BEFORE AND AFTER MORTON

A HISTORICAL SURVEY OF ANAESTHESIA

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On October 16, 1946, the world will celebrate the centenary of the advent of surgical anaesthesia as a practical measure. The man was W. T. G. Morton; the country, the United States of America. As in the case of most great practical discoveries, there had been forerunners who, with little success themselves, laid the stepping-stones without which the stream dividing the impracticable from the practicable could not have been crossed. Many of these forerunners were British, and it is a happy coincidence that the city in which Morton's courage enabled him to succeed in the supreme test was Boston, Massachusetts—named after its spiritual parent in East Anglia. But Morton's success was not due to a lucky accident. His immediate predecessors were all American. Leake (1945) has recently suggested that it was not by chance that the problem happened to be solved on the other side of the Atlantic, since in 1846 the American nation was still partly in the pioneering state; and since the chief problems in medical practice were surgical, surgeons were always on the watch for something to relieve the pain which hampered their operations. It is perhaps more probable, however, that America succeeded because her surgeons were not so fettered by the long tradition of necessarily painful operations which was the heritage of the Old World.

The occasion is fitting for a brief review of man's efforts to prevent—or at least obtund—the pain of surgical procedures.

History of the Term "Anaesthesia"

The *New English Dictionary* (Oxford) indicates that the word was first used by Bailey in 1721 as meaning "a Defect of Sensation as in Paralytic and Blasted Persons." In 1829 it was used by Reid as synonymous with "loss of sensation." The same authority gives the earliest use of the word "anaesthetic" as by J. Y. Simpson in 1847. But five weeks after Morton's famous operation Oliver Wendell Holmes (1847) wrote to Morton to suggest that the state should be called "anaesthesia," from which the adjective would be "anaesthetic." O. W. Holmes appears therefore to be responsible for the birth of the latter word.

Sir James Young Simpson (1871), in quoting from Theocritus, notes that the poet used the word "nodynia" (νόδυνη) for

"insensibility to pain." Simpson stated that he thought this was a better word than "anaesthesia," and that he had often regretted that he had not adopted it. He was therefore probably under the impression even years later that he had been the first to suggest the word "anaesthetic."

Early Attempts to Produce Anaesthesia

Prehistoric Times.—Since there were no written records in prehistoric times, it is natural that our knowledge is entirely speculative. On the analogy of certain primitive races existing in modern times, it has been suggested by some that relief from pain was sought by the agency of magic and witchcraft. The operation of trephination was, however, quite common locally in the neolithic period. It is strange if some degree of anaesthesia was not produced for this operation, either by induced mild concussion or by the use of some drug. A skull of a native of New Ireland in the Wellcome Historical Museum proves that the individual had been successfully trephined eight times during life, and it seems difficult to believe that even a hardy native would have consented to undergo the operation so often unless some anaesthetic had been employed.

The Early Civilizations.—The Assyrians and Egyptians were supposed to use pressure on the carotid arteries to secure temporary loss of consciousness. Prosper Alpinus (1591) stated that the Egyptians used the fumes of Indian hemp to stupefy the patient before operations, but this statement has been contested. The "nepenthe" of Homer (*Odyssey*) was thought by Simpson to have been Indian hemp, and indeed this drug was widely

used as a soporific in ancient times. Pliny mentions it—but not in a medical context. Celsus refers to the use of mandragora, and Spencer considers that he possibly means *Atropa belladonna*. However, it is also admitted that the mandrake may have been indicated.

Of all plants used in the practice of medicine none has a more picturesque history than the mandrake. Still found in the Mediterranean basin, the plant may be said in some ways to resemble a human figure. The ever-recurring legend has it that the plant shrieked when uprooted, and that the uprooter

FIG. 1.—W. T. G. Morton (1819–68).

FIG. 2.—Hickman (1800–1830), the first experimenter in anaesthetics. (From the water-colour painting in the Wellcome Historical Medical Museum.)

fell dead. Hence arose the practice of hitching a dog to the mandrake and letting it suffer extinction. Dioscorides, the famous physician of the first century A.D., wrote much on the mandrake. In the quaint words of his first translator, John Goodyer (Dioscorides, 1934), Dioscorides says: "And some do seeth the roots in wine to thirds, & straining it set it up. Using a Cyathus of it for such as cannot sleep, or are grievously pained, & upon whom being cut, or cauterized they wish to make a not-feeling pain." Or, speaking of another sort of mandrake: "For a man sleeps in ye same fashion, as when he ate it, sensible of nothing for 3 or 4 hours, from the time that it is brought to him. And Physicians also, use this, when they are about to cut, or cauterize." Randolph studied about 150 passages in Greek and Latin literature which bore on surgery, and he concluded that "the mandragora was the principal and almost the only anaesthetic of antiquity, that the use of anaesthetics never became general." Despite the frequency with which mandragora was mentioned later by lay writers in many countries—compare, for example, *Othello*—it would appear from Oppenheimer's work (1928) that it was not mentioned by any of the Latin poets.

In the second century the Chinese physician Hua T'o used a wine of unknown composition—*ma-yao*—as an anaesthetic (Sarton).

The Arabian practitioners of the healing art undoubtedly used certain plant infusions as supposed anaesthetics. For example, Avicenna says that if it is desirable to procure a deeply unconscious state so that a painful application to the body can be tolerated, darnel-water should be given in wine; or fumitory, opium, hyoscyamus, nutmeg, or crude aloes should be administered (Gruner, 1930).

The Middle Ages.—It should be noted that up to this period all the narcotics or would-be anaesthetics which were used were administered by mouth. Before the advent of Salernitan medicine in the Middle Ages, however, a new method makes its appearance—that of the *spongia somnifera*, or soporific sponge—though narcotic beverages, mostly containing mandragora, continued to be used. The earliest known recipe for a soporific sponge is the Antidotary of Bamberg, dating from the ninth century. It contains opium, mandragora, cicuta, and hyoscyamus (Sigerist, 1923). The interesting point about these sponges

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much more suddenly brought on by the agency of sulphuric acid and carbonate of Lime. The results in this case were not so satisfactory; some blood escaped from the wounds, and a slight degree of inflammation followed, and the wounds did not heal so rapidly as the first experiment.

EXPERIMENT 4th. Mice, having been confined in a glass tube of a foot long, were rendered insensible by carbonic acid gas slowly introduced in small quantities, and one foot from each was taken off; no hemorrhage took place upon the return of sensation, and the wounds appeared quite healed on the third day, without the animals having apparently suffered pain, when they were given their liberty.

EXPERIMENT 5th. An adult dog was rendered insensible by means similar to the preceding, and the muscles and blood-vessels of one of its legs were divided. There was no hemorrhage from the smaller vessels; a ligature which secured the main artery came away on the fourth day, and the ani-

FIG. 3.—An important page of Hickman's rare pamphlet, *A Letter on Suspended Animation . . .*, Ironbridge, 1824. (From the copy of the original in the Wellcome Historical Medical Museum. Half size of original.)

types of soap produced narcosis sufficient to dull the pain of torture. Opium was largely used by surgeons, but in 1784 Moore stated that the strongest dose a surgeon dared give before an operation had little or no effect in mitigating the pain of the procedure. Velpeau, as late as 1832, thought that it was impossible to prevent pain during operations. Alcohol had been employed for centuries, but it was generally admitted that, though success might be achieved by chance in certain cases, there could be no guarantee that this method would be in the least effective.

Mesmerism and Hypnotism

Franz Anton Mesmer (1734–1815) published his book on animal magnetism in 1779, but he was generally derided as a quack, and it was not until James Braid became interested in the subject over sixty years later that the possibility of using the hypnotic sleep for curative purposes was realized. His book on this subject (1843) was published contemporaneously with the work of the early pioneers of ether anaesthesia. Two entirely different methods of preventing pain during operations were therefore developing at the same time.

Hypnotism was first actually used for this purpose by John Elliotson (1843), of University College Hospital, London. The reaction was so violent that he had to resign from his official posts. Two years later James Esdaile, a Scot resident in Calcutta, found by chance that he had the power to induce in an Indian native a state of hypnosis in which painful stimuli were not felt. He started to use the method for surgical operations, and by 1846—the year in which Morton made ether anaesthesia practicable—Esdaile was able to report 261 painless operations with a mortality of only 5.5%. However, on his return to Scotland Esdaile found the inhabitants of that, his native, country too hard-headed to be susceptible to his influences. Meanwhile "etherization" had started on the path from which it has not since diverged.

Early Pioneers of Inhalation Anaesthesia

The starting-point in the history of inhalation anaesthesia is the fact that Sir Humphry Davy (1800) breathed nitrous oxide in the pure state in 1799. He observed the sensations produced in himself by both low and high concentrations of the gas. He also noted that a headache and the pain associated with the cutting of a wisdom tooth were both relieved at the time of breathing the gas. He suggested that the gas might "probably be used with advantage during surgical operations in which no great effusion of blood takes place." Despite this hint Davy's influence on the development of anaesthesia was only indirect. At the time his suggestion was not followed up, but the practice which he introduced at the Pneumatic Institute at Clifton of

is that the drugs were inhaled from the sponge held to the nostrils. Baur (1927) made a thorough examination of these mediaeval recipes, and carried out an experimental investigation on animals of the use of various soporific sponges made according to them. She concluded that the effect produced would not be sufficiently marked to warrant their use as anaesthetics in surgery. However, it must be remembered, as she admits, that there was something of the secret art about the surgery of these centuries, and that if a surgeon stumbled on a good narcotic he would tend to keep it to himself.

Later Centuries.—In the sixteenth and seventeenth centuries knowledge of narcotics was largely bound up with the trials of witches and the torture of malefactors. It was believed that the swallowing of certain

inviting visitors to inhale nitrous oxide and note their sensations had important social and medical consequences. Demonstrations of the effects of nitrous oxide were frequently given, and at a later date nitrous oxide parties and "ether frolics" were very popular.

As an example of such a demonstration of the effects of nitrous oxide it is interesting to quote a passage from a little book published in 1839—exactly forty years after Davy had popularized the method. The work is *Chemistry No Mystery* (1839), by John Scoffern, a surgeon and hospital chemist. He professes to report the words of a lecturer who is speaking to a popular audience: "Having proceeded thus far in his Lecture, the old gentleman handed round a great number of bladders filled with the gas (nitrous oxide); and here our shorthand writer ceased from his work. Anxious to enjoy the fun as well as the rest, his office of scribe did not hinder him from seizing a bladder too: for my part I determined to have some amusement of another kind, in witnessing the effects produced by the gas upon others, without breathing any myself; and, perhaps, I laughed more than either of the breathers. Oh, how shall I describe the scene which followed? For one instant, the silence of our Lecture-room was only broken by the deep-drawn inspirations of those who were breathing the gas: all seemed to be enjoying the extreme happiness, they puffed and pulled as if they could not get enough. It was, indeed, irresistibly ridiculous to see a large room filled with persons, each of whom was sucking from a bladder, and this alone made me laugh right well; but in another instant began their ecstasies, some cast their bladders from them with a jerk, and, forgetting the ridiculous figure they made, kept breathing laboriously; their mouths thrown wide open, and their noses still tightly clenched: some jumped over the tables and chairs; some were bent on making speeches; some were very much inclined to fight; and one young gentleman persisted in attempting to kiss the ladies. I have heard it insinuated that he breathed very little of the gas, and that he knew very well what he was doing; but this statement I consider to be untrue. As to the laughing, I think it was chiefly confined to the lookers-on."

"A few minutes served to restore those maniacs to their senses, and they felt as if nothing had occurred; for it is a peculiarity of this gas, that it does not act like intoxicating liquors in producing depression of spirits, disorder of the stomach, or indeed any other unpleasant effects."

"As our instructor had predicted, we did not after this exhibition feel very much inclined to study philosophy, and

FIG. 5.—Horace Wells (1815-48).

therefore the Lecture, although short, was brought to a conclusion."

This scene is freely illustrated by George Cruikshank in a frontispiece to the book, which is here reproduced as Fig. 6. An article, attributed to Michael Faraday and pointing out the change of these practices, appeared in the official organ of the Royal Institution (1818). I shall return shortly to the result of one of these strange demonstrations.

Hickman and Suspended Animation

It would be difficult for anyone associated with the Wellcome Historical Museum not to have a tender spot in his heart for Henry Hill Hickman—the Rupert Brooke of anaesthesia—since that Museum possesses practically all his extant manuscripts in addition to a copy of his very rare published work and a number of relics. The Museum also possesses a fine water-colour painting of Hickman carrying out his experiments (Fig. 2). (Owing to an error in the Souvenir Volume (1930) this picture is often wrongly stated to be in oils.) With a view to writing these few lines I have re-studied his writings, which were published in facsimile by the late Sir Henry Wellcome (1930).

Hickman, a "Shropshire Lad," was born in 1800, and before he had attained his majority he had become a member both of the Royal College of Surgeons of London and of the Royal Medical Society of Edinburgh. During his short life of thirty years he practised in Ludlow, in Shifnal, and in Tenbury. Hickman was of a gentle disposition, and he was obviously much affected by the pain which he had to cause while operating. From manuscript notes in this Museum it is proved that his experiments on animals dated from at least the spring of 1823, and on Feb. 21, 1824, he addressed a letter to T. A. Knight, of Downton Castle, near Ludlow, in which he pleads for the use of "suspended animation" in surgical operations, and as an appendix gives details of seven experiments on animals. In the same year Hickman (1824) published an amended version of this letter in pamphlet form, printed by W. Smith of Ironbridge. An important page of this letter is reproduced here (Fig. 3). Knight was a friend of Sir Humphry Davy and a Fellow of the Royal Society—though interested mainly in trees. Hickman obviously hoped that his animal experiments would receive the sympathetic consideration of the great scientists of the day, so that some eminent surgeon might be induced to try his methods on the human subject. His hopes were disappointed. During the next three years he probably continued his experiments, and in 1828 he repaired

FIG. 4.—Crawford W. Long (1815-78).

FIG. 6.—“Laughing Gas.” Cartoon by George Cruikshank, from *Chemistry No Mystery*, by John Scoffern, London, 1839.

to Paris, where he addressed a memorial to Charles X. As a result, Hickman's case for a trial of suspended animation was submitted to the Académie de Médecine, which appointed Dubois, Richerand, Merat, Segallas, and Ribot to constitute a commission and to report. Unfortunately, no evidence has been found of any action taken by the commission. Sick at heart, Hickman returned home, and shortly afterwards died at the age of thirty years.

Hickman believed that suspended animation could be induced without too great risk to life, and in his experimental work he confined animals individually in a bell-jar over water and induced the “torpid state” either by allowing them to rebreathe their own exhaled air or by passing carbon dioxide, produced by the action of sulphuric acid on calcium carbonate, into the bell-jar. While the animal was in the state of torpor he performed a surgical operation on it. In his early experiments he used a puppy, a mouse, a dog, a rabbit, and a kitten. It should be noted that Hickman's object was not only to produce a state in which an operation could be carried out painlessly, but also to ascertain whether the wounds would heal more or less quickly under these conditions. He pointed out that “carbon has a most powerful antiputrescent quality,” and believed that a wound made on an animal in a torpid state heals more quickly than one made on a “sensible” animal. It should be noted that in his early experiments Hickman was apparently wedded to carbon dioxide, and that it is only in the memoir of 1828 that the possibility of using other gases is mentioned.

The following appears to me to be a fair estimate of Hickman's importance. (a) In the first place he was one of the earliest, if not the earliest, to carry out planned experiments on animals in connexion with anaesthesia. (b) His adoption of the term “suspended animation” seems to have been fundamental to his system. Insensibility to pain was to be effected by the production of total suspension of most of the functions of animation—the heart being probably the only exception. That he recognized the grave risk is obvious. He said: “I used inflating instruments in one experiment only, and therefore am not prepared to say to what extent such may be used with advantage; but I think it probable that those and the Galvanic fluid would operate in restoring animation in some cases.” (c) This being the case, even if Hickman experimented with other gases, which is doubtful, he probably did not conceive of them as acting in such a way that the “state of torpor” was unaccompanied by any serious effect upon a function such

as the respiration. (d) The question arises whether the whole of the effects which were produced in Hickman's experiments were due to asphyxia, or whether any part was a result of the anaesthetic effect of carbon dioxide gas. Chauncey Leake and

FIG. 7.—The ether inhaler designed by Peter Squire and used by him at Liston's operations on Dec. 12, 1846.

Waters (1928) did some work on this problem, and found that carbon dioxide did indeed have in itself a certain anaesthetic effect.

Hickman's position may be summarized finally by saying that he was among the first to carry out planned operations on animals in this connexion, and that he was certainly the first to set out deliberately to obtund the pain of a surgical operation by the inhalation of a gas. In 1847 Dr. Thomas Dudley espoused the cause of his priority, and the resulting correspondence is given in the Wellcome volume.

Founders of Inhalation Anaesthesia

The stage was now set for the men who used effective gases or vapours to produce unconsciousness during surgical operations.

According to Lyman (Keys, 1945) William E. Clarke, a young doctor in Rochester, U.S.A., administered ether on a towel to a Miss Hobbie in January, 1842, and one of her teeth was then extracted painlessly by a dentist, Dr. Elijah Pope. The

FIG. 8.—Sir James Young Simpson (1811–70).

experiment arose out of Clarke's knowledge of ether acquired by frequent attendance at "ether frolics." This was apparently the first use of ether for a dental or surgical operation. Clarke did not follow up his discovery, and presumably considered it of no importance.

Crawford W. Long, 1815-78 (Fig. 4), a practitioner of Jefferson, Georgia, had also had experience of "ether frolics," and on March 30, 1842, he used ether, given on a towel, as a general anaesthetic. The patient was a young man called James M. Venable, and the operation was removal of a tumour on the back of the neck. The operation was successful and painless. During the next four years Long gave ether four or five times. Claims have been made for him as the discoverer of anaesthesia, and statues have been erected in his honour. But Long published nothing at the time, and it was not until 1849 that he issued a statement of the reasons which prevented him from pressing the use of ether by others. None of his reasons is very convincing. In any case, if mere priority of personal use is alone considered, it would appear that Long's claims must now be surrendered in favour of those of Clarke.

Horace Wells, 1815-48 (Fig. 5), was a dentist in Hartford, Connecticut, and on Dec. 10, 1844, he attended a public demonstration of the effects of nitrous oxide, given by "Professor" Colton, a noted lecturer on popular science. As a result of the fact that a friend of Wells who, while under the influence of the gas, did not feel the pain of mild injuries which he had received at that demonstration, Wells determined to try the effect of nitrous oxide for tooth extraction. On Dec. 11, 1844, Wells had one of his own teeth extracted by his colleague, Dr. John M. Rigg, in the presence of Colton, Cooley, and another person. Wells exclaimed afterwards: "I didn't feel it so much as the prick of a pin." Wells was convinced that his discovery was of use to mankind, and determined that it should be made widely known.

After giving nitrous oxide in about fifteen further cases Wells accordingly went to Boston, Mass., where he called on W. T. G. Morton and C. T. Jackson, the well-known geologist and chemist. As a result of his statements John Collins Warren asked Wells to give a demonstration before the class of surgery at the Harvard School. Towards the end of January, 1845, Wells gave this demonstration, but unfortunately the boy whose tooth was being extracted groaned during the operation—although he later stated that he had felt no pain. Wells said later that he had removed the gas-bag too soon. The critical audience laughed and considered the whole thing as a hoax. Wells returned to Hartford and continued to use nitrous oxide and to experiment on certain vapours, but for the world at large surgical anaesthesia remained an unattainable goal—if it was even thought of as a goal at all, except by a few visionaries.

William Thomas Preen Morton, 1819-68 (Fig. 1), a dentist of Boston, had been a pupil of both Wells and Jackson. He had been at the unsuccessful demonstration given by Wells. For some months he appears to have done nothing, although in the subsequent controversies he wrote and said that he had been experimenting on animals and on two assistants with ether

FIG. 11.—Joseph Thomas Clover (1825-82).

during this period. On Sept. 30, 1846, Morton appears to have called on Jackson and asked him to give him some nitrous oxide. Jackson told him his gas-bags were empty and suggested that Morton should try sulphuric ether, which he would find just as efficacious. The same evening Morton used the ether in the extraction of a tooth; the patient was Eben H. Frost. Without delay Morton took his first steps to patent "etherization," and he also called on J. C. Warren and asked permission to give ether as an anaesthetic at the Massachusetts General Hospital. On Oct. 14 Dr. C. F. Heywood, house-surgeon to the hospital, wrote to Morton at Warren's request, inviting him to be present at 10 a.m. on Friday, Oct. 16 (Keys, 1945).

The events which preceded this historic operation, and the operation itself, have often been described (see especially Keys, 1945; Raper, 1945; Duncum, 1946). Morton, in the short time at his disposal, went to considerable trouble to provide himself with a suitable inhaler—a glass globe with two necks. The globe contained "the prepared vapour with sponges to enlarge the evaporating surface." Air entered through the upper neck, and after passing through the vapour, was inspired through the side neck. The side neck or mouthpiece contained a valve which prevented the expired air from passing back into the globe (Bigelow, 1847). This inhaler is still preserved in the Massachusetts General Hospital. The patient was a young printer, Gilbert Abbot (or Abbott); the condition a tumour of the neck; the surgeon, J. C. Warren; and the anaesthetist, W. T. G. Morton. The patient was strapped to an operating chair. The demonstration was completely successful. Warren (1846) published his own account of it. At the end of the operation Warren is reported to have said to the audience: "Gentlemen, this is no humbug." Poor Wells!

On the following day, Oct. 17, Morton gave his second demonstration, in the case of a tumour of the shoulder. This too was successful. In his next case, one of amputation of the breast on Nov. 4, he was unable to anaesthetize the patient after trying for an hour and a half (Raper, 1945). On Nov. 7 he had his most spectacular success. The patient was Alice Mohan and the operation was for amputation of a leg.

The subsequent history of Morton and his discovery is too complicated to be told here. He was a man of affairs, not a scientist. From the first he had been determined to make a fortune out of his method. Even at the Boston operation he

(Figs. 9 and 10 are photographs of busts specially made (1946) for the Wellcome Historical Medical Museum by Ruth Poynter.)

FIG. 9.—Robert Liston
(1794-1847).

FIG. 10.—John Snow
(1813-58).

had added colouring matter and other substances to his liquid ether, and the result he called a "compound." It was not until Nov. 6 that he admitted in a confidential letter to the hospital authorities that his medium was simply sulphuric ether. Almost immediately Morton applied for a patent; but Jackson, who had a reputation for trying to steal inventions, had brought pressure to bear on him, and when the patent was issued on Nov. 12, 1846, it bore the joint names of Jackson and Morton, with Jackson assignor to Morton. A photostat copy of this Letters Patent, No. 4848, lies before me as I write. Morton spent the rest of his life trying to establish his claims, and he made no further contribution to the history of anaesthesia.

First Operation under Ether in Europe

Up to the present it has always been recognized that the first major operation under general anaesthesia in the old world was that carried out by Liston at University College Hospital, London, on Dec. 21, 1846. From research on which I am engaged at the time of writing it is evident that some weeks previous to this date ether was used as a general anaesthetic in a case of amputation of a limb at the Dumfries and Galloway Royal Infirmary. There was a direct link between the Boston operation and that carried out at Dumfries. Scotland can therefore justifiably claim the first use of general anaesthesia in Europe. An extended account of this operation will be published at an early date.*

Practical Application of General Anaesthesia in England

On Nov. 28, 1846, Prof. Jacob Bigelow, of Harvard, wrote to his friend, Dr. Francis Boott, of Gower Street, London, a letter acquainting him of Morton's achievement. Boott was an American, a Harvard man. Bigelow enclosed a newspaper article by his son which related to the discovery. The letter was three weeks in transit, and was probably received by Boott about Dec. 17. On Saturday, Dec. 19, Boott gave ether as an anaesthetic to a Miss Lonsdale while a tooth was extracted by his dentist friend, James Robinson. Meanwhile Boott had written to Robert Liston (Fig. 9) of University College Hospital, and on Monday, Dec. 21, the latter wrote to Boott the historic letter (Liston, 1847) in which he said that he had that day carried out two operations under ether, one being a case of amputation of the thigh, and the other evulsion of both sides of the great toe-nail. Joseph Lister was present at these operations. The anaesthetic was given by Peter Squire, who improvised an inhaler for the occasion (Forbes, 1847) (Fig. 7).

The practice of "etherization" was thus safely launched in this country, and its use on the Continent of Europe followed in the early weeks of 1847.

Simpson and Chloroform

On Jan. 19, 1847, James Young Simpson, of Edinburgh (Fig. 8), was the first to use ether as an anaesthetic in obstetric practice. The ether was given at the time when the labour pains were strongest. Prof. Jacob Bigelow, of Boston, in 1870 claimed that this honour belonged to America, and in his reply Simpson (1871) not only discredited this assertion but gave an illuminating discussion of the whole position. Simpson soon found that his patients objected to the smell of ether, and in an endeavour to discover a more suitable volatile anaesthetic he experimented with various substances on himself and his friends. The use of chloroform was suggested to him in October, 1847, by David Waldie, Chemist to the Apothecaries' Company of Liverpool. Simpson (1847) began to use chloroform as an anaesthetic in obstetrics early in November, 1847, and he employed it in three cases of operation in the Edinburgh Royal Infirmary on Nov. 15 of that year. Within a matter of weeks it had almost displaced ether as a general anaesthetic.

A word should be said about the heated and prolonged controversy which hinged on religious objections to the use of anaesthetics in childbirth. The objections were on various grounds, but a very strong one depended upon the translation of the Authorized Version of Genesis iii. 16: "In sorrow [*etzebh*] thou shalt bring forth thy children." Simpson quoted Genesis ii. 21 to show that God was the first Anaesthetist, and he asserted that the Hebrew word *etzebh* does not imply the sorrow associated with physical pain but rather the muscular effort involved in labour. The controversy did not really abate

until Queen Victoria had chloroform during the birth of Prince Leopold in 1853. It is interesting to note that De Quincey's son, Francis, was a medical student at Edinburgh when chloroform was first used, and he immediately wrote to his father regarding the religious scruples. De Quincey replied, and his arguments against the religious scruples are printed in his collected works (1890). They no doubt helped to get Francis his M.D. in 1849.

Snow, Clover, and Late Developments

It is often overlooked that John Snow (Fig. 10), one of the greatest of epidemiologists, was the same John Snow who became the first professional anaesthetist, the first research worker on anaesthetics, and the greatest of all the early workers in the field of practical anaesthetics. A Yorkshireman, Snow was born in 1813, qualified in London in 1838, and by 1841 was working on the scientific aspects of asphyxia. Snow very soon became Liston's anaesthetist, and in November, 1847, he adopted chloroform as a better anaesthetic than ether. Snow devised various types of inhalers and other pieces of apparatus, and the influence of his writings on the later developments of anaesthetic practice was of the greatest importance. He twice gave chloroform to Queen Victoria. Snow was an amateur epidemiologist, and he it was who was responsible for terminating the terrible cholera outbreak of 1854, which is known in history as the episode of the Broad Street pump. Snow died in 1858.

Snow's leading place in the anaesthetic field was taken by J. T. Clover (Fig. 11). In 1862 he devised a new inhaler which permitted the accurate regulation of chloroform and air mixtures. This inhaler necessitated the use of a large reservoir bag which was slung on the back of the anaesthetist. In 1874 he advocated a supplemental bag which allowed of the rebreathing of a portion of the anaesthetic, and two years later he introduced the gas-ether sequence. In 1877 he devised a portable inhaler for the regulation of the ether flow.

The later developments of the technique of anaesthesia—the controversy over ether versus chloroform, the re-introduction of nitrous oxide in 1862, the Hyderabad Commission, the introduction of new methods, new anaesthetics, and a plethora of new inhalers—are all far too complicated and too recent to warrant discussion here. The trail had been blazed, religious objection had been overcome, and thanks to the greatest of the early anaesthetists the subject had become not only a profession but a science.

Epilogue: The "Discoverer" of Anaesthesia

In this paper I have set out a few of the facts which are known about those who may have some claim to be named the "discoverer" of anaesthesia. On this subject there has been a wealth of writing, not to mention all the arguments which passed through the United States Courts and Congress over many years. Let each choose according to his judgment. After some considerable study of the evidence I venture to give here my own views.

The five possible contestants are Clarke, Long, Wells, Jackson, and Morton. If by "discovery" we mean a "discovery to satisfy the discoverer," the palm goes to Clarke by a short head, and then to Long. But Clarke had only one case, which was unpublished. Long had a number of cases over years, but he never expressed the slightest interest in promulgating his discovery. It was apparently only when Fame seemed to be looking for a head on which to bestow the laurel that Long woke up and saw what he had missed. If therefore by "discoverer" we mean one who "uncovers" for the world to see, to use, and to emulate, then both these men are out of the running. Wells is in a different position. He set out consciously to discover an anaesthetic agent which would be effective in major surgery, and he intended that the world should use it. Chance turned him to nitrous oxide. Had it not been for the unfortunate circumstances attending his first and only public demonstration he might have been hailed as the discoverer of general anaesthesia, though not of ether anaesthesia. Jackson, even if he did have the idea that sulphuric ether was the substance to try in the human, never took any steps in the matter until jealousy of Morton goaded him into action. Had Morton not used sulphuric ether, he would have succeeded—at least fairly well—with nitrous oxide. Further, whether or not he had been experimenting with ether

* This operation will be described at a meeting of the History of Medicine Section of the Royal Society of Medicine on Oct. 16.

before he consulted Jackson, it seems certain that he would have lighted on that substance himself. Discoverers are usually the children of preceding events. If one man can be called the discoverer of general anaesthesia, then that man is Morton. On the centenary of his discovery, we salute him for his good fortune, his perseverance, and for the inestimable boon which he conferred on humanity.

On the centenary day, Wednesday, Oct. 16, at 4.30 p.m., an exhibition at the Wellcome Historical Medical Museum, illustrating the whole history of anaesthesia, will be officially opened by Lord Moran.

REFERENCES

- Alpinus, Prosper (1591). *De Med. Aegypt.*, 4, 2.
 Baur, M. L. (1927). *Recherches sur l'Histoire de l'Anesthésie avant 1846*, Leyden.
 Bigelow, H. J. (1847). *Brit. Foreign med. Rev.*, 13, 310.
 Braid, J. (1843). *Neurypnology*.
 Celsus. *De Med.*, with an English translation by W. G. Spencer (Loeb Library), 1, 296; 2, 60.
 Davy, H. (1800). *Researches, Chemical and Philosophical, chiefly concerning Nitrous Oxide*.
 De Quincey, T. (1890). *Collected Works*, 14, 286.
 Dioscorides (1934). *The Greek Herbal*. Englished by John Goodyer, and edited by R. T. Gunther, Oxford.
 Duncan, B. M. (1946). *The Development of Inhalation Anaesthesia*.
 Elliotson, J. (1843). *Numerous Cases of Surgical Operations without Pain in the Mesmeric State*.
 Esdaille, J. (1846). *Mesmerism in India*.
 Faraday, M., *Quart. J. Sci. & Arts*, 1818, 4, 158.
 Forbes, J. (1847). *London med. Gaz.*, 4, 38.
 Gruner, O. C. (1930). *A Treatise on the Canon of Medicine of Avicenna*.
 Hickman, H. (1824). *A Letter on Suspended Animation containing experiments showing that it may be safely employed during operations on animals, with the view of ascertaining its probable utility in surgical operations on the human subject*. . . Ironbridge. (From copy in the W.H.M.M.)
 Holmes, O. W., quoted by Warren, E., *Some Account of the Letheon*, p. 84, Boston, 1847.
 Homer. *Odyssey*, 4, 221.
 Keys, T. (1945). *The History of Surgical Anaesthesia*, New York.
 Leake, C. D., and Waters, R. M. (1928). *J. Pharmacol. exp. Therap.*, 33, 280.
 Liston, R. (1847). *Lancet*, 1, 8.
 Moore, J. (1784). *Method of Preventing or Diminishing Pain in Severe Operations of Surgery*.
 Oppenheimer, H. (1928). *Medical and Allied Topics in Latin Poetry*, London.
 Pliny. *Hist. Nat.*, 19, 36.
 Randolph, C. B. (1905). *The Mandragora of the Ancients in Folk-lore and Medicine*, Boston.
 Raper, H. R. (1945). *Man Against Pain*, New York.
 Sartton, G. (1927). *Introduction to the History of Science*, 1, 325, Baltimore.
 Scoffern, J. (1839). *Chemistry No Mystery*. . . , p. 115.
 Sigerist, H. E. (1923). (Bamberg Antidotary.) *Studien und Texte zur frühmittelalt. Rezeptliteratur*, Leipzig.
 Simpson, J. Y. (1871). *Anaesthesia, Hospitalism, Hermaphroditism*, p. 10, Edinburgh.
 ———. *Ibid.*, p. 18.
 ———. (1847). *Account of a New Anaesthetic Agent as a Substitute for Sulphuric Ether in Surgery and Midwifery*, Edinburgh.
 Underwood, E. A. (1946). *British Medical Journal*. In press.
 Velpeau, A. A. L. M. (1832). *Nouveaux Eléments de la Médecine Opératoire*, Brussels.
 Warren, J. C. (1846). *Boston med. surg. J.*, 24, 375.
 Wellcome, H. S. (1930). *Souvenir of the Henry Hill Hickman Centenary Exhibition, 1830-1930, at the Wellcome Historical Medical Museum, London*.

RECENT ADVANCES IN ANAESTHESIA

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In putting together any account of recent advances the first question to be decided is the meaning to be attached to "recent." The science and art of anaesthesia is now one hundred years old, but it is convenient and also useful to compare the state of the specialty as it was just after the war of 1914-18 with that at the present time.

To deal first with the preparation of the patient: at the beginning of the period selected pre-operative starvation and purging were all too common, and the unhappy victim was often in a very poor condition before the anaesthetic was administered at all. Premedication was practically confined to subcutaneous morphine and atropine administration, basal narcosis being unknown. The anaesthetics in common use were nitrous oxide, chloroform, ether, and ethyl chloride. Short procedures such as dental extractions were usually performed under a "straight" gas, although it must be remembered that Hewitt's two-bag nitrous-oxide-and-oxygen apparatus had been in use since 1892. For minor operations in children the usual anaesthetic was ethyl chloride. For major surgery the two commonest standard techniques were the nitrous oxide-ether-chloroform sequence and nitrous oxide-ether-open ether. In either case anaesthesia was induced with an original or modified Clover's inhaler, thereby obviating, on the one hand, the

unpleasantness and tedium of starting with open ether and, on the other, the dangers of a chloroform induction.

Continuous nitrous oxide and oxygen was used to a limited extent with the original Boyle apparatus with bubble sight-feeds, which was based on Gwathmey's American machine. The value of gas and oxygen in shocked battle casualties had been recognized towards the end of the war of 1914-18, and a portable machine designed by Geoffrey Marshall on the same principle as Boyle's apparatus had been used in France. Children were usually given the open ethyl chloride-ether sequence. Inhalation with a face-piece was the predominant technique, although the insufflation endotracheal method had been developed for the plastic repair of facial wounds. For this purpose a stiff gum-elastic catheter was passed into the trachea by direct laryngoscopy. Excision of malignant growths of the tongue and adjacent structures was dealt with by chloroform dropped on to a Hahn cone connected by rubber tubing to a laryngotomy tube. Leakage of blood into the trachea was prevented by a large marine sponge in the oro-pharynx.

Pharyngeal insufflation of chloroform and air from a Junker bottle was used for dissection tonsillectomy and for other operations about the mouth. Occasional alternatives to inhalation were rectal oil-ether and intravenous ether in saline. Local analgesia was practised very considerably, particularly on the Continent. Cocaine was used as a surface analgesic and procaine for injection purposes. These drugs permitted an operating time of only about three-quarters of an hour. Spinal analgesia was confined to hyperbaric solutions, usually of stovaine or tropacocaine, and little was known as to control-lability.

Having passed briefly in review the position as it was at the end of the last war, we are now able to assess the advances made in the quarter of a century which has since elapsed.

Preparation of the Patient and Premedication

The preparation of the patient is directed towards putting him in the best possible condition immediately before operation. It may include the administration of extra glucose or possibly a blood transfusion, but there should be an absolute minimum of purging and abstinence from food and drink. Premedication is no longer a mere routine, but is calculated for each individual patient. Sedation is often adequate, usually with a morphine derivative and scopolamine or with an oral barbiturate; but complete basal narcosis may be indicated for the highly strung nervous patient, particularly if suffering from thyrotoxicosis. For this purpose rectal paraldehyde is often used for children and bromethol (avertin) for adults.

If the patient is conscious when he arrives in the anaesthetic room he can then be anaesthetized in a few seconds by an intravenous injection if he dislikes the application of a face-piece. There is no doubt that the introduction of the rapidly acting barbiturates constituted a major advance in anaesthesia between the wars, and although they possess disadvantages (chiefly in producing respiratory depression and a tendency towards laryngeal spasm) they have proved extremely safe in the hands of experienced anaesthetists. For prolonged operations, however, continuous intravenous anaesthesia is not quite so satisfactory as was originally predicted.

New Volatile Anaesthetics

Various new volatile anaesthetics have been introduced since the end of the last war. The hydrocarbon gases were investigated—particularly ethylene, acetylene, propylene, and cyclopropane. Ethylene attained much popularity in America, but never came into extensive use in Great Britain owing to its smell and inflammability. Acetylene had some vogue in Germany. Propylene was found to have too great a tendency to cause cardiac arrhythmias and was soon abandoned. Cyclopropane alone of the series has gained a permanent place in anaesthesia in this country. It possesses the valuable properties of being non-irritating and potent, so that a high proportion of oxygen can be used with it. These properties have encouraged its employment in thoracic surgery in practically all cases in which it is not essential to use the diathermic cautery inside the chest. Owing to its high cost, cyclopropane is always used in a closed circuit.

Certain ethers besides the usual diethyl variety have been investigated, but the only one to attain any popularity has been