Anaesthetics Antient & Modern

AN HISTORICAL SKETCH OF ANAESTHESIA

SECTIONAL INDEX

Burroughs Wellcome & Co., London (Eng.)
New York Montreal Sydney Cape Town

"What's best is best;
'Twere ill to waste one's energies on less."

AN OPERATION ON THE EYE

From an MS. of the XIII century

A Surgeon Performing an Operation

From a woodcut of the XVII century

ANÆSTHETICS
ANTIENT AND MODERN

AN
HISTORICAL SKETCH
OF
ANÆSTHESIA

BURROUGHS WELLCOME & CO.
LONDON (ENG.)
Branches: NEW YORK MONTREAL SYDNEY CAPE TOWN

INDEX

Comment adam et eue furent crees au ij·et au·iiij·c·de genesis

From a woodcut of the XV century

"And the Lord God caused a deep sleep to fall upon Adam, and he slept: and He took one of his ribs, and closed up the flesh instead thereof."

Genesis, chap. ii, verse 21

ANÆSTHETICS, ANTIENT AND MODERN

An Historical Sketch of Anæsthesia

"So God empal'd our Grandsire's (Adam's) lively look,
Through all his bones a deadly chilness strook,
Siel'd up his sparkling eyes with Iron bands,
Led down his feet (almost) to Lethe's sands;
In briefe so numm'd his Soule's and Bodie's sense,
That (without pain) opening his side from thence
He took a rib, which rarely He refin'd,
And thereof made the mother of Mankind."

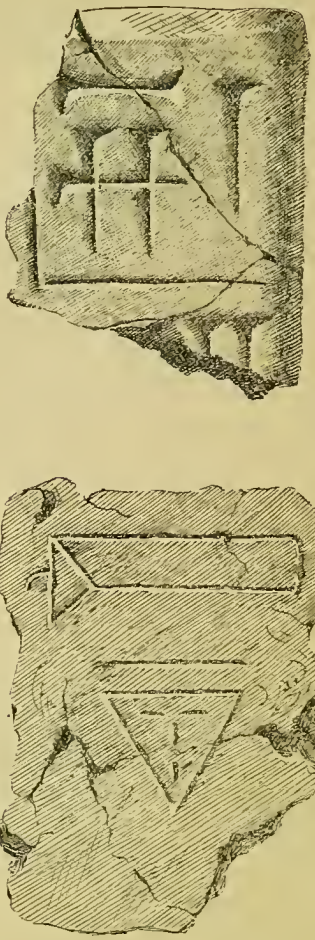
Thus a sixteenth century poet quaintly describes, and draws an impression of, from sacred records, the first operation tempered hy anæsthesia. It has heen claimed that in the "deep sleep" that the Creator "caused to fall upon Adam" is the germ of the idea of anæsthesia that has come down to us from the dim ages of the past. It is prohahle that primitive man employed digital compression of the carotid arteries to produce anæsthesia, as the ahoriginal inhabitants of some countries do to-day. According to Caspar Hoffmann, this method was practised hy the antient Assyrians hefore performing the operation of circumcision. Curiously enough the literal translation of the Greek and Russian terms for the carotid is "the artery of sleep."

The Dawn of Anæsthesia

The antient Egyptians are helieved to have used Indian hemp and the juice of the poppy to cause a patient to hecome drowsy hefore a surgical operation. Pliny relates that they applied to painful wounds a species of rock hrought from Memphis, powdered, and moistened with sour wine, which is the first record we have of local anæsthesia with carhonic acid gas.

Early Egyptian anæsthetics

The "sorrow-easing drug" which, as we are told in the fourth hook of the "Odyssey," was given hy Helen to Ulysses and his comrades, probahly consisted of poppy juice and Indian hemp. It is indeed



MANDRAGORA *(the Phallus of the Field)*
Inscribed in cuneiform characters and in Egyptian hieroglyphics
ca. 3000 B.C.

actually stated that she learned the composition from Polydamnia, the wife of Thone, in Egypt. It is possible also that the "wine of the condemned," mentioned by the prophet Amos, may have been a preparation of these drugs.

The "Wine of the Condemned"

There are several passages in the Talmud which point to the fact that the practice of easing the pain of torture and death, by stupefying the sufferers, was a very antient one.

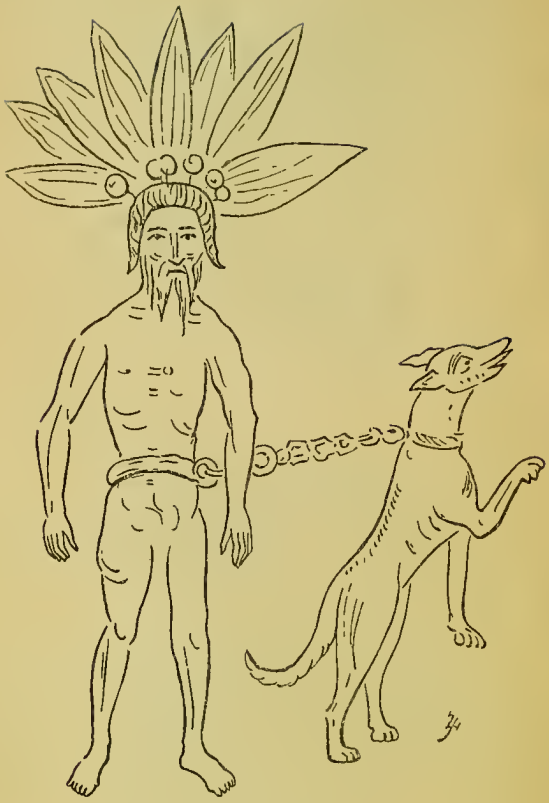
Thus it is stated: "If a man is led forth to death, he is given a cup of spiced wine to drink, whereby his soul is wrapped in night"; and again, "Give a stupefying drink to him that loseth his life, and wine to those that carry bitterness in their heart."

In connection with crucifixion, which was a common punishment for malefactors among the Jews before the Christian era, with the sanction of the Sanhedrin, the women were wont to ease the terrible 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, was offered to Christ before nailing Him upon the Cross, was indeed a narcotic draught, given with the object of lessening His sensibility to the agony.

The earliest reference to anæsthesia by inhalation is contained in the works of Herodotus, who states that the Scythians were accustomed to produce intoxication by inhaling the vapour of a certain kind of hemp, which they threw upon the fire or upon stones heated for the purpose. This was probably *Cannabis indica*, or Indian hemp, which was employed by Oriental races as an anæsthetic from very early times.

At the siege of Troy the Greek army surgeons employed anodyne and astringent poultices to assuage the pain of the wounded. Thus Patroclus, when his dagger from the thigh of Euryphylus—

Anodyne poultices to deaden pain



GATHERING MANDRAGORA

From an MS. of the XII century

Cut out the biting shaft; and from the wound
With tepid water cleansed the clotted blood;
Then, pounded in his hands, the root applied
Astringent, anodyne, which all his pain
Allay'd; the wound was dried, and stanched the blood.

Iliad.

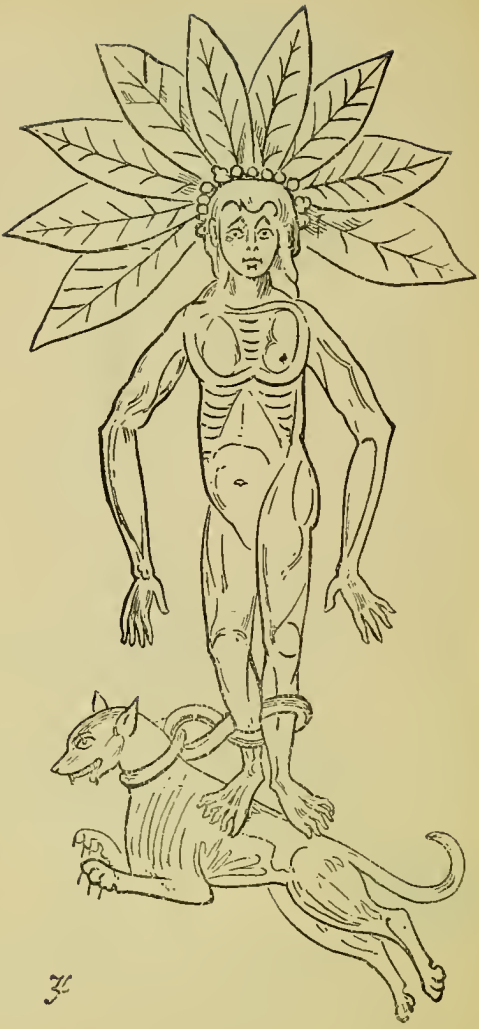
From this interesting description of the manner in which the early Greek surgeons treated a wound, it is evident that, although they had no actual knowledge of anæsthetics, they had found from experience the advantage of cleansing the wound and applying an astringent and anodyne dressing to deaden sensibility to pain, which probably, unknown to them, also possessed antiseptic qualities.

Mandragora as an Anæsthetic

That the early Greeks also used certain methods for deadening sensibility to pain is evidenced by several of the antient writers. Pindar states "Machaon eased the sufferings of Philoctetes with a narcotic potion." Theocritus also alludes to Lucina, the goddess of the obstetric art, as "pouring an insensibility to pain down all the limbs of a woman in the throes of labour." Aphrodite, to assuage her grief for the death of Adonis, is said to have thrown herself on a bed of lettuce and mandragora.

The anæsthetics of antient Greece

There is no medicinal plant around which cluster more mysterious and quaint associations than mandragora. The Babylonians employed it more than 2000 years B.C., and a figure cut from the root was used at that early period as a charm against sterility. It is probable that the antient Hebrews also believed it to possess these properties, judging from the story of Rachel related in the book of Genesis. The early Egyptians employed mandragora, which they called the "phallus of the field," as a medicinal agent, both as an anodyne and an anæsthetic, and also used it in many of their superstitious rites.



MANDRAGORA

From an MS. of the XV century

The first mention of mandragora (*Mandragora Atropa*, *L.*), as an anæsthetic, is made by Dioscorides (*ca.* A.D. 100), who evidently recognised the differeuce between the hypnotic and anæsthetic effects of the drug, from which one may assume that it was employed for both purposes in the medical practice of that day. Respecting the former, he states: "Eating which [mandragora] shepherds are made sleepy," and, referring to the latter property, he remarks that "three wine-glassfuls of a liquid preparation of the root are given to those who are about to be cut or burnt, for they do not feel the pain."

Mandragora as an anæsthetic

Of the preparations of mandragora, he gives the following: "There are those who boil the root in wine to a third part, and preserve the decoction, of which they give a cyathus [small glass] in want of sleep or severe pains in any part, and also before operations with the knife, or the actual cautery, that they may not be felt"; also "a wine is prepared from the bark of the root, without boiling, and three pounds of it are put in a cadus [eighteen gallons] of sweet wine; of this, three cyathi are given to those who require to be cut or cauterised, when, being thrown into a deep sleep, they do not feel any pain."

Dioscorides also refers to a substance called "morion," believed to be the white seed of the mandragora root, which is mentioned also by Pliny as a narcotic poison. "A drachm of it," he states, "taken in a draught, or 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. Physicians use it when they have to resort to cutting or burning."

"Morion," a Grecian anæsthetic

These allusions serve to prove how frequently anæsthesia was practised by the physicians of antient Greece, to whom the narcotic property of mandragora, which is allied to *Atropa Belladonna*, or deadly nightshade, was well known.

The younger Pliny (A.D. 32-79), in his "Natural

GATHERING MANDRAGORA

From a drawing of the XVI century

The plant is being uprooted by the struggling dog, whilst a horn is blown to drown the cries of the fatal herb

History," also describes the use of mandragora as a narcotic, and gives preference to the use of the leaves over the root for that purpose. "The dose," he says, "is half a cyathus, taken against serpents, and before cuttings and puncturings, that they may not be felt." He further adds: "For these purposes it is sufficient for some persons to seek sleep from the smell," from which it is clear that this anæsthetic was also used by inhalation.

With reference to mandragora, Sir Benjamin Ward Richardson once prepared a draught according to one of the recipes given by Dioscorides, and took it. He tells us that "the phenomena repeated themselves with all faithfulness, and there can be no doubt that, in the absence of our now more convenient anæsthetics, 'morion' might still be used with some measure of efficacy for general anæsthesia."

Further allusion is made to mandragora as a surgical anæsthetic by Apuleius in his "Liber de Herbis," in which he says: "If anyone is to have a limb mutilated, burnt, or sawn, he may drink half an ounce of mandragora with wine; and while he sleeps the member may be cut off without any pain or sense."

Avicenna, the Father of Arabian medicine, gives special directions as to the employment of mandragora, both as an anæsthetic and a hypnotic; while Averrhöes, another Arabian physician, refers to the soporific effects of the fruit of the same plant. Galen also alludes to its powers to paralyse sensation, and Paulus Ægineta states: "Its apples are narcotic, when smelled to, and also their juice, that if persisted in they will deprive the person of his speech." According to Isidorus, "a wine of the bark is given to those about to undergo operations, that, being asleep, they feel no pain"; and Serapion confirms this statement in his works.

Anæsthesia in Roman times

Evidence of the practice of surgical anæsthesia is to be found in the writings of several physicians during the time of the Roman Empire. It is probable that the practice came to them

from the Greek school, for mandragora, which they almost invariably used, grew largely in the Grecian Archipelago. Celsus recommends a pillow of mandragora apples to induce sleep.

Hindu Anæsthetics

From ancient records it appears probable, that the Hindus inhaled the fumes of burning Indian hemp as an anæsthetic at a period of great antiquity. As early as the year 977 they also knew of other drugs which they employed for the same purpose.

Pandit Ballala describes an interesting surgical operation which was performed on King Bhoja at that period. The patient was suffering from severe pain in the head, and, his condition becoming critical, two brother-physicians happened to arrive in Dhar, who, after carefully considering the case, came to the conclusion that a surgical operation was necessary to give relief. They are said to have administered to him a drug called *sammohini* to render him insensible, and while he was completely under its influence they trepanned his skull and removed the real cause of the complaint. They closed the opening, stitched up the wound, and applied a healing balm.

After the operation, they are said to have administered to the King a drug called *sanjivini*, to accelerate the return of consciousness and to minimise the chances of death.

An antient Chinese anæsthetic

It is recorded that "a Chinese physician named Hoa-Tho, who lived about A.D. 220 or 230, was accustomed to administer to his patients on whom he wished to perform painful operations, a preparation called 'Ma-yo' (Indian hemp, probably), the effect of which was that, after a few moments, they became insensible as if they were deprived of life."

Miss Isabella Bird, when visiting the Tung-wah Hospital, in Hong-Kong, states: "The native surgeons

do not use chloroform in operations, but they possess drugs which throw their patients into a profound sleep, during which the most severe operations can be performed. One of them showed me a bottle containing a dark brown powder, which, he said, produced this result; but he would not divulge the name of one of its constituents, saying it was a secret taught him by his tutor."

From very early times the fumes of burning lycoperdon *(Lycoperdon gygantum)* have been used for stupefying bees before taking honey from the hive.

Thus it will be seen from the many allusions we have quoted from writers in the early ages, it is evident that mandragora and Indian hemp were the two drugs which were more or less in general use as anæsthetics in antient times.

Anæsthetics in the Middle Ages

In a Celtic manuscript of the twelfth century on materia medica, a preparation called "potu oblivionis" is mentioned, of which mandragora was probably an ingredient. A draught of this preparation was used by the early Irish to induce sleep.

An early Irish anæsthetic

Coming to the fifteenth century, the method of producing insensibility to pain by the inhalation of the volatile principles of drugs, which had been handed down by tradition from the early ages, seems to have been revived by Hugo of Lucca, a Tuscan physician. He is described as "chief of a school of surgeons that treated wounds with wine, oakum and bandaging, with happy success." Theodoric, his son, who was a monk-physician, and practised surgery, mentions, in 1490, a preparation used by his father which he calls "oleum de lateribus." This he describes as "a most powerful caustic, and a soporific which, by means of smelling alone, could put patients to sleep on occasion of painful operations which they were to suffer." The mixture was

The "Sleeping Sponge"

An Operation on the Liver

From an MS. of the XIV century

placed on a sponge in hot water, and then applied to the nostrils of the patient, and was called the "spongia somnifera." The following is the composition of the "sleeping sponge" and the method of using, as stated by Theodoric: "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 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 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."

Method of using the "Sleeping Sponge"

According to Bodin, the sleep produced was so profound that the patient often continued in that condition for several days afterwards. The method of arousing the patient employed by Hugo, however, is thus described: "In order to awaken him, apply another sponge, dipped in vinegar, frequently to the nose, or throw the juice of fenugreek into the nostrils; shortly he awakens."

According to Canappe, in his work "Le Gyidon pour les Barbiers et les Chirurgiens," published in 1538, the "Confectio soporis secundum dominum Hugonem" was used by surgeons at that period.

Reginald Scott, in a work written in the sixteenth century, gives the following recipe for making an anæsthetic: "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

A Surgeon Amputating a Leg

From a woodcut of the XVI century

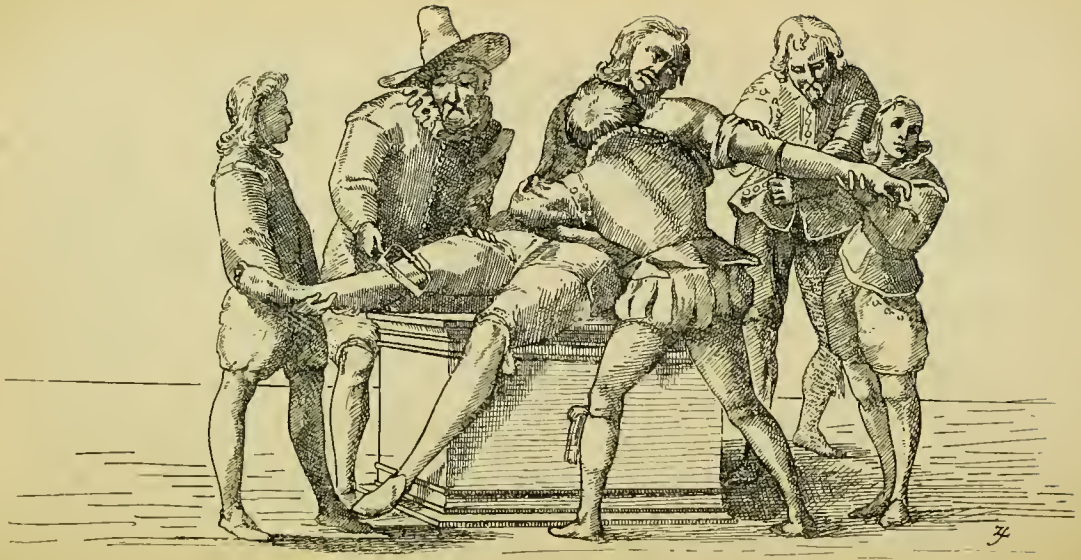
may do what you will. To wake him up, dip the rag in strong vinegar. The same is excellent in brain-fever, when the patient cannot sleep; for if he cannot sleep, he will die."

The writers and poets of mediæval romance in more than one instance allude to anæsthesia produced by drugs. Boccaccio, who wrote his "Decameron" in 1352, in the story of Dionius, alludes to a certain anæsthetic liquid of Surgeon Mazzeo della Montagna, of Salerno. "The doctor," he says, "supposing that the patient would never be able to endure the pain without a soporific, deferred the operation until the evening, and in the meantime ordered the water to be distilled from a certain composition, which, being drunk, would throw a person asleep as long as he judged it necessary." Boccaccio, probably, borrowed his idea from the recipe given by Nichols, a provost of the famous old school of Salerno, who published a recipe for making an anæsthetic, similar to that of Reginald Scott.

Anæsthesia in romance

In Brooke's "Tragicall Historye of Romeus and Julietta," printed in 1562, which supplied Shakespeare with the plot and much material for his play "Romeo and Juliet," Friar Laurence thus speaks to Julietta: "I have learned and proved of long time the composition of a certain paste which I make of divers somniferous simples, which beated afterwards to powdere, and dronke with a quantitie of water, within a quarter of an houre after, bringeth the receiver into such a sleepe, and burieth so deeply the senses and other spirits of life that the cunningest phistian will judge the party died.

"And, besides that, it hath a more marvellous effect, for the person which useth the same feeleth no kind of grief, and, according to the quantitie of the draught, the patient remaineth in a sweete sleepe; but when the operation is perfect and done, he returneth unto his first estate."



A Surgeon Amputating a Leg

From a woodcut of the XVI century

Shakespeare's references to mandragora, poppy and other "drowsy syrups," are too well known to need quotation; but the following allusion by Middleton, in his play called "Women beware Women!" is not without interest:—

> 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.

William Bulleyn, the author of "A Bulwark of Defence against Sickness," who practised as a surgeon in the reign of Henry VIII, describes an anæsthetic which he directs to be prepared from the juice of a certain herb (probably mandragora) "pressed forth, and kept in a closed earthen vessel according to art, bringeth deep sleep, and casteth man into a trance, or deep terrible sleep, until he shall be cut of the stone."

Allusions to anæsthesia by antient poets

The poet Marlowe thus refers to mandragora in his play "The Jew of Malta":—

Barabas:

> I drank of poppy and cold mandrake juice,
> And being asleep, belike they thought me dead,
> And threw me o'er the walls.

Du Bartas, as translated by Sylvester in 1592, makes the following allusion to anæsthesia:—

> Even as a surgeon minding off to cut
> Som cureless limb; before in use he put
> His violent engins in the victim's member,
> Bringeth his patient in a senseless slumber:
> And griefless then (guided by use and art)
> To save the whole, saws off the infested part.

Porta, writing in 1579, says: "It is possible to extract from several soporific plants a quintessence, which is to be shut up in a well-covered leaden vessel, lest the drug should evaporate. When it is to be used, the lid is to be removed and the medicament held to the nostrils, when its vapour will be drawn in by the breath and attack the citadel of the senses, so that the patient will be sunk in a deeper sleep not to be shook off without much labour."

A Surgeon Performing an Operation on the Eye

From a woodcut of the XVII century

Besides mandragora, opium, Indian hemp, and other plants with narcotic properties already referred to, that were used for anæsthetic purposes in mediæval times, certain substances are mentioned by early writers that cannot be identified. Thus Albertus Magnus mentions an animal product, of which he says: "Any person smelling it falls down as if dead and insensible to pain," but there is no reference to such a drug by other writers of the period.

Local anæsthesia was not unknown during the middle ages, and Cardow recommends the inunction of a mixture consisting of "opium, celandine, saffron, and the marrow and fat of man, together with oil of lizards." He also adds: "If the patient drinks wine in which the seeds of the patulica marina have been steeped for a week, it will prevent him feeling any pain."

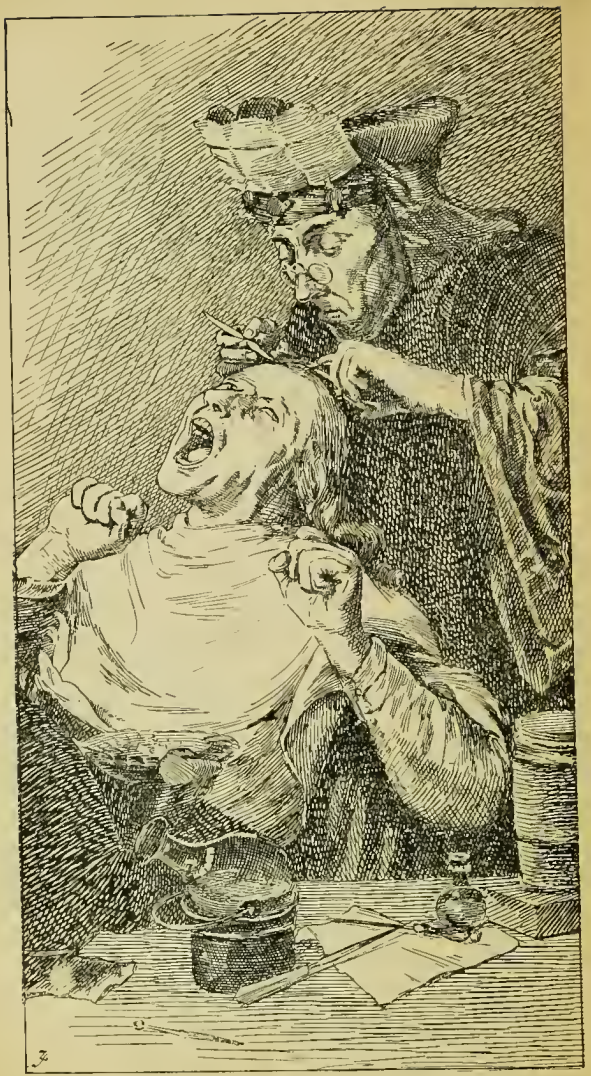
Local anæsthetics in antient times

Bernard mentions that it was customary in Salerno to mix the crushed seeds of poppy and henbane, and apply them as a plaster, to deaden sensibility, to parts that were about to be cauterised; while Bartolinus states that local anæsthesia was sometimes produced by freezing, thereby foreshadowing the use of ether and ethyl chloride as local anæsthetics.

First mention of freezing as an anæsthetic

During the seventeenth century the belief in the narcotic draughts of the antients for producing anæsthesia appears to have waned, and few allusions are made to them until the middle of the eighteenth century, when fresh interest seems to have been excited in the subject. The famous Boerhaave is said to have used opium as an anæsthetic, both by inhalation of its vapour and also by internal administration in powder. According to Van Swieten, in his commentaries upon Boerhaave's "Aphorisms," the following is given as the recipe: "Oil of cinnamon, 2 drops; oil of cloves, 1 drop; citron peel, 2 grains; sugar, 2 drachms. Mix and add red coral, prepared, 1 drachm; pure opium, 2 grains. Mix for two doses, one of which

Boerhaave's anæsthetic



An Operation in the Seventeenth Century
From a painting by Franz Hals

is to be taken one hour before the operation, and the other one quarter hour before it, if the patient has not slept."

In 1782, Weiss is said to have operated on the foot of Augustus, King of Poland, having previously placed the royal patient under the influence of "a certain potion surreptitiously administered." Shortly afterwards Sassard, a surgeon of La Charité, in Paris, suggested that patients who were about to be operated upon should be drugged with narcotics as a means of preventing shock. That this method was sometimes practised is evidenced from a chapter in "Bell's Surgery," where the author not only refers to it but objects to the method on account of the sickness and vomiting it produced.

An operation on the King of Poland

As late as 1847, Chisholm, of Inverness, recorded his use of a drug given internally to produce anæsthesia for surgical purposes; he substituted the internal use of morphine for ether inhalation in a case of ablation of the breast successfully performed upon a woman, who declared that she felt no pain during the operation.

Other means of producing insensibility were suggested in the eighteenth century, and the antient method of compressing the carotid arteries was revived. This method had been used by Valverdi about 1560, and Morgagni employed it about 1750 in his experiments on animals, and suggested that it might be used on human beings. Compression of the nerves of the limb about to be removed, was also proposed, by James Moore in 1784, and tried by Hunter and others, but the results could not be regarded as successful.

Anæsthesia by compression of the carotid arteries revived

Surgical operations at this time meant periods of agonising pain, and the stoutest hearts often quailed at the prospect. It is said that Lord Nelson was so painfully affected by the coldness of the operator's knife when his right arm was amputated at Teneriffe, that at the Battle of the Nile he gave orders to his surgeon to have hot

Nelson's arm amputated

water kept ready, so that at the worst he might be operated upon with a warm knife.

Thus from the dawn of creation anæsthesia for surgical operations had been practised to some extent, but, owing to the uncertainty of the potency and action of the powerful narcotics and palliatives administered, and the danger attending their use when exact science was unknown, the practice seemed likely to fall into oblivion. At last a series of brilliant discoveries in chemistry created a new epoch in the history of anæsthesia.

The dawn of a new era

The Chemical Era of Anæsthetics

The discoveries of Priestley about 1767 led up to the plan of administering gases and vapours of definite composition by inhalation through the lungs, and directly he had demonstrated the existence of "vital air," or oxygen, the properties of this body were tested in the hope of great results in the art of medicine. Priestley's experiments concerning the inhalation of oxygen were in time followed by those of Beddoes, who recommended the inhalation of oxygen, hydrogen and other gases in the treatment of disease. It seemed only natural that experiments with other gases and vapours by inhalation should follow. Pearson, of Birmingham, administered ether in this way in 1795 for the relief of consumption, and ten years afterwards Warren, of Boscombe, employed ethereal inhalation to relieve the sufferings attending the later stages of phthisis.

Priestley's discoveries

Priestley's discoveries of the method of liberating and collecting gases, and his demonstrations that certain gases could be absorbed and compressed in water, led to the introduction of aërated waters—carbonic acid gas being the first to be employed.

In the course of time, nitrous oxide, which had been discovered by Priestley in 1776, was compressed

Joseph Priestley

in water, and came into general use as a medicinal agent.

In 1798, a Medical Pneumatic Institution was established at Bristol by the exertions of Beddoes and others, and Humphry Davy was appointed superintendent. It was here that he commenced and carried on his notable researches on nitrous oxide. In one of his experiments he constructed a box or chamber in which he inhaled the gas in measured quantities. One day, in the year 1799, when suffering from toothache or inflammation of the gums, he resorted to the inhalation of the gas, and discovered to his great delight that it relieved the pain, which led him to the conclusion he expresses in the following words in "Researches Chemical and Philosophical," 1800: "As nitrous oxide in its extensive operation seems capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place."

Anæsthetic properties of nitrous oxide

About 1806, Woolcombe, of Plymouth, prescribed for Lady Martin, a patient suffering from asthma, the inhalation of sulphuric ether to relieve the attacks. Lady Martin found the inhalation gradually caused her to become unconscious, from which state she would recover in a short time, with the result that the paroxysm of dyspnœa had disappeared. But the teaching of this case, and even the more explicit account of Humphry Davy, was overlooked; and no further development occurred until the year 1818, when Faraday pointed out, in "The Quarterly Journal of Science and Arts," that the inhalation of the vapour of sulphuric ether produced effects similar to those caused by nitrous oxide.

Faraday points out similarity in the effects of nitrous oxide and sulphuric ether

About this time Professor Thompson, of Glasgow, was accustomed annually to amuse his students by allowing them to inhale ether and nitrous oxide until they were intoxicated, and occasionally became unconscious, when it was noticed that they were insensible to the

prick of a pin, or a blow. In these cases the gas or ether was inhaled from a bladder. Two drachms of rectified and washed ether were poured into a bladder and allowed to diffuse. Then the mixture of air and ether vapour was breathed, the expired air being allowed to enter the bladder also. Curiously enough, very little improvement has been made on this method of administration to the present day.

It is an extraordinary fact that, even in the face of such experiments as those we have referred to, no one among the investigators who stood at this time on the brink of so great a discovery ventured over the threshold. It is almost inconceivable in these days to realise, that for thirty-nine years these substances were used for experimental purposes, and even for amusement, without a realisation of the great blessing to humanity that lay almost within grasp. The things that are apparently most plain may lie longest buried; so with the discovery of efficient anæsthesia, which even then developed in an indirect manner.

On the brink of the discovery

Mesmerism as an Anæsthetic

From the earliest ages the apparent power of some men to influence the minds and bodies of others has been known. Certain diseases were said to be affected by the touch of the hand of certain persons, who were supposed to communicate a healing virtue to the sufferer, and these practices were often connected with religious and magical rites. This method of healing was practised in antient times by the Chaldæans, Babylonians, Egyptians, Persians, Hindus, Greeks and Romans. Their priest-physicians are said to have effected cures and to have thrown people into deep sleep in the precincts of the temples. Such influences were at that time held to be due to supernatural power, a belief which was no doubt fostered by the priesthood. In the middle of the seventeenth century an Irishman named Valentine

Mesmerism in antient times

Sir Humphry Davy

Greatrakes aroused great interest in England by his supposed power of being able to cure scrofula by stroking the patient with his hand. Most of the distinguished scientific men of the day, such as Sir Robert Boyle, witnessed and attested his cures, and thousands of sufferers crowded to him from all parts of the country. Since his time other men have come forward with similar claims, notably one Gassner, a Roman Catholic priest of Swabia, who in the early part of the eighteenth century attracted attention by stating that he could cure the majority of diseases by exorcism. His method had an extraordinary influence over the nervous systems of his patients, who in the end generally confessed themselves cured.

Healing by "stroking"

In 1766, Mesmer, who was a pupil of Hehl, professor of astronomy at Vienna, and an advocate of the efficacy of the magnet for the cure of disease, met Gassner, and observed that the priest effected cures without the use of magnets and by manipulation alone. This led him to believe that some kind of occult force resided in himself, by means of which he could influence others. He held that this force permeated the universe, and more especially affected the nervous systems of men. In 1778, he removed to Paris, and shortly afterwards the French capital was thrown into a state of great excitement by the fact that human beings could be placed in a state of artificial sleep or trance, which was then called "mesmerism."

Mesmer's experiments

Mesmer's disciples claimed that even painful operations could be performed on patients in this condition without consciousness of pain.

Braid, who made a further investigation of the subject, dissented from the mesmerists as to the cause of the phenomenon, and called the condition "hypnotism." In 1846, the Deputy-Governor of Bengal appointed a committee to observe and report on the surgical operations

Braid's researches on hypnotism

that were then being performed in India by Esdaile upon his patients, while under the influence of alleged mesmeric agency. The Committee reported on various experiments carried out under their observation, some of which had apparently been performed with great success. But from further investigation it was apparent that the method was uncertain, and success seemed to be due to the peculiar susceptibility of the patient operated upon. These experiments are worth recording, as they indirectly led to the practice of administering certain vapours to produce anæsthesia.

Esdaile operates on hypnotised patients

One of the pioneers in the practice of inhalation was Robert H. Collier, who was a believer in mesmerism. In 1835 he was present at a lecture given by Dr. Turner, Professor of Chemistry at University College, London, and in the course of some experiments in the inhalation of ether was himself rendered unconscious, and also observed that his fellow-students who had inhaled it were insensible to pain. Four years later he went to America, and, while visiting his father's estate near New Orleans, he was called to one of the negroes who had become insensible by inhaling fumes from a vat of rum, and who, in falling, had dislocated his hip. Finding the muscles flaccid, Collier reduced the dislocation without exciting the least sensation of pain in the patient. A little later he performed two operations upon patients while under mesmeric influence, with apparent success. These facts led him to connect the phenomenon of mesmerism with narcotism produced by inhalation, and in 1840 he commenced a lecturing tour throughout America on the subject. Three years later he returned to this country, and at Liverpool, where he landed, gave his first lecture, which he illustrated by experiments in mesmerism, and also showed the possibility of rendering a subject unconscious by the fumes of alcohol in which poppy-heads and coriander had been macerated. The theory he advanced, and attempted to prove

Robert Collier one of the first pioneers

MICHAEL FARADAY

throughout, was that the so-called mesmeric influence was identical in action with that of narcotic vapours.

He claimed to have administered the fumes of his alcoholic mixture to a Mrs. Allen, of Philadelphia, in 1842, and while under its influence he extracted a tooth without causing her pain. Collier's lectures excited general attention at the time, and there is little doubt that they gave a fresh impetus to research on the subject of anæsthesia by inhalation. He must therefore be regarded as an important pioneer, who, had he given up his ideas of mesmerism and proceeded systematically with his plan of making the body insensible by inhaling the vapour of alcohol, would have had no one to dispute with him in priority.

Uses his alcoholic mixture as an anæsthetic in 1842

The Nitrous Oxide Era

Although, as already stated, Humphry Davy had discovered the anæsthetic properties of nitrous oxide as far back as the year 1800, forty-four years elapsed before his idea was put into practical use.

On December 11th, 1844, Dr. G. Q. Colton, a well-known lecturer on popular scientific subjects in America, and a pupil of Professor Turner, of London, delivered a lecture at Hartford, Connecticut, during which he gave a demonstration of the action of nitrous oxide gas. Horace Wells, a dentist, then in practice in the same town, formed one of the audience.

Colton lectures on nitrous oxide

Among the persons who were invited by the lecturer to inhale the gas for the amusement of the audience was a man named Cooley, who wounded himself severely by falling against the benches, and only became aware of the fact when he saw the blood. Wells was greatly struck by this incident, and he determined to test the anæsthetic effects of the gas upon himself the next day by having a decayed upper molar extracted

Wells makes his historic experiment

"A New Era in Tooth-Pulling"

The first dental operation performed on Horace Wells whilst under the influence of nitrous oxide gas

while under its influence. After the lecture he asked Dr. Colton if he would come to his house and administer the gas to him; and, on receiving his promise, he induced a Dr. Riggs to be the operator.

The historic event is described by the latter as follows: "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 Dr. 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, 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."

"A new era in tooth-pulling"

After this, Wells extracted several teeth from his patients under nitrous oxide gas with equal success, and 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 hope of being allowed to try the gas in a case of amputation in the Massachusetts General Hospital, but the experiment was postponed. Dr. Warren, senior surgeon to the institution, however, invited him to address his class on the subject of anæsthesia, after which he was asked to administer the gas in a case of tooth extraction. He was assisted on this occasion by Morton, a Boston dentist 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.

Wells disheartened by failure

Disheartened at length by the failure of his repeated attempts to establish his claims to priority as the discoverer of anæsthesia, his mind appeared to become affected, and for a time he wandered about the streets of New York. On January 4th, 1848, he was arrested and charged with throwing vitriol, but while in gaol he opened his radial artery, having first inhaled ether to make death painless. This sad event closed, at the age of thirty-two, the career of Horace Wells, to whom at least 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 death of Horace Wells

The Ether Epoch

Probably the first published account of the use of ether as a medicinal agent was made by Morris in a letter read before the Society of Physicians in London,* on December 18th, 1758, in which he advocates its use internally, and also as an external application.

In 1818, Faraday, as already stated, had called attention to the anæsthetic properties of ether, and showed that the vapour of sulphuric ether, when inhaled, produced effects similar to those of nitrous oxide. After Wells' failure at Boston nothing further seems to have been done for a time to investigate the use of nitrous oxide as an anæsthetic.

Early experiments with ether

In 1839, William E. Clarke, a young medical student of Rochester, New York, was in the habit of amusing some of his friends, among whom was another student named W. T. G. Morton, by the inhalation of ether. Emboldened by his experiences, in 1842 he is said to have administered ether,

* "Med. Obs. and Enq." by the Society of Physicians in London, vol. 2, page 176, 1764.

HORACE WELLS

by means of a towel, to a young woman named Hobbie, and during the period of insensibility which followed, one of her teeth was extracted by a dentist named Elijah Pope.

J. Marion Sims relates the following incident which he states happened in the year 1839:—"A number of youths in Anderson, South Carolina, were exhilarating themselves one day with the seductive vapour of ether. In their excitement they seized a young negro who was watching their antics, and compelled him to inhale the drug from a handkerchief which they held over his mouth and nose by main force. At first his struggles only added to the amusement of his captors, but they soon ceased as the boy became unconscious, stertorous and apparently dying. After an hour or two of anxiety on the part of the spectators he, however, revived, and was apparently no worse for his alarming experience."

Three years after this incident one of the participators in the affair, named Wilhite, became the pupil of Dr. Crawford W. Long, a physician then practising in Jefferson, Jackson County, Georgia. Both the doctor and his pupils used occasionally to amuse themselves by inhaling ether, and the former often noticed that while thus excited he was insensible to blows and bruises. Wilhite recounted to him his memorable experience with the negro boy; and, in March, 1842, Long is said to have persuaded a patient, on whom he was about to operate for a small encysted tumour, to inhale ether until he was insensible. The patient consented, and the tumour was removed without any pain or accident. This memorable event was simply recorded by Long in his ledger thus:—"James Venable, 1842. Ether and excising tumour, $2.00." Three months later he removed another tumour from the same patient in a similar way, and also performed three other operations during that year. He is said to have again repeated the experiment in 1843 and 1845, but the district in which he lived was so far removed from contact with the large cities and

Long claims to have used ether in 1842

centres of thought, that the discovery remained unknown and unpublished until long after the anæsthetic properties of ether had been fully proved elsewhere. Long himself admits that he considered ether impracticable owing to the shortness of the anæsthetic state, and he therefore abandoned its use.

Marcy's experiment

Towards the end of the year 1844, Dr. E. E. Marcy, a surgeon of Hartford, is said to have administered ether to a patient, and to have removed an encysted tumour about the size of a walnut from the scalp.

It is stated that Horace Wells was present at this operation, which was quite successful, but, being warned that ether was dangerous to life, the experimenters abandoned its use in favour of nitrous oxide gas.

Morton's experiments with ether

In 1846, W. T. G. Morton (referred to previously) who had been in partnership with Wells as a dentist, and assisted him in the unfortunate experiment with nitrous oxide in Boston, now directed his attention to the finding of a more suitable anæsthetic for painless operations in dental surgery. After many unsuccessful attempts with various narcotics, Charles T. Jackson, a chemist of Boston, whose pupil he had been, suggested that he should try sulpburic ether, the properties of which had been known for so long.

Jackson's story

It was about the end of September, 1846, that Jackson states he informed Morton that he had experimented on bimself by inbaling ether on a folded towel. He found that he lost all power over himself, and fell back in his chair in a state of curious sleep. Morton, however, tells another story, and relates how, having procured some chemically pure etber on September 30th, 1846, he shut himself in a room alone and inhaled the vapour. He states: "I found the ether so strong that it partly 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

CHARLES T. JACKSON

sensation like nightmare. I thought for a moment I should die in that state, but 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 the second effort I touched it, but there seemed to be no sensation. I attempted to rise from my chair, but fell back, and looked immediately at my watch and found that I had been insensible between seven and eight minutes."

The First Dental Operation under Ether

Morton soon had an opportunity of making a practical experiment with the anæsthetic, for the same evening, about nine o'clock, a man named E. H. Frost called upon him suffering from a violent attack of toothache. "Can't you mesmerise me?" asked the sufferer. "Upon which," says Morton, "I told him 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 handkerchief with ether, I gave it to him to inhale. He became unconscious almost immediately. It was dark, and 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 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. 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."

Morton next appealed to Dr. John C. Warren, who was then Senior Surgeon at the Massachusetts General Hospital, and obtained permission to test his new anæsthetic on a patient about to undergo a surgical operation. The date fixed was Friday, October 16th, 1846, and at the

First surgical operation under ether

appointed time a large number of medical men had assembled in the theatre. Morton administered the anæsthetic successfully, and the operation, which was for a congenital vascular tumour of the neck, in a young man named Gilbert Abbot, was completed in about five minutes without a groan from the patient. When it was finished, Dr. Warren exclaimed: "Gentlemen, this is no humbug!" The interest excited amongst those who witnessed the operation was naturally very great, and Dr. Henry J. Bigelow, who was present, said to a friend whom he met later in the day: "I have seen something to-day that will go round the world!" His prophecy proved correct.

Up to this time Morton had not disclosed the nature of the agent he employed, and nothing more was done until November 7th, when he expressed his willingness to reveal the secret. On this date two major operations were performed under ether, one by Dr. Hayward and the other by Dr. Warren.

From this time ether took its place as a general anæsthetic, and the practice of anæsthesia was firmly established.

The origin of the words "anæsthesia" and "anæsthetic"

Soon after the memorable 16th of October, a meeting was held in Boston, to choose a name for the new anæsthetic agent, and the word "letheon" was chosen by Morton himself; but, subsequently, Dr. Oliver Wendell Holmes suggested the name "anæsthesia" for the condition, and "anæsthetic" for the agent, which names have since come into general use.

Although it has never been very clearly established whether Morton or Jackson was the prime originator of the use of ether as an anæsthetic, the former was recognised by the United States Government as the discoverer, and received from it a handsome award. It seems most probable that Jackson supplied the inspiration, while Morton practically demonstrated it.

W. T. G. Morton

In reviewing the steps which led up to the discovery, it must not be forgotten that both Morton and Jackson were after all but followers of Collier, who first rendered himself unconscious with ether in the laboratory of University College, London, and forged one of the most important links in the chain of development.

Morton spent most of the remainder of his life in disputes about priority, and in efforts to secure recognition. He died bankrupt and broken-hearted on July 15th, 1868, before he had completed his forty-ninth year.

Curiously enough, Jackson, like Wells, became insane, and died in an asylum in 1880. When the friends of the rival claimants of the discovery of anæsthesia were proposing that monuments should be erected to each, Oliver Wendell Holmes characteristically suggested that all should unite in erecting a single memorial, with a central group symbolising painless surgery, a statue of Jackson on one side, a statue of Morton on the other, and the inscription underneath :—

TO E(I)THER

The news of the "ether process for removing pain," as it was then called, spread rapidly. A private letter from Dr. J. Bigelow to Dr. Francis Boote, of Gower Street, carried the first news to England, and was communicated to the medical profession in London on December 17th, 1846. Two days later, Mr. James Robinson, a dentist, of Gower Street, performed the first dental operation under ether in England, the patient being a Miss Lonsdale, and the operation the extraction of a firm molar tooth.

An apparatus called "Letheon" One of the earliest employed for the administration of Ether

On December 21st the first surgical operation under the new anæsthetic in England was performed by Robert Liston, in University College Hospital, London.

First surgical operation under ether in Great Britain

In the operating theatre, thronged with students, were the late Sir John Erichsen, the present Lord Lister, and many other famous surgeons. Mr. Barton relates an amusing incident which happened prior to the operation. Before the patient was brought in, the anæsthetist asked the students who crowded the benches in the theatre from floor to ceiling for some volunteer who would submit himself to be anæsthetised. A young man, Sheldrake, of very powerful build and a good boxer, at once offered to take the new anæsthetic, and came into the arena. "He lay on the table, and the anæsthetist proceeded to administer the ether. After the administration had proceeded for about half a minute, the subject of the experiment suddenly sprang up and felled the anæsthetist with a blow, and, sweeping aside the assistants in the arena, sprang shouting up the benches, scattering the students, who fled like sheep before a dog. He fell at the top bench, where he was seized and held down till he regained his senses. The whole scene hardly occupied a minute."

New method of administration

Before operating, Liston addressed a few words to those present as to the nature of the experiment about to be tried. The ether was administered by Mr. William Squire in an apparatus he had devised, which consisted of a large bell-shaped receiver containing the ether, to which was attached a long tube and mouth-piece. The patient, a middle-aged man, who was suffering from malignant disease of the skin and tissues of the calf of the leg, for which amputation of the thigh was deemed necessary, passed easily into complete insensibility, and Liston rapidly removed the thigh, the cutting operation being declared to have lasted only thirty-two seconds. In a few moments the patient

completely recovered consciousness, and apparently did not know that the limb was off. 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. Both surgeon and patient were much affected, and the scene in the theatre was most impressive. All appeared to see what an incalculable boon was in store for the human race, and Liston could scarcely command his voice sufficiently to speak.

Some amusing stories are related of Liston, who was a very big, powerful man. His fine physique was often useful in the pre-anæsthetic days, when a patient's nerve gave way at the last moment at the sight of the crowded theatre and the operating-table with its straps. It is said that on one occasion a patient, losing his courage at the last moment, rushed shrieking down the long corridor of the hospital, with Liston at his heels. The man locked himself in a room, but the surgeon with his shoulder broke in the door, and half-dragged half-carried the poor wretch back to the operating theatre, where the operation for stone was successfully performed.

A story of Liston

The practice of using ether was soon followed in other hospitals, and not only medical men but distinguished laymen crowded to witness its use. In Scotland, Dr. Moses Buchanan, Professor of Anatomy in Anderson's University, was the first to have news of the event, and immediately after his lecture that day he experimented with ether inhalation. On the following day, in the operating theatre of Glasgow Royal Infirmary, a patient was placed under the anæsthetic and successfully operated on for fistula. So rapidly, indeed, did the practice spread from one centre to another, that by the end of the first quarter of 1847 the use of the new anæsthetic may be said to have become general in all operation cases.

First surgical operation under ether in Scotland

Simpson proves value of ether in midwifery

The value of ether in midwifery practice still remained to be proved, and Sir James Simpson was the first to suggest and test its use in this department. On January 9th, 1847, he first administered ether to a patient in order to facilitate the operation of turning. The result, he reported, was most satisfactory and important, for it at once afforded evidence of the one great fact upon which the whole of the practice of anæsthesia in midwifery is founded, viz., that though the physical sufferings of the patient could be relieved by the inhalation of ether, yet the muscular contractions of the uterus were not interfered with.

The Discovery of Chloroform as an Anæsthetic

The next epoch-making event in the history of anæsthesia was the discovery of the anæsthetic properties of chloroform. The substance itself had been known for over a quarter of a century. Thomson, in his "System of Chemistry," 1820, describes a liquid which is formed by the union of chlorine and olefiant gas, called "Dutch liquid," or chloric ether. Early in the year 1831, Samuel Guthrie of Brimfield, Massachusetts, who was then residing in Sackett's Harbour, New York State, in consequence of a statement that he had read that the alcoholic solution of this chloric ether was useful in medicine as a diffusible stimulant, devised an easy method of preparing it. This being done, he wrote an article which he entitled "A Spirituous Solution of Chloric Ether," and forwarded it to the editor of the "American Journal of Science and Art," in which it was published in October of the same year. In this article he fully describes his method of preparation. A few months later, in January, 1832, Soubeiran published a paper in a French journal, stating that he had discovered this method in 1831, and to the distilled fluid he produced he had

DAVID WALDIE

given the name of "bichloric ether," the formula being CHCl. Still a third claimant to the discovery came forward in the person of Liebig, who published his account in November, 1831, six months after Guthrie's manuscript was in the publisher's hands, and one month after its publication. The formula which Liebig deducted from his analysis was C_4Cl_5, and he called his product "chloride of carbon." Although there may be some doubt as to which of these claimants was actually the first to manufacture the liquid, it is clear that Guthrie was the first to publish the account of the discovery. He was born in 1782, was a surgeon in the United States Army in 1812, and died in 1848.

From an account given by D. B. Smith, of Philadelphia, in the "Journal of the College of Pharmacy"* in 1832, there can be little doubt that the liquid first made by Guthrie was a fairly pure chloroform. He describes it in the following words: "The action of this ether on the living system is interesting, and may hereafter render it an object of importance in commerce. Its flavour is delicious, and its intoxicating properties equal to or surpassing those of alcohol." In 1834, Dumas examined the liquid as prepared by Soubeiran, and declared that he had not obtained it pure, and further, that Liebig had made an error in its composition. On further research, Dumas gave the liquid the name of "chloroform," and first worked out the real formula, C_2HCl_3 (or, using the present system of atomic weights, $CHCl_3$).

Previous use of chloroform in medical practice

Although its narcotising properties were known to some extent, no one who used it at that time seems to have conceived the idea of fully testing its properties. In 1831, Ives, of Newhaven, treated a case of difficult respiration by actual inhalation of the vapour, and published the facts in "Silliman's Journal" in January, 1832. Four

* Now the "American Journal of Pharmacy"

years later, Dr. Formby, of Liverpool, prescribed it in hysteria; and Tuson, of London, employed it in the treatment of cancer and neuralgia in 1844.

Simpson's investigations

The fact that one or two deaths had been attributed to the use of ether about this time, caused many workers to make a search for other agents with similar properties. Foremost among these investigators was Dr. James Young Simpson, Professor of Midwifery in the University of Edinburgh, who personally experimented with several chemical liquids in the hope of finding something less disagreeable and persistent in smell than ether.

About this time, Jacob Bell, a chemist, and a founder of the Pharmaceutical Society, published a suggestion that chloric ether should be used for inhalation instead of sulphuric ether; but his suggestion was apparently never put into practice. In October, 1847, Waldie, a chemist of Liverpool, was visiting Edinburgh, and in conversation with Professor Simpson, suggested to the latter the use of chloroform. He recommended the Professor to try it as an anæsthetic, and promised to make and send him some on his return to his home in Liverpool.

Waldie suggests the use of chloroform

It appears to have been in that city that the drug was first introduced and probably first used in England as a medicinal agent. Waldie states that about the year 1838 a prescription was brought to the Apothecaries' Hall, Liverpool (where he held the position of manager), of which one of the ingredients was chloric ether. The preparation was at that time apparently not known in this country, for Dr. Brett, the chemist of the Company, specially prepared some from the formula he found in the United States Dispensatory. Its properties pleased some of the medical men, particularly Dr. Formby, by whom it was introduced into local practice. Waldie, finding that the preparation was not uniform in strength, improved the

Sir James Young Simpson

process by separating and purifying the chloroform, and dissolving it in pure spirit, by which a product of sweet flavour was obtained.

There seems little doubt that Waldie was the first to suggest the use of chloroform, as an anæsthetic, to Professor Simpson, who at once resolved to try it by experimenting on himself and his assistants. He made the first experiment in his own house on November 4th, 1847, and in a letter written to Waldie thus describes the event: "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." Professor Miller, who was a neighbour of Simpson's, used to come every morning to see if the experimenters had survived! He describes how, "after a weary day's labour, Simpson and his assistants sat down and inhaled various drugs out of tumblers, as was their custom. 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, 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 above him. They made several more trials of it on that eventful evening, and were so satisfied with the results that the festivities did not terminate until a late hour."

On the eve of the great discovery.

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." A day or two afterwards an arrangement was made with Simpson to administer the new anæsthetic to a patient who was about to be operated upon, but, owing to some cause, he was unable to be present. The operation went on without him, and the patient died on the first incision of the knife. Simpson's absence was providential indeed, for it saved the reputation of chloroform at the outset. On November 15th, chloroform was used for the first time in a surgical operation in the Edinburgh Royal Infirmary. Three patients were operated on successfully under its influence. One, who was a soldier, was so delighted with the effect that, on awaking after the operation, he is said to have seized the sponge with which administration had been made, and, thrusting it into his mouth, again resumed inhalation more vigorously than before.

Simpson achieves success

To Simpson, there is no doubt, belongs the merit of having made anæsthesia triumph over all the opposition, which was at first, actively, offered to its use. For this he well deserved the rewards which fell upon him in the evening of his life.

Among those who aided in the establishment of the use of anæsthetics, mention must be made of the work of John Snow, who by his researches placed the practice on a scientific basis.

The advent of chloroform gave an impetus to other investigators in the field of anæsthesia, and during the last fifty years many other bodies have been introduced and tried with more or less success for the same purpose. Methyl chloride, which was discovered by Dumas and Peligot, was introduced by Deboe in 1887, who used it extensively in local affections. In 1867, Sir B. W. Richardson introduced methyl bichloride or methylene [methylene dichloride]. He formed a very high estimate of its properties as a good

general anæsthetic, and said he preferred it for many reasons to chloroform, as he found that the anæsthetic sleep was produced more quickly and was more prolonged.

Sir T. Spencer Wells also advocated its use, and stated, in 1872, that it had fewer drawbacks than any then known anæsthetic. Tetra-chloride of methyn [carbon tetrachloride], which much resembles chloroform, was discovered by Regnault in 1839, and its anæsthetic properties were first made known by Sansom and Harley in 1864. Simpson was of the opinion that it had a more depressing effect upon the heart than chloroform, and was more dangerous generally as an anæsthetic.

Nunneley, of Leeds, also contributed work of value in this department of research, and introduced ethyl bromide and chloride of carbon. He dispelled the idea, long prevalent, that anæsthetics could be found only in a limited class of chemical compounds.

Among other substances which have been introduced during the last twenty-five years, but which, owing to one defect or another, have since been practically abandoned, mention should be made of butylic hydride [butane], ethylene, amylene, ethyl nitrate, aldehyde (introduced by Poggiale), carbon bisulphide, ethidene dichloride [ethylene dichloride] (discovered by Regnault and first used as an anæsthetic by Snow), and ethyl bromide, first prepared by Serullus in 1827.

Local Anæsthetics

Local anæsthesia, already alluded to as probably the earliest form of numbing sensibility to pain, was practised in antient times by the inunction of various narcotics, but after the seventeenth century the practice seems to have almost entirely gone out of use. The latter end of the nineteenth century, however, marks a new era in this department.

On September 15th, 1884, considerable interest was

aroused by a communication made at the Ophthalmological Congress at Heidelberg, by Karl Koller, of Vienna, in which he demonstrated the effects of cocaine as a local anæsthetic.

The alkaloid now known as cocaine was isolated by Gädeke, from the leaves of the *Erythroxylon Coca* as far back as 1855. He called it ethroxylene. Four years later a further investigation of the plant was made by Nieman, who noticed that the leaves produced a numbness of the tongue; and in 1874 Hughes Bennett demonstrated that cocaine possessed anæsthetic properties. In 1880, Von Anrep, who made a careful investigation of the drug, hinted that the alkaloid might be of use in general surgery as a local anæsthetic, and Koller undertook a series of experiments on animals in the laboratory of Professor Stricker, in which he found that complete anæsthesia of the eye, lasting, on an average, ten minutes, followed the introduction of a two per cent. solution of the alkaloid.

The discovery of Cocaine

The immense value of such an anæsthetic in ophthalmic operations was universally recognised, and it at once came into general use. In painful conditions of mucous surfaces, and for minor operations, cocaine has been found of great service, and as a local anæsthetic it has a large field of usefulness. Since the introduction of cocaine, other substances have been brought forward, which, after extensive trials, have proved to be of real clinical value. Of these may be mentioned eucaine, a synthetic product (benzoyl-vinyl-diaceton-alkamine) discovered by Merling, and first studied by Vinci in Liebreich's laboratory. Of the two forms of this drug used, which are known as A and B, the latter was soon found to be the only one suitable for producing local anæsthesia. Its properties are similar to those of cocaine, with the exception that it produces no vaso-constriction, and it is claimed that it is equal in anæsthetic power, whilst its toxicity is very much less.

Stovaine, or benzoyl-ethyl-dimethylaminopropanol hydrochloride, more recently introduced, is a synthetic product elaborated by Fourneau, and derived from tertiary amyl alcohol. It is much less toxic than cocaine, but its comparative value still remains to be proved by further trial. Tropacocaine, a drug closely allied to cocaine, and derived from the leaves of the Java coca plant, has recently been much used in Germany, but it does not appear to possess any advantages over cocaine or eucaine.

Stovaine and Tropacocaine

Novocaine, or para-amido-benzoyl-diethylaminoethenol hydrochloride, has lately been found to possess satisfactory properties as a local anæsthetic in dental operations. It is said to be free from the toxic and local irritant action common to other local anæsthetics.

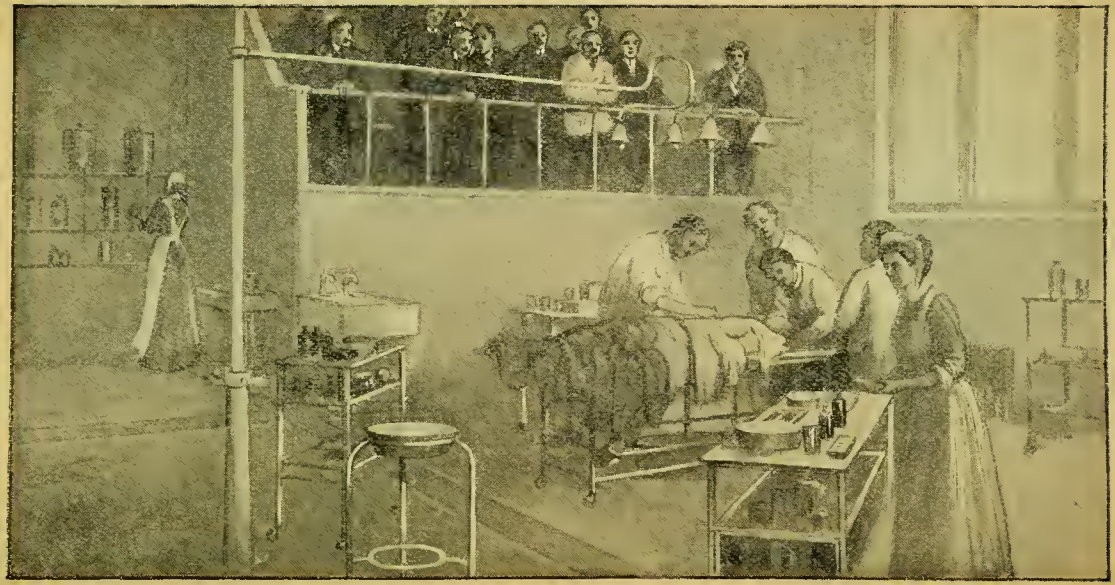
The Necessity for Absolute Purity in Chloroform

Considerable attention has been directed to different methods of administering chloroform, and various forms of apparatus have been devised which claim to reduce to a minimum the dangers of anæsthesia. Assuming a most skilled and competent administrator, an ideal method of administration, and a suitable patient, an unsatisfactory result can only be attributed to the chloroform employed. Purity of chloroform is a most important factor in contributing to safe anæsthesia. The physician claims that absolute purity shall characterise all medicinal agents, and the justice of the claim is acknowledged by the trend of recent legislation. Purity is a prime essential of any anæsthetic. The presence of impurities largely increases the risk inseparable from the use of chloroform. The train of symptoms observed during the normal process

Administration of Chloroform

Purity an essential

Danger of impurities



An Operation in the Twentieth Century

of anæsthesia may be masked and altered, and dangerous results may supervene under the most competent, careful and observant administrator.

That some of the chloroform offered to the profession may reasonably be regarded with suspicion is evidenced by the words of a prominent obstetrician, based on the experience of 40 years in the use of chloroform; this authority expresses himself as follows: "I may say I fear the chloroform in common use is often far from being as pure as it should be, and is sometimes very defective in this respect." Expert testimony

Impurities may result from the process of manufacture, or from decomposition. Conspicuous amongst these undesirable elements are chlorine, hydrochloric acid and carbonyl chloride (phosgene), which irritate the lining membrane of the respiratory tract and interfere with the normal process of respiration. Such irritation may result in arrest of cardiac action or may produce a severe form of bronchitis. It is obviously of great importance that chloroform should be free from irritating properties, that the respiratory passages should not be obstructed, and that during anæsthesia the breathing and the circulation should approximate the normal. Superadded to these results, produced by local irritation, is the effect of other impurities which exert their action after absorption. These latter markedly increase the cardiac depression which has been shown to follow the administration of pure chloroform. Such an action is difficult of detection, and is, probably, in large degree responsible for a considerable number of the accidents reported. Effects of impurities

Of recent years increased knowledge has elaborated exact tests, which ensure the absence of these impurities. Nevertheless, anæsthetists of wide experience have obtained results which could not be reconciled with the use of pure chloroform. It has been observed that

different chloroforms, all of which answer the official tests for purity, give effects which are difficult to harmonise, and the interpretation of which only appears satisfactory on the assumption that the chloroforms differ in composition. Whilst one chloroform acts most satisfactorily, another produces, during the early stages of administration, a marked excitement and an irregularity of breathing, which prolongs the period of induction. Further investigation has therefore been deemed necessary, and a comprehensive and careful research has elucidated the cause of these hitherto unexplained phenomena (Wade and Finnemore, "Journal of the Chemical Society," 1904, **85**, 938). In the chloroforms which produced anæsthesia in a satisfactory manner, has been demonstrated the presence of ethyl chloride in minute and varying quantities. When the undesirable effects were noted, no ethyl chloride was detected in the anæsthetic. A physiological test conclusively proved that ethyl chloride was the factor which determined these differences.

Contradictory results

Recent research

Ethyl chloride

A chloroform which had previously given undesirable effects, and in which the presence of ethyl chloride could not be demonstrated, was modified so as to contain a small proportion of the latter. The chloroform then proved a most satisfactory anæsthetic, and there was entire absence of the excitement and respiratory irregularity previously observed. The results of this research are of the utmost value. In the initial stages of the induction of chloroform anæsthesia, the presence of a small quantity of ethyl chloride has a beneficial effect, leading to the absence of mental excitement, and steadies the breathing. The respiration is stimulated and becomes regular and deep. In these circumstances, satisfactory anæsthesia is induced with rapidity and ease.

Value of the investigation

A Chronological Table of Chief Events and Discoveries in the History of Anæsthesia

Nitrous Oxide

Joseph Priestley 1776
Humphry Davy 1800
Horace Wells (Colton, Riggs, Evans, Best) ... 1844

Alcohol

Collier 1835–42

Ether

Michael Faraday 1818
W. E. Clarke 1839
Crawford W. Long 1842
E. E. Marcy 1844
W. T. G. Morton 1846
Charles T. Jackson 1846
First surgical operation in America October 16, 1846
First surgical operation in Great Britain, December 21, 1846
(Warren, Hayward, Bigelow, Boote, Robinson, Liston, Buchanan, Louget, Snow, Simpson, Bernard, Clover)

Chloroform

Guthrie 1831
Waldie 1847
James Young Simpson 1847
First surgical operation under chloroform, in Edinburgh, November 15, 1847
(Soubeiran, Liebig, Dumas, Flourens, M. Duncan, G. Keith, Snow, Nunneley, James Arnott)

Cocaine

Gädeke 1855
Hughes Bennett 1874
Von Anrep 1880
Koller 1884

'WELLCOME' BRAND CHLOROFORM—*continued*

in administration, and its freedom from irritating and depressant principles removes the source of many of the accidents which have hitherto been regarded as grave objections to the employment of chloroform as an anæsthetic.

Confidence in administration

'Wellcome' Brand Chloroform is issued in 2 oz., ¼ lh., ½ lh. and 1 lb. amber-coloured bottles; also in 30 c.c. and 60 c.c. hermetically-sealed tubes, as illustrated on the previous page.

'WELLCOME' BRAND ETHER

'Wellcome' Brand Ether is prepared specially for anæsthesia and is thoroughly pure and reliable. When the administration of ether is desired, this product will be found eminently suitable.

The method of packing in hermetically-sealed tubes is especially desirable with such a volatile substance as ether, and the shape of the glass tube admits of the contents being readily transferred to the graduated bottles usually employed.

Ideal packing

'Wellcome' Brand Ether conforms to the requirements of the British Pharmacopœia for *Æther Purificatus*, and has a specific gravity of 0·720.

Conforms to B.P.

'Wellcome' Brand Ether is issued in hermetically-sealed tubes containing 30 c.c. and 60 c.c., similar to the Chloroform packing illustrated on the previous page.

The anæsthetics issued under the 'Wellcome' Brand denote the highest degree of perfection and purity.

It is well known tbat considerable variation exists in the quality and activity of tbe medicinal chemicals of commerce.

The need for reliable Medicinal Chemicals

Purity and reliability are matters of the utmost importance to prescriber, dispenser and patient alike, and every opportunity should therefore be taken to ensure the supply of only tbose chemicals and galenicals which are known to be thoroughly pure and trustworthy.

In order that goods answering to tbis description in the bighest sense may be at the disposal of the profession, Burroughs Wellcome & Co. manufacture and issue a series of fine cbemicals, alkaloids, etc., to whicb they bave recently added a series of standardised liquid and granular extracts and concentrated tinctures, under the distinctive title of the 'Wellcome' Brand.

Tbe advantages of galenicals containing a definite proportion of active principle over tbose that vary in strength with every sample of drug employed are now fully recognised, and several such have been admitted into the Pharmacopœia. With regard to galenicals, Burroughs Wellcome & Co. bave extended the standardisation by total alkaloid assay, and bave never adopted the basis of total extractive, regarding it as misleading and useless. Total alkaloid estimations have been adopted in so far as tbey secured definite standards of truly representative activity, but tbe firm has not been content to rely on this means alone. As the result of extensive researcb, they are able to offer many otber standardised preparations in addition to the official ones. Those galenicals which are known to be extremely variable in their character and action, and by their nature do not admit of exact control by chemical means, have been the subject of physiological research. Not being satisfied with the methods hitherto available, special processes of

Standardised galenicals

Physiological standards

designed to superscde, it is not compatible with acid liquids.

BISMUTH AND LITHIUM CITRATE (SOLUBLE), 'WELLCOME' BRAND. This new combination, in the form of handsome colourless scales, is readily soluble in water. It is thus particularly convenient when the effects of both lithium and bismuth are desired, as in gouty dyspepsia.

BISMUTH AND IRON CITRATE (SOLUBLE), 'WELLCOME' BRAND, permits the sedative properties of the bismuth to be exerted on the digestive organs, while the iron, which is presented in a soluble, non-irritating and non-astringent condition, is readily absorbed to attack the anæmia which is the exciting cause in some cases of dyspepsia. The salt is in the form of yellowish-green scales, readily soluble in water.

Sedative and hæmatinic

IRON ARSENATE (SOLUBLE), 'WELLCOME' BRAND, differs from the insoluble amorphous powders, of indefinite composition, so often prepared under this name, in being a scale preparatiou readily soluble in water, and containing an amount of arsenic equivalent to 34-35 per cent. of anhydrous ferric arsenate.

Definite composition

A series of *soluble* MANGANESE SALTS and combinations of the same with Arsenic, Quinine or Strychnine are unique forms in which this chemical may be prescribed with the best effect.

Soluble Manganese Salts

The 'WELLCOME' BRAND salts of PILOCARPINE, as a result of prolonged and costly investigations, are free from the less active isopilocarpine and the inactive pilocarpidine with which they are usually found to be associated. The melting point indicates the high purity of these salts.

Pilocarpine

A special feature is made of QUININE SULPHATE in the convenient form of *compact crystals* occupying one-third the space of the bulky chemical ordinarily offered.

Quinine Sulphate

'WELLCOME' Brand CHEMICALS

were awarded

A GRAND PRIZE

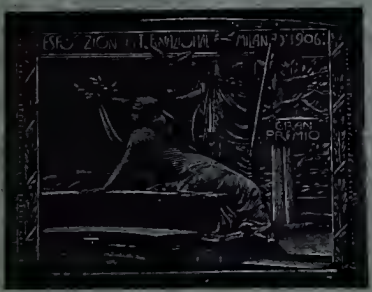
at each of the following International Exhibitions

ST. LOUIS, 1904 LIÉGE, 1905

MILAN, 1906

Grand Prize, St. Louis

Grand Prize, Liége



Grand Prize, Milan

DATE DUE

HISTORICAL

JUN 1 5 1997

YALE MEDICAL LIBRARY