

ON THE
INHALATION
OF THE
VAPOUR OF ETHER
IN
SURGICAL OPERATIONS:

CONTAINING A

DESCRIPTION OF THE VARIOUS STAGES OF ETHERIZATION,

AND

A STATEMENT OF THE RESULT OF NEARLY EIGHTY OPERATIONS IN WHICH
ETHER HAS BEEN EMPLOYED IN ST. GEORGE'S AND
UNIVERSITY COLLEGE HOSPITALS.

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PREFACE

FROM questions addressed to me by medical visitors and students, after the operations in the two hospitals in which I have had the honour of frequently administering the ether, I judged that a fuller account than I had hitherto given of the process might be useful and not unacceptable to many members of the profession, and that there would be some advantage in presenting it in a separate form, although, as a general rule, the medical periodicals and transactions of societies offer the best medium for communications of moderate length like the present.

I have treated as briefly as I could, in the following pages, of the chief application only of the great discovery that will render last winter a memorable epoch in the annals of medical science. I have not even alluded to the use of the vapour of ether in medicine or midwifery, and I have not entered on the relations of etherization to medical science or physiology, although there is a tempting field for research; for the power we have acquired, through the discovery of our medical brethren in America, of inducing at will and with perfect safety such a state of insensibility as we should previously have thought to be alarming, cannot be without its influence on the progress of our knowledge of the diseases of which insensibility forms a symptom, and of the functions of the nervous system generally.

The remarks in the text are confined strictly to the practical part of the subject, and a few explanatory notes that seemed to be required are placed in a short appendix.

The inhalation of ether will, no doubt, have superior works to the present dedicated to its elucidation before long, not only from increase of knowledge respecting it, but from improved ways of treating on it, for it is not easy to reduce a new branch of science to suitable language in the first attempts.

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THE point requiring most skill and care in the administration of the vapour of ether is, undoubtedly, to determine when it has been carried far enough. In order to communicate, with some degree of clearness, what I have been able to observe by close attention to the subject, I shall divide the effects of ether into five stages or degrees; premising, however, that the division is, in some measure, arbitrary,—that these different degrees run gradually into each other, and are not always clearly to be distinguished,—and that the language I have used has been chosen with the sole object that my meaning might not be mistaken.

In the first degree of etherization I shall include the various changes of feeling that a person may experience, whilst he still retains a correct consciousness of where he is, and what is occurring around him, and a capacity to direct his voluntary movements. In what I call the second degree, mental functions may be exercised, and voluntary actions performed, but in a disordered manner. In the third degree, there is no evidence of any mental function being exercised, and consequently no voluntary motions occur; but muscular contractions, in addition to those concerned in respiration, may sometimes take place as the effect of the ether, or of external impressions. In the fourth degree,

no movements are seen except those of respiration, and they are incapable of being influenced by external impressions. In the fifth degree, (not witnessed in the human being), the respiratory movements are more or less paralysed, and become difficult, feeble, or irregular.

If a middle-aged man, of about the average size, is supplied with air mixed with vapour of ether, in the proportion of 45 per cent. vapour to 55 per cent. air, and breathes it easily and without obstruction, he usually consumes about two drachms of ether per minute. It is not all absorbed, for a part is expired after passing no farther than the trachea. At the end of the first minute he is usually in the first degree of etherization; of the second minute, in the second degree; of the third minute, in the third degree; and at the end of four minutes, having inhaled an ounce of ether, in the fourth degree. If the inhalation is now discontinued, he commonly remains in this degree of etherization for one or two minutes, passes gradually back into the third degree, which lasts for three or four minutes, at the end of which time he is in the second degree, which lasts about five minutes, to give place to a feeling of intoxication and exhilaration, which lasts for ten or fifteen minutes or longer before it entirely subsides.

Having thus sketched an outline of the process of etherization, we may now proceed to examine the different states of it a little more closely.

Generally, all that the patient remembers of the effects of ether occurs whilst he is under its influence in the first degree only, and his feelings are usually agreeable—often highly so. I consider that it is not practicable to perform operations, in the absence of pain, without carrying the effects of ether further than this degree. Whilst the effect of the ether is going off, however,—after persons have been completely insensible,—they are not unfrequently free

from the pain of an operation, which is still going on, at a time when the mental faculties have returned, together with the special senses of sight and hearing, and when they are consequently in what I have denominated the first degree. Of this degree, as it follows the others, we shall have to speak again. If etherization is not carried further than this degree it quickly subsides, without leaving any appreciable effects; but if the inhalation is continued, the second degree succeeds to this.

When the ether is administered in the method that I recommend, the patient usually passes quietly and quickly through the second degree of etherization without its being manifested in any way. As he is not questioned, the state of his mental faculties does not appear, and he passes rapidly into the next degree. Sometimes, however, when from the tendency of the vapour to produce coughing it is given in a more diluted form than usual, and occasionally, also, from peculiarity of constitution, this degree of the effect of ether is made apparent by gesticulation, words, or attempts to move; and in hysterical females, sometimes by sobbing, laughing, or screaming. The patient often tries, by lifting up his hands or moving his head, to remove the **inhaler** from his face whilst in this stage. He feels something there interfering with his ordinary respiration, and the purpose and nature of it have passed from his mind; his endeavours are voluntary, but guided by instinct rather than reason. He can often be quieted by language addressed to him, and will do as he is bid, although unconscious of where he is,—as his answers, if he makes any, shew. At other times he is obstinate, or regardless of what is said. I believe that all the dreams which patients have when **taking** ether, occur only whilst they are under its influence in this degree. If the ether is discontinued at this stage of the inhalation, the patient goes back into the first degree,

either immediately or in the course of a few minutes, according to the extent he has advanced, or the time he has been kept in this degree. According to what I have seen, a surgical operation would cause pain, if etherization were not carried farther than this degree, although, if the pain should not arouse the patient and bring him back to the first degree, he would probably not remember it. But it would be more difficult for the surgeon to operate with this amount of etherization than without ether.* It appears that surgical operations have often been performed in this stage, and several eminent surgeons were at one time opposed to the use of ether, on account of the struggling which they supposed to be inseparable in most cases from operations performed under its effects.

When the patient has been more deeply etherized, he is often totally insensible to a surgical operation, as the effect of the ether is going off, whilst he is under its influence only to the second degree. Of this we shall speak below.

To proceed to the third degree. It is stated above that if the patient moves or struggles, when under the influence of ether in the second degree, his movements are guided by volition, though not by knowledge or reason; but if he struggles in the third degree of etherization his movements are not voluntary, any more than the struggling in hysteria or epilepsy. Usually, however, there is no struggling. The patient may have moved his eyes about in the second degree, and even directed them to objects, but in this degree they are stationary, or if they do move, their motions have

* From accounts that I have heard of two or three cases, it seems probable that if the patient were kept for some time in this stage of etherization, by breathing very diluted vapour, an immunity from pain might in some cases result; and this is corroborated by an observation I made on a bird, which had been for ten minutes in an atmosphere containing ten per cent. of vapour of ether; but it is not likely that such a plan of administering ether would generally succeed, or be so good as that usually adopted.

nothing of a voluntary character. They are sometimes turned upwards as in sleep, but I think not so frequently as in the next degree. The eyelids may be either open, or partly or tightly closed, but in either case, if lifted or moved by the finger, the orbicularis palpebrarum contracts. The breathing is usually regular and somewhat deep; the patient lying still, or, if sitting, having a tendency to slide out of the chair; but occasionally the limbs are rigidly contracted, and when this is the case the patient sometimes holds his breath for several seconds at a time. He may moan in this degree of etherization, but never gives utterance to articulate sounds, which are always an indication that he has not advanced farther than the second degree, or has returned to it. Therefore the performance of a surgical operation in this stage would not cause a person to cry out in articulate sounds, unless it roused him, and caused him to return to the second degree; it might, however, cause him to groan and flinch. If this degree is well established, and if the patient has been detained in it, at the same point, by inhaling at intervals, or by inhaling dilute vapour, an operation may usually be performed without producing any other effect than a distortion of the features expressive of pain, and, perhaps, a slight moaning, and an increased frequency of respiration, and, in some instances, a general rigidity of the muscular system. If this degree of etherization is not well established when the operation begins, the first cut may cause a sudden contraction of the whole muscular system. Persons in a full state of health, and more particularly those in a state of plethora, are much more liable to struggling and rigidity in this degree, than those whose strength is reduced by illness; and if from any cause the supply of atmospheric air is limited, and something of asphyxia is combined with etherization, I believe that the struggling is more liable to occur,

and is more severe. There is never any recollection of operations in this degree, even when symptoms of pain have been exhibited, and there is scarcely ever, I believe, any sign of pain in this degree, when it succeeds to the fourth, as the influence of the ether is subsiding. If the exhibition of ether is discontinued in the third degree, the patient goes back into the second degree immediately, or in the course of two or three minutes.

In the fourth degree all the muscles are relaxed, and the limbs hang down, or rest in any position in which they are supported. The eyelids fall down over the eyes, or remain as they are placed by the finger. The eyes are either turned up or remain central. The breathing is deep, regular, and automatic, and there is often snoring. The muscles of the face partaking in the general relaxation, the countenance is devoid of expression, having a placid appearance as in a sound sleep. Sometimes the lower jaw has a tendency to droop; the mouth is partly open, and the features are so relaxed, that the countenance is altered, and has the vacant appearance seen in paralysis, idiocy, or a helpless state of drunkenness; and if there is at the same time snoring and blowing of the lips in respiration, as now and then happens, an appearance is met with that would be truly alarming, if we did not know that it was only due to an agent which is flying away every moment in the breath, to leave the patient, in a few minutes, without any permanent trace of its having been there. In this degree of etherization the patient always remains perfectly passive under every kind of operation; and as the muscles are completely relaxed, this is the proper stage for the reduction of dislocations. The patient never begins to snore until he has reached the fourth degree, or is passing into it from the third, and from all that I have hitherto observed, I believe that when he snores from the effects of ether, he

is always totally insensible to every thing which is done to him. This degree of etherization seldom continues more than two or three minutes after the process of inhalation is left off, and I have never kept the patient in this stage more than five or ten minutes; but in operations of long duration have allowed the effects of the vapour to diminish somewhat from time to time. The integrity of the functions of respiration and of circulation is not impaired in this degree. The breathing is generally deeper than usual, and although it has been somewhat stertorous in two or three instances, yet it continued with great regularity, and the stertor subsided in a minute or two. The pulse is distinct and of good volume, even in patients affected with hectic, in whom, just before the inhalation, it was small and hard. It is usually accelerated, as in all the other stages of etherization. The sensibility of the glottis and pharynx continues in this degree, for the blood which flows backwards in operations on the nose and mouth is all swallowed, none of it getting into the trachea.

In the fifth degree, as met with in animals inferior to man, they remain motionless and flaccid as in the fourth degree, and respiration begins to be irregular, feeble, or laborious. The muscles of respiration begin to suffer the loss of power which already involved the merely voluntary muscles. The sensibility on which respiration depends, and which has outlasted the special senses and common sensibility, now begins to be abolished under the effects of an increased quantity of ether. This is the stage immediately preceding death when animals are killed by ether, and there can be no doubt that it would be met with in the human being, if the vapour were exhibited so as to increase its effects to a dangerous degree beyond what is ever required (1).*

* The numbers refer to the Appendix.

the breathing has not actually ceased when the vapour is discontinued, they always recover, as was stated by the author, at the College of Physicians, when he had the honour of performing some experiments at the conclusion of Dr. Wilson's Lumleian Lectures, on the subject of Pain, in March last. This circumstance illustrates forcibly the great safety of the inhalation of ether, and how much it differs in this respect from asphyxia, and the exhibition of narcotics by the stomach.

The fifth degree of etherization has only been mentioned as a state to be avoided, and we proceed now to the degree which follows the fourth, when the patient is no longer kept in it; and this is the third degree, as it appears a second time. It is usually less marked now than when it preceded the fourth degree, and struggles and rigidity are less frequent,—seldom, if ever, taking place except they have previously occurred in the same degree, and not by any means constantly, when such has been the case. If struggles do occur, and especially if they are accompanied by moaning, as sometimes happens, and if a surgical operation is going on, it may appear to an inattentive observer that the patient is feeling pain, when such is not the case; for a closer attention will shew that the supposed signs of pain are not increased when cuts are made, or ligatures tied on the arteries; and if the ether is not re-administered, and the patient is allowed to recover still further during the operation, it will probably happen that in the second degree he will either lie perfectly calm, or talk in his dreams about subjects totally unconnected with pain, or the operation which is still going on. And it is not to be supposed that he is becoming less sensible as the effects of the narcotic are subsiding. I believe that pain is seldom felt in the stage of which we are treating—the third degree succeeding the fourth—and of course never remembered afterwards,

as there is no knowledge or mental perception of it. This stage of etherization seldom lasts longer than from two to four minutes before it gives place to the second degree, if the inhalation is not resumed.

The second degree is usually much better marked as the patient is recovering from the ether, than when he is getting under its influence; it also lasts much longer at this time, the reason of which is obvious; for when he is inhaling the vapour he is quickly removed from this into the third degree, but when the inhalation is discontinued the vapour is got rid of, in a ratio varying directly with the quantity in the blood, which is a constantly decreasing ratio. The blood, in passing through the capillaries of the lungs, shares its ether with the air taken into the air cells, and, consequently, the process of de-etherization becomes slower as it goes on (2). For this reason, also, this degree continues longer than the third, often lasting five minutes, and occasionally more than twice that period. The dreams which patients so often say that they have had during the operations, take place, I believe, only in the second degree of etherization; and generally in the recurrence of this degree, as the effects of the ether are subsiding, and more commonly after than during the operation. If the patient talks, it often happens that what he says is in accordance with what he afterwards remembers of his dreams, which often refer to early periods of his life; and a great number of patients dream that they are travelling. The impression of the length of the dreams can of course be no argument as to how long the person was dreaming, and that impression is often of a longer time than the whole period of insensibility; and I think that there is every reason to presume, that there can be no dreams or ideas of any kind in the third and fourth degrees of etherization, and that for a short time there is not only, as in a sound sleep,

the absence of mental functions, but also the impossibility of their performance. Indeed, from a comparison of what patients sometimes express by words or gestures under the influence of ether, with what they say of their dreams, it would appear that the dreams which are remembered occur only when the patients are fast emerging from the second degree into a state of complete consciousness. Some of the mental states met with in this degree are highly interesting in a psychological view, but the description of them does not form a necessary part of this small treatise. The laughing and crying, which are now and then met with in this degree, are not always the result of joy or sorrow, or even connected with any state of mind corresponding to the expressions, but resemble the laughing and crying of hysteria. The patient is often incapable of pain in the stage which we are considering, but not always so; very commonly he is so in a part of this stage, but if the operation continues he begins to shew signs of feeling it, and the inhalation has to be resumed before he passes into the first degree.

After the patient has recovered his consciousness of surrounding circumstances, there is usually a degree of exhilaration, or some other altered state of the feelings for a little time,—accompanied, sometimes, with a little confusion of the mind, and inability to walk steadily. This, which I have called the first degree of etherization, subsides more slowly than the other degrees, remaining, in some instances, half an hour in a marked degree, and to a slight extent for two or three hours. The patient often expresses his gratitude to his surgeon in more ardent and glowing terms than he otherwise would do if the remaining effect of the ether were not counteracting his usual reserve. Let us hope that *in æthere veritas* is as applicable as the old reading, and that, in these instances, we only witness

the usual feeling of the public towards the medical profession. Commonly, the patient would feel pain if any part of an operation were performed in this stage, but not always; for, in some instances, the special senses of sight and hearing, and complete consciousness and volition, return before common sensibility, and the operation may be going on, for a short time, without his feeling it, and perhaps, whilst he, thinking that it is concluded, is remarking that he did not feel it. But even in these exceptional cases the patient soon begins to complain if the operation continues. Sensation usually, however, remains blunted for some time, and there is generally no smarting in the wound for a little time (often half an hour) after consciousness has completely returned.

The effects of ether were divided into three stages by Dr. Plomley, of Maidstone,* early in the year. The first degree in the above division would include his first two stages, and the next three degrees would be comprised in his third stage. M. Longet † divides etherization into that of the cerebral lobes, and that of the annular protuberance; and M. Flourens makes three degrees as follows:—

“Under the action of ether, the nervous centres lose their powers in regular succession; first, the cerebral lobes lose theirs, viz. the intellect; next, the cerebellum loses its, viz. the power of regulating locomotion; thirdly, the spinal marrow loses the principle of sensitiveness and of motion; the medulla oblongata still retains its functions, and the animal continues to live: with loss of power in the medulla oblongata, life is lost.” (*Gazette des Hôpitaux*, 20 Mars, 1847: quoted in *Brit. and For. Med. Rev.*)

My second degree corresponds to the etherization of the cerebral lobes of M. Flourens. There are, to be sure,

* *Lancet*, Jan. 30.

† *Archives de Méd.*, Mars 1847.

occasionally, dreams and indications of disordered intellect, but these could not be recognized in animals, the subjects of his experiments. His next stage corresponds to my third degree; and his last, or the etherization of the spinal marrow, to my fourth degree. The division I have made from observations on patients, will, I think, be found to be better for practical purposes than this, which it very much resembles, of M. Flourens, the result of experiments on dogs; and it involves no theory about the functions of the nervous centres, which is perhaps an advantage, as those, particularly of the cerebellum, are probably not definitively known.

It will be observed, that the non-liability to pain does not correspond uniformly with the state of the patient in other respects when under the effects of ether, and that I have made the division into degrees, according to the other and obvious symptoms, and not according to that which could only be determined by the knife.

The question may be asked, whether the medical man can always determine in what degree of etherization the patient is, and by that means estimate correctly whether or not he is liable to pain. I am not sure that he always can, by the mere observation of the patient. I have never been deceived as to the degree of etherization, but then I always know the strength of the vapour which the patient is breathing, and by observing the length of time that he has been inhaling, and the depth of his inspirations, I know in what stage he ought to be, and am in this way guided in the cases in which well-marked symptoms are absent. In many cases, the moment when an operation may, with propriety, be commenced, is indicated by unmistakable signs; but, in other instances, it must be acknowledged that the point has to be determined by the consideration and balancing of several particulars. This, however, ought to

be no obstacle; for it is only in this way that the medical man is guided in his usual avocations. His diagnoses and prognoses are generally arrived at by a mental operation of this kind, and not by the observation of some certain sign.

(To be continued)