anaesthetists of Great Britain and Ireland (AAGBI) suggested that they run a second ISHA in London in July 1987 and this duly took place under the leadership of Tom Boulton. The 2nd ISHA was held at the Royal College of Surgeons of England in Lincoln's Inn Fields and had over 500 registrants and 130 lecturers with many giving more than one presentation. Each day started with short, personal reflections by some of the influential British anaesthetists like Sir Robert Reynolds Macintosh (1897-1989) and Thomas Cecil Gray (1913-2008). The meeting was held under the Patronage of Her Royal Highness Princess Alexandra of Kent who attended the opening reception and took time to meet a great many of the delegates present. There was a lavish dinner at the Banqueting House in Whitehall which was built in 1622 having been

designed by Inigo Jones and used by royalty ever since. In 1636 the ceilings were adorned by nine paintings by Rubens which mean that no one has been allowed to smoke in these rooms for long before the current laws of smoking in public buildings were enacted. However, at that ISHA dinner, someone set off all the fire alarms by smoking in the toilets! Another evening entertainment at this second ISHA was a cruise on the River Thames during which Torsten Gordh demonstrated his skills as a magician, these skills having been learnt to augment his income whilst paying his way through medical school.

At this ISHA a format for future meetings was established; those wishing to hold an ISHA would present their ideas to a small committee made up of those who had been involved with previous ISHAs. Of the greatest importance was the willingness to publish Proceedings of the meeting and the 2nd set of these appeared in 1989. 650 pages of fascinating historical research this was published by the Royal Society of Medicine. The meeting was backed by the AAGBI but sponsorship was obtained from 21 companies who were able to exhibit their products. Atlanta, Georgia hosted the third ISHA in 1992. Held in March to mark the sesquicentennial anniversary of the use of ether anaesthesia by Crawford Williamson Long (1815-1878) in Jefferson Georgia on 30 March 1842. The morning of the first day of the meeting focussed on Long the man and his time and the afternoon allowed a tour to the Long Museum in Jefferson. This meeting was sponsored by the AHA, the Georgia and Greater Atlanta Societies of Anesthesiology, and the Departments of Anesthesiology of Emory University and the Medical College of Georgia. In addition, financial help was obtained from eight major companies who also provided technical exhibits. Betty Bamford (1923-2001) was President of the meeting and John Edward Steinhaus (1917-2012) was Chairman. This was a smaller meeting with 100 abstracts submitted mainly from the USA and UK but with contributions from all around the world. The Proceedings were published by the Wood Library Museum of Anesthesiology in 1992 having been edited by Bernard Raymond Fink (1914-2000), Lucien Ellis Morris (1914-2011) and Charles Ronald Stephen (1916-2006).

In April 1997 the fourth ISHA took place in the Congress Centre, Hamburg, Germany. The Chairman was Jochen Schulte am Esch (1939-)

and the Co-Chairman was Michael Goerig (1951-).The meeting was created in collaboration with Arbeitskreis Geschichte fur Anasthesie (the German History of Anaesthesia Society), the AHA and the HAS. Financial support was provided by 11 companies of whom Drager provided the greatest part including the printing of a very high-quality Proceedings with a myriad of illustrations together with a catalogue of the historical apparatus displayed. The success of the meeting was assisted by am Esch being the current president of the German national anaesthesia society, the DGAI. 150 papers were presented at the meeting to which over 250 delegates attended and there was an extensive exhibition of historical anaesthesia apparatus. In the evenings it was possible to attend one of three musicals Phantom of the Opera, Cats or The Buddy Holly Story and there was a memorable evening banquet at the Kempinski Hotel Atlanta in Hamburg o the Monday night. As with other ISHAs to date there was a large international committee of advisors. It was decided in Hamburg that future ISHAs should follow every four years instead of the five years used to date.

Santiago de Compostella, Spain were the hosts of the 5th ISHA held in September 2001. The timing of this was brought into sharp focus by the act of terrorism just a week before the meeting, when three aircraft were hijacked and crashed into America two of them destroying the twin towers of the World Trade Centre in New York and which became known as 9/11. The closing of all airspace for some time undoubtedly deterred many from attending but nevertheless the meeting did take place and was a very memorable occasion. Santiago de Compostella has a cathedral which houses the remains of St James, one of the apostles of Jesus Christ, and is the end point of a Christian Pilgrimage, The Way of St James, since the Middle Ages. Modern pilgrims follow the Way or Camino which is classically marked by scallop shells. The ISHA was a great success perhaps the smaller meeting enhanced communication between delegates and was run by Jose Carlos Diz Gomez (1966-), Avelino Franco Grande (1937-2023) and Julian Alvarez Escudero (1956-). Around 100 delegates attended the meeting, and 92 papers were published in the Proceedings which appeared in 2002 having been edited by Diz, Franco, Alvarez, Douglas Richard Bacon (1959-) and Joseph Rupreht (-). The social

events at the meeting were enhanced by high quality Spanish wine and cuisine especially at the dinner held in the Hostal de los Reyes Catolicos. Visits were possible to the cathedral of St James and, on one evening, delegates were able to witness the Botafumeiro Ceremony where a 65 kg thurible is swung by eight men in a 65-metre arc across the cathedral spreading incense fumes as it travels at impressive speeds. The organisers made the decision not to have commercial sponsorship for the meeting from companies associated with anaesthesia instead they used the resources of the Department of Anaesthesia in Santiago and were able to access funds from trials and grants held by that department. In addition, many of the facilities used were provided free of charge by institutions like the local School of Medicine. In addition, the reception held at the Palacio de Fonseca was paid for by the university.

Queens College Cambridge, England was the venue for the sixth ISHA held in September 2005. The College was founded in 1448 and has buildings on either side of the River Cam linked by the famous wooden Mathematical Bridge. The meeting was organised with a very small committee by Christopher Neil Adams (1954-) who utilised the AAGBI meeting rooms to hold meetings which involved Peter Morris (1933-2016) the then Vice-President of AAGBI, David John Wikinson (1948-), Ian McLellan (1943-), George William 'Bill' Hamlin (1954-), Jean Mary Horton (1924-2021), Sally Garner and John Pring. Jean Horton was able to secure the venue at Queen's and arranged the Duxford visit. 190 delegates attended the meeting, and the majority were able to stay in rooms within the College as the meeting took place outside of the college's term time. Meals were taken in the hall with delegates seated at communal tables with bench seats a process which encouraged new conversations and proved very popular. Almost half of the delegates were from the UK but over 20 countries were represented at the meeting. There were two major outings available to delegates, one to the Madingley American Cemetery and Memorial is over 30 acres in size, was dedicated in 1956 and contains over 3800 American war graves and the second was to the Imperial War Museum Site at Duxford Aerodrome. At this latter venue delegates were able to visit the American Hanger before sitting down to listen to a presentation by Selma Calmes who read extracts from letters and

postcards sent home by her father who had been stationed in England whilst a member of the 82nd Airborne 508 Parachute Infantry Regiment, prior to the invasion of France on D-Day in 1944. The meeting was further enhanced by the provision of a travelling museum exhibition from The Bonn Anaesthesia Museum in Germany, run by Horst Otto Stoekel, the Wood Library Museum in Chicago facilitated by Judy Robins (1953-) and the AAGBI museum facilitated by Trish Willis (1956-). Alistair Mckenzie (1947-) brought an amazing exhibition of postage stamps relating to anaesthesia history and Gary Robert Enever also brought apparatus to exhibit as did GE Healthcare. The meeting had sponsorship from nine companies and from Mrs Regina Bullough who raised over £2000 to provide a prize for the best trainee presentation at the meeting in honour of her anaesthetic husband John Bullough (1921-1999) who had pioneered new techniques of resuscitation. The Proceedings for this Symposium had a troubled gestation. The head editor, Peter Mary Edward Drury (1932-2017), suffered an aortic aneurysm rupture in 2005 a few months after the meeting and, although he survived, he was not able to complete the Proceedings, so 12 further editors were volunteered to complete the book which appeared in 2007. Although full of excellent historical material the 800 pages suffer from the absence of an index.

In October 2009, Eleni (Helen) Askitopoulou (1944-) hosted the 7th ISHA in Hersonissos, Crete. Held in the Creta Maris Hotel Convention Centre it received support from the Faculty of Medicine at the University of Crete, the International Hippocratic Foundation, the Hellenic Society of Anaesthesiology and the Hellenic society of Anaesthesiology and Intensive care of Northern Greece. In addition, 13 companies provided commercial support. There was a large local organising committee and around 100 presentations which evolved into a 585-page Proceedings some 3 years after the meeting which only included 47 of these presentations. There were undoubtedly language challenges and the high academic standards set by the editors probably caused this noticeable ‘wastage’. I suspect that this is the first of this set of Proceedings to undergo such stringent editorial assessment. The social programme included a welcome reception, visits to Knossos and Archanes, a Cretan evening with Greek

music and a farewell Gala Dinner. The good weather and generous hospitality were enjoyed by all.

In January 2013, ISHA moved to the southern hemisphere for the first time for a meeting in Sydney, Australia. Opened by the Governor of New South Wales the meeting had the theme of 'History Matters' and 160 registrants heard papers from 72 speakers. The meeting was co-chaired by Ross Beresford Holland (1927-2017) and Jeanette RaeThirlwell Jones (1938-2025) and the scientific convenors were Michael Cooper (1959-) and Christine Ball (1957-). Held in collegiate surroundings again in the grounds of St John's College, part of the University of Sydney, it had been founded in 1857 and was the oldest in Australia. There was an excellent display of old books in the Fisher Library and a memorable evening boat trip round Sydney Harbour. Trainees were plentiful in their presence and contributions and there was an interesting Workshop, the first at an ISHA, on the *History of Anaesthesia; securing the future*. On the day after the meeting in Sydney there was a satellite meeting for one day at the Australian and New Zealand College of Anaesthetists , Melbourne entitled the Geoffrey Kaye Symposium which was coordinated by Chris Ball and allowed visits to the museum and a range of old apparatus normally in storerooms to be seen. The Proceedings, edited by Cooper, Ball and Thirlwell were published in 2016 and comprise 794 pages of over 100 papers.

The ninth ISHA returned to the USA and was held immediately after the annual meeting of the American Society of Anesthesiologists Congress in Boston in October 2017. It was organised by the husband-and-wife team of Manisha Sukumar Desai (1957-) and Sukumar Paramanand Desai (1953-) and held in the Massachusetts General Hospital (MGH). Delegate registrations were undoubtedly enhanced by following on from the ASA, and being held jointly with the AHA annual meeting, around 175 registrations took place with people from 19 countries around the globe, and they were able to listen to over 70 lectures. There were a series of interesting presentations from anaesthesia museum curators and librarians. The social programme included a reception at MGH with a tour of the Ether Dome, an evening boat trip on the Boston Harbour and a Gala Dinner at which a play was

performed about the events leading up to the start of anaesthesia performed by the Drama Club of Weston High School. After the scientific programme it was possible to visit notable anaesthesia sites in and around Boston like the Francis A Countway Library, the Ether Monument, the Mount Auburn Cemetery as well as homes related to WTG Morton in Wellesley and Charlton, Mass. The Proceedings were published within a year and were edited by the Desai team and comprise 390 pages with some papers of one page and others over 20 pages long.

Kobe, Japan won the right to hold the 10th ISHA in 2021, but world events conspired to make this one of the most difficult events relating to the history of anaesthesia ever. In 2021 the world was experiencing the full force of the Covid-19 epidemic. Travel was completely banned by many countries, and so the Japanese Society of Anesthesiology and the organising committee of the ISHA postponed the meeting until June 2022. The meeting was held at the Kobe International Conference Centre, and like the Boston ISHA, was held in conjunction with the JSA national congress. Chair of the meeting was Shigeru Saito aided particularly by Hiroshi Makino (1973-) and Kentaro Dote (1956-)who travelled extensively in the USA and UK to present their own research as well as advertise the forthcoming meeting often with remarkable masks and clothing representing Seishu Hanoaka (1760-1835). By June 2022 matters were a little improved in relation to Covid, but at that time Russia invaded Ukraine adding further aircraft restrictions and so delegates were still reluctant to travel and so for the first time the ISHA became an interactive one with presentations made by video as well as in person. Despite travel difficulties many delegates did travel from the USA, UK and Australia. Delegates were able to visit the National Anaesthesia Museum in Kobe and the site where Seishu Hanoaka provided anaesthesia in 1804. The Proceedings were published in 2023, and its 516 pages are full of valuable material. The editorial process undergone by the papers was solely to format the papers into a uniform style so that no journal type editing process took place.

In September 2025, Paris will host the 11th ISHA and challenges of financial backing and wider delegate interest remain unsolved. Each of the ISHAs to date has seen new historical research presented, historical

apparatus shown and visits to local historical sites of interest included. The Proceedings from these meetings encompass a huge historical resource but remain inaccessible to those without the paper formats. Their digitalisation would solve this but has not been possible because of copyright, permission and cost issues.

Over recent years attendance at history-based meetings has diminished as older members have passed and trainees have found their study leave budgets allocated to meetings that would help them pass examinations and move up their career pathways. History used to be part of the College examinations in the UK but that disappeared in the 1980s and so trainees have moved away from learning history. The ISHAs have been catalysts to the development of interest in the history of anaesthesia. What has made this system work and work so well is the social interchange that has taken place at every meeting. Trainees can talk to those who created the drugs and apparatus they now use. New focusses are created for future research and 'Names' become warm friendly people who enjoy learning from, and teaching to, others

It will be interesting to see how this develops over future decades.

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