

Operations Without Pain: The Practice and Science of Anaesthesia in Victorian Britain

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In her introduction the author emphasizes that her book, *Operations Without Pain: The Practice and Science of Anaesthesia in Victorian Britain*, is 'In no way ... intended to be a linear history of discoveries, techniques, or famous men' (p. 4). It is a pity, therefore, that the title is so misleading, since this book is not a history of 'the practice and science of anaesthesia in Victorian Britain' either. 'Aspects of...' or 'A Consideration of ...' would have been a fairer description. Nor, although it is one in the series entitled 'Science, Technology and Medicine in Modern History', is there a great deal of science or medicine, and technology is hardly mentioned at all. Thus such neglected technological topics as the contribution of the commercial chemists and instrument makers, still of great relevance today, do not feature. Instead, taking Pernick's treatise on the early years of anaesthesia in the United States as an example ([1](#)), Dr. Snow has used the history of anaesthesia 'to illuminate three areas of current historical interest: the relationship between medical practice and science; the dynamics which structured patient-doctor relations; and the specialization of medical practice'. She has, also, 'approached the first two issues from a particular historiographical vantage, using a typological model of medicine'. So, essentially, it is an intellectual and social history of the introduction of general anaesthesia and of the response of surgeons and the general public to its early problems, leading up to its secure establishment in medical practice and its gradual acceptance as a specialty, and which is written from the viewpoint of a particular school of social history. As such it invites comparison with Pernick's approach.

Dr. Snow, in her introduction, explains that, ‘Most writers portray anaesthesia as a natural and inevitable phenomenon of “modern” medicine which enjoyed an immediate and sustained take-up and developed uniformly. But this was not so; the early use was uncertain and differed between nations’. She suggests that, ether being a difficult agent to use, it was only the introduction of chloroform that saved anaesthesia from remaining ‘on the margins of British practice’. But chloroform was occasionally associated with sudden death, and she notes the different responses in different parts of the world, abandonment in some, acceptance in others, with the development of different methods of administration in, for example, England and Scotland. ‘To skate over such complexities is to prevent the history of anaesthesia from informing our deeper understandings of nineteenth-century medicine and society.’ This accusation is hardly fair, since the response of the medical profession during the remainder of the century is a major feature of serious histories of anaesthesia. In Duncum’s book, for example, the bible of the historian of anaesthesia, over one hundred pages are devoted to the first twenty five years of the use of chloroform, including some twenty to an analysis of the report of the Chloroform Committee of 1864 alone (2). In this respect Dr. Snow’s exclusion of the physiologist A. D. Waller and the second dosimetric movement that he spearheaded is a major omission.

Now we come to the crux of Dr. Snow’s book. The late Richard Ellis developed the thesis, not generally accepted, that after the initial enthusiasm, a run of time-wasting failed inductions and inadequate anaesthetics put the procedure in danger of being abandoned, and that it was only kept going by the persistence of the dentist James Robinson, until John Snow produced predictable and reliable effects by establishing it on sound scientific principles. This would have put it at hazard for at most two months. But Dr. Snow, ‘putting anaesthesia under a wider historical lens’, has turned her gaze onto the ‘complex patterns of innovation, reversals, debate, and geographical difference by which anaesthesia became established in British medicine’, and as a result feels that the doubts persisted for up to twenty years. She has identified two distinct phases, the first extending from 1846 to 1860, during which it was debated whether the risks were greater than the benefits—‘That issue is the heart of this book ...’ (p. 4). So although she covers the period 1790 to 1900, by which time the practice of anaesthesia had become ‘embedded into social and medical culture’, the larger part of her discourse is devoted to a close examination and analysis of opinion, theory, and practice, during the years up to the mid-1860s. Her penultimate chapter takes the emerging specialty to 1900, and she concludes with an overview of national similarities and differences, and a brief look at developments into the twenty-first century.

It is impossible in the space available to comment, as an anaesthetist, on all the disputatious points that Dr. Snow makes; that would require an even longer book than the original. So I will try to answer two questions and deal only with her main thesis in any detail, commenting briefly on others points. Unlike Pernick, the book begins conventionally with the pre-history of inhalational anaesthesia, with Humphry Davy’s and his friends’ observations on the effects of inhaling nitrous oxide, and its analgesic property. Dr. Snow comments that historians have failed to tackle the commonest of the FAQs about the history of anaesthesia: why neither Davy nor his contemporaries pursued his suggestion that nitrous oxide ‘may be used with advantage during surgical operations ...’. Careful reading of Davy’s treatise on nitrous oxide, however—something it doesn’t get very often nowadays—shows this was a throw-away remark, and that his real interest was elsewhere (3). But nitrous oxide *was* tried, with alarming results, at a meeting of the Askesian Society in March 1800, which was attended by, among others, the influential surgeon Astley Cooper. William Allen, of Allen and Hanburys, lecturer on chemistry at Guy’s Hospital, related his own sensations, and the reaction of his friends. ‘The company said that my eyes were fixed, face purple, veins in the head very large, apoplectic stertor. They were all much alarmed, but I suffered no pain and in a short time came to myself’ (4). His friends thought he was having a stroke, and this was sufficiently alarming for the experiments to be terminated. Does one need more explanation of why Davy’s suggestion was not taken up? Furthermore, it is tacitly understood by anaesthetists that nitrous oxide was the wrong agent. It was suitable for the uncomplicated extraction of a small number of teeth or the lancing of an abscess, but for nothing more. This was the limitation faced by Horace Wells, the real pioneer of general anaesthesia, who, sadly, Dr. Snow has airbrushed almost completely out of the picture. Wells’s search for a method of pain relief in dentistry was

philanthropic, motivated by his desire for improvements in denture technology, and neither his nor Morton's discoveries were, as she says, serendipitous. Wells's mind was the prepared soil into which the Colton-scattered seed fell and germinated. Morton, following Wells, was looking for a better agent deliberately; in his case, for commercial gain.

Dr. Snow continues with the influence on medical practice in the early-nineteenth century of changes in the attitude to the body, from what she calls 'biographical' to 'scientific' medicine. This is the typological model to which she referred earlier. I am not clear from her description whether in their essentials these not necessarily exclusive approaches to medical practice are different from what has been described elsewhere as 'bedside' and 'scientific' or 'hospital' medicine (5). It appears to be distinct from the change from 'Rush heroic' to the more moderate approach labeled 'environmental moral' by Pernick. At any rate, a gradual change did occur, but slowly, as can be seen from the conservative nature of some of the contributions to discussions in the Westminster Medical Society as late as the mid-1840s, in spite of the efforts of John Snow. But whatever they are called, these attitudinal changes, while she concedes that they had no influence on the actual introduction of general anaesthesia, were of great importance in preparing 'elite physicians and doctors'—a group Dr. Snow mentions several times, one wonders who these were—for its acceptance.

This leads to the second of the FAQs about anaesthesia echoed by Dr Snow—why it emerged in the 1840s rather than in an earlier period, 'though the gases used had been known for some time and inhaling vapours was an established therapeutic practice'. She comments that few historians have sought to explain this; so, the answer being crucial to the main burden of her book, let us try. Just posing the question implies, rather ahistorically, that since we now know that general anaesthesia is 'a good thing', therefore it was the duty of someone to have introduced it as soon as it became feasible. It also makes the enormous assumption that the procedure could, like Botticelli's Venus, have emerged from the foam fully formed, perfect, demure, and ready to go. But great innovations are made by people, and Dr. Snow, by excluding from her discourse the vagaries of 'the crooked timbers of humanity', such as enthusiasm, inventiveness, persistence, ambition, greed, inertia, and lack of interest or of imagination, has, unlike Pernick, excluded a whole stratum of explanation. Because the truth is that, humanitarian arguments notwithstanding, before Henry Hickman no one was looking; it never appears to have entered anyone's mind that it could be done (6). The possibility had been positively dismissed by the great French surgeon Velpeau, and by the American Valentine Mott. So, conceptually speaking, *acceptance of the idea* that one might safely and reversibly deliberately produce unconsciousness, hitherto an ominous sign of life-threatening illness, was a *Kuhnian paradigm shift* (7). Other biological examples may be mentioned. Until Pasteur's flash of inspiration, no one believed that living organisms could survive without oxygen, but seeing dead bacteria round the edge of a cover slip he discovered, or constructed, anaerobes. No one believed that any living organisms could withstand prolonged boiling, or live under the enormous pressures of the depths of the Pacific Ocean, until the opposite was demonstrated. The acceptance of the controlled and reversible unconsciousness of general anaesthesia was a conceptual change of similar magnitude, and once this acceptance is recognized as a Kuhnian shift, then all is illuminated. The twenty years of uncertainty, the acceptance by the next generation, and the normal science developed by John Snow, are then to be expected, being, by definition, predicted. Although she does not give any indication that she recognizes the nature of this acceptance, Dr. Snow is moving in the right direction when she claims that the attitudinal change already mentioned prepared her 'elite physicians and doctors' for it.

There are two further considerations. In early-Victorian times people were not as accustomed to the rate of change as we ourselves have become conditioned to, and this has to be taken into account when looking back at that period. Consequently, prolonged opposition to such a dramatic and potentially dangerous procedure as general anaesthesia is not surprising. The second and clinching factor was the introduction of antiseptic, shortly followed by aseptic, procedures into surgery. If general anaesthesia had not already arrived, it would have had to be invented. Anyone who has seen a patient, restless under regional or spinal anaesthesia, disturbing the sterile drapes will see the force of this argument. In the words of the great physician Sir Clifford Albutt,

When I was a boy ... the best surgeon was he who broke the three-minute record for amputation or lithotomy. What place could there be in record-breaking operations for the fiddle-faddle of antiseptic precautions? The obvious boon of freedom from pain, precious as it was ... was the boon of time. With anaesthesia ended slapdash surgery; anaesthesia gave the necessary time for the theories of Pasteur and Lister to be adopted in practice.

Pernick makes a similar point, less eloquently. So really, by the mid-1860s there was no question of turning back.

To proceed with Dr. Snow's arguments, most of four chapters are devoted to what we may now call the phase of paradigm resistance. She makes a great point of the restraint, the self-control, that had become expected by the early-Victorian period of patients undergoing surgery, sometimes described as 'bottom', and suggests that after the first successful demonstration, 'reputable doctors' would have difficulty accommodating to ether anaesthesia because it 'placed patients beyond individual self-control' (p. 40). It seems that she is referring to the stage of excitement through which most patients passed, more marked with ether than chloroform, before full surgical anaesthesia was reached. Yet in her introduction she says, without supporting references, that 'surgeons were accustomed to terrified or restless patients, but not to the newly insensible body which still breathed and might struggle in a way that inhibited surgery' (p. 3). The only author I am aware of who clearly expressed the reaction of the surgeon to operating on the anaesthetized patient was the great Russian, Pirogoff, whose treatise on ether is required reading for anyone setting out to write about the early days of general anaesthesia (8). He described with great eloquence his initial reluctance to use ether, his rapid acceptance, and his equally rapid realization that it greatly extended the scope of palliative surgery; yet his work is not referenced nor included in the bibliography.

After the initial demonstrations, there was a short period during which many doctors, druggists, and pharmacists, thought that anyone could administer anaesthetics, and inhalers were designed by the dozen. Few practitioners realized the physiological complexity of the process, and speedy disillusionment resulted in a spate of horror stories. John Snow, in the meantime, designed an inhaler that allowed him to control the concentration of the ether inhaled, and embarked on a programme of research that aimed principally to establish the relationship between the resulting blood content and the depth of anaesthesia. But Dr. Snow describes his approach in terms that will be foreign to most anaesthetist historians. He had placed anaesthesia, 'in the elite frameworks of anatomical and physiological knowledge, and then, by the use of analytical principles, he had tailored a specific intellectual framework for the etherisation process' (p. 59). Whether the high level of intellectualization that one encounters here, and throughout the book, is appropriate to the subject may be debated. After all, the chap just prepared a table of concentrations at different temperatures, designed an appropriate apparatus, and experimentally determined the percentages necessary to produce the required depths of anaesthesia. Was it not Freud himself who is reported to have said, that whether we have snipped the end off it or not, there must be an occasion when a cigar is just a cigar?

The chapter concludes with the replacement of ether by chloroform, and an account of the first chloroform death. There is not room here to discuss this in detail, but Dr. Snow is not entirely accurate in suggesting that Fife and Glover, the expert witnesses, equated the congestion of the lungs that they found with asphyxia (9).

Dr. Snow continues with an account of the Snow/Simpson dispute, and John Snow's attempts to persuade the profession to establish the practice of anaesthesia on sound physiological principles. This is analysed in terms of 'the very different models of the body and its systems each drew on', and in Simpson's case there was also the 'particular resonances of Scottish Enlightenment philosophies' with their emphasis on philanthropy. 'For Simpson and other Scottish doctors anaesthesia was a vivid articulation of the humanitarianism which lay at the heart of medical practice', but there is nothing to suggest that John Snow was any less humane, and it is very likely that he was as well acquainted with the works of the Scottish Enlightenment philosophers as Simpson (10). The difference can be explained more simply by reference to

Celsus, who wrote, around the beginning of the first millennium, in the introduction to his *De Medicina*: ‘... there is a primary difference of opinion, some holding that the sole knowledge necessary is derived from experience, others propounding that practice is not efficient enough except after acquiring a reasoned knowledge of human bodies, and of nature ...’. The conflict described by Celsus runs throughout this book, exemplified by the difference between John Snow and the English school of anaesthetists, and Simpson and the Scottish.

The next chapter deals with the risks of anaesthesia, and its use in midwifery. Here Dr. Snow says that by the early 1850s the patient’s dread of surgery had metamorphosed into a particular fear of the anaesthetic. But it is not generally recognized that patient reluctance dates back to the very earliest days of general anaesthesia. On 28 December 1846, a patient of Robinson’s refused to inhale ether vapour, having heard, ‘that I sent people to sleep and then took out all of their teeth’. Here, astonishingly, is the birth of a meme, a transferable unit of cultural information, that has multiplied and spread beyond measure. Where could this fear have come from? Robinson by then had administered fewer than ten anaesthetics. The patient had no reason to fear death, because there had been none. His fear was of the loss of autonomy, of what might happen to him while unconscious; and patient reluctance continued to be a feature. Pernick makes the same point. Hooper’s remarkable suggestion about the desirability of patient-controlled inhalational analgesia to overcome it was published as early as April 1847 (11)!

The almost equal reluctance of doctors to administer anaesthetics, which Lister spent some twenty years trying to overcome, which operates even to this day, and which is an important factor in its availability, is barely recognized by any of the writers on this subject. Dr. Snow, by focussing, as we shall see later, on the practice of John Snow, which was by no means typical, has excluded consideration of what was happening elsewhere. Thus Lister, writing in 1862 in T.A. Holmes’s *A System of Surgery*, was concerned that general anaesthesia ‘was scantily used in parts of the United Kingdom because of fear of fatalities’. In Scottish hospitals, where most of the anaesthetics were given by medical students ‘coming fresh every three months’ a simplified technique had to be developed. For the conscientious anaesthetist this concern never wholly goes away. Some years ago a very distinguished dean of the then Faculty of Anaesthetists—now the Royal College—confided to me his initial nervousness on returning to the anaesthetic room after an absence of several weeks, a feeling well-known among the specialty; ‘It was just like starting all over again’. So there is always the mundane possibility that the patient did not receive an anaesthetic because there was no one prepared or available to administer it, a situation not unknown in our hospitals today. Even John Snow records occasions when, under pressure of work, he induced anaesthesia but did not stay for the operation, relying on the speed of the surgeon to see the patient through. While Dr. Snow mentions part of Lister’s article, she references not the original but only the excerpt in Duncum. If that is all she read, she missed some matters of great importance.

Pernick surveyed anaesthetic usage as recorded in three sets of mid-nineteenth century surgical records. Dr. Snow, similarly, has examined the records of a number of London teaching hospitals, and, taking John Snow as an exemplar of anaesthetists practising during the 1850s, has analysed his work as described in his casebooks in some detail. John Snow anaesthetized regularly for William Fergusson, and Dr. Snow, from an examination of patients’ statistics recorded at King’s College Hospital, and a comparison of the ratio of the total of Fergusson’s hospital consultations to those operated on at various times, has identified a period during 1854 when fewer operations were performed under general anaesthesia than in the preceding and following months. She attributes this to Fergusson’s anxiety about an increase in the number of chloroform deaths, although a comment in the *Lancet*, cited in an earlier chapter but not here, is also of relevance. The samples, however, are small, and there are a number of inconsistencies in the tables—I am indebted to Dr. Henry Connor FRCP for his very careful examination of these—and we are not told whether they have been subjected to statistical analysis, nor what was happening in other hospitals. Only one of the deaths was at King’s (p. 104), although this is missing from the list in the Appendix, and John Snow had none. It must be significant that during the month immediately after John Snow’s amylene death in 1857 he anaesthetized the greatest number of Fergusson’s private patients in any four weeks, as well as Queen Victoria. A reduction in the number of operations in 1857 similar to that in 1854 receives no comment. There are many reasons for

the curtailment of operating lists, as we know only too well today, staff shortages, ward closures, and so on, and these need to be excluded. Also, while John Snow may rightly be regarded as an example to be followed, he was in no way an exemplar in the sense that Dr. Snow is using the word, that is as a fair sample of the average in anaesthetic practice. He was unique, and it would be misleading to generalize from his experience.

Dr. Snow's discussion of the pros and cons of the use of inhalational analgesia to relieve the pains of labour is comprehensive, occupying ten pages. It culminates in the experiences of Queen Victoria, expressing the conventional view that after her first child, in 1853, 'there had been a significant change in attitudes to childbirth anaesthesia ...' (p.122), but she does not mention the research of the Connors, which throws serious doubt on the need for, and extent of, Her Majesty's influence (12).

It is not apparent that Dr. Snow consulted any anaesthetists during the course of her research, since they would surely have advised her, among other things, that ether and chloroform are not gases; that chloroform kills by inducing ventricular, not atrial, fibrillation; that atropine, which causes excitation of the central nervous system, is not a narcotic, and, since it dilates the pupils, is not used to treat this condition; and that Junker's apparatus, the first plenum vaporizer, introduced in 1867, which is mentioned only in passing, was technologically a great step forward in that it allowed anaesthesia to be maintained during operations with the mouth open. The importance of this is seen in the tribute paid by Fergusson to Thomas Smith, surgeon to St Barts, who greatly increased the success rate of operations for congenital cleft palate by advocating, in 1868, the use of his gag to keep the mouth open, together with general anaesthesia. She would have been advised also not to dismiss Joseph Clover—generally recognized as John Snow's successor as the leading English anaesthetist, who for a while practised also as a surgeon, inventing the Clover crutch, a lithotrite, and a cervical cautery—because he 'did not champion anaesthetic matters through medical networks' (p. 192). Duncum says exactly the opposite (p. 457). Clover spoke at meetings, especially of the Odontological Society, where in the late 1860s most of the action was as regards advances in anaesthetic techniques, taught medical students, invented apparatuses, published papers in journals, and wrote the article on anaesthesia in Quain's encyclopaedia. Dr. Snow does not explain what other medical networks she has in mind.

The book concludes by considering the acceptance towards the end of the century of anaesthetics as a specialty, and, without supporting references, unconventionally attributes the anaesthetists' claim to this status not to their technical expertise, as one might expect, but to their ability to induce a sense of calm in the patient. I would have thought that the ability to give an effective anaesthetic smoothly and safely was the primary consideration of most surgeons. This view was expressed most strikingly at a meeting reported in the *British Journal of Dental Science* in 1868 by a dental surgeon, Mr. Mummery, who said, '... that the Dentist was often placed in very painful circumstances of anxiety by the medical attendant of the patient coming and volunteering to give chloroform, when, perhaps, he knew a great deal less about it than the Dentist did'. Of three of his cases that had nearly terminated fatally, he was sorry to say that two of the gentlemen administering the chloroform were Scotch doctors. 'They had seen Dr. Simpson give chloroform, and therefore thought they knew all about it.' One doctor, 'seemed to think he had a sort of heaven-born talent for administering chloroform, because he had seen Dr. Simpson exhibit it ... He had operated many times with Mr. Clover... and never had the slightest passing uneasiness, but he had been frightened out of his wits by people's own doctors'. So it seems that it is the ability to induce a sense of calm in the operator, not the patient, that is the criterion.

Dr. Snow does not give us her definition of a specialty. The one I have found most applicable is an extension of that formulated by Friedson for a profession (13), that it should determine its own standards of training, recognize its practitioners by some form of licensure, and control and man its own examination board; and anaesthetics did not fulfil these requirements until the 1930s (14). But even by Dr. Snow's standards, the position of the anaesthetist was by no means secure at the beginning of the twentieth century. 'Who, in the eye of the law, is qualified to administer an anaesthetic?' asked Buxton in the 1914 edition of his textbook. 'Nurses, students, butlers, coachmen, dispensers, and various unqualified persons have been frequently permitted to give the anaesthetic, or, as the phrase is, "keep it going", while the surgeon, besides operating, is supposed to exercise a general supervision over the administrator's proceedings'. Six years later, Barton

laconically summed up the contemporary situation (15):

The anaesthetist does not loom largely in the public eye. With few exceptions his very name is unknown to the public, and his services are not carefully selected by the patient ... The patient writes the cheque and promptly forgets the anaesthetist's name; he probably never considers, and certainly is not in a position to know, what he owes in safety and comfort to his skill.

Dr Snow says, confusingly, that by the 1890s 'the minutiae of anaesthetic practice was outside the experience of most doctors', and a little later, that 'until the inauguration of the National Health Service in 1948 ... general practitioners undertook the majority of administrations ...'. This was certainly true of elective anaesthetics in large areas of the country, but emergencies were almost all anaesthetized by junior hospital doctors (16). It is doubtful whether there was one anaesthetist in specialist whole time practice between Birmingham and Bristol before the NHS. However, lumping all general practitioners together is misleading. Some of the leading anaesthetists, right until 1948, when the NHS drove a wedge between hospital and domiciliary practitioners and forced them to choose, also engaged in general practice—the great Alfred Lee, author of the *Synopsis*, in its tenth edition at the time of his death, translated into six languages and used worldwide, and John Beard, of the Royal Postgraduate Medical School and Hammersmith Hospital, a pioneer in anaesthesia for vascular and cardiac surgery—to mention two.

Dr. Snow makes wide generalizations without supporting references. Her criticisms may apply to some of the standard histories of anaesthesia, most of which were published many years ago, but she almost completely ignores the considerable mass of more recent work to be found in the thirty-five volumes of the *Proceedings of the History of Anaesthesia Society*, of which she is a member, and the proceedings of the five international symposia—the sixth is under preparation—held since 1982. Similarly her journal references are strongly biased towards the *Lancet* and the *London Medical Gazette*, with the result that such important matters as the enquiry and campaign to replace chloroform by ether, led by the *British Medical Journal* during the 1870s, are not mentioned. Her bibliography, by listing the editions she presumably referred to, and not including the earliest date of publication, is disconcerting, to say the least. Dr. Duncum's book was first published in 1947, not 1994; Bichat, who died in 1801, did not first publish his *Physiological Researches* in 1987; and Davy's treatise on nitrous oxide came out in 1800, not 1972. There are also references which could not be found in the bibliography, one or two entries that are out of order, and the founder and first editor of *The Lancet* has become reconstructed into Wakely. The impression is left of not very careful attention to accuracy of detail.

The high level of intellectualization has already been mentioned. Space is spent, for example, discussing the difference between mesmerism and inhalational anaesthesia, without mentioning the down-to-earth fact that ether is a substance that can be seen, felt, smelled, and measured, while hypnotism is not. In some places the language is obscure, and shows evidence of inadequate editorial attention. 'The surgical focus was on the body'—where else? 'The design of inhalers should mesh with the clinical context' (p. 81). Presumably this means that they should be suitable for the conditions in which they are being used. 'Prior to ether the surgeon and patient functioned as a symbiotic unit.' To discover that this means more than that if asked, the patient would move a limb or change position, it is necessary to turn to Pernick. Also there are certain expressions, the nuances of which were not appreciated, that will mislead the anaesthetist. Thus neither Brodie nor Hawkins 'used' chloroform (p. 100), they operated on patients anaesthetized by it. John Snow used it, and would have used it on Peel, at their request. One wonders why he was not consulted—an interesting sociological question.

I hope I have not been unfair in any of my comments. Obviously a lot of hard work has gone into writing the book, as Dr. Snow says in her acknowledgements. It contains a collection of information on the disputation phase of the paradigm shift that is not readily available elsewhere. It is well referenced, nicely produced, well bound, with good heavy covers, and, although expensive, I hope it will score a bulls-eye on the target readership at which it is aimed.

Notes

1. M. S. Pernick, *A Calculus of Suffering: Pain, Professionalism, and Anesthesia in Nineteenth Century America* (New York, 1985). [Back to \(1\)](#)
2. B. M. Duncum, *The Development of Inhalation Anaesthesia* (London, 1947). [Back to \(2\)](#)
3. D. Zuck, 'Humphry Davy, Nitrous Oxide, Lung Volumes, and Elective Affinity', *Proceedings of the History of Anaesthesia Society*, 25 (1999), 19–30. [Back to \(3\)](#)
4. T. E. Keys, *The History of Surgical Anesthesia* (New York, 1945), 17–18. [Back to \(4\)](#)
5. *Cholera, Chloroform, and the Science of Medicine: A Life of John Snow*, ed. P. Vinten-Johansen et al (Oxford, 2003). [Back to \(5\)](#)
6. D. Zuck, review of *Tarnished Idol* by R.J. Wolfe, *Proceedings of the History of Anaesthesia Society*, 30 (2002), 115–120. [Back to \(6\)](#)
7. T. Kuhn, *The Structure of Scientific Revolutions*, second edn. (Chicago, 1970). [Back to \(7\)](#)
8. N. Pirogoff, *Recherches Pratiques et Physiologiques sur l'Éthérisation* (St. Petersburg, 1847), translated by B. R. Fink, Park Ridge, Illinois, Wood Library-Museum, 1992. [Back to \(8\)](#)
9. D. Zuck, 'Death from Chloroform?' *Anaesthesia*, 59 (2004), 834. [Back to \(9\)](#)
10. A. Herman, *The Scottish Enlightenment* (London, 2001). [Back to \(10\)](#)
11. A. Macdonald and D. Zuck, 'The Robinson-Hooper Connection', *Anaesthesia*, 61 (2006), 553–6. [Back to \(11\)](#)
12. H. Connor and T. Connor, 'Did the use of chloroform by Queen Victoria influence its acceptance in obstetric practice?', *Anaesthesia*, 51 (1996) 955–7. [Back to \(12\)](#)
13. E. Friedson, *Profession of Medicine: A Study of the Sociology of Applied Knowledge* (New York, 1970), 27–33. [Back to \(13\)](#)
14. D. Zuck, 'The development of professional organizations in anaesthesia', *Current Anaesthesia and Critical Care*, 11 (2000), 141–9. [Back to \(14\)](#)
15. G. A. H. Barton, *Backwaters of Lethe* (New York, 1920), 1–2. [Back to \(15\)](#)
16. T. B. Boulton, *The Association of Anaesthetists of Great Britain and Ireland 1932–1992 and the Development of the Specialty of Anaesthesia* (London, 1999), 11–12. [Back to \(16\)](#)

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