# THE JUBILEE OF ANÆSTHESIA.

## HISTORY OF THE DISCOVERY.

### The "Wine of the Condemned" in Antiquity.

The idea of blunting the sensibility by artificial means, in order to lessen the pain caused by the knife and the cautery, is almost as old as surgery. The ancient Egyptians are believed to have used Indian hemp and poppy juice for the purpose, and the *φάρμακον νηπενθὲς*, the sorrow-easing drug which, as we are told in the fourth book of the *Odyssey*, was given by Helena to Ulysses and his comrades, may have contained these substances; at any rate, it is expressly stated that she had learned its composition from Polydamnia, the wife of Thone, in Egypt. The "wine of the condemned," referred to by the prophet Amos (ii, 8), is conjectured by Simpson to have been a preparation of cannabis indica. Whatever it was, it in all probability was a narcotic potion of some kind. The Jews were more humane in their method of dealing with condemned criminals than the Greeks or the Romans. In the Talmudic writings there are several passages which seem to show that it was the practice to ease the pain of torture and death by stupefying the sufferers. Thus: "If a man is led forth to death, he is given a cup of spiced wine to drink, whereby his soul is wrapped in night"; and again: "Give a stupefying drink to him that loseth his life, and wine to those that carry bitterness in their heart." According to tradition, while the Roman conqueror held sway in Palestine, and crucifixion was a common punishment of malefactors, the Jewish women, with the sanction of the Sanhedrin, were wont to ease the death agony of the sufferers by giving them something in the nature of a "wine of the condemned" upon a sponge. It is probable that the "wine mingled with myrrh" which, according to St. Mark (xv, 23), was offered to Christ while he was hanging on the cross was a narcotic draught intended to make death painless. In China it is well known that opium is used at the present day, and executioners are often bribed to allow it to be administered before they begin their cruel work.

The Greeks also used means to deaden sensibility to pain. Pindar tells us that Machaon eased the sufferings of Philoctetes with a narcotic potion. Theocritus speaks of Lucina, the goddess whose speciality was the obstetric art, pouring an insensibility to pain down all the limbs of a woman in labour. Unfortunately no details are given of the method adopted. The narcotic properties of mandragora (atropa mandragora, *L.*), which is allied to our atropa belladonna, or deadly nightshade, appear, however, to have been known to the Greeks, and various preparations of that plant were in use as anæsthetics among the Romans. The younger Pliny (A.D. 32-79), in his *Natural History*, says that a decoction of it was used by way of preparation for surgical treatment: "Bibitur contra serpentes et ante sectiones punctionesque ne sentiantur." The agent was sometimes inhaled, as is clear from Pliny's remark that in some cases sleep may be induced by the smell. Dioscorides (*circ.* 50 A.D.) gives several prescriptions for the use of the drug for the same purpose. One of these, as quoted by Simpson, is as follows:

> Some persons boil the root in wine down to a third part and preserve the decoction, of which they administer a cyathus in want of sleep and severe pains of any part, and also before operations with the knife or the actual cautery that they may not be felt.

Of a special variety of the plant, which was called *μώριον*, probably because it engendered *μωρία*, or foolishness, in those that partook of it, the same author speaks as follows:

> They relate that a drachm of it being taken as a draught, or eaten in a cake or other food, causes infatuation and takes away the use of the reason. The person sleeps without sense in the attitude in which he ate it for three or four hours afterwards. Medical men also use it when they have recourse to cutting or burning.

Atropa mandragora grows in the Grecian Archipelago, and Sir Benjamin Ward Richardson says that many years ago he received some specimens from the late Mr. Daniel Hanbury, who had collected them while travelling in Greece. Sir Benjamin prepared a draught of mandragora according to the prescription of Dioscorides. He says that "the phenomena repeated themselves with all faithfulness," and he adds that "there can be no doubt that in the absence of our now more convenient class of anæsthetics, morion[1] might still be used for general anæsthesia." Seneca, Apuleius Lucius, and other ancient authors also refer to the narcotic effects of mandragora. From a casual reference made by the theological writer Origen to a draught which cast patients, when surgical operations are to be performed, into a deep sleep, the practice of inducing anæsthesia would appear to have been common in the third century. The drug used was doubtless mandragora. In the same century Indian hemp was employed for the same purpose in China.

In a collection of old Chinese writings, entitled Kou-Kin-I-Tong, presented many years ago to the French Academy by M. Stanislas Julien, there is a biographical sketch of a surgeon named Moa-Tho who in the years 220-230 of our era gave patients on whom he wished to perform painful operations a substance called Ma-Yo, which is said to have been Indian hemp, the effect of which was that after a few moments they became insensible as if they were drunk or deprived of life.

A local anæsthetic agent is referred to by Pliny and Dioscorides as *lapis Memphiticus* or Memphis stone. This powdered and mixed with vinegar was applied to parts which were to be cut or burnt. Littré conjectures that this stone was a kind of marble which on the addition of vinegar gave off carbonic acid which deadened the sensibility of the nerve ends. Withington suggests that it may have been a kind of bitumen and that such anæsthetic effect as it may have had was due to the phenol which it contained.

### The "Drowsy Syrups" of the Middle Ages.

Down to the sixteenth century, mandragora was in more or less general use as an anæsthetic. The most celebrated prescription for its use was that given in the *Chirurgiæ* of Theodoricus of Lucca, Bishop of Cervia (lib. 4, cap. viii.) under the name of "Spongia Somnifera." Theodoricus, who died in 1298, was the son of the famous surgeon Hugo of Lucca, and was himself at the beginning of his career a surgeon. On entering the church he published the secrets which he had learnt from his father. The following is the composition of the "sleeping sponge."

> Take of opium, of the juice of the unripe mulberry, of hyoscyamus, of the juice of hemlock, of the juice of the leaves of mandragora, of the juice of the woody ivy, of the juice of the forest mulberry, of the seeds of lettuce, of the seeds of the dock which has large round apples, and of the water hemlock—each an ounce; mix all these in a brazen vessel and then place in it a new sponge; let the whole boil as long as the sun lasts on the dog days until the sponge consumes it all, and it has boiled away in it. . . . . As oft as there shall be need of it place this sponge in hot water for an hour and let it be applied to the nostrils of him who is to be operated on until he has fallen asleep, and so let the surgery be performed.

After the operation the patient was to be aroused in the following manner:

> This being finished, in order to awaken him, apply another sponge dipped in vinegar frequently to the nose or throw the juice of the root of fenugreek into the nostrils; shortly he awakens.

The "Confectio Soporis Secundum Dominum Hugonem" was still in use in the sixteenth century as we learn from Jean Canappe, whose work *Le Guidon pour les Barbiers et les Chirurgiens* was published in 1538. The concluding sentence of the following passage shows that opium was also used as an anæsthetic in his day:

> Aucuns, dit-il, comme Theodoric, leur donnent médicines obdormifères qui les endorment, afin que ne sentent incision, comme opium, succus morellae, hyoscyami, mandragorae, circutae, lactucae, et plongent dedans esponge et la laissent seicher au soleil, et quand il est nécessité, ilz mettent cette esponge en eaue chaulde, et leurs donnent à odorer tant qu'ilz prennant sommeil et s'endorment; et quand ilz sont endormis, ilz font l'opération; et puis avec une autre esponge baignée en vin aigre et appliquée ès narilles les esveillent, ou ilz mettent ès narilles ou en l'oreille, succum rutae ou feni, et ainsi les esveillent, comme ilz dient. Les autre donnent opium à boire, et font mal, spécialement s'il est jeune; et le aperçoivent car ce est avec une grande bataille de vertu animale et naturelle. J'ai ouï qu'ilz encourent manie et par conséquent la mort.

[1] Sir Benjamin uses the word "morion" as denoting the potion itself rather than the particular kind of mandragora from which it was made. He further translates "morion" as "death wine," as if it had something to do with the Latin *mori*, an etymology which, as Count Smorltork might have said, "surprise by himself."

Dr. E. T. Withington, in his *Medical History from the Earliest Times*, quotes the following recipe from the author of the *Breviarium* (Arnald of Villanova ?):

*To produce sleep so profound that the patient may be cut and will feel nothing as though he were dead.* It is an "experimentum" of Magister Michael Scot. Take of opium, mandragora bark, and henbane root equal parts, pound them together, and mix with water. When you want to sew or cut a man dip a rag in this and put it to his forehead and nostrils. He will soon sleep so deeply that you may do what you will. To wake him up, dip the rag in strong vinegar. The same is excellent in brain fever, when the patient cannot sleep, for if he do not sleep he will die.

A somewhat similar prescription is given by Nicholas, provost of the famous old medical school of Salerno, in his *Antidotarium*.

The idea of anæsthesia produced by drugs was familiar to mediæval romance writers and poets. In Boccaccio's *Decameron* the catastrophe of one of the stories turns on a gallant drinking by mistake a draught prepared by a surgeon for a patient whose leg he was about to amputate. Marco Polo tells us that the Old Man of the Mountain used to drug his victims. Du Bartas, who wrote in the middle of the sixteenth century, wrote, (as Englished by Silvester):

Even as a surgeon, minding off to cut
Some cureless limb, before in use he put
His violent engines on the vicious member,
Bringeth his patient in a senseless slumber,
And griefless then (guided by use and art)
To save the whole cuts off th' infected part

Shakespeare's allusions to poppy, mandragora, and other "drowsy syrups," are too familiar to need quotation, but the following passage from a somewhat later dramatist is interesting. Middleton, in a play called *Women, beware Women*, writes:

I'll imitate the pities of old surgeons
To this lost limb, who, ere they show their art,
Cast one asleep, then cut the diseased part.

In the days of the rack and the thumbscrew it was natural that there should be traditional secrets among criminals for baffling their tormentors. The following passage is quoted by Simpson from *Le Procès Criminel* of Claude Lebrun de la Rochette:

As to their artifices not to feel the pain of the rack, I saw [in the first year of my reception at the bar of Beaujolais, which was in the year 1588, that one of four thieves who were prisoners, the chief named Grand François, a man of gigantic stature, was put to the rack, fell asleep, and the toes were torn from both his feet, without his manifesting any signs of pain. One of his companions observed that he had eaten soap which stupefied the nerves. The remedy to the artifice is to give wine, which being brought and drunk, he then said he was dead, and without further torture freely confessed an infinite number of murders and robberies.

From other writers of the same period it may be gathered that soap dissolved in clear water was believed by the poor wretches who went in fear of the attentions of the ministers of the law to have the power of making them insensible to torture.

Local anæsthesia was not unknown. Besides the Memphis stone already referred to, we read of inunctions of opium, celandine, saffron, the marrow and fat of a man, with the oil of lizards, as likely to help a person on the rack in withholding the confession it was desired to extract from him. Bernard states that the Salernitans used to rub up poppy seed and herbane and applied them as a plaster to deaden sensibility of parts to be cauterised.

Local anæsthesia was sometimes produced by freezing, as is shown by the following passage from Thomas Bartholinus:

Antiqua cauterio ulcera in membris excitentur; nix affricata induit stuporem. Id me docuit Marcus Aurelius Severinus in Gymnasio Neopolitano olim præceptor meus et hospes, Chirurgorum hoc saeculo princeps. Rectissime autem nivem in vasculum materiæ convenientis capax, sed oblongâ ad extremum et myrtiformi specie, conjectam, sine rei ullius interventu applicavit. A gangraenae metu securos nos jussit, medicamento sub angustis parallelis lineis applicato, sensu vero post horae quadrantem sopito, secare locum indolentem licebit.

About the end of the sixteenth century the belief in mandragora and other substances so long credited with anæsthetic properties seems to have died out rather suddenly. Ambroise Paré speaks of the "spongia somnifera" as "used formerly" by operators. Simpson conjectures that it was found too dangerous; Snow, however, expressed his "utter disbelief that a sponge containing the oil prepared as above, would, after being placed in hot water, give off any odour or vapour that would cause insensibility." However that may be, we do not hear much of anæsthetic draughts or inhalations till near the end of the last century. In 1782, Weiss, a pupil of J. L. Petit, is said to have operated on the foot of Augustus, King of Poland, while the royal patient was under the influence of "a certain potion surreptitiously administered."

Other means of producing insensibility were tried and one after the other found wanting. Compression of the carotid arteries, which according to Casper Hoffmann, used to be practised by the Assyrians of old in the circumcision of boys, was employed by Valverdi and others in the sixteenth and seventeenth centuries. Morgagni used this method in vivisections of animals, and suggests that it might be used on human beings. Surgeons have, however, left this mode of producing anæsthesia to garotters, who found it very successful for the particular purpose they had in view. Compression of the nerves supplying the limb to be removed was proposed by James Moore in 1784 and was tried with no very brilliant success by Hunter, Malgaigne, and others. Three years before, Sassard, surgeon to the Charité of Paris had recommended that patients should be prepared for the knife by free drugging with narcotics as a means of preventing shock. In 1800, Humphry Davy in experimenting with nitrous oxide gas found that it relieved pain. To quote his own words:[2]

The power of the immediate operation of the gas in removing intense physical pain I had a very good opportunity of ascertaining. In cutting one of the unlucky teeth called *dentes sapientiæ*, I experienced an extensive inflammation of the gum, accompanied with great pain, which equally destroyed the power of repose and of consistent action. On the day when the inflammation was most troublesome I breathed three large doses of nitrous oxide. The pain always diminished after the first four or five inspirations, the thrilling came on as usual, and uneasiness was for a few minutes swallowed up in pleasure. As the former state of mind, however, returned, the state of organ returned with it.

In the following passage Davy clearly points out the anæsthetic properties of the gas and the use to which they might be put by surgeons:—

As nitrous oxide in its extensive operation appears capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place.

The anæsthetic effects of ether were also plainly enough shown by the case of Lady Martin, reported by Sir Thomas Watson in his classical *Lectures on the Principles and Practice of Physic*:—

Long before its power was used to prevent the inflicted pain of surgical operations, the vapour of ether had been successfully employed to suppress the inbred sufferings of natural disease. A former patient of mine told me this story of herself. She had been sorely tried, in her earlier years, with paroxysms of urgent dyspnœa, frequently recurring, and her life was thought to be in danger. After fruitless trials of various other remedies, the following method was adopted, with the happiest result, under the advice of a physician of high promise, who died young, the late Dr. Woolcombe, of Plymouth.

About two teaspoonfuls of sulphuric ether were poured into a saucer, which was placed on her lap, and over which she breathed, as she sat gasping in bed, with a shawl thrown over head to prevent the escape of the vapour. Very soon a delightful sensation of tranquillity ensued; she felt (I quote her own words) "as if going to heaven in a most heavenly way"; and presently she sank back unconscious. As soon as this happened, her husband (the late distinguished Admiral of the Fleet, Sir T. Byam Martin), by whom the process was managed, withdrew the shawl, and in a short time Lady Martin gradually recovered, breathing calmly.

This mode of quieting her attacks of asthma was begun in 1806, a few years after the publication of Sir Humphry Davy's hint; and it was repeated again and again, sometimes twice in the same day, for a very considerable period. Lady Martin survived the prediction of her speedy death for forty-three years.

But the teaching of this case and the more explicit statement of Humphry Davy were overlooked, and both nitrous oxide and ether remained little more than scientific playthings, which were used by professors of chemistry to relieve the tedium of their prelections. Meanwhile the operating theatre continued to be a place of hideous torture, and surgeons were often too glad to take advantage of any means of escape from the necessity of using the knife.

### THE ADVENT OF TRUE ANÆSTHESIA.

So far the history of the efforts to free surgery from the black shadow of pain which darkened its footsteps had been a record of delusion and failure. Surgeons had given up hope of finding any means of masking the terrors of the knife, and Velpeau had declared that "the prevention of pain in operations is a chimera which it is not permitted to pursue." Yet the words had scarcely been written when the problem

[2] *Researches, Chemical and Philosophical, chiefly concerning Nitrous Oxide.* London. 1800

which had so long been the "mere despair of surgery," and which had just been pronounced on such high authority to be insoluble, was triumphantly solved. This great step in the progress of mankind we owe to America. To a young dentist of Hartford, Connecticut, belongs the credit of having practically proved for the first time the possibility of abolishing sensation so utterly that a painful operation could be done without being felt.

### Nitrous Oxide.

On December 11th, 1844, Horace Wells, the dentist in question, inhaled nitrous oxide gas, and had a tooth extracted by a professional brother while under its influence. The day before he had been present at a popular scientific lecture given by Colton, who had been a pupil of Professor Turner, of University College, London. Some persons were asked to inhale laughing gas for the amusement of the rest, and one of these, named Cooley, wounded himself severely by falling against the benches, and only became aware that he was hurt by seeing the blood. Wells was greatly struck by the occurrence, and the next day he determined to test the anæsthetic effects of nitrous oxide gas on himself by having a diseased upper molar extracted under its influence. The operator, Dr. Riggs, gives the following account of the event:

"A few minutes after I went in, and after conversation Dr. Wells took a seat in the operating chair. I examined the tooth to be extracted with a glass as I usually do. Wells took a bag of gas from Mr. Colton and sat with it in his lap, and I stood by his side; he then breathed the gas until he was much affected by it; his head dropped back, I put my hand to his chin; he opened his mouth and I extracted the tooth. His mouth still remained open some time. I held up the tooth with the instrument that the others might see it; they, standing partially behind the screen, were looking on. Dr. Wells soon recovered from the influence of the gas so as to know what he was about, discharged the blood from his mouth, swung his hand and said, 'A new era in tooth-pulling!' He said it did not hurt him at all. We were all much elated, and conversed about it for an hour later."

Wells extracted teeth under laughing gas from several persons with equal success. He then went to Boston in order to make his discovery known to the medical profession in that city. He remained there some days in the expectation of being allowed to try the gas in a case of amputation in the Massachusetts General Hospital, but the operation was postponed. He was then invited by Dr. Warren, senior surgeon to the hospital, to address his class on the subject of anæsthesia, and afterwards he was asked to administer the gas in a case of tooth extraction. He was assisted on the occasion by a Boston dentist named Morton, who had been his pupil and afterwards for a time his partner. The experiment, as Wells himself confesses, was not quite a success, the gas bag having been removed too soon. The whole thing was denounced as a piece of humbug, and Wells was hissed out of the room as an impostor. He himself states that the excitement of this adventure brought on a protracted illness, which compelled him to relinquish his profession for some time. The remainder of his life was spent mainly in the endeavour to establish his claims to priority as the discoverer of anæsthesia. These were vehemently opposed by Morton and Jackson, who introduced ether, but it is generally admitted now that to Wells belongs the credit of having first shown the practicability of producing insensibility by nitrous oxide, and of having thus in his own words established the principle of anæsthesia. The story of his career is one of the saddest in the annals of scientific discovery. After fruitless efforts to get his claims acknowledged in France as well as in his native country, his mind became diseased, and for a time he wandered about the streets of New York seeking to avenge himself on society by throwing vitriol on women's dresses. He was arrested, and while in gaol he opened his radial artery on January 24th, 1848, having first inhaled ether to make death painless. This was the only benefit which this great benefactor of mankind derived from his discovery. He was only 32. Some reparation has recently been made to his memory. On December 11th, 1894, a bronze memorial tablet, towards which 250 dentists of the United States had subscribed, was put up in Hartford, with an inscription setting forth the fact that to Horace Wells the world owes the discovery of anæsthesia.

### Ether.

After Wells's unsuccessful exhibition at Boston, nitrous oxide was put aside as a discredited agent, till the method of administration was perfected and its use in dentistry was revived under happier auspices some years after the unfortunate discoverer's death. In the meantime a better anæsthetic for surgical purposes had been discovered.

W. T. G. Morton, another dentist who had worked with Wells and thus had his mind directed to the subject of anæsthesia, had been seeking for a means of making dentistry painless. He, as has already been said, shared to a certain extent in the disgrace of Wells's failure; but he was not discouraged. After many unsuccessful experiments with various opiates, Dr. Charles T. Jackson, of Boston, a distinguished chemist, whose pupil he had been, suggested to him that sulphuric ether might be tried with some hope of success. The stupefying properties of ether were known to chemists, and also, as appears from the case of Lady Martin related above, to physicians. No one, however, seems to have thought of using it as an anæsthetic in surgical operations, and, in fact, it was looked upon as a highly dangerous substance.[3] Morton had neither the training nor the mental equipment of the scientific investigator, but on the other hand he had the daring of the explorer. After some successful experiments with ether on animals he proceeded to test its action on himself and on his assistants. Owing to impurities in the ether, and doubtless also to defects in the mode of administration, the results were at first not altogether satisfactory. At last, however, his courage and perseverance were rewarded. On September 30th, 1846, came the crucial experiment. Having procured some chemically pure ether, Morton shut himself up in a room alone on that day and inhaled the vapour. Let the story be told in his own words:

> Taking my tube and flask, I shut myself up in my room, seated myself in the operating chair, and commenced inhaling. I found the ether so strong that it partially suffocated me, but produced no decided effect. I then saturated my handkerchief, and inhaled it from that. I looked at my watch, and soon lost consciousness. As I recovered I felt a numbness in my limbs, and a sensation like nightmare, and would have given the world for somebody to come and arouse me. I thought for a moment I should die in that state, and that the world would only pity or ridicule my folly. At length I felt a slight tingling of the blood in the end of my third finger, and made an effort to press it with my thumb, but without success. At a second effort I touched it, but there seemed to be no sensation. I gradually raised my arm, and pinched my thigh, but I could see that the sensation was imperfect. I attempted to rise from my chair, but fell back. I immediately looked at my watch, and found that I had been insensible between seven and eight minutes.

### The First Dental Operation under Ether.

The next thing to be done was clearly to put the new-found anæsthetic into actual practice. By a lucky chance the opportunity presented itself almost at once. The narrative may be continued in his own words (as reported by Mr. E. L. Snell in the *Century* for August, 1894):

> I had become much excited, and had determined that I would not leave the office until I had seen something more of the power of this new agent. Twilight came on; but in my present state I felt it to be impossible to go home to my family. As the evening wore away my anxiety increased. The hour had long passed when it was usual for patients to call. I had just resolved to inhale the ether again and have a tooth extracted under its influence, when a feeble ring was heard at the door. Making a motion to one of my assistants, who started to answer the bell, I hastened myself to the door, where I found a man with his face bound up, who seemed to be suffering extremely.
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> "Doctor," said he, "I have a dreadful tooth, but it is so sore I cannot summon courage to have it pulled. Can't you mesmerise me?"
>
> I need not say that my heart bounded at this question, and that I found it difficult to control my feelings, but, putting a great restraint on myself, I expressed my sympathy for the man, and invited him to walk into the office. There were no instruments in sight to terrify him, and the ether was close at hand, every arrangement having been previously made in the hope that a similar case might occur. I examined the tooth, and in the most encouraging manner told the poor sufferer that I had something better than mesmerism by means of which I could take out his tooth without giving him pain. He gladly consented, and, saturating my

[3] Claims of priority have been advanced on behalf of Dr. Crawford W. Long, of Georgia, and Dr. Marcy, of Hartford, both of whom are said to have used ether in surgical operations before either Wells or Morton came on the scene. Whether this be the fact or not, it is certain that neither Long nor Marcy published his cases; and in the records of scientific discovery, as in law, the maxim *De non apparentibus ac de non existentibus eadem est ratio* must hold good. The same principle applies to the claim made on behalf of Dr. Thomas Beddoes, of Bristol, on the ground that he knew the effect of nitrous oxide in relieving pain and used it in practice, and that it was from him that Davy, who was his assistant at the time, learned the properties of the gas. As Dr. Beddoes did not give his alleged discovery to the world, it must be assumed that he did not appreciate its importance.

handkerchief with ether, I gave it to him to inhale. He became unconscious almost immediately. It was dark. Dr. Hayden held the lamp. My assistants were trembling with excitement, apprehending the usual prolonged scream from the patient, while I extracted a firmly rooted bicuspid tooth. I was so much agitated that I came near throwing the instrument out of the window. But now came a terrible reaction. The wrenching of the tooth had failed to rouse him in the slightest degree. Instead of the quick start of relief with which a patient usually leaves the operating chair the moment the instruments are withdrawn, he remained still and motionless as if already in the embrace of death.

The terrible thought flashed through my mind that he might be dead—that in my zeal to test my new theory I might have gone too far and sacrificed a human life. With the rapidity of lightning my mind ran through the whole process of my investigations up to the present hour. I trembled under the sense of my responsibility to my Maker and to my fellow-men. The question, Can I restore him to consciousness? startled me into action. I seized a glass of water and dashed it in the man's face. The result proved most happy. He recovered in a minute, and knew nothing of what had occurred. Seeing us all stand around him he appeared bewildered. I instantly, in as calm a tone as I could command, asked: "Are you ready to have your tooth extracted?"

"Yes," he answered, in a hesitating tone.

"It is all over," I said, pointing to decayed tooth on the floor.

"No!" he shouted, leaping from the chair.

The following certificate, signed by the patient and duly witnessed, shows that in Morton scientific ardour was combined with the aptitude for business characteristic of his nation:

Boston, September 30th, 1846.

This is to certify that I applied to Dr. Morton at 9 o'clock this evening, suffering under the most violent toothache; that Dr. Morton took out his pocket handkerchief, saturated it with a preparation of his; from it I breathed for about half a minute, and then was lost in sleep. In an instant more I awoke and saw my tooth lying upon the floor. I did not experience the slightest pain whatever. I remained twenty minutes in his office afterwards, and felt no unpleasant effects from the operation.

EBEN. H. FROST,
42, Prince Street, Boston.

We witnessed the above operation, and the statement is in all respects correct; and, what is more, the man asked where his tooth was, or if it was out.

A. G. TENNY, Journal Office.
G. G. HAYDEN, Surgeon Dentist.
Boston, September 30th, 1846.

### THE FIRST SURGICAL OPERATION UNDER ETHER.

It only remained then to make the discovery known to the medical profession. After the piece of "humbug" in which he had been concerned with Wells, the surgeons could hardly be expected to welcome another futile attempt in a public hospital. Morton, however, applied to Dr. John C. Warren, then senior surgeon to the Massachusetts General Hospital, and obtained permission to test his new anæsthetic on a patient about to undergo a surgical operation. The day fixed for the experiment was Friday, October 16th, 1846. At the appointed time a large number of medical men had assembled in the theatre, the patient was brought in, and the surgeon was ready—but the discoverer was not there. After waiting a quarter of an hour Dr. Warren said drily, "As Dr. Morton has not yet arrived, I presume that he is otherwise engaged." He was about to begin the operation when Morton, who had been delayed by some difficulty in the making of a suitable inhaler, entered. Dr. Warren told him abruptly that the patient was ready. An experiment commenced in such discouraging circumstances might well have proved a *fiasco;* fortunately for the world, however, Morton did not lose his nerve. He administered the anæsthetic successfully, and the operation (which was for a congenital vascular tumour of the neck in a young man named Gilbert Abbott) was completed without a groan from the patient. When all was over, Dr. Warren said in an impressive tone: "Gentlemen, this is no humbug!" The effect on those who witnessed the scene was naturally very great. Dr. Henry J. Bigelow, who was present, said to a doctor whom he met later in the day: "I have seen something today that will go round the world." It was a true prophecy. Ether went rapidly round the world. There was at first some little difficulty as Morton wished to make a mystery of his discovery, and the surgeons of the Massachusetts General Hospital very properly objected to the use of an unknown substance on patients for whose safety they were responsible. Morton, however, expressed his willingness to inform them confidentially of the nature of the agent, and it was soon used in amputations, the reduction of dislocations, and other surgical procedures.

W. T. G. Morton

(Reproduced from the *Century*.)

### THE SAD FATE OF THE DISCOVERERS.

To Morton himself the discovery brought little but disappointment and vexation of spirit. The rest of his life was spent in wrangles about priority and efforts to secure recognition and reward, which were for the most part fruitless. He died bankrupt and heartbroken on July 15th, 1868, before he had completed his 49th year.

It is sad to relate that Jackson, like Wells, became insane, and after lingering for some years in an asylum, died in 1880.

### THE PATENTING OF THE DISCOVERY.

It is impossible not to pity the misfortunes of Morton, who, in the words of the trustees of Massachusetts General Hospital, became "poor in a cause which made the world his debtor;" but sympathy is tempered by the reflection that after all he in large measure brought his troubles upon himself. On an impartial study of the vast amount of documentary evidence in the case, one cannot resist the conclusion that Morton's main object was to make a profit of his discovery. As soon as he had satisfied himself that ether really possessed anæsthetic properties, his first thought seems to have been to patent his discovery. The following is the text of the patent as copied from the records of the United States Patent Office and published in the *Boston Medical and Surgical Journal*, April 7th, 1847:

To all persons to whom these presents shall come: Be it known that we, Charles T. Jackson and William T. G. Morton, of Boston, in the County of Suffolk and State of Massachusetts, have invented or discovered a new and useful improvement in surgical operations on animals, whereby we are enabled to accomplish many, if not all, operations, such as are usually attended with more or less pain or suffering, without any or very little pain to, or muscular action of, persons who undergo the same; and we do hereby declare that the following is a full and exact description of our said invention or discovery.

It is well known to chemists that when alcohol is submitted to distillation with certain acids peculiar compounds, termed ethers, are formed, each of which is usually distinguished by the name of the acid employed in its preparation. It has also been known that the vapors of some, if not all, these chemical distillations, particularly those of sulphuric ether, when breathed or introduced into the lungs of an animal, have produced

a peculiar effect upon its nervous system, one of which has been supposed to be analogous to what is usually termed intoxication. It has never (to our knowledge) been known until our discovery that the inhalation of such vapors (particularly those of sulphuric ether) would produce insensibility to pain, or such a state of quiet of nervous action as to render a person or animal incapable, to a great extent, if not entirely, of experiencing pain while under the action of the knife or other instrument of operation of a surgeon calculated to produce pain. This is our discovery, and the combining it with, or applying it to, any operation of surgery, for the purpose of alleviating animal suffering, as well as of enabling a surgeon to conduct his operations with little or no struggling or muscular action of the patient, and with more certainty of success, constitutes our invention. The nervous quiet and insensibility to pain produced on a person is generally of short duration; the degree or extent of it, or time which it lasts, depends on the amount of ethereal vapor received into the system, and the constitutional character of the person to whom it is administered. Practice will soon acquaint an experienced surgeon with the amount of etheric vapor to be administered to persons for the accomplishment of the surgical operation or operations required in their respective cases. For the extraction of a tooth the individual may be thrown into the insensible state, generally speaking only a few minutes. For the removal of a tumour, or the performance of the amputation of a limb, it is necessary to regulate the amount of vapor inhaled to the time required to complete the operation. Various modes may be adopted for conveying the etheric vapor into the lungs. A very simple one is to saturate a piece of cloth or sponge with sulphuric ether and place it to the nostrils or mouth, so that the person may inhale the vapors. A more effective one is to take a glass or other proper vessel like a common bottle or flask. Place in it a sponge saturated with sulphuric ether. Let there be a hole made through the side of the vessel, for the admission of atmospheric air which [(*hole*) may or may not be provided with a valve opening downwards, or so as to allow air to pass into the vessel], a valve on the outside of the neck opening upwards, and another valve in the neck and between that last mentioned and the body of the vessel or flask, which latter valve in the neck should open towards the mouth of the neck or bottle. The extremity of the neck is to be placed in the mouth of the patient, and his nostrils stopped or closed in such a manner as to cause him to inhale air through the bottle, and to exhale it through the neck and out of the valve on the outside of the neck. The air thus breathed, by passing in contact with the sponge, will be charged with the etheric vapors, which will be conveyed by it into the lungs of the patient. This will soon produce the state of insensibility or nervous quiet required.

In order to render the ether agreeable to various persons, we often combine it with one or more essential oils, having pleasant perfumes. This may be effected by mixing the ether and essential oil, and washing the mixture in water. The impurities will subside, and the ether, impregnated with the perfume, will rise to the top of the water. We sometimes combine a narcotic preparation, such as opium or morphine, with the ether. This may be done by any ways known to chemists, by which a combination of etheric and narcotic vapours may be produced.

After a person has been put into the state of insensibility, as above described, a surgical operation may be performed upon him, without, so far as repeated experiments have proved, giving to him any apparent or real pain, or so little in comparison to that produced by the usual process of conducting surgical operations, as to be scarcely noticeable. There is very nearly, if not entire absence of all pain. Immediately, or soon after the operation is completed, a restoration of the patient to his usual feelings takes place without, generally speaking, his having been sensible of the performance of the operation.

From the experiments we have made we are led to prefer the vapors of sulphuric ether to those of muriatic or other kinds of ether, but any such may be employed which will properly produce the state of insensibility without any injurious consequences to the patient.

We are fully aware that narcotics have been administered to patients undergoing surgical operations, and, as we believe, always by introducing them into the *stomach*. This we consider in no respect to embody our invention, as we operate through the *lungs and air passages*, and the effects produced upon the patient are entirely or so far different as to render the one of very little, while the other is of immense, utility. The consequences of the change are very considerable, as an immense amount of human or animal suffering can be prevented by the application of our discovery.

What we claim as our invention is the hereinbefore described means by which we are enabled to effect the above highly important improvements in surgical operations, namely, by combining therewith the application of ether or the vapor thereof, substantially as above specified.

In testimony whereof we have hereunto set our signatures this twenty-seventh day of October, A.D. 1846.

CHARLES T. JACKSON,
WM. T. G. MORTON.

Witnesses: R. H. EDDY.
W. H. LEIGHTON.

### The Real Discoverer of Ether.

The association of Jackson's name with Morton's in the patent shows that he had some part in the discovery. It seems quite clear that he suggested the use of ether to Morton, but it is equally clear that he took no part in the experiments which proved its practical applicability as an anæsthetic. Indeed, it may be gathered that he rather mistrusted the issue of the adventure, for he was not present at an administration of the vapour for surgical purposes till some weeks after the first operation on October 16th. Jackson, however, claimed the whole credit of the discovery. The relative shares of the two men in the discovery may be summed up in the statement that Jackson supplied the inspiration and scientific guidance and Morton made the idea a reality. The following letter from Dr. Oliver Wendell Holmes to Mr. E. L. Snell, who published a good account of the discovery of anæsthesia in the *Century* for August, 1894, may be taken as setting the matter in its true light:

Boston, April 2nd, 1893.

MY DEAR SIR,—Few persons have or had better reason than myself to assert the claim of Dr. Morton to the introduction of artificial anæsthesia into surgical practice. The discovery was formally introduced to the scientific world in a paper read before the American Academy of Arts and Sciences by Dr. Henry J. Bigelow, one of the first, if not the first, of American surgeons.

On the evening before the reading of the paper containing the announcement of the discovery, Dr. Bigelow called at my office to recite this paper to me. He prefaced it with a few words which could never be forgotten.

He told me that a great discovery had been been made, and its genuineness demonstrated at the Massachusetts General Hospital, of which he was one of the surgeons. This was the production of insensibility to pain during surgical operations by the inhalation of a certain vapour (the same afterwards shown to be that of sulphuric ether). In a very short time, he said, this discovery will be all over Europe. He had taken a great interest in the alleged discovery, had been present at the first capital operation performed under its influence, and was from the first the adviser and supporter of Dr. W. T. G. Morton, who had induced the surgeons of the hospital to make trial of the means by which he proposed to work this new miracle. The discovery went all over the world like a conflagration.

The only question was whether Morton got advice from Dr. Charles T. Jackson, the chemist, which entitled that gentleman to a share, greater or less, in the merit of the discovery.

Later it was questioned whether he did not owe his first hint to Dr. Horace Wells, of Hartford, which need not be disputed. Both these gentlemen deserve "honourable mention" in connection with this discovery, but I have never a moment hesitated in awarding the essential credit of the great achievement to Dr. Morton.

This priceless gift to humanity went forth from the operating theatre of the Massachusetts General Hospital, and the man to whom the world owes it is Dr. William Thomas Green Morton.

Experiments have been made with other substances besides sulphuric ether for the production of anæsthesia. Among them, by far the most important, is chloroform, the use of which is introduced by Sir James Y. Simpson. For this and for the employment of anæsthetics in midwifery he should have all due credit, but his attempt to appropriate the glory of making the great and immortal discovery, as revealed in his contribution to the eighth edition of the *Encyclopædia Britannica*, is unworthy of a man of his highly respectable position. In the ninth edition of the same work his article—Chloroform—is omitted, and a fair enough account of the discovery is given under the title Anæsthesia.

Yours very truly,
O. W. HOLMES.

A further testimony of the fact that Morton is generally accepted by his fellow-citizens as the real discoverer of anæsthesia is afforded by the fact that a monument has been erected over his grave in Mount Auburn Cemetery, near Boston, by a number of prominent persons. It bears the following inscription:

WILLIAM T. G. MORTON,

INVENTOR AND REVEALER OF ANÆSTHETIC INHALATION.

BY WHOM PAIN IN SURGERY WAS AVERTED AND

ANNULLED.

BEFORE WHOM, IN ALL TIME, SURGERY WAS AGONY.

SINCE WHOM SCIENCE HAS CONTROL OF PAIN.

His name has also recently been inscribed among those of the fifty-three most distinguished sons of Massachusetts round the base of the dome of the new Chamber of Representatives.

### Origin of the Term "Anæsthesia."

The proper naming of a new substance or a new process is often almost as troublesome as the discovery of it. Soon after the memorable 16th of October, a meeting was held at the house of Dr. A. A. Gould, in Boston, to choose a name for the last heir of Morton's invention. At this meeting were present Dr. Henry J. Bigelow, Dr. O. W. Holmes, and Dr. Morton, and Dr. Gould read aloud a list of names which he had prepared. On hearing the word "Letheon" Dr. Morton exclaimed, "That is the name the discovery shall be christened." Dr. Gould and the others also favoured this name, which is derived, of course, from Lethe, the river of forgetfulness. Subsequently, however, Dr. Holmes wrote the following letter, in which he proposed the name which has since come into general use:

Boston, November 21st, 1846.

MY DEAR SIR,—Everybody wants to have a hand in a great discovery. All I will do is to give you a hint or two as to names, or the name, to be applied to the state produced and the agent.

The state should, I think, be called "anæsthesia." This signifies insensibility, more particularly (as used by Linnæus and Cullen) to objects of touch. (See Good, *Nosology*, p. 259.) The adjective will be "anæsthetic."

Thus we might say the state of anæsthesia, or the anæsthetic state. The means employed would be properly called the antiæsthetic agent. Perhaps it might be allowable to say anæsthetic agent, but this admits of question.

The words antineuric, aneuric, neuroleptic, neurolepsia, neuro-ectasis, etc., seem too anatomical; whereas the change is a physiological one. I throw them out for consideration.

I would have a name pretty soon, and consult some accomplished scholar, such as President Everett or Dr. Bigelow, senior, before fixing upon the terms, which will be repeated by the tongues of every civilised race of mankind.

You could mention these words which I suggest for their consideration, but there may be others more appropriate and agreeable.—Yours respectfully,

O. W. HOLMES.

Dr. Morton.

Simpson afterwards found that the word *νωδυνία* had been used by Theocritus to express insensibility to pain, and regretted that he had not adopted it in preference to "anæsthesia."

THE FIRST OPERATION UNDER AN ANÆSTHETIC IN ENGLAND.

The first operation under ether in this country was performed by Robert Liston in University College Hospital on December 22nd, 1846. Among those present on the occasion were the late Sir John Erichsen, Sir Joseph Lister, Mr. William Cadge of Norwich, Dr. W. H. Ransom of Nottingham, and Dr. William Squire. A full account of that memorable event will be found in Dr. Squire's paper, published at p. 1142, and further details are given in Mr. Christopher Heath's lecture published at p. 1123. Mr. William Cadge has been good enough to send us the following interesting note on the subject:

I have no written notes of what took place on that memorable occasion, and I must trust to my memory, which may betray me into mistakes as to some minor details, but as to the main incident of amputation of the thigh, the scene was too startling and dramatic ever to be erased from my recollection.

Dr. Boot, of Gower Street, had reported to Mr. Liston the definite and authentic information of the effect of ether inhalation that he had received from Dr. Bigelow, of Boston, in December, 1846. Two days after this communication was the operating day at University College Hospital, and Liston resolved to put the matter to the test. In the interval, Mr. Squire, the well-known chemist of Oxford Street, prepared the apparatus, and Mr. (now Dr.) William Squire administered the ether.

On December 21st, 1846, at 2 o'clock, the operating theatre was filled with students and spectators; Liston addressed a few words to them as to the nature of the experiment about to be tried, and it was manifest that he had but faint hopes of its success.

The patient was a man rather below middle age who, to the best of my recollection, had malignant disease of the skin and tissues of the calf of the leg, for which amputation of the thigh was deemed to be necessary. He was a man of courage and of intelligence above the average of hospital patients, and he expressed his willingness to try the inhalation of ether. The apparatus comprised a large bell-shaped glass reservoir containing ether, and a long tube and mouthpiece. Fortunately the vapour caused no bronchial irritation or nervous excitement; the patient passed easily into complete insensibility, and Liston removed the thigh as rapidly as possible; a gentleman present, watch in hand, declared that the cutting operation lasted thirty-two seconds only. It was done by the antero-posterior flap method; the femoral artery was controlled by finger pressure; only three or four vessels required a ligature; lint dipped in water was placed between the flaps, and the stump was folded in a towel and all signs of blood cleared away.[4]

In a few minutes the patient woke up completely, and could answer these questions: Did he feel able to undergo the pain of the operation? Yes, he would submit as best he could. Did he not know that the limb was off? Then he remonstrated against trifling with his feelings at such a moment; but, when the towel was removed from the uplifted stump so that he could see it, he burst into tears and fell back on his pillow.

The scene at this moment was most impressive, for the success of the whole proceeding was as complete as could be witnessed at the present time. The great surgeon was almost as much affected as the patient; he saw at a glance what a blessing was in store for the human race, and what a boon for the surgeon, and he could scarcely command himself sufficiently to address even a few words to the spectators.

The next case did not go off so smoothly. The patient was a rough fellow with an ingrowing toenail. He became boisterous and violent under the inhalation, he thrust the assistants on one side, jumped off the table, and, so far as I remember, escaped from the theatre. He must, however, have been restrained or brought back and rendered insensible, seeing that the necessary operation was done without pain.

Liston for that day could think of nothing but this wonderful discovery. He wrote this short note to Dr. Boot: "5, Clifford Street, December 21st, 1846.—Dear Sir,—I tried the ether inhalation to-day in a case of amputation of the thigh, and in another requiring evulsion of both sides of the great toe-nail, and with the most perfect and satisfactory results. It is a very great matter to be able thus to destroy sensibility to such an extent without apparently any bad result. It is a fine thing for operating surgeons, and I thank you most sincerely for the early information you were so kind as to give me of it.—Yours faithfully, ROB. LISTON." He also wrote a characteristic letter to his old friend and former assistant, Professor Miller, of Edinburgh. I think the letter found its way into a Scotch newspaper, but I can only remember that it began and ended with a quotation from St. Paul, "Rejoice, and again I say rejoice."

That evening I dined with Mr. Liston (I was acting as his private assistant at the time). Two ladies were present, and after the cloth was removed nothing would content him short of my exhibiting the effects of ether by inhalation. When about half under its full effect I could just hear the elder lady say, "Liston, for God's sake stop; you will be the death of that poor young man." He did stop, but I felt the effect of his strong grip of the lobe of the ear for a day or two.

CHLOROFORM.

To no man in this country was the announcement that a means of inducing anæsthesia had been discovered more welcome than to Dr. James Young Simpson, at that time Professor of Midwifery in the University of Edinburgh. As his daughter, Miss Eve Blantyre Simpson, relates in the most interesting *Life* of her distinguished father, with advance sheets of which we have been favoured,[5] "very early in his student days he had so sickened at the suffering he witnessed in the operating theatre that he had shrunk from the scene, decided to abandon his medical studies, and seek his way in the paths of the law." Happily for mankind—and particularly for womankind—he did not carry out this determination. As soon as he heard of the use that was being made of ether for surgical purposes in America he tried it in midwifery. This was on January 19th, 1847, and Simpson was the first to use the anæsthetic for the relief of the pains of labour. Finding, however, after a time, to quote his own words, that "no busy obstetric practitioner could extensively employ sulphuric ether without inevitably carrying about with him, and upon his clothes, an odour so disagreeable to many other patients, and other houses, as to make his presence there aught but desirable," he set himself to discover something better than ether. Speaking of this search he says:

Latterly, in order to avoid if possible some of the inconveniences pertaining to sulphuric ether, particularly its disagreeable and persistent smell, its occasional tendency to irritation of the bronchi during its first inspirations, and the large quantity of it required to be used (more especially in protracted cases of labour), I have tried upon myself and others the inhalation of different other volatile fluids, with the hope that some one of them might be found to possess the advantages of ether without its disadvantages. For this purpose I selected for experiment and have inhaled several chemical liquids of a more fragrant or agreeable odour

[4] This was Liston's usual method of amputation. It was the duty of the house-surgeon in the evening, after full reaction from shock, to remove the lint, tie any bleeding points if necessary, and close the flaps with a few points of suture and isinglass plaster.

[5] The book will shortly be published as one of the "Famous Scots Series" now being issued by Messrs. Oliphant, Anderson and Ferrier, of Edinburgh and London. We have much pleasure in acknowledging the courtesy of the publishers, and of the editor of the series (Mr. Oliphant Smeaton) in the matter.

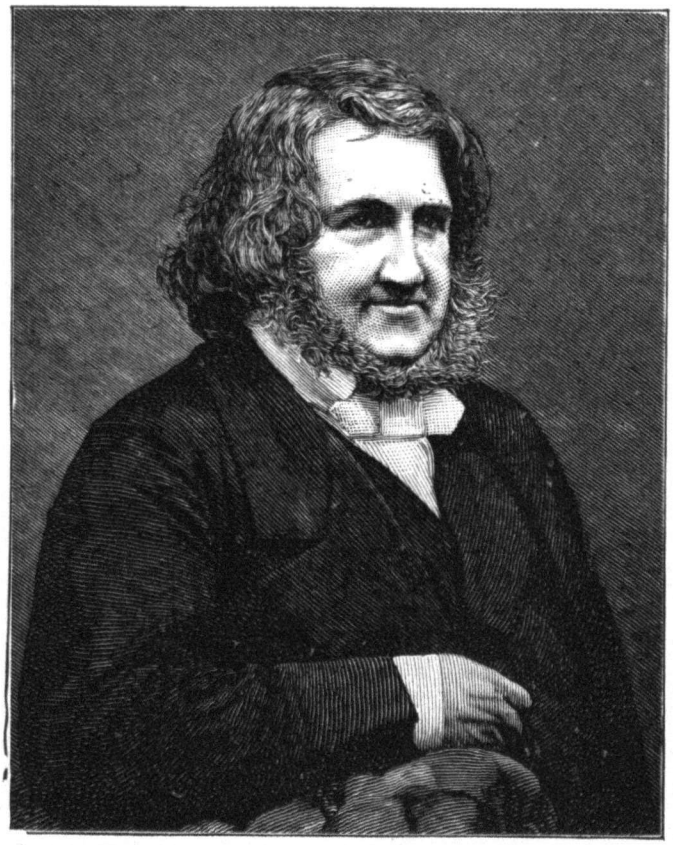
such as chloride of hydrocarbon, etc. Then Mr. Waldie, a Linlithgowshire man, first named perchloride of formyle as worthy, among others, of a trial.

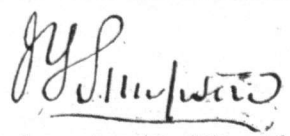
Dr. Jacob Bigelow, of Boston, and Mr. Jacob Bell, a well-known London pharmacist, had both previously tried chloric ether, and Mr. Bell's experiments had been so successful that Mr. Lawrence used it in surgical operations. Bell, however, failed to recognise that it was the chloroform in the chloric ether that produced insensibility. Mr. David Waldie, who was connected with the Apothecaries' Company at Liverpool, seems to have guessed that chloroform was the active agent, and he promised to procure some for Simpson. There was some delay in carrying the promise into effect, however, and in the meantime Simpson, who was not a man to let the grass grow under his feet, got some chloroform from Messrs. Duncan and Flockhart of Edinburgh, and at once began to experiment with it on himself and his assistants, Dr. George Keith and the late Dr. Matthews Duncan and others. The first trial of chloroform was made in Simpson's house on November 4th, 1847. Miss Simpson quotes the following passage from a letter written by her father to Mr. Waldie, who had drawn his attention to chloroform:

> I am sure you will be delighted to see part of the good results of our hasty conversation. I had the chloroform for several days in the house before trying it, as after seeing it such a heavy unvolatile-like liquid, I despaired of it, and went on dreaming about others. The first night we took it Dr. Duncan, Dr. Keith, and I all tried it simultaneously, and were all "under the table" in a minute or two.

Miss Simpson also quotes the following passage from a letter written to her by Dr. George Keith in 1891:

> Dr. Miller, in the appendix to his work on Surgery, published soon after, gives a full account of the scene. It is pretty correct, only he says we all took the chloroform at once. This, with a new substance to try, would have been foolish, and the fact is, I began to inhale it a few minutes before the others. On seeing the effect on me, and hearing my approval before I went quite over, they both took a dose, and I believe we were all more or less under the table, much to the alarm of your mother, who was present.





For the loan of this block we are indebted to the courtesy of the Editor of the *Practitioner*.

### "Far Stronger and Better than Ether."

Miss Simpson adds that Professor Miller, who was their neighbour, used to come every morning to see if the experimenters had survived. The following passage, which embodies Professor Miller's account of the proceedings, will doubtless be read with interest:

> These experiments were performed after the long day's toil was over, at late night or early morn, and when the greater part of mankind were soundly anæsthetised in the arms of common sleep. He describes how, after a "weary day's labour," the two sat down and inhaled various drugs out of tumblers, as was their custom, and chloroform was searched for and found beneath a heap of waste paper, and with each tumbler newly charged the inhalers resumed their occupation.....A moment more, then all was quiet; then a crash. On awakening, Dr. Simpson's first perception was mental. "This is far stronger and better than ether," said he to himself. His second was to note that he was prostrate on the floor, and that among the friends about him there was both confusion and alarm. Of his assistants, Dr. Duncan he saw snoring heavily, and Dr. Keith kicking violently at the table about him. They made several more trials of it on that eventful evening, and were so satisfied with the results, that the festivities of the evening did not terminate to a late hour—3 A.M.

On November 10th, 1847, Simpson communicated his discovery to the Medico-Chirurgical Society of Edinburgh in a paper entitled "Notice of a New Anæsthetic Agent as a Substitute for Sulphuric Ether." On November 15th, 1847, chloroform was used for the first time in a surgical operation in the Edinburgh Royal Infirmary. A public trial of the new agent had been proposed for a previous date, but fortunately for the future of chloroform Simpson could not be found in time to give it, and the patient was operated on without an anæsthetic. The case was one of strangulated hernia, and the operator, Professor Miller, had only proceeded the length of dividing the skin when the patient fainted and died with the operation unfinished.

As Simpson himself says: "If the chloroform had happened to be used and this fatal syncope had occurred while the patient was under its action, the whole career of the new anæsthetic would have been at once arrested." On the first occasion of its use three patients were operated on successfully under its influence. One of them (a soldier) was so pleased with the new elixir of oblivion that on awaking after the operation "he seized the sponge with which administration had been made and, thrusting it into his mouth, again resumed inhalation more vigorously than before, as if it were too good a thing to be stopped so soon." At this first public trial of the new anæsthetic Dumas, the great French chemist, who had first definitely determined the composition of chloroform, was present, "and was in no small degree rejoiced to witness the wonderful physiological effects of a substance with whose chemical history his own name was so intimately connected."

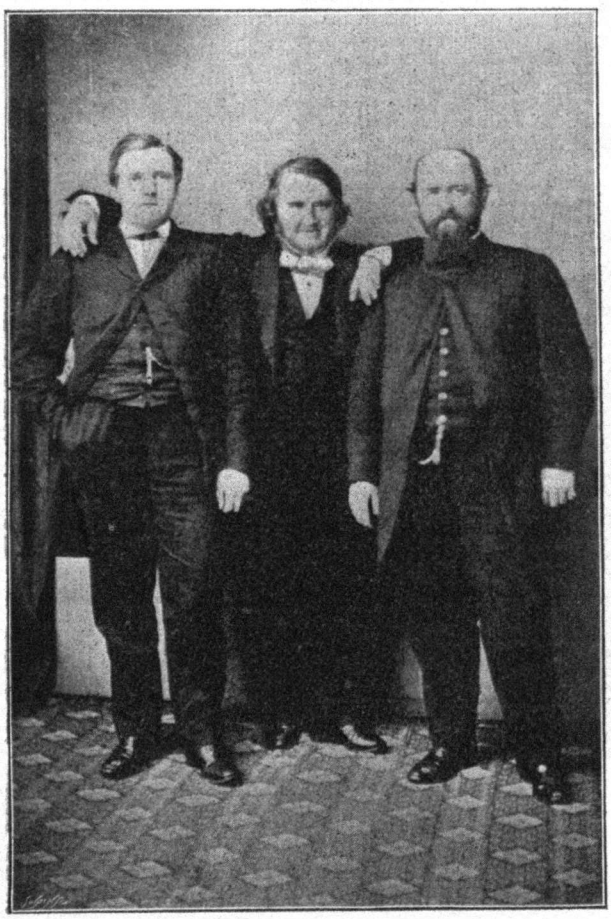
### Opposition to its Use.

Strange to say, the introduction of chloroform met with great and even violent opposition in many quarters. It was not received with enthusiasm by the profession. Surgeons probably were inclined to look askance at a thing which came to them from an obstetrician. Moreover, it was a prevalent belief among them that the pain of an operation was a useful stimulant to the patient. On this ground, as we learn from Sir William Priestley (whose authority we have for citing him as the author of an excellent account of the beginnings of chloroform, which appeared in Dickens's *Household Words* on February 12th, 1859) the chief of the Army Medical Staff recommended the surgeons during the Crimean army not to use chloroform. Fanatical clergymen denounced its use in labour as an impious attempt to evade the curse pronounced by the Almighty on Eve and all her daughters. Simpson fought these men with their own weapons, pointing out that the first operation under an anæsthetic had been performed by God himself when he cast Adam into a deep sleep before removing his rib. The "scientific"

objectors he met with a wealth of convincing argument reinforced by statistics which bore down all opposition. The fight was an obstinate one, but Simpson was victorious, and chloroform won the place, which it held for many years, as the anæsthetic most widely used in this country. Its triumph was greatly helped by the courageous example of Queen Victoria, who submitted to be anæsthetised at the birth of the late Duke of Albany and at that of Princess Henry of Battenberg. Dr. Snow was the administrator on each of these occasions. On the former of them the inhalation lasted fifty-three minutes. The chloroform was given on a handkerchief in 15-minim doses, and the Queen expressed herself as greatly relieved by the administration. Dr. Snow said that Her Majesty was a model patient.

### A Lady's Retrospect.

We have been favoured with the following interesting reminiscences from the wife of a distinguished physician, who was well acquainted with Sir James Simpson:



Sir James Simpson, one of his sons, and a friend.
*(From a photograph kindly lent by Sir W. Priestley.)*

My earliest recollections of the introduction of chloroform are curiously mixed up with electro-biology, our evenings in my youth being given up occasionally to the one, sometimes to the other. My parents, from a science point of view, were decidedly "advanced," and regarded their daughters as fair media for any scientific experiments that might be going. Hence doors and minds were always open to those who came on scientific thoughts intent, and required a girl or two to practise on.

The electro-biology evenings were conducted by Sir Edward Bulwer Lytton, who made us, or some of us, imagine the bell-rope was a ladder up which we had to climb; or would fix us to the wall, from which only his magic power could remove us. Professor Simpson frequently took part in these occult *séances*, and was always ready to cast a mesmeric spell over troublesome patients to keep them quiet till his next visit. In the midst of all this the professor and his assistants were going through—generally at midnight—the awful perils attending the development of chloroform, and it was only when the welcome anæsthetic was brought to perfection that he ventured to pursue the experiments among his friends.

I remember one evening entering my mother's drawing room and finding the professor in the midst of a group of girls all lost in slumber, some just going under the heavenly influence, others coming round. The room reeked with the smell of chloroform. Presently I subsided into the corner of a sofa, and seeing a suspicious-looking handkerchief by my side took it up, found it soaking with something, smelt it, inhaled it, and soon went "glittering through a dream of things that were." I knew no more till I came round to a consciousness of the lights in the chandelier above, and of the professor flitting about in great glee calling everybody "dear."

These pleasant evenings were occasionally diversified by private theatricals, when on one occasion I took the part of Fatima to Professor Aytoun's Blue Beard, and Dr. Simpson, with Dr. Lyon Playfair (now Lord Playfair), brought the house down as "The Babes in the Wood," appearing dressed in white frocks with blue ribbons, and sucking oranges.

Such were the surroundings as I recollect them in the days when chloroform burst upon the public as one of the greatest boons to suffering humanity.

### Anæsthetics and Experiments on Animals.

It has recently been stated[6] that as regards the "instauration of anæsthesia" "there is no suspicion of any experiment on a lower animal in connection with it." This is not the case. Experiments on animals were made by Morton, by Snow, and by Simpson. Simpson's life was, in all probability, saved by an experiment on animals. Lord Playfair speaking in the debate on vivisection in the House of Commons in 1883, related how Simpson in his search for an ideal anæsthetic, came to his laboratory. A new liquid was put into his hand, and Simpson wanted to inhale it there and then. Playfair, however, insisted on first trying it on two rabbits, which speedily died. Simpson, like Morton, was a reckless experimenter on himself. Miss Simpson tells us that he was once found insensible in his room by his servant Clarke, who said, "He'll kill himsel' yet wi' thae expeeriments, and he's a big fule, for they'll never find onything better than chlory."

### The Work and the Workers.

To sum up the story of anæsthesia: Nitrous oxide, for surgical purposes, was discovered by Horace Wells; ether we owe to William Thomas Green Morton; chloroform to James Young Simpson. Among these, the largest share of glory may fairly be allowed to Morton, of whom we may say, with Dr. Jacob Bigelow, that, "as far as we know, he was the only man without whom inhalation might have remained unknown to the present day." To Simpson, however, unquestionably belongs the merit of having made anæsthesia triumph over all opposition. For this he deserved the rewards which fell to him in the evening of his days, and the motto which he chose when he was made a Baronet, *Victo Dolore*, is the expression of a truth, and not an empty boast.

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## THE FIRST OPERATION UNDER ETHER IN GREAT BRITAIN.

By WILLIAM SQUIRE, M.D., F.R.C.P.

Looking back fifty years to the induction of anæsthesia by inhalation of ether vapour during surgical operations, my own share in securing the early success and general adoption of this method seems to me greater now than it did at one time. With the first announcement from America no details of the mode of administration were received, and failure at the outset would have brought discredit on the discovery,

[6] Sir B. W. Richardson, *Biological Experimentation*, London, 1896, p. 47.

and might have delayed indefinitely the benefit it offered. Several circumstances combined in producing the successful result attained. I had come up to University College in October, 1846, after two or three years' pupilage with an old student of the College, bringing introductions to Quain and Liston, together with specimens of bony union in fractured neck of the femur now in the College of Surgeons. I had assisted Robert Ceely in his experimental transfer of variola into vaccinia, and had gained an interest in surgery from my teacher at Chesham, and from Aston Key at Hemel Hempstead.

Liston, a friend of my uncle the chemist, drew my attention to some cases in his wards, and especially to a delicate fair-haired man, worn out with suppurating knee-joint disease and loss of sleep from the "jerks" caused by eroded cartilage; the man from weakness and fear had more than once refused his consent to amputation. On Saturday, December 20th, I think, Liston came early to the hospital with news of Morton's discovery; he took me with some ether from the hospital to the house of Dr. Boot, and then to Mr. Robinson's opposite; but little ether had been used in the case of the lady who had first submitted to the dentist's hands, whether on that or the previous day I cannot say, but the second case of tooth extraction at the dentist's house was a failure, not from want of a supply of ether but from want of efficient means of giving sufficient to prevent or overcome the excitement it occasioned. To risk such failure at the hospital, or a repetition of the O'Key's mesmeric deceptions, then of recent notoriety, was out of the question, but ether vapour had been inhaled in the chemistry class at the college as well as nitrous oxide in the same manner from a bag, while Hutchinson's spirometer was then in daily use. A more efficient means of administration was evidently needed, and Liston drove me on to my uncle's laboratory to see what better means could be devised.

My confidence in success was unshaken; I had breathed ether in the College demonstrations, and had noticed that while under its influence my knuckles were bruised against the iron edge of the class room desks without any sense of pain at the time. With a larger supply of vapour than that supplied for inhalation at the College, less excitement and further insensibility might be produced. Among the glass vessels in Oxford Street was one sufficiently large, with an opening below where a good-sized tube could be fixed, and a larger one above where more ether could be introduced; this was at first closed with a sponge, a suitable tube was fitted into the lower opening, and for a mouthpiece a folded towel was bent into a funnel, the tube enclosed in the apex of the cone,[1] and when Liston returned in the afternoon all was in readiness. Enough ether to produce the volume of vapour required to fill the vase was put into it, and the upper opening filled with a new sponge on which the same quantity of ether was poured, and I commenced inhalation. At first I could not hold the cone close to my face, but soon took in deep breaths, and evidently soon became unconscious and dropped the tube. Liston made a small puncture under my fingernail, and was satisfied as to my insensibility to pain. It was arranged for us to meet at Mr. (now Sir Edwin) Sanders's the next morning, and, as my uncle had to be in his hands, he would try its effects.

I made further experiments upon myself on Saturday, and my uncle's chief assistant, Mr. John Taylor, now of 14, Baker Street, consented to a further experience. At this time a small glass vessel with two openings, one fitting into the larger vase and another at top was used to contain the sponge, and a larger supply of ether was used. When my subject began to tolerate the stronger vapour, I brought the smooth base of the cone over the nose and the lower end of it under the chin, and a very quiet and complete anæsthesia was produced, which lasted some minutes after the inhalation ceased. The meeting at Mr. Sanders's was deferred, and Liston, after further demonstration in Oxford Street, arranged for the removal of the diseased knee next day at the hospital, the patient being only too glad to submit himself to the prospect offered him. Notes were sent to several men of eminence in the profession, among others to Mr. Wakley, who was present; Mr. Cadge, now of Norwich, accompanied Liston; Dr. Ransom, now of Nottingham, was one of Liston's dressers at this time. On Monday I took the glass vase and a supply of ether prepared by my uncle to the hospital. I have seen it stated by an intimate friend that he was present at the operation, but neither he nor my friend were in the operating theatre, and neither of them had much liking for that arena. A similar mistake as to my uncle's administering ether for surgical operations has been made more than once.

The first operation in London under ether has been described elsewhere. A more striking display could hardly be imagined; the general effect upon the foremost professional men present was almost of awe, yet not unlike that expressed by the American surgeon Warren, after his first operation under ether, administered by Dr. W. T. G. Morton, "Gentlemen, this is no humbug." Liston said nothing. My own sensations were chiefly directed to the aspect of the patient; the look of alarm on his emaciated pale face soon gave way to the flush of ether; his quiet breathing and calm repose was a joy to witness. When unconsciousness was reached Liston completed the amputation at the thigh by the flap operation in twenty-eight seconds from the first thrust of the knife to the last touch of the saw. It had been arranged for the arteries to be tied after the patient had been carried from the operating table to an adjoining room, but his deep and quiet sleep continuing, the arteries were leisurely secured, and the flaps closed in Liston's usual manner, and neatly dressed, before the return of consciousness was announced by the patient's old cry of, "I can't have it done, I must die as I am." On being told that all was over, he said he still had pain extending to the toes, then when gently raised to see the shortened limb the look of delight in his face will never pass from my mind while memory holds its place. Liston could hardly speak at first, and finally said that he was as surprised as those around him.

Had I not myself felt that ether could annul pain and seen it inhaled in the chemistry class; had I not been so much noticed by Liston and interested in this particular patient; had I not had the resources of my uncle, Mr. Peter Squire, at hand, and been assisted by his experience and ready invention, the full effects of this anæsthetic would not have been obtained and made so evident in the course of one or two critical days. The next few days were fully occupied in administering ether vapour and inhaling it myself. Some failures were met with small tubes, where imperfect mouthpieces or insufficient vapour were used. One Friday evening, soon after Christmas, I went with Mr. Taylor to the Royal Institution with one somewhat cumbrous inhaler where he submitted to complete anæsthesia at my hands before the assembled members.

During a short Christmas holiday my respiration was so impeded by frequent inhalations of ether that I could not face the outside coach journey of forty miles to my home in Bedfordshire. I returned to my interrupted medical studies henceforth in close company with Russell Reynolds. I once gave ether for Dr. Murphy in some obstetric difficulty; sometimes I gave ether at the hospital until Thomas Park and Clover took it up, and there met Dr. Snow. Chloric ether, used by Morton before sulphuric ether, was tried, I believe, at St. Bartholomew's Hospital, the form used, like the American preparation, containing more chloroform than that in our *Pharmacopœia*. Chloroform had been prepared by Soubeiran ten or twelve years earlier. Liston was informed by Mr. Syme of Simpson's use of chloroform, and again asked me to administer it. Subsequently my chief reliance was on this anæsthetic. For the mixtures of chloroform with ether and spirit, whether under the designation of methylene, A.E.C., or other names at a labour period, Junker's method of administration seemed specially suitable.

[1] The sponge soon found its way into the cone, or the ether was sprinkled there without the intervention of jar and tube

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## FIFTY YEARS OF ANÆSTHETICS.

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Retrospects, if honestly made, certainly can be very valuable. Perhaps it is natural that those who live in the days when anæsthetics are so commonly administered as to have become almost a routine of surgical procedure should care little about the times of storm and stress which ushered in

the great agents, ether and chloroform. The facile jingle of men's names by a daily press, not often well informed upon scientific questions, gives a sense of general information to the man in the street. He knows of Horace Wells, the shrewd dentist, who grasped the fringe of a vast discovery only to let it finally elude him; he is familiar, after his manner, with the rival claims of Morton, the dentist, and Jackson, the chemist, and has adopted the claims of Simpson as the father of chloroform anæsthesia. Yet all this amounts to very little. The fifty years which have elapsed since that eventful day in the Massachusetts General Hospital at Boston when ether was shown before all the world as a possible anæsthetic have revolutionised surgery, have altered completely men's minds as regards surgical operations.

In pre-anæsthetic days recourse to the knife was an alternative to death or a living misery even more terrible to contemplate. Now the enlightened journalist tells us picturesquely that to take chloroform is as little serious as sipping whisky and water. And in the chloroform sleep ills cosmetic or ills too hideous for endurance may be mended without fear, hurry, or strain to patient or surgeon. This has not been done without strenuous work and constant experiment. The anæsthetics of 1846 are not the agents used in 1896; at least we no longer regard them in the same way nor use them in the same manner. Ten lustres have taught us lessons, some unpalatable, and it is with these that the present paper has to deal.

### SURGERY IN THE PRE-ANÆSTHETIC ERA.

The most potent foe with whom the surgeon had to deal was shock. It was recognised that over and above the perils resulting from hæmorrhage and manipulation there was the terrible horror and dread of the knife, which prostrated the patient and rendered him a ready prey to surgical collapse. The strong man might keep his body still while his arm or leg was cut off, but his mind made havoc with his vitality, and determined his death, perhaps the more so because of the severe strain he imposed upon himself to check movement or exclamation of anguish. It was to obviate this that men's minds turned in hope towards the alembic which was to give them a narcotic of which it could be said:

> But there is
> No danger in what show of death it makes
> More than the locking up the spirits a time,
> To be more fresh, reviving.

Obviously the substances in use by the ancients failed in many points. A sleep produced by cannabis indica, opium, the solanaceæ, was too uncertain alike in its depth of stupor and in duration, and, further, was too unmanageable for the purposes of surgery. Medicine had begun to employ various volatile bodies, such as the gases—nitrous oxide, oxygen, carbonic acid—with ether, chloric ether, in the treatment of pulmonary, bronchial, and some nervous diseases. The surgeons advocated mechanical means of deadening sensation, such as compression of blood vessels and benumbing nerve trunks by pressure. Mesmer's thesis, *The Influence of the Planets in the Cure of Diseases* (1766), had commenced the *furore* which gradually led thoroughly honest and thoughtful men into the doubtful regions of clairvoyance and "animal magnetism."

It is very difficult to realise what surgery was before anæsthetics were in general use. And yet there can be little doubt that the enormous developments made within the last fifty years in all departments of the surgeon's art only became possible when ether and chloroform became available. The requirements of the surgeon were less then than now; for, while the range of surgery was much narrower, the average duration of an operation was one of minutes and not of hours. Indeed, we are told that ether could safely be employed for very brief operations—that is, lasting from five to ten minutes—while doubt was felt as to whether it would be safe to use it in more protracted cases. We shall shortly see, when comparing the methods of etherising of fifty years ago with our modern ones, that those formerly in vogue were adapted rather for brief than for prolonged cases.

### THE EARLY DAYS OF ANÆSTHESIA.

When the success which attended Morton's public demonstration of ether on October 16th, 1846, in the Massachusetts General Hospital was reported by letter to Dr. Boot, and by him communicated to Mr. Robinson, of Gower Street, anæsthesia by ether vapour became an accomplished fact in England. Trial, more or less succesful, was made at the various London hospitals, Liston leading off at University College Hospital on December 21st. The medical papers, notably the *London Medical Gazette*, luckily published full reports of these experiments, so that we are able to contrast them with what we see in 1896. In the first instance various inhalers were employed: Robinson's, Tracy's, Startin's, Charrière's, Duroy's, and, best of all, Snow's. The principle involved in these more or less complicated apparatuses was the admission of ether vapour warmed by water, and the complete disposal of exhaled breath. The method was certainly in most cases to give ether vapour until stertor appeared, and then to remove the mouthpiece and allow the surgeon to commence his work. Subsequently the patient received alternate inspirations of ether or air, or the inhaler was kept on for a few minutes. Five minutes appears to have been an average time of induction. As to dangers and difficulties, some of these were real, some were certainly farcical. Of the latter category, we may cite the grave assertion that "pain" was a necessity to rapid recovery, and that to abrogate that by ether was to prevent healing by first intention, and even to jeopardise the patient's life. In several instances of death following ether inhalation after some hours or days, there is evidence which shows that the fatality was the result of surgical shock.

The complete ignorance of the substances brought into use naturally led even acute observers astray, alike in method and reasoning. In French journals bitter diatribes appeared accusing such men as Liston of cheap fraud, and hinting pretty broadly that chicanery and quackery shook hands over the hypothetical anæsthesia of the hypnotised subject and the patient made drunk by ether. Braid in an able paper sought to show that while ether might avail to remove consciousness of pain during surgical operations, hypnotism could in nowise stand aside for the new invention, but would still take its place in the treatment of disease, and indeed, as Esdaile had shown, prove of value as an anæsthetic. However, ether, except in the hands of a few experts who from the first had studied it and grown familiar with its management, grew less of a nine days' wonder, and complaints of its inadequacy and even of its perils began to be heard. Judging from what the malcontents themselves wrote, it would appear that the real cause of their trouble was their insufficient knowledge of the action of the anæsthetic they were using. The various inhalers fell into desuetude, and a large sponge rolled in a towel or covered in in some equally simple manner became the recognised method of exhibiting the drug.

In Edinburgh Simpson, keenly interested in the reports of Morton's discovery, soon employed ether in his obstetric work, and expressed himself well pleased with its powers. Snow having experimented with ether upon himself and upon the lower animals, began to recognise that the only possible way to achieve success was to learn first the physiological behaviour of ether when brought into the organism, and then to apply that knowledge systematically when narcotising his patients. Longet and Flourens had already worked at the matter from the point of view of physiology, and the latter agreeing with Majendie strongly deprecated the use of ether as an anæsthetic for human beings.

Snow[5] made the important advance of recognising that it is not enough to give your patient ether—enough to stupefy him—but it is necessary to be able to appreciate the degree of etherisation required for any given person and at any given time of the operation, and to be able to regulate the strength of the vapour you employ. The neglect of these two canons appears to have been the cause of many of the failures which attended the use of ether in 1846. Surgeons then, as now, who were not familiar with competent etherisation, assumed that asphyxial symptoms, furious struggling, pulmonary complications are necessary sequelæ to the exhibition of ether. Snow insisted, further, that the respiration of the patient was the essential matter in ether inhalation. Whatever mechanical cause arose interfering with that would, by bringing about asphyxial complications, introduce an element of danger which formed no part of the *rôle* of the ether.

[5] *On the Inhalation of the Vapour of Ether*, 1847.

### Snow's Views.

Still accepting Snow's work as most meritorious and careful, it must be said that he never obtained a complete mastery of the administration of ether. The trend of fate was too strong for him. The year 1846 to 1847 brought him some experience but not enough, and then came the swing of the pendulum with Simpson's powerful advocacy of chloroform as a substitute for ether. Snow, however, had his views on this matter, although it did not prevent him floating with the tide and taking chloroform into his armamentarium and ceding to it the premier position. In his papers On the Inhalation of Chloroform and Ether read before the Westminster Medical Society in January, 1848, he institutes a comparison between the two anæsthetics: "They act, it is true, with great rapidity, yet to become imbibed by the blood, to pass through the heart and reach the nervous centres must occupy a little time, and I have often observed the insensibility to increase for twenty seconds after the inhalation has been left off. I have experienced this cumulative property myself to extend to twenty seconds by taking a few inspirations of vapour, leaving off and looking at a watch; consequently, I like to have about six times this period, or two minutes, for inducing complete insensibility; but when administered by the way Dr. Simpson recommends, chloroform often produces its full effects in much less time than this. He himself observes that he has seen a strong person rendered insensible by six or seven inspirations of thirty drops. Danger, it is true, may possibly be avoided by putting a limited quantity on the sponge or handkerchief, but then the full effect might be reached, especially as it cannot be determined how much the patient inhales of what is put on, and the dose will have to be repeated, so that this plan is not very applicable to surgery: and Dr. Simpson himself recommends that 'one or two teaspoonfuls of the chloroform should be at once placed upon the hollow of a handkerchief, and immediately placed upon the face of the patient.' He adds that 'generally a snoring sleep speedily supervenes.'" This "snoring sleep" is, as Snow pointed out, the fourth stage of anæsthesia, and in it the medullary centres are being narcotised. It is a question of fine limitation between this and total abeyance of respiration. This "cumulative" effect was then a danger of chloroform but not of ether, since the latter more rapidly leaves the lungs than the former.

Snow regarded ether as acting in the same way as chloroform in so far as the phenomena of anæsthesia went, and divided its action into five stages. The first stage includes the various changes in feeling that a person experiences as he inhales and still retains control of his movements. In the second, the mental faculties still are active, and movements are controlled by the nervous system, but the whole are disorganised. The third is where mental functions are in abeyance, and the movements of muscles, rigidity, and contractions are involuntary. In the fourth all movements save those of circulation and respiration are absent; while in his fifth stage these vital functions gradually grow feeble and irregular, and eventually cease. This stage is "not witnessed in the human being." He taught that a middle-aged robust subject passed through each stage in about one minute. Having reached the fourth stage in four minutes the inhalation was stopped, and renewed from time to time if a prolonged anæsthesia is required. Snow's inhaler consisted practically of a volute or spiral along which the ether flowed, being evaporated by a water chamber. Expiration and inspiration valves prevented rebreathing expired air and pollution of the ether chamber. An opening permits of the entry of air drawn in to replace the air drawn out of the chamber by the patient's inspiration. With it the patient inhaled an atmosphere of 45 or 55 per cent. air, and consumed two drachms of ether a minute. Referring to the fifth stage, Snow remarks that no doubt the human subject would enter it if the ether inhalation were so conducted that hyperetherisation took place.

He further, in his experiments upon the lower animals, had found, "however nearly dead animals may be from ether, if the breathing has not actually stopped when the vapour is discontinued, they always recover." And this "illustrates forcibly the great safety of the inhalation of ether, and how much it differs in this respect from asphyxia." It may be interesting to pursue Snow's views a little further: "Sudden death from paralysis of the heart never occurs." He failed to kill the lower animals with ether, for whenever the respiration failed the heart still beat, and as soon as the ether was removed natural breathing slowly resumed. "I hold it, therefore," he says, "impossible that a death from this agent can occur in the hands of a medical man who is applying it with ordinary intelligence and attention." Some six cases of reported deaths were published within six years, and Snow advances strong arguments to show that in these the death was *post* rather than *propter hoc*. Snow taught that ether was more especially suitable for children of tender years and for cases of operations about the mouth and pharynx, thus differing from many later authorities.

It is curious that no record has reached us of those after-complications of ether which at the present time are advanced as proof that ether is inferior to chloroform. Thus, Snow makes no mention of pulmonary, bronchial, or nephritic sequelæ to ether administration. The alleged perils are apoplexy, uncontrollable excitement, hysteria, erotic hallucinations, and the instances of these were so reported as to show clearly that the patients had never been completely under the influence of the anæsthetic. Indeed, it may be accepted that, with the exception of a few experts, the ether in the first year of its trial was given badly and was little understood.

### A New Era in Anæsthetics.

With the memorable paper of Sir James Y. Simpson—then Dr. Simpson—read on November 10th, 1847, a new era in anæsthetics appeared. He urged chloroform, "the new anæsthetic," was in every way superior to ether in midwifery and general surgery for the following reasons: A less quantity was required, its action was more rapid and complete and more persistent, it was more pleasurable to take, was less expensive, and involved the use of no apparatus, the patient and operator were free from the clinging disagreeable odour of ether. The method Simpson advocated was simplicity itself. A drachm or two of the fluid was thrown on the interior of a pocket handkerchief arranged in a cone or cup-like form in the hand of the exhibitor, and applied over the nose and mouth of the patient, the fluid being from time to time renewed. The patient was placed on his back and told to take full inspiration. All noise and excitement round the patient was strictly forbidden, the anæsthetic was pushed until breathing became loud and snoring. It was then withdrawn, and renewed from time to time as the patient showed signs of passing into a lighter degree of narcotism. For midwifery the method was slightly altered, and a less degree of narcotism was aimed at.

Miller, the surgeon, following Simpson's lead, gave a somewhat more detailed account of the method in his surgical experience of chloroform, published in 1848. He said "many machines have been invented. I believe they are all useless, and not a few decidedly mischievous. With an inhaler it is very easy to choke the patient; without one it is not easy to avoid, if one were willing, the admission of a very considerable amount of atmospheric air along with the chloroform vapour—an amount quite sufficient to avert asphyxia." In several places he emphasises what he regards as an explanation of the absence of any fatalities having occurred in Edinburgh from the use of chloroform, believing it due to the purity of the chloroform employed, and the absence of "machines" for administering it. A handkerchief, lint, or glove was used, saturated with pure chloroform, held at a distance of a few inches from the face and gradually approximated, no attempt being made to measure the quantity employed. "We begin with generally two or three drachms applied on a handkerchief or lint; we refresh them or not from time to time as circumstances require."

Simpson in more than one place asserts the great *desiderata* in producing safe chloroform narcosis were the purity of the drug employed, and using a large quantity of it at first so as to bring about a rapid anæsthesia, a result arrived at in one or two or three minutes. Stertor to him was a sign not of danger but of successful anæsthesia. Simpson taught that chloroform was prone to cause syncope, but he does not appear to have regarded this as a dangerous complication. The supervention of asphyxial phenomena was in his eyes the sign of a careless, inexpert, or faulty method of admini

stration, to be dealt with by removal of the chloroform and the admission of atmospheric air. This Miller regarded as the best antidote against chloroform. Simpson again shrewdly points out that a very considerable number of deaths occurred in Edinburgh and of course elsewhere from syncope or other undetermined causes, whilst the operation was in contemplation or in actual performance, but when no anæsthetic was used. This he says will doubtless explain some of the casualties referred to the anæsthetic. A careful collation of Simpson's numerous papers shows conclusively that he recognised in chloroform there was a considerable liability to failure of the circulation, and he admitted that a death occurring in his practice was due to this cause.

The teaching of Snow upon chloroform was very different from that of Simpson. In the first place, as the quotations given above show, he always insisted that chloroform was a less safe anæsthetic than ether. He undertook some careful experiments upon the lower animals, following in the steps of the physiologist Flourens, but arrived at different conclusions. He divided the induction of anæsthesia into five stages, to which reference was made in giving his views upon ether, and taught that circulatory failure was one of the dangers to be dreaded. Snow made careful calculations of the quantity of chloroform which entered the blood during the stages of anæsthesia; he expressed this quantity as so many drops, and it is probable that some who read this statement have been misled into a belief that Snow relied upon a dosimetric or drop system in using chloroform. This he did not, as the sequel will show. Indeed Snow was one of those who pointed out very clearly that there was considerable danger in incomplete narcotism. He objects to Simpson's handkerchief method because by it "the proportions of vapour and of air which the patient breathes cannot be properly regulated. Indeed the advocates for this plan proceed on the supposition that there is no occasion to regulate these proportions, and that it is only requisite that the patient should have sufficient air for purposes of respiration and sufficient chloroform to induce sensibility and all will be right. The truth is, however, if there be too much vapour of chloroform in the air which the patient breathes it may cause sudden death, even without previous insensibility, and while the blood in the lungs is of a florid colour." "The process, however, of inhaling chloroform from a handkerchief is always uncertain and irregular, and is apt to confirm the belief in peculiarities of constitution, idiosyncrasies, and predispositions, which have no existence in the patient."

The desideratum he taught was to present "to the patient such a mixture of vapour and air as will produce its effects gradually, and enable the medical man to stop at the right moment." "Insensibility," he adds, "is not caused so much by giving a dose as by performing a process." As is well known, he sought to arrive at this result by his ingeniously contrived inhaler, which it is unnecessary to describe in detail. Insensibility was judged of by the loss of conjunctival reflex and not by the supervention of stertor. Referring to the pulse, Snow says, that while of itself it "gives no indication as to how far the patient is under the influence of chloroform, it is proper to pay attention to it, not only during the first administration of the chloroform, but also throughout the operation." Snow's teaching regarding the action of the eyes under chloroform is that which is accepted at the present day.

### DEATH UNDER CHLOROFORM.

Dealing with the cause and prevention of death from chloroform, he accepts Simpson's view that fatal cases of inhalation of chloroform are caused by its paralysing the heart; he had observed this paralysing action in the lower animals, and taught that the same phenomenon took place in man. "I was able to ascertain," he says, "and point out the strength of vapour which will produce this effect, and how one may avoid the risk of it by having the vapour sufficiently diluted. The greater number of experimenters who have killed animals with chloroform found that the action of the heart continued after the breathing ceased, but they do not either control or ascertain the proportion which the vapour of chloroform holds to the inspired air."

A commission which reported to the Society of Emulation of Paris in 1855 came to the conclusion that in all instances in which animals are killed by chloroform the action of the heart survives the respiration, "but," says Snow, "they might have administered chloroform to an equal number of human beings without any one of them being cut off by sudden paralysis of the heart. If animals were usually to die of paralysis of the heart when the chloroform is given in a manner similar to what may be called its ordinary administration to patients, we should be at a loss to know how that agent could be used at all."

Snow, in speaking of chloroform and heart disease, points out that shock is more dangerous than chloroform, and that chloroform does not appear to affect a person with an ordinary form of heart disease, although he cautions against its employment where the action is feeble and the organ presumably fatty; and, to put it briefly, it appears that a heart, whether healthy or diseased, would be paralysed provided the strength of vapour admitted to the patient was of the adequate potency, and would in either case run about the same risk. The potency he estimates at about 8 or 10 per cent.; the average range of safe dilution he puts at below 5 per cent. Besides the danger to the heart Snow recognised a paralysis of respiration due to the effect of the chloroform on the brain and medulla oblongata. He grouped syncope under two heads, the simple syncope such as occurs from anæmia with cardiac syncope following narcotism or an inherent weakness of its structure, or of its being overpowered by the quantity of blood with which it is distended.

Syme's teaching is commonly referred to; but he followed the method of Simpson and taught what Simpson had from the beginning inculcated. However, Syme made a great point that the pulse was no guide as to the effect of the chloroform. To put the matter in his own words, first, he says, he gives "a free admixture of air with the vapour of chloroform, to ensure which a soft porous material, such as a folded towel or handkerchief, is employed, presenting a pretty large surface.....Secondly, if this is attained, the more rapidly the chloroform is given the better the effect produced, and hence we do not stint the quantity of chloroform. Then—and this is the most important point—we are guided as to the effect, not by the circulation but entirely by the respiration; you never see anyone here with the finger on the pulse while chloroform is given."

A considerable misapprehension would seem to have arisen in the minds of some upon this matter. Neither Snow nor those who hold that chloroform acts upon the heart ever taught to rely upon the pulse as a guide to the effect the chloroform produced—if by "the effect" is meant the stage or degree of narcotism arrived at. The respiration and the state of the pupil have always been accepted as the criteria upon this point.

The effect of Simpson's teaching and Snow's example resulted in a rapid popularising of the new anæsthetic. Ether was but seldom employed, its effect but little studied, and the results arrived at in its uses were unsatisfactory.

### THE COMMISSION OF THE ROYAL MEDICAL AND CHIRURGICAL SOCIETY.

The number of deaths, however, having increased with startling rapidity from the time of the death of Hannah Greener, at Winlaton, on January 28th, 1848, a commission was appointed by the Royal Medical and Chirurgical Society, who submitted their report in June, 1864, "on the uses and the physiological, therapeutical, and toxical effects of chloroform, as well as the best mode of administering it and of obviating any ill-consequences resulting from its administration." It should be mentioned, however, that previous to this Clover had become a prominent figure in the world of anæsthetics, Dr. Snow having died in 1858. Clover's chloroform apparatus had been devised with the view of regulating the percentage of vapour employed, and the results arrived at by the Commission were largely obtained by its use. Their conclusions briefly were in complete anæsthesia the heart in all cases acts with less than its natural force, the strongest doses when freely admitted into the lungs destroy animal life by arresting the action of the heart, moderate doses at first weaken the heart, then respiration fails either before or coincidently with cessation of the heart's action, the danger attending the use of chloroform increases with the degree of stupor it induces. "Apparent irregularities in the action of chloroform mainly depend

on the varying strength of the vapour employed, on the quality of the chloroform, and on the constitution of the patient." They also reported on the action of ether, making the following important statement: "The slow and uncertain action of ether renders this agent an inconvenient anæsthetic, and though it is capable of producing the requisite insensibility and with less danger in its operation than chloroform, the Committee concur in the general opinion which in this country has led to the disuse of ether." Then, as is well known, this Commission drew up certain valuable rules relating to the administration of chloroform, rules which we may venture to say might be more studied and more frequently carried into effect with advantage to the community.

The strong impression is left upon the mind that the Committee were rather afraid of chloroform, and, not knowing how to use ether with advantage, adopted the suggestion made before the Royal Society by Dr. Harley that these substances be employed as a mixture together with alcohol.

The indisputable safety of ether still found favour with some persons, notably with Mr. Clover, who, writing to the *Lancet* in 1875, suggested the employment of nitrous oxide in conjunction with ether. The simplicity and efficacy of Mr. Clover's inhalers soon gave them a vogue, and it became recognised that whatever might be the failings of ether it could be given rapidly, safely, and without discomfort to patients. The inhalers of Snow and those who argue on his lines went upon the principle of compelling the patient to draw air over the ether vapour, with Clover's inhaler the patient impregnates his own breath with the ether vapour. The strong revival of the advocacy of ether and the general feeling of uncertainty as to which anæsthetic was in reality the best and safest, led to the appointment of a Committee of the British Medical Association, which issued its preliminary report in 1879. They dealt with a large number of bodies, but for our purpose it will be enough to state that in the main their conclusions were that ether was a comparatively safe body and chloroform left something to be desired in the matter of safety; this Committee recognised circulatory failure as one of the modes of death when chloroform is given. They said, "Chloroform and ethidene dichloride administered to animals had a decided effect in reducing the blood pressure, while ether has no appreciable effect of this kind. Chloroform has sometimes an unexpected and apparently capricious effect on the heart's action, the pressure being reduced with great rapidity almost to *nil*, while the pulsations are gradually retarded or even stopped. The occurrence of these sudden and unlooked for effects on the heart's action seems to be a source of serious danger, all the more that in two instances they occurred more than a minute after choloroform had ceased to be administered and after recovery of the blood pressure. Chloroform may cause death in dogs by primarily paralysing either the heart or respiration. In most cases respiration stops before the heart's action." Ethidine was highly eulogised in the report, and its value insisted upon by Mr. Clover. Unfortunately as in the case of Snow's advocacy of amylene (pental), so in the case of ethidene experience has not confirmed the original estimate of the value of these anæsthetics. Undoubtedly a strong reaction in favour of ether has since this time taken place. It has been shown that in the hands of those who have been drilled in its use it can produce at least as good an anæsthesia as chloroform, and mortalities under its use have been far below those of chloroform. That ether is less commonly employed than chloroform is probably true, that it requires an apparatus is in the eyes of many people an advantage since it presupposes the persons employing it know the alphabet of their duties, an assumption which in the case of chloroform when used with a towel may not be true. The views, however, of Simpson are still kept alive in his school, and it was to prove the truth of his teaching that the subject was reinvestigated in Hyderabad under the able conduct of Dr. Edward Lawrie. The first report was issued in 1880, and was followed by a more elaborate one in the following year. The labours of these Commissions have been too recently in the hands of the public to require more than passing notice; they reiterate the safety of chloroform, while they deny under any circumstances that heart failure follows its use, a contention which Sir James Simpson had not advanced. There can be no doubt that if the experience of the numerous and careful experiments made by these Commissions be accepted, heart failure under the conditions of the experiments will not occur. However, it has been advanced by many whose experience is very large that the experiments of the Hyderabad Commissions are in conflict alike with the physiological work of many physiologists of note, and do not bear out the clinical evidence of the last fifty years.

### Recent Researches.

It would be beside the scope of the present paper to attempt either a criticism or a collation of the various physiological studies which have been crowded into the last few years. Upon the clinical side of the question we may, however, offer some comments. The number of deaths which have occurred under chloroform must certainly be arranged under two headings: preventable and inevitable. The teaching of the Hyderabad Commissions does not admit this. According to them all deaths are preventable if certain simple rules be followed. Undoubtedly many deaths reported in the press are due to want of care or experience on the part of the administrators. It is probably not too much to say that the grave responsibility which attaches to the office of chloroformists is not adequately appreciated either by the profession or the public. Be this as it may, the facts remain that chloroform as at present administered has shown itself to be a dangerous anæsthetic, and even in the hands of the most experienced it has given rise alike to fatalities and cases causing the gravest alarm. Ether, on the other hand, in spite of the use of apparatus and the number of extremely unfavourable cases in which it is used, has come out, from a statistical point of view, as a safer anæsthetic than chloroform. This much is advanced by those who prefer ether to chloroform; but, upon the other hand, it must not be lost sight of that many of the cited instances of after-effects dangerous or even fatal to life which have been due, it is alleged, to the persistent action of ether, whether cases of pneumonia or nephritis and so on, are the result of ether or may not be sequelæ of the conditions under which the operations were performed it is difficult to determine. The reports of the various hospitals seem to show that those whose experience is widest, and who are giving anæsthetics constantly, and whose cases are often the gravest, as a rule prefer the employment of ether when they deem their patients are capable of taking it. The present tendency is to follow the advice of Mr. Syme and anæsthetise by principle rather than by rule, to give chloroform when it is thought chloroform is best alike for patients and surgeon, to give ether when there is no contra-indication, or to substitute some other anæsthetic.

What, then, has been the teaching of these fifty years? It would appear to be this: that the use of anæsthetics must increase rather than diminish; that the employment of chloroform, to be safe, must not be carried on upon any haphazard principles; that to push it to the extent to which Simpson advocated is perilous; stertor should be regarded as a sign of danger rather than evidence of profound anæsthesia; that the opposite extreme is at least as dangerous, imperfect anæsthesia leading to death through shock; that the employment of an inhaler for chloroform is probably safer than to rely upon the open method, provided no slavish trust is placed upon the mechanism. The clinical experience of fifty years appears to us to prove that chloroform does in some cases kill through failure of circulation, notably in those instances in which a powerful vapour is allowed suddenly to enter the lungs; that no age and neither sex are immune from its dangers; that after all the question of method is of less importance than of the man who makes use of the method; a careful administrator may follow a faulty method with the greatest success, having once recognised the principles that chloroform kills when given in too concentrated a form, while another, whose method may be good of its kind, may jeopardise his patients through failure to appreciate the principles involved in carrying out the details in method; that the physical condition of the patient tells against him only so far as it affects his vitality: to label him with any disease may mean nothing provided his resistive power is sufficient; and this brings out what is emphatically one of the most important lessons of these years of the ingathering of experience that every case has to be studied upon its own merits, and there is no royal

road along which the anæsthetist may travel untrammelled by anxiety, unhampered by danger or difficulty, being sure that the goal of safety awaits his arrival. It is unfortunate that in reference to anæsthetics one is compelled to dwell upon the dangers and difficulties involved in their use. It is needful to remember how few these dangers and difficulties are when compared with the enormous number of instances of safe anæsthesia accomplished day by day and year by year. Perhaps when more men are taught, and when those in high places appreciate more the necessity for this education in anæsthetics, the present loss of life, small as it is, will be even less. One's daily work, making the pain-saving effect of anæsthetics a matter of routine, cannot lessen the admiration one feels for these pioneers who, in spite of the fulminations of well-meaning but short-sighted people, and the opposition of the leaders in their profession, achieved the task of making anæsthesia an accomplished fact, and so opened up the way to surgical triumphs then undreamed-of even by the most sanguine.

## THE GLUCOSIDE CONSTITUTION OF PROTEID MATTER.

DR. PAVY'S paper on the Glucoside Constitution of Proteid Matter, read in the Physiological Section of the British Association—a brief note of which was published in our report of the proceedings—deals with a question of such fundamental importance to physiology that a fuller account of it will be read with interest. Glucosides are bodies which, when acted upon by ferments, by acids or alkalies, and even by water at an elevated temperature, undergo cleavage or disruption, a carbohydrate being one of the products. Such bodies have long been known to chemists in the vegetable kingdom. Salicin is an example of a very simple glucoside. It contains only the three elements—carbon, hydrogen, and oxygen. A more complex glucoside is amygdalin, which contains the four elements carbon, hydrogen, oxygen, and nitrogen. Myronic acid, contained in black mustard seed, affords an example of a glucoside in which complexity has gone a step further, for it contains sulphur in addition to the four elements just mentioned. Of a much greater degree of complexity are certain bodies which form the basis of living matter. Thus mucin, which is found not only in mucus, but is a constituent of connective tissue, was shown not long ago by Landwehr to be in constitution a glucoside. Dr. Pavy,[1] in 1894, advanced evidence to prove that proteid matter generally, whether derived from the animal or the vegetable kingdom, was in constitution a glucoside. Dr. Pavy states that he was led to this conclusion by the results of his quantitative examinations of the various components of the body for glycogen. In making the estimation of glycogen the process followed for many years was to dissolve the substance by boiling with a solution of potash, to pour the resulting solution into alcohol, to collect the precipitate thus produced, to convert it into glucose with sulphuric acid, and to estimate the amount of glucose thus obtained by titrating with the copper test. The product obtained by boiling with potash and precipitating with alcohol was at first looked upon by Dr. Pavy as glycogen, but this view became untenable when it was ascertained by further experiments that the quantity yielded varied when the length of time during which the potash was caused to act, or the strength of the potash solution was varied.

Had glycogen been the sole source of the product, treatment with potash should, Dr. Pavy argued, have produced no effect beyond dissolving the nitrogenous matter with which it was associated. The actual quantity of glucose-yielding substance should not have been increased by varying the strength of the alkali or the length of time for which it was permitted to act. The conclusion was inevitable that there must be something beyond glycogen, and Dr. Pavy was then led to the opinion that the only feasible conclusion was that an amylose carbohydrate, which was not glycogen, was liberated by a cleavage of the proteid molecule produced by the action of the alkali. Purified egg albumen was chosen as a convenient proteid for further experiment. Dr. Pavy then went on to state that by the action on it of potash, an amylose carbohydrate corresponding to Landwehr's "animal gum" obtained, and can be converted by sulphuric acid into a bod giving the various characteristic reactions of sugar. It wa found further that sugar is yielded by the direct action c sulphuric acid on egg-albumen, and that the same occurs as result of pepsin digestion.

Dr. Pavy observed that he had published details on thes points in 1894,[2] and that subsequently[3] analytical evidenc was supplied by Mr. Ling, which afforded decisive proof tha the osazone derived from the cleavage product was a sug osazone. Dr. Pavy stated that since the publication of thes results he had found that Schutzenberger, upwards of twent years ago, had published analytical experiments which cor firmed his own results. This distinguished chemist, i recounting[4] his study of the products of the breaking up c egg albumen by strong chemical agents, mentioned tha sulphuric acid caused the appearance of a non-nitrogenou body, which reduced Fehling's solution energetically, wa precipitated by ammoniated acetate of lead solution, and, t quote his actual words, *parait être de la glucose ou un corp analogue*. Schutzenberger found also that by exposing eg albumen to baryta water at 100° C. for 120 hours he obtaine a non-nitrogenous body, insoluble in alcohol, precipitable b ammoniated acetate of lead, not reducing Fehling's solution but transformable by boiling with sulphuric acid into a bod which did. Its elementary composition was found to agre very closely with that of dextrin, with which, Schutzenberge remarks, it presents the greatest analogy. Baryta accom plishes in 120 hours what is accomplished by potash in hal an hour. Schutzenberger remarked that there is evidently connection between the body obtained in these experiment with baryta and the cupric oxide reducing substance obtaine in the experiments with sulphuric acid. Dr. Pavy pointe out that though his own experiments were started from point differing totally from the purely chemical investigation of Schutzenberger the results were strictly conformable.

Schutzenberger's results, however, had hitherto receive little attention beyond an incidental mention in books of th bare facts he had observed. That proteid matter, Dr. Pav continued, should be a glucoside in constitution, was, how ever, a point of the deepest physiological interest, and on which harmonised with facts which could be adduced as to it formation. Thus, Pasteur's experiments on the growth o yeast afforded irrefutable evidence that carbohydrate matte is used up in the construction of proteid. He showed tha yeast cells multiplied freely in a medium consisting of sugar ammonium tartrate, the ash of yeast, and water. The multi plication of the yeast cells implied a growth of cell proto plasm, and a corresponding formation of proteid matte Moreover, in the solution, the ammonium tartrate may b replaced by ammonium nitrate, and then absolutely the onl source for the carbon of the proteid is the sugar. Carbohydrat matter thus shown to be incorporated in the proteid durin its construction could, as Dr. Pavy has shown, be cleaved o from it again by chemical and ferment action.

We are thus, Dr. Pavy added in conclusion, brought t this position: the carbohydrate of food is in part applied t the construction of proteid matter, and is in this locked-u condition conveyed to the tissues to supply the needs of thei growth and renovation. From the proteid of the tissues i may be cleaved off by ferment action, and this is probabl the source of the free carbohydrate found to be present to certain extent in the various components of the body. Thei could be no doubt that in the grave form of diabetes the sug eliminated is derived not only from the food but also from th tissues. The glucoside constitution of proteid matter fitte in with this, and afforded a ready explanation of the observe facts, all that it was necessary to assume being the existenc in diabetes of the requisite ferment agency.

[1] *Physiology of the Carbohydrates*, p. 27 *et seq.*

[2] *Loc. cit.*

[3] *Epicriticism*, 1895.

[4] *Bull. de la Soc. Chim. de Paris*, vol. xxiii. 1875, p. 161.

EDINBURGH ROYAL INFIRMARY.—Dr. Francis D. Boyd h been appointed Clinical Tutor to the extramural medic wards in the Edinburgh Royal Infirmary for the ensuir winter and summer sessions. Dr. Alexander Miles has bee appointed to the extramural surgical wards. John W Dowden, M.B., C.M., has been appointed to the Universit surgical wards.