SULPHURIC ETHER AND CHLOROFORM

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ANÆSTHETICS,

CONSIDERED

WITH REFERENCE TO THEIR RELATIVE SAFETY AND EFFICIENCY.

BY

FREDERICK D. LENTE, M. D.,

OF COLD SPRING, NEW YORK.

EXTRACTED FROM

The American Journal of the Medical Sciences for April, 1861.

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NOTWITHSTANDING the many plans that have been devised within the past few years for avoiding the dangers of chloroform inhalation, or for recovering the patient when threatened with its occasional alarming consequences, and the many ingenious contrivances, in the way of inhalers, invented for the same purpose; deaths, which, upon autopsy, can be attributed to no other cause than the anæsthetic, do still occur; and seemingly in as large a ratio as ever; for we are, every now and then, as we open a number of some foreign or domestic journal, greeted with the unwelcome caption, "Death from chloroform;" not occurring as they formerly did, in a considerable proportion of the cases, during the administration of the agent by dentists and non-medical persons, but in the practice of men well known in the profession. One effect of this, on the writer at least, is to produce a very unpleasant anxiety during the performance of any operation with the aid of anæsthesia, in addition to that which naturally attaches itself to every operation of importance, and which, more or less, distracts the attention of the operator, according to the more or less reliance we place on the judgment of the person intrusted with the administration of the anæsthetic; and unless in a city, a reliable assistant is not always to be obtained. The important question is then still before the profession—*how are the dangers of anæsthesia to be avoided?*

Greater or less danger is inseparable from the administration of every powerful agent in the Materia Medica, however cautious and skilful the practitioner by whom it is employed; nor can we reasonably expect that an agent, so powerful as in a few minutes to render the body insensible to the pain of a torturing operation, shall be entirely exempt from risk. By what means, then, can we reduce this risk to its *minimum?* One tells us that it is to be effected by the use of his inhaler; another by his; another by some peculiar arrangement of the sponge or towel so as to insure a due admixture of atmospheric air, or by regulating the successive doses of the agent. But still the fact stares us in the face that the number of deaths is not diminished.

Various anæsthetics have been proposed, but only two have stood the test of time—sulphuric ether and chloroform. Both have been used to a

great extent all over the world; but, for some years past, the latter has almost entirely superseded the former in Europe,[1] and still retains the confidence of many of the profession in this country. Five years ago, when the number of deaths from anæsthetics had fully aroused the profession to the necessity of seeking some means of diminishing its danger, the writer published an article in the *New York Journal of Medicine*, calling attention to the fact that it was from chloroform that all these accidents had occurred, and that the most obvious means of avoiding their repetition was its entire disuse, and the substitution of its less dangerous, but no less efficient competitor—sulphuric ether. Some months after this, an article, from the pen of M. Barrier, of the Hôtel Dieu de Lyons, appeared in a French journal, taking precisely the same ground, which was extensively noticed in foreign journals. But whether either article had any effect in directing the notice of surgeons more forcibly to the comparative safety of ether is not apparent. Since that date we have met with additional facts bearing on the relative value of these anæsthetics, and have thought that some good might perhaps result from again endeavouring to direct the consideration of surgeons to this matter.

In the first place, it is important to correct a very erroneous impression which has got abroad in consequence of the publication of certain European statistics of death from sulphuric ether and chloroform. These statistics have been recently referred to as authority in an editorial in the *American Medical Times* (August 18th), which gave rise to a correspondence in the September number; from which it appears that they were taken from a work by Dr. Kidd, or from an extract from this work published by the author in the *London Med. Times and Gazette.* From these statistics it would appear that, out of one hundred and twenty-five deaths from anæsthetics in Europe, twenty-five are from ether, which, if accepted, would indicate that it is fully as dangerous as chloroform, the latter having doubtless been employed in at least five times as many instances. Upon examination, however, we find that the authority for the ether cases is, in most instances, a bare statement of M. Trousseau, without any reliable details whatever. Some of these alleged cases of death from ether are noticed by Dr. Snow in his work on *Anæsthetics;* and, except in two instances, the fatal result is clearly not chargeable to the ether, but to the shock of the operation; as for instance in the two cases on p. 365 (Lond. edit.). In one of these cases, the patient did not succumb until the third day; and in the other, forty hours after the operation, which was a very protracted one, and during which the patient was not even thoroughly etherized, thus failing, as it should have done, to diminish the shock. The coronor's verdict was, nevertheless, "Death from ether." I will only refer

[1] Sulphuric ether is not, I believe, employed anywhere in Europe except in Lyons and Naples.

to two other cases (pp. 268–269). In one, the operation was an amputation of the thigh for compound fracture of the thigh with extensive laceration, and a simple fracture of the other thigh. The etherization was not perfect during the most painful steps of the operation, and its shock thus undiminished; as might have been anticipated from the nature of the injury, the patient died, but not until *three hours* after the amputation. In the second case, a cancerous tumour, weighing three and a quarter pounds, was removed from the breast of a feeble old man; and here also the fatal result occurred only after the lapse of *seven hours*. Dr. Kidd's language is too vague to admit of any confidence in his reports regarding so important a matter as the one under discussion. He speaks of deaths from ether, and from a mixture of ether and chloroform, and from amylene, in such a confused manner that one is completely in the dark as to how many are to be attributed to each of these agents individually, even if it be admitted that they were due to the anæsthetic, and not to the accident or operation. But if any one wishes to get a clear idea of how utterly unreliable Dr. Kidd's writings are, he would do well to peruse the review of his "little work on chloroform" in the *London Med. Times and Gazette*, or the *Edinburgh*, or the *Dublin Medical Journal* for 1858. Whether the death in any given case is to be attributed to the anæsthetic, or the shock, or hemorrhage, or other accident connected with the operation itself, is often a matter of opinion or judgment, and sometimes, perhaps, even of prejudice; as in some of the cases above alluded to. Therefore, each case, to be accepted as authentic, should be carefully given in detail, and, if possible, accompanied with the autopsy. For instance, in two cases of alleged death from sulphuric ether recorded in Dr. Snow's work (pp. 362–64), the author repudiates the idea of the death being due to the anæsthetic; whereas, both cases certainly admit of doubt, and most readers would find the ether guilty in one instance.[1]

Let us now inquire how many authentic cases of death from sulphuric ether are to be found on record. Happily they are few indeed. The only European case worthy of credit, and this repudiated, as we have seen by the highest authority, is that which happened at the Hôtel Dieu d'Auxerre. At the autopsy, the spleen was found disorganized; but the general condition of the patient was good previous to the operation, which was for cancer. The case which happened under M. Barrier's hands at Lyons, I think, we may fairly attribute, with Dr. Snow, to the hemorrhage and shock of the operation. With regard to American cases, I will first notice that which happened at Bellevue Hospital in the city of New York; which will be found well reported in the *New York Journal of Medicine*

[1] Dr. G. Hayward, of Boston, who is excellent authority in this matter, agrees with Dr. Snow, that no well attested case of death from sulphuric ether is recorded. (British and For. Med.-Chirurg. Rev. for 1859.)

for July, 1859. It is hardly fair to attribute the fatal result in this instance to the anæsthetic, when it is known that the autopsy revealed a *large malignant tumour of the cerebellum;* also that the patient had been suffering for weeks with unmistakable symptoms of serious disease of the brain; unsteadiness of gait, loss of vision in one eye, partial loss of mental power, constant tendency to roll out of bed, always to one side; and especially when it is known that sudden death is very apt to occur, if indeed, it does not always occur, in these cases of tumour of the cerebellum. Dr. A. Clark referred to two cases at the meeting of the Pathological Society of New York, at which this case was reported, of sudden death, where the autopsy revealed tumour of the cerebellum. Dr. Eve relates two cases of what he considers death from inhalation of sulph. ether, in the *Southern Med. and Surg. Journ.* for 1849, republished in the *Am. Journ. of Med. Sci.* for the same year. The first was that of a medical student, who, for amusement, inhaled about an ounce of the liquid, and became furiously excited, so that it required several persons to restrain him. He fell into a deep sleep, was awakened, and became again excited and uncontrollable; then was allowed to be quiet, and slept well all night, complaining next morning only of a slight headache. This soon increased to severity, and he died of symptoms of *phrenitis.* But no autopsy was held, nor is there any evidence of inquiry into his previous history, as to symptoms of cerebral disease. It is at least doubtful, admitting phrenitis to have been the immediate cause of death, whether this was due to the ether directly, or to the violent excitement caused by the etherization having been arrested previous to complete insensibility. Dr. Eve's second case occurred in the practice of his friend Dr. Bassett, at Huntsville, Ala. The patient was labouring under a violent attack of tetanus; and, we may infer from the history, that he was well nigh exhausted by the disease before the consultation was held at which it was determined to give ether. The report states that, *in one minute,* he was under its full influence, and in a quarter more, he was dead. This case occurred shortly after the discovery of the anæsthetic influence of ether; and probably none of those present were acquainted with its phenomena. If they had had the experience of the present day, they never could have arrived unanimously at the conclusion that the patient died of the effects of the ether. It is almost, if not absolutely impossible to induce full anæsthesia with ether in the time alleged; the supposed anæsthesia was doubtless the death-stroke of the disease.[1]

But it scarcely falls within the scope of this paper to discuss the use of anesthetics or their dangers in *medical* practice; and we might, with propriety, have omitted all reference to these cases, were it not that we might be suspected of concealing unfavourable facts, in order to place sulph.

[1] Dr. Hayward relates one case, which he saw at Naples, where anæsthesia was effected with sulph. ether in one minute and a third. But this case is unique.

ether on a more favourable basis. If anæsthetics be made use of in medical practice, especially in those violent, dangerous, and oftentimes almost incurable cases to which they are generally applied, as in tetanus, epilepsy, puerperal convulsions, delirium tremens, cerebral diseases, and the like, we must expect a sudden death now and then—either from the disease, and coinciding with the administration of the anæsthetic, or from the combined effect of the disease and the remedy—just as we occasionally witness the death of a patient from croup, during the attempt to save life by tracheotomy. I have myself desisted from administering chloroform to a man labouring under tetanus, who had been relieved again and again by it of his terrible suffering, because it was evident that he was liable to die during the application of the remedy. I have abandoned anæsthetics in the paroxysms of delirium tremens, because I found there was danger of immediate death from the combined effect of the vapour and the violent resistance to its reception by the raving patient. I deem it my duty to allude here to two other *surgical* cases which I know to have happened recently, where the ether might be considered as chargeable with the fatal result. In one, at least, from the history of the case, I think it was so. It is to be regretted that the history of these cases cannot be fully given. In one the patient was exceedingly reduced, and in an almost hopeless condition, previous to the operation; but the death, which occurred suddenly, and during the insensibility from the anæsthetic, was probably not entirely due to the shock of the operative procedure. In the second case, the operation, which was not a "cutting" one, necessitated a very unfavourable position for giving ether, the head being flexed forcibly on the chest; and it was while in this position, that the patient was noticed to be in a dying condition—too little attention having probably been given to the state of the respiration and pulse. Both these operations were performed by a skilful and experienced surgeon.

We thus admit *three deaths* from sulph. ether throughout the world. It is safe to say that there have been at least a hundred from chloroform in Europe alone. It is impossible to give the *ratio* of deaths to the *number* of inhalations of these two agents respectively, which is very desirable. But, we know that, for one year before the introduction of chloroform into practice, sulph. ether was the sole anæsthetic; that it was very extensively employed in Europe and America; that ever since, ether has been almost the only anæsthetic in some of our large cities, and for some years past almost exclusively used in most of our large hospitals in the United States. Dr. Geo. Hayward, of Boston, who was the first surgeon to use an anæsthetic successfully, in a capital operation, and to whom is due the credit of having made the most persevering and successful efforts to obviate the dangers of anæsthesia, by recommending the disuse of chloroform, had personal experience of near a thousand cases of ether inhalation, near two years ago, which of course only comprise a certain proportion of

the cases that have occurred in his city under other surgeons. Dr. Hayward informs us, in a letter just received, "that ether is administered in this city (Boston) daily to a great extent, without producing death in a single instance, or any alarming or troublesome symptoms." In the New York Hospital, ether has been almost, if not entirely, the only anæsthetic for some twelve or fourteen years. It has been stated, by French authority (*L'Union Médicale*), that from 18,000 or 19,000 chloroform inhalations in the Crimea, only two deaths took place—one in the English, and one in the French army. The assertion of M. Baudens, that among 30,000 cases in the Crimea, no death occurred from anesthesia, is denied by other French army surgeons, who themselves saw deaths from it. As we have before asserted, it is a matter of individual judgment, in many cases, as to whether the death is to be attributed to the anæsthetic; and we may well suppose that, on the field of battle, it would be extremely difficult, if not impossible, in most cases, to judge whether a death, occurring during a terrible operation or soon after it, while the patient is still suffering from the shock, is due to the one cause or the other. This must have been especially the case on the sanguinary fields of the Crimea, where the surgeons were so overtasked that they could have had but little time or inclination to note the relative effects of the chloroform and the knife, or the injury. In the hospital operations the case might be different; but even there, the same cool judgment cannot be bestowed on the cases as in civil hospitals, where medical assistants and spectators are numerous, and not personally absorbed in the operative procedure. If these reflections are unjust, it is unaccountable that such a disproportion of deaths to the number of cases of inhalation should have occurred in military surgery, and under comparatively unfavourable circumstances. Every medical man who reads the periodicals of the present day, especially the foreign, must be struck with the frequency with which "death from chloroform" meets the eye, and yet it would require many months to add up 30,000 cases of chloroform inhalation in civil hospitals; and it is from hospitals almost exclusively that we get our reports of fatal cases. The ratio of fatal to successful cases of chloroform inhalation must therefore be greater than these military statistics would indicate.[1]

But, there are other evidences in favour of the superior safety of sulph. ether besides those deduced from statistics, which latter may be considered, and are to some extent, imperfect, as regards both these agents. First, it is admitted, universally, that ether is less powerful than chloroform, and therefore there is less danger of that sudden and unexpected action, which

[1] It is a significant fact, alluded to by Dr. Snow, that although ether was used over a year in Europe and America before the discovery of chloroform, only one death occurred from anæsthesia. Whereas, chloroform was only introduced to the profession in November, and in January a death from it occurred, and soon after, others in various parts of the world.

has been the cause of most of the deaths from anæsthesia; or, of the ill consequences of carelessness or inattention on the part of the person intrusted with its administration, which has no doubt been the true cause of not a few of the fatalities.

The evidence of physiologists, who have largely used both these agents in quieting animals subjected to vivisection, points strongly to the greater safety of ether inhalation, the occurrence of accidental death being very common under the use of chloroform, and very rare with ether—the insensibility being complete in both instances. My friend, Dr. H. B. Sands, of the University of New York, found it so in his numerous experiments, and he informs me that Prof. Dalton, the distinguished physiologist of the same institution, has met with like results. Dr. Snow, whose authority has been so often quoted, and whose opinions on these subjects are regarded with the greatest respect by the profession in Great Britain, says, p. 362, "I have not been able to kill an animal in that manner (meaning the sudden manner in which he found chloroform act) with ether, even when I have made it boil, and administered the vapour almost pure." He adds, "I hold it therefore almost impossible that a death from this agent can occur in the hands of a medical man, who is applying it with ordinary intelligence and attention." The following incident, which recently fell under my own observation, is sufficiently interesting in this connection to merit an introduction here, for it seems to settle the question, as far, at least, as the inferior orders are concerned, of the relative safety of the two anæsthetics under discussion. My old friend, Mr. John Lyell, a teacher in this place, has a large number of bees, with whose operations he has long been in the habit of amusing himself, during his leisure hours, and wishing to take his honey without destroying his pets, asked my advice about resorting to anæsthetics. I advised chloroform, as being the stronger and more convenient agent, and the one usually employed for such a purpose. He accordingly tried it; but, on finding that he lost a great many bees by suffocation, he substituted sulph. ether. This he found equally efficacious, and, what is very remarkable, that he did not by it lose a single bee, while he showed me more than a quart that had been destroyed by the chloroform, the insensibility having been just as perfect and prolonged in both instances, and both agents employed in the same manner, and under the same circumstances. It may not be out of place to relate a case which occurred a year ago, in my own practice, as showing the greater facility with which recovery ensues from too thorough anæsthesia from ether than from chloroform. The operation consisted in the removal of a fibrous tumour from the submaxillary region, together with the submaxillary gland. It was requisite that the insensibility should be complete; and, in addition to this, the necessity for keeping the handle of a knife in the mouth in order to force out the tumour, and render it salient externally, tended to impede the respiration still more. The ether was superintended by a sur-

geon attached to a large hospital, and well acquainted with the action of anæsthetics, who noticed, after the inhalation had proceeded satisfactorily for some time, and after the operation was nearly finished, that the respiration and pulse were both failing. Further proceedings were immediately suspended, and for a time the danger seemed imminent. The window was opened, a little water dashed in the face, and the patient allowed to remain perfectly quiet. In a few moments he revived, the respiration and pulse resumed their natural rhythm; he was again brought under the influence of the ether, and the operation completed. It was not only my opinion, but that of at least two of the hospital surgeons present, that had it been chloroform instead of ether, the case would not have terminated so favourably.

Another case, illustrating still more forcibly this matter, occurred a short time since at the New York Eye Infirmary, to which I am permitted to allude, by Dr. Noyes, of that institution. The patient had been thoroughly *etherized*, and had been breathing stertorously, when his countenance was observed to be livid, his respiration to cease, and his pulse very feeble. He was turned on his side, his tongue drawn forward; and, very soon, without any further treatment, his pulse and respiration resumed their wonted fulness and regularity. Some cases have been reported of apparent death from *chloroform*, in which the patients were resuscitated; but it was only by the most energetic means, including skilful and protracted artificial respiration. But, it is unfortunately true that artificial respiration, which, by Marshall Hall's method, is so successful in cases of asphyxia from quite protracted submersion, and in suspended fœtal animation, and even after poisoning by narcotics, has very generally failed in suspended animation from chloroform inhalation. A few cases, however, of resuscitation of patients asphyxiated by chloroform vapour, which have fallen under my notice, seem to indicate that artificial respiration, if resorted to at once, and before loss of time, and possibly additional injury to the patient by other less efficient measures, might prove less unsuccessful. Prof. Metcalfe, in a paper on this subject read before the New York Academy of Medicine, some years ago, mentions four cases of recovery after pulse and respiration had ceased. One occurred in his own practice. He promptly applied his lips to the mouth of the patient, and inflated the lungs, while another physician compressed the thorax and produced expiration. Prof. Valentine Mott informs me that he had two cases in his own practice, where the patients were rescued from impending death by prompt artificial respiration. One was the case of the wife of a medical gentleman in New York; the other was a child, on whom he operated for stone. I find a case in a late number of the London *Lancet*, of which the following is a brief abstract: Chloroform was administered to a girl 23 years of age, for the purpose of amputating the thigh. Everything seemed to be going on as usual, and the operation was about to be commenced, when "she *sud-*

denly ceased to breathe, and the pulse could not be felt; cold water was instantly thrown on her face, air freely admitted into the room, and artificial respiration kept up by alternately compressing and relaxing the chest." No success. "The head fell on the chest, the chin dropped—in fact, she appeared quite dead. As a last resource, in order to use artificial respiration more effectually, it was decided to open the trachea, and inflate the lungs through the wound. This was at first done with the mouth applied to the wound, with some success. A female catheter was now introduced into the trachea, and artificial respiration kept up through it." This was fully successful. In most, I believe in all the above cases, the respiration was kept up by the old method—*insufflation;* in the last case, we see that it was successful after the mechanical method had failed. It may be that chloroform asphyxia is not as amenable to the "ready method," and other similar means of inducing respiration, as the asphyxia referable to other causes. It is certain that to be effective it must be far more prompt.

It is proper to make a brief allusion to a mixture of chloroform and sulphuric ether, which has been recommended as an anæsthetic, with a view to combine the advantages of both, and to lessen the danger of the former. It was at one time used to a considerable extent. A death from this anæsthetic occurred in the service of M. Valette, of Lyons; and another is reported from Virginia; but, from the history of this case, there is doubt whether the fatal result might not have been, with greater propriety, attributed to the operation. My own opinion of this mixture, without any actual experience, is that it is more dangerous than either the one or the other anæsthetic alone. For, the person intrusted with its administration, supposing it to be less dangerous than chloroform, gives it more rapidly, and perhaps with less care; whereas, he may be giving the chloroform almost as pure as if it had not been mixed; for the ether being far more volatile than the chloroform, six times, according to Dr. Snow, is soon dissipated, and the latter left on the sponge to be inhaled alone. Unless they could be uniformly evaporated together, I see only danger in combining them.

But, even if admitting the greater safety of sulph. ether, its opponents argue that, after all, the proportion of deaths from chloroform is extremely small compared with the aggregate number of cases of inhalation; that no powerful drug in the *materia medica* can show as clean a record, and that the complexity of the apparatus necessary for giving it, the inconvenience, the delay, the quantity required, and other alleged disadvantages of ether, more than counterbalance its greater safety. Let us now examine these objections; but, first, I am ready to admit the wonderful safety of chloroform inhalation, considering its astonishing power in annulling pain and spasm, and that the proportion of fatal cases to the actual number in which it has been employed under almost every conceivable circumstance, is extremely small. But, if we have a simple means of reducing this pro-

portion still more, as I contend we have, it is our duty to do so. The objections above enumerated are urged by those who have not given ether a fair trial, and would soon vanish if they were deprived of chloroform. I know this from actual experience. Connected with the New York Hospital, at the period of the discovery of the anæsthetic power of sulph. ether, as assistant to the house surgeon, it was one of my duties to administer it to patients about to undergo operations, and no difficulty was experienced in producing its full effect. It was administered by all the surgeons until the introduction of chloroform. It was now soon discovered that ether was troublesome, that large quantities were required, increasing the expense, and that it often failed to produce full insensibility even after considerable delay; it would often be cast aside after a few minutes' trial, and chloroform substituted; with a few drachms, or perhaps an ounce or so of this, and the delay of only a few minutes, the patient would be in a stertorous condition, and all trouble over. The inference was plain, ether was uncertain in its operation, productive of unnecessary delay, and ought to give place to chloroform; and so it did. But, soon one or two deaths from it were reported; and, one day, while we were chloroforming a patient, to whom I had myself assisted in giving it but a short time before without a bad symptom, he suddenly died, and nobody was to blame on the coroner's inquest, and to nothing else could the unfortunate result be attributed but the anæsthetic.[1] So to avoid a similar occurrence, as no one had then heard of a death from ether, it was resolved to return to it; and, after this, we had no more difficulty in etherizing patients. But let us take up the objections in detail, and consider them fairly. First, as to *quantity*, being a less powerful agent than chloroform, it must of course be used in larger quantity to produce the same effect, but by no means in the enormous quantities alleged by those who prefer chloroform; that is, if properly administered; and the proper mode of giving it will best be considered here. If one accustomed to the careful and gradual manner in which chloroform must needs be given to insure any degree of safety, attempts to give ether in a similar manner, and without bearing in mind that it is not liable to that sudden action of the former, and especially that it is six times more volatile, he will certainly fail, or be subjected to great delay and inconvenience, and use enough of the drug to put half a dozen patients asleep. I have known skilful physicians to do this very thing, and have put patients sound asleep for the dentist with two or three ounces, who had been previously subjected to the fumes of ether for half an hour, in one instance, the patient said, an hour, involving also the waste of near a pound of the anæsthetic, the effort finally ending in failure. For an adult, two or three ounces, sometimes less, are abundant for the production of full anæsthesia for a painful operation. For children, from three drachms to

[1] Case reported in Dr. Snow's work, p. 136.

an ounce and a half, according to age; children are affected much more readily and pleasantly by anæsthetics than adults, with the exception of the preliminary struggles from fright, during which the inhaler should be kept closely applied. By using a properly constructed inhaler, even less ether would probably be consumed. And this I conceive to be the only advantage of an "inhaler." As regards delay, I think it is increased; as regards safety, I cannot see that it is enhanced by any of the various apparatus invented. In the very first fatal case reported as having occurred from ether, an "inhaler" was used.[1] The principal alleged advantage of a regular inhaler is the regulation and due admixture of the air admitted. But this can be just as well regulated by a proper arrangement of the sponge, or even the towel, as will presently be explained. My friend, Dr. Squibb, of Brooklyn, has recently, through some mistake, represented me as advocating the inhaler which he highly approves of, made by rolling up a thick, folded towel in a cylindrical form, open at top and bottom; the ether is poured around the inside of this, and the open top insures a safe amount of air—unfortunately, for its success, too large an amount. On this recommendation, Dr. Weir, of the New York Hospital, tried it, but found that it caused much waste, both of time and ether. I will quote from an article on this subject, furnished by me to the *New York Journal of Medicine*,[2] to explain my mode of employing it, which is the plan originally adopted in Boston, and now generally used throughout the United States, with some trifling modifications. "To be effective within a reasonably short time, it must be given rapidly, and the *access of air cut off as much as possible*, the reverse of what is safe with chloroform. The only effective inhaler we have used or seen used, is a large cup-shaped sponge, sufficient to cover completely the nose and mouth, and covered with a thick folded napkin, to prevent undue evaporation as far as possible." I now pour into the sponge about half an ounce of ether, and, covering it fully with two thick towels placed together and folded into a square large enough to cover both it and the face to some extent, approach it gradually, but without much delay, close to the face of the patient, after directing him to take full inspirations through nose and mouth. If he is disposed to hold his breath during the inhalation, or to cough, I withdraw it a trifle to allow a larger admixture of air, and then immediately approach it again to the face; and as soon as it can be inhaled fully, without coughing or strangling, the sponge is kept lightly *in contact* with the face, and the towels held completely over the sponge and face, gathered in around the edges so as to cut off *evaporation of ether*, and *ingress of air*. The half ounce is soon followed by about an ounce, which is rapidly poured

[1] From Scotland we have had fewer reports of death from chloroform than from any other part of Europe, although this anæsthetic is exclusively used there, and still on a folded handkerchief or towel, as at first.

[2] September, 1855.

into, and not *on* the sponge, though the latter is occasionally preferable, as recommended by Dr. Hayward. The necessity for replenishing being judged of by the time, or by the nose applied to the edge of the sponge a little raised. When insensibility is *complete*, judged of by the relaxation of the muscles of the arms, or by touching the *conjunctiva oculi*, the sponge is either entirely or partially removed from the face, according, sometimes, to the nature of the operation, sometimes to the character of the respiration and pulse—stertorous breathing contraindicating even the smallest quantity of the vapour.[1]

As regards the *quantity* of ether required in protracted operations, it is not so great as is generally supposed. I have no statistics to guide me; but, more than a pint, if judiciously used, even in the most tedious cases, is seldom necessary—the patient gets so saturated with the ether, after six or eight ounces have been inhaled, that very little, applied from time to time, will keep up full insensibility. The last protracted operation of mine, a few nights ago, required the patient, a female in delicate health, to be constantly kept in a state of full anæsthesia for at least an hour and a half, and not more than eleven ounces of ether were consumed, and it was administered most of the time by an apothecary. Dr. Hayward says from four to eight ounces, but he means for the whole operation, not merely for the preliminary anæsthesia, of which we have been speaking, when alluding to the minimum quantity; and he adds, that less would be required if care be taken to exclude atmospheric air, which he either thinks not quite safe, or unnecessary. I am well aware that much larger quantities of ether are used than are spoken of as sufficient by Dr. Hayward and myself, even where this agent is extensively employed, as for instance, even now, at the New York Hospital. But, still, if they proceeded upon the principle of saving ether, and of using only enough to produce the desired effect, even without entirely excluding the air, as here recommended, much less would be consumed. But, it is obviously idle to discuss quantity, except with reference to time; for, what difference does it make, in a painful and important operation, whether the surgeon uses four ounces or eight ounces? If quantity is referred to by those who object to ether, with reference to expense, a pound of Dr. Squibb's article, the best for inhalation in the market, in our judgment, can be purchased for half a dollar, and two fluid-ounces of his chloroform costs as much or more.

As to *time:* to induce full anesthesia in an adult with sulph. ether should not require more than five minutes, sometimes six. With children much less time is required. Dr. Snow gives two or three minutes as the average for children, and four or five for adults. And how much sooner

[1] I have never heard that this precaution, of cutting off as far as possible, all admixture of air, has been attended to anywhere, either here or in Europe, except in Naples, where, Dr. Hayward informs us, it is very successful.

can a patient be *safely* chloroformed? Dr. Hayward states that "*in no case* were more than eight minutes required to produce complete anæsthesia." This is the maximum; he does not state the average.

I do not desire to be understood as ignoring all danger and all necessity for caution in the administration of sulph. ether. On the contrary, I hold that every surgeon, who performs an operation with the aid of any anæsthetic, is bound, if possible, to secure the services of some competent person to attend to this department, or to look to the condition of the patient himself from time to time; and this he may generally do in the case of ether, an agent so uniform and regular in its action, without distracting his mind too much from the operative procedure itself. It is of great importance also to attend to the state of the pulse for a short time subsequent to the completion of the operation; for, occasionally, alarming prostration has followed anæsthesia, after trivial operations, even where the inhalation has proceeded with perfect regularity and success. I do not of course allude to those alleged *deaths* from ether, previously referred to in this paper, where the patients died hours, and even days after protracted and dangerous operations, but to such cases as one which I reported in the *New York Journal of Medicine*, for 1856, and which is referred to in the last edition of the *U. S. Dispensatory*. I have recently met with one almost precisely similar, of which, the fear of occupying too much space in the Journal, forbids any notice at present. Should vomiting succeed the administration of the anæsthetic, the patient being partially under its influence, the air-passages may become suddenly clogged by the lumps of food which some people bolt, and thus endanger life. We have not always the opportunity of enjoining an empty stomach, which is advisable. Another danger, that we occasionally meet with, is the falling backward of the tongue, as in the case at the Eye Infirmary. There is no danger, however, that may not be readily avoided by a little care.

An important preliminary with patients who are nervous, or alarmed at the idea of taking the ether, is to get their confidence, to assure them positively of the thorough safety of the drug, and to explain the sensations which they are likely to experience in passing through the several stages to complete anæsthesia; especially the choking feeling which immediately precedes total insensibility, and which often otherwise causes a struggle, and delays the operation. It is sometimes necessary to administer the agent in an adjoining room, when there are a number of spectators or assistants assembled. With sulph. ether, it is also sometimes advisable to close the doors and windows, if open, should there be a current of air, as I have found this to delay the anæsthesia. The objection urged against ether, that its odour is disagreeable, and saturates the clothes, and penetrates the whole house, is too puerile to merit notice. Its inflammability is a more valid objection during operations by candlelight; but, a little care will remove all danger from this source.

I am aware that all this minute account of a simple matter, which everybody is supposed already to understand fully, will be considered by many only tedious and useless; but, that it is not entirely unnecessary, is apparent from the following paragraph, which I quote from an editorial in a leading London Journal.[1] "The complexity of the apparatus necessary for its administration, the large quantity required, and the time taken up, are the great hindrances to its more general use in this country." It has been my humble endeavour and sole object in writing this paper, as it was in coming before the profession previously on the same subject, to aid in correcting these very erroneous impressions regarding sulph. ether, under which many of the profession in this country, and almost the entire profession in Europe, are labouring.

NOTE.—Soon after forwarding the above paper to the Editor, I observed, in a medical periodical, a brief notice of a case of "death from sulphuric ether," said to have been read before the Cincinnati Academy of Medicine, by Dr. W. H. Mussey. Upon application to the reporter, I was very promptly furnished with the details of the very interesting case, which will be found in the *Cincinnati Lancet and Observer*, January, 1861. From a careful consideration of these details, I cannot attribute the fatal result to the anæsthetic. Only *four* ounces of ether were used; and, as it was poured on a folded towel, and from twenty to twenty-five minutes, apparently, consumed in its administration, there having been two intermissions on account of vomiting, but a very small proportion of these four ounces must have been breathed. And when the operation was *commenced*, the administration had been discontinued on account of some peculiarity of the breathing, "the patient screaming out and writhing with pain, and apparently perfectly conscious." Prompt artificial respiration, and other energetic means, failed to restore life.

The autopsy revealed extensive injuries (from the accident), sufficient, in the opinion of Dr. Mussey, and several other physicians present, to have caused death in a short time. The brain was not examined; and the left ventricle of the heart was empty, which is not the case after death from suffocation, or from anæsthetics.

Dr. M. remarks, that—"A lengthy discussion arose in the academy, occupying two evenings of its session, in which, two members contended that the case was clearly one of death from ether. Of the remaining disputants, two thought ether possibly auxiliary, while a majority thought ether not at all responsible."

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[1] London Medical Times and Gazette, July, 1858.