

This latter fact is always to be held in strictest remembrance when exhibiting the agent.

In oral surgery, where it is desirable to secure the profoundest and most prolonged primary impression, chloroform, if it were without danger, would be the anæsthetic most indicated and required. Indeed, in the writer's practice he finds many cases where he does not seem able to get along without it, using the agent in association with either brandy or ether. Because its use is so frequently necessary, the oral surgeon is to make himself as familiar as possible with all that concerns its defects as well as its virtues.

Experiments have demonstrated that eighteen minims of chloroform is the average quantity necessary to put an adult in a condition of insensibility,—that is to say, this amount is to be absorbed and carried to the nerve-centres.

It has also been shown that chloroform vapor has the effect of suddenly arresting the action of the heart, when it is mixed with the respired air to the extent of eight or ten per cent. or upward. With these two lessons appreciated, it is seen that the matter and manner of the exhibition of the agent have much to do with the result: not everything, however, as it is undeniable that fatal accidents have occurred in the best and most skilful hands.

Eighteen minims, according to Dr. Snow, are to be absorbed from thirty-six breathed; allowing thus that one-half is lost in expiration. But atmospheric conditions, as in the case of ether, has much to do with the taking up of quantity. The following table comprises experiments in this direction. At a temperature of 40° Fahrenheit, one hundred cubic inches of air will take up but seven cubic inches of the vapor.

At 45°	8 cubic inches.	At 70°	24 cubic inches.
50°	9 “	75°	29 “
55°	11 “	80°	36 “
60°	14 “	85°	44 “
65°	19 “	90°	55 “

This table exhibits the fact that anæsthesia by the use of chloroform must come on at varying periods, and that therefore no judgment of its proper exhibition is to be derived in the direction. Again, outside of these atmospheric associations, the manner of the exhibition has much to do with the minims inspired. Where, for example, the agent is exhibited poured upon a single layer of linen (as upon a handkerchief laid over the face), quite as much is lost in the surrounding atmosphere as is inhaled into the lungs.

Recognizing the danger as arising from the direction of cardiac syncope, advantage is to be taken of means antagonistic to such depression. In blood-letting, it is known that such a condition is much the most readily brought about when the operation is performed on the patient standing, and when the primary impression is made most marked through a large exit for the blood. In states of depression arising from whatever cause, either of physical or mental disturbance, such tendency is increased. A surgeon always hesitates to bleed a depressed patient; or, if such bleeding seem a necessity, support-

ing means are employed and continued in conjunction with the depletion. Advantage is taken also of all collateral indications, as, for example, position, the patient lying down, the head perhaps being placed on a lower plane than the body, the orifice of exit being made very small, intermissions in the flow of the blood, stimulants, as the pre-exhibition of brandy or wine, kind and encouraging assurances, etc. The depressing effect of fear on the heart's action is never to be lost sight of in the administration of chloroform. How many patients faint even while preliminary arrangements in anticipation of an operation are going forward! indeed, how many are the cases on record of death from such fright! It would seem, then, that one would never be justified in administering chloroform to a patient laboring under marked depression; at least such is the author's conviction, and on such impression has he always acted. All persons, or nearly all, approach a surgical performance with a certain amount of trepidation, but such fear may, in the majority of cases, be dispelled; or if this be impossible, then a preliminary artificial courage is to be given by the use of stimulants; or cerebral consciousness may be confused by the inhalation of a few drachms of ether.

The objection that chloroform is not to be given a patient in a sitting posture does not seem to hold entirely good. In oral surgery this is nearly always the necessary position; and the agent is thus administered in hundreds of cases without ill result. A difference in the character of cardiac syncope is here to be recognized. The paralysis may arise from two sources, and exhibit, as the state of the heart is concerned, quite different appearances; that is, there is a syncope of anæmia and a syncope of narcotism. Now, while there is between these two conditions much relationship, as the question of a vital propulsive force is concerned, yet there are also certain differences, of which, as surgeons, we are to take advantage. Paralysis of the heart occurs when, from any reason, the organ is deprived of the effect of its natural stimulus, the blood: this is the syncope, or paralysis, of anæmia. It occurs again when, through the action of a common or a specific narcotic, its muscular fibres are relaxed and deadened. The two causes may exist and act in conjunction. Chloroform is a specific narcotic, as the heart is concerned; at least this is the deduction from post-mortems made in the fatal cases of its exhibition. In anæmia, syncope is partly a mechanical production; the patient, in a standing position, faints, as the result of gravity counterbalancing the natural distribution of the blood. In narcotic syncope, position is, perhaps, of little consequence, at least as the action of the producing cause is, of itself, concerned. The question, then, of sitting or of lying, as the exhibition is concerned, resolves itself into a consideration of the state of the general health of a patient: if there be deficiency either in quality or in amount of the vital fluid, then the erect or even semi-erect station is not to obtain. If, on the contrary, a patient does not present such conditions, then it would seem that there is no special danger in the position.

Prefatory stimulation, if not contra-indicated, is happily employed in con-

junction with chloroform. A tablespoonful or more of brandy given to a patient some five or ten minutes before exhibition of the agent, will frequently support the natural action of the heart through a prolonged operation, and thus antagonize the common source of alarm.

In his own practice the author never likes to use chloroform but in conjunction with ether; not mixing them, as in the common chloric ether, but alternating, as the case seems to require or allow. Thus, employing the cone, the process is commenced by pouring within it a quantity of ether, when it is gradually, and yet as rapidly as possible, brought to cover the mouth and nostrils. If now the pulse rapidly increase, or even remain fixed and steady, and particularly if undue cerebral excitability manifest itself, ten or twenty drops of chloroform are dropped into the sponge. This is found to quiet the patient almost instantly. From this point the surgeon proceeds, using chloroform or ether, according to the result to be secured. If an operation be one of simple character and of quick performance, as the extraction of teeth, or the making of a puncture or incision, then it is not wise to risk anything with chloroform. If, on the contrary, it be some difficult and tedious case about the mouth, where, after commencing, the operator cannot well stop to readminister the anæsthetic, the risk of the excess of chloroform may be taken for the prolonged effect yielded and the greater profundity of impression secured.

The manner of the exhibition of the agent has, as one would infer, much influence, as result is concerned. Thus, of the various apparatus that have from time to time been devised to assist in the use of chloroform many are deserving of no better name than life-traps; and in this connection one naturally finds himself wondering at the character of contrivances which, particularly in the earlier history of chloroform, were employed, even by the ablest men, in experiments directed to the testing of the general safety and results of the agent. One cannot read of the white mice, guinea-pigs, cats, and bell-jars of these pioneers, without wondering that it should never have occurred to the experimenters that animals might as readily die from lack of proper respirable air as from effects of anæsthesia.

In using pure chloroform, it is most desirable that there be the fullest admixture of air; with this intention the sponge is used, first softening it with warm water, which water is to be well squeezed away. The respiration should be easy and natural, and the patient fully *en rapport* with the operator. He should be given to understand that anæsthesia is but a gentle and harmless sleep, and that one is to enter on it as he does on natural slumber. If such confidence be secured, there will be found little trouble in producing narcotism. Another plan of using the agent, and one which has many advocates, is to let fall drop after drop upon a napkin, laid loosely over the air-passages. The tin cone shown will not disappoint.

However employed, the principal indication is to have the agent in proper dilution and combination with atmospheric air: this secured, any mode of

inhalation must be a proper one. Insensibility, as wisely remarked by Dr. Snow, is not caused so much by giving a dose as by performing a process. Nature, continues this gentleman, supplies but one mixture of diluted oxygen, from which each creature draws as much as it requires; and so, in causing narcotism by inhalation, if a proper mixture of vapor and air be supplied, each patient will gradually inhale the requisite quantity of the former to cause insensibility, according to his size and strength. It is desirable to vary the proportions of vapor and air, but rather according to the purpose one has in view, whether medicinal, obstetric, or surgical, than on account of the age or strength of the patient; for the respiratory process bears such a relation to the latter circumstances as to cause each person to draw his own proper dose from a similar atmosphere in a suitable time.

The induction of insensibility varies with the individual, or rather, it is to be suggested, with classes of individuals. One class will breathe quietly and slowly, until unconsciousness supervenes as if by a natural sleep: persons of this kind are of the lymphatic temperament. The nervo-sanguine or bilious class are apt to become restive and frightened, and require a great amount of care and attention, being the most difficult to impress. The true and full nervous man, while timid and frightened, is yet apt to be impressed by a very few inhalations. There is one question that here arises in regard to an exhibition of timidity. When a patient becomes excited, shall the chloroformization go on? Yes, is to be answered, if such exhibition be associated with mental disturbance produced by the agent; for here it is not as the condition previously named, but is rather an hallucination. These patients are to be forced rapidly beyond the state of excitement. Here is the point in which the production of anæsthesia demands skill, courage, and judgment. Over and over again incompetent operators worry poor creatures into most wretched conditions simply by fearing to pass the Rubicon of excitement. If assured that all be right (and such assurance is to be derived from noting closely the circulation), we are to get over this intermediate excitable stage as quickly as possible, and get over it by concentrating the chloroform. Patients laboring under such excitability will, often enough, assure you that they feel that another inhalation will kill them; that it is impossible to breathe; that the heart is laboring under woful depression; with many complaints of like character. Such speeches are mostly to be taken *cum grano salis*; the practitioner is to judge for himself. Danger is, however, at the bedside, let it not be *overlooked*. Chloroform is more treacherous than is Mephistopheles.

Before an operation of magnitude is commenced, it behooves a surgeon to assure himself that his patient is in the proper anæsthetic condition. Entire paralysis of the muscles of animal life is commonly received as indicative of such a state,—this being manifested in the lifeless falling of an arm when raised. But this is not strictly reliable, as to obtund sensation we are aware the posterior column of the spinal cord is to be affected, while loss of motion implies only anæsthesia of the anterior. So quickly, however, does the action

of the agent pass from the one to the other of these parts, that this sign is found to be one most convenient of acceptance.

Three degrees of narcotism are described. The first includes all the effects of chloroform that exist while a patient retains a perfect consciousness of where he is and what is occurring. In the second, there is no longer correct consciousness; the mental functions are impaired, but not necessarily suspended. In the third there are no longer any voluntary motions.

The circumstances which influence or modify the effects of chloroform are thus considered by Dr. Snow, than whom, perhaps, there is no one whose observations have been of a more extended or thorough nature; although it is not to be overlooked that he was so enthusiastic in his direction that perhaps, in some instances at least, his prejudices may have influenced somewhat his judgment. The writer puts it on record that he discountenances the employment of chloroform. He uses it, never save under compulsion, and fears always while he uses. *He never administers it without the conjunction of a prophylactic—ether or brandy.*

I arrived at the conclusion, says Dr. Snow, after much careful observation, that chloroform might be given with safety and advantage in every case in which the patient requires, and is in a condition to undergo, a surgical operation. And having acted on this conclusion for several years, I have found no reason to change it. It is desirable, however, to pay attention to every circumstance connected with the health and constitution of the patient before exhibiting chloroform, as many of these circumstances influence its effects.

The conclusions arising out of Dr. Snow's experience concerning circumstances of exhibition are thus to be epitomized. Those of the writer accord with them.

AGE.—The age of a patient has considerable influence in modifying the effects of chloroform. It acts very favorably on children. These sometimes oppose the inhalation of it as long as they are conscious, but it does not occasion the rigidity and struggling, after loss of unconsciousness, which are sometimes met with in the adult. Anæsthesia is generally induced with a less amount of narcotism of the nervous centres in children than in grown persons.

The effects of chloroform are produced more rapidly, and also subside more quickly, in children than in adults, owing, no doubt, to the speedier breathing and circulation. It often happens, however, that when the insensibility has been kept up for some time, say twenty minutes or half an hour, in a child, it is followed by a natural sleep of a few hours' duration, provided there be no painful wound or other cause to prevent the sleep. It is worthy of remark that none of the accidents from chloroform which have been recorded have occurred to young children.

There is nothing peculiar in the effect of chloroform upon people advanced in years, except that its influence subsides tardily, on account of the slower breathing and circulation.

STRENGTH OR DEBILITY.—The comparative strength or debility of a

patient has considerable influence on the way in which chloroform acts. Usually the more feeble the person, whether from illness or any other cause, the more quietly does he become insensible; while if he be strong and robust, there is very likely to be mental excitement in the second degree of narcotism, and rigidity of the muscles, and probably struggling, in the third degree. Patients in a state of debility resemble children, not only in coming quietly and easily under the influence, but also in the circumstance that the common sensibility is suspended with less narcotism of the nervous centres than is generally required in robust people. Children, and persons in a state of weakness, have usually an acute sensibility, which causes them to suffer pain from very slight injuries, but this sensibility is more easily suspended by chloroform than the less acute sensibility of the robust.

HYSTERIA.—Patients who are subject to hysteria have sometimes symptoms of the complaint, such as sobbing, crying, or laughing, as soon as consciousness is suspended, or even impaired, by the chloroform; but these symptoms can always be subdued by proceeding with the inhalation.*

In some persons who are subject to hysteria the breathing becomes excessively deep and rapid while inhaling chloroform.† This usually occurs just as the patient is becoming unconscious, but in a few cases even earlier, and the subject is aware of the impulse to breathe in this manner. After this kind of hysterical breathing has lasted a little time, the individual generally rests nearly a minute without breathing at all, after which the respiration becomes generally natural. Chloroform is to be given very sparingly during the violent breathing, or else withdrawn altogether for a moment or two.

PREGNANCY.—It is not generally thought that there is anything in this condition objectionable to the use of chloroform.

THE MENSTRUAL PERIOD.—This time is certainly not to be preferred or selected as an occasion of chloroform exhibition. Yet there is nothing at all in it adverse to the administration. The controlling effect of the agent over hysterical symptoms has just been remarked, and such irritability of the system is a peculiarity of the state. Indeed, it is very common that the hysterically inclined female is compelled to resort to chloroform, particularly in conditions of dysmenorrhœa.

* Chloroform in hysteria is one of the most valuable medicines of the *Materia Medica*, while, on the contrary, sulphuric ether is most decidedly objectionable to such patients. The writer has treated females afflicted in this way where ether had been used by the pound with no other effect seemingly than increasing, intensifying, and prolonging the paroxysm; yet with a very few inhalations of chloroform has had the pleasure of seeing the persons fall into the most natural slumber, and after resting quietly for hours, the sleep prolonged, perhaps, as sometimes has seemed indicated, by occasional repetition of the inhalation, has again and again seen them awake perfectly recovered.

† Dr. Snow, in his paragraph, remarks the supervening of this condition after the first few inhalations, but, according to the writer's experience, it is as uncommon when chloroform is used as it is common in the employment of ether. When, in administering ether, the slightest signs of hysteria are seen either in male or female, control is to be secured by replacing the ether with chloroform.

DISEASES OF THE LUNGS.—Affections of the lungs sometimes cause a little difficulty and delay in the administration of chloroform, as the vapor is liable to excite coughing when the mucous membrane of the air-passages is irritable. The inconvenience is, however, confined to the time of inhalation, for the cough is generally relieved afterward.*

I have given, says Dr. Snow, chloroform for surgical purposes in many cases where phthisis was present, and in several patients who had suffered from hæmoptysis, and have not seen any ill effects from its use. Chloroform is, indeed, often inhaled with advantage to relieve cough in consumption. The instances of chronic bronchitis in which the agent is administered for relief of the condition and for operations are still more numerous.

DISEASE OF THE HEART.—There is a very general impression that the use of chloroform is unsafe when disease of the heart exists, more particularly fatty degeneration of that organ. This belief has been encouraged by the circumstance that the affection has been present in a few of both the real and alleged deaths from the agent, and also by the fact that, in the accidents that have been really due to chloroform, the heart has been the organ on which it has exerted its fatal influence. When we come to investigate these cases, however, we shall find reason to conclude that the heart has probably been diseased in quite as great a proportion of the patients who have taken chloroform without ill effects as of those who have succumbed under its influence. As regards my own practice, says Dr. Snow, the only case in which death could in any degree be attributed to the chloroform, was one in which there was extreme fatty degeneration of the heart; but, on the other hand, I have given chloroform in numerous cases without ill effect where the symptoms of this, as well as of other affections, were present in a marked degree. Indeed, I have never declined to give chloroform to a patient requiring a surgical operation, whatever might be his condition, as I early arrived at the conclusion that this agent, when carefully administered, causes less disturbance of the heart and circulation than does severe pain. Wherever, continues Dr. Snow, I have had an opportunity of seeing an operation performed without chloroform, I have carefully examined the pulse, and although none of these operations have been of a very severe nature, I have found the circulation to be much more disturbed than it would have been by the agent carefully administered. The pulse, in most of the cases, has been exceedingly frequent during the operation, and in some instances it has intermitted to an unusual extent.

In one case, this gentleman says, I had an opportunity of witnessing a similar operation on the same patient, first without chloroform, and afterward under its influence. In the first, which was lithotrity, I began to feel the

* This difficulty, as observed not only by Dr. Snow, but also by nearly all writers on anæsthesia, is found to be almost, if indeed not entirely, obviated by preceding the exhibition with a tablespoonful of thick mucilage of gum acacia, the patient allowing it gradually to lose itself over the mucous surfaces.

pulse just when the patient saw the lithotrite about to be introduced. It was 120 in the minute. As soon as the instrument was in the bladder the pulse increased to 144, and immediately afterward it became uneven, irregular, and intermitting. I could not count more than three or four beats at a time; and occasionally, when the pain seemed greatest, and the man was straining and holding his breath, the pulse was altogether absent for four or five seconds. In order to ascertain whether the loss of beat at the wrist might not depend on the pressure of the muscles of the arms, caused by grasping the table, I applied my ear to the chest, and found that there was no sound whatever to be heard during the intervals when the beat was imperceptible. It was evident that the patient held his breath till the right cavities of the heart became so distended as to stop the action of the organ till the respiration returned. The man did not complain or cry out during the operation.

A week afterward the lithotrity was repeated, but on this occasion I administered chloroform. The pulse was 120 in the minute when the patient began to inhale the anæsthetic, but it became slower as he was made unconscious, and it was regular during the operation. It was only toward the end of the performance, when the effect of the agent was allowed to diminish, and when the man began to strain a little, though not yet conscious, that the pulse intermitted slightly, passing over a single beat occasionally. There were none of the long intermissions observed on the former occasion.

It is very evident that if the above-mentioned patient had been the subject of any affection of the heart which weakened or embarrassed its action, he would have run a much greater risk from the pain of the first operation than from the inhalation of the chloroform in the second one.

In a few of the patients having the arcus senilis of the cornea, a weak, intermitting, or irregular pulse, and other signs of fatty degeneration of the heart, there have been a feeling of faintness and a tendency to syncope as the effects of the chloroform were subsiding, especially when the operation had been performed in the sitting position; but these symptoms have soon subsided, in all cases I have met with, on placing the patient horizontally, with, or without, the help of a little ammonia to the nostrils.*

CEREBRAL DISEASES.—Affections of the head, according to this same authority, offer no obstacle to the administration of chloroform. I have given chloroform, he says, to several patients who had suffered previously from an attack of apoplexy; some of them still retained the paralysis resulting from the attack, but the exhibition has not been attended or followed by ill effects in any of these cases.

The following interesting and most instructive case is mentioned in this direction:

The 31st of October was a day appointed by Mr. Fergusson to perform

* However imposing and authoritative the testimony favoring the exhibition of chloroform where organic heart derangements of any kind exist, the writer puts in his own word of warning. He believes the agent full of risk.

lithotrity on a gentleman seventy-eight years of age, who had a phosphatic calculus in his bladder. He was a patient of Mr. Propert, and Mr. Ferguson had removed a similar calculus by lithotrity, and I had given him chloroform at each of the operations, and it was arranged that he should have it on the present occasion. Mr. Propert informed Mr. Ferguson and myself on our arrival that his patient had, the night before, an attack resembling apoplexy; he had been insensible; the breathing had been stertorous, the pupils dilated, and the face very red and congested. Mr. Propert had caused him to be cupped to fourteen ounces, and had given him twenty grains of calomel in the course of the night, and in the morning he was as usual, and remained so at the time of our visit. We considered the case with his attendant, and, as there were no reasons for postponing the operation, it was determined that the man should inhale the chloroform rather than be subjected to pain. The vapor acted very favorably: he recovered his consciousness a few minutes after the crushing, and expressed himself as feeling quite well.

INSANITY.—Chloroform acts on insane patients just as it does on others; when the effects subside they are in the same state of mind as before. Mr. Snow remarks the suspiciousness of the insane, but gives his experience where teeth have been extracted and other operations performed which it would have been impossible to accomplish in the same individual without resorting to inhalation. The employment of chloroform in the delirium of mania a potu has, through the experiments of Dr. Ely McClellan, of the United States Army, lately been revived, and commands much attention, the success of this gentleman being verified by practitioners in every part of the country. Given in drachm doses, *pro re nata*, chloroform seems to break the paroxysm completely, causing the patient to fall into a profound sleep, from which, after eight or ten hours, he awakes, commonly entirely relieved. In delirium, however, the chloroform is to be taken into the stomach, not breathed.

This consideration of chloroform may be closed by remarking, as alluded to in the commencement of the chapter, that the agent, if one feels justified in using it, is far to be preferred in oral surgery to the ether; a profound impression created through chloroform will not infrequently continue through quite a prolonged operation; or, if it be necessary to renew the inhalation, the desired impression is generally made with great rapidity. Performances about the mouth, unlike most other surgical services, require to be executed with rapidity; therefore it is a necessity to be as little interfered with as possible: an impression, apparently very profound, made with ether, is apt to be broken in the very first shock of an oral operation. This first step may be of a character starting, in some instances, frightful hemorrhage, and which is to be combated only at the completion of the service. To have a patient pass from control at such moment, and under such circumstances, is sometimes a matter of serious concern. If one has not used chloroform up to this

time, and the article be at hand, it is apt to be given the patient in a quite free manner.

The author in this chapter has used in many instances the strong authoritative experiences of Dr. Snow. He is convinced of the truth of all that is maintained; personally, however, he is afraid to use chloroform except in conjunction with ether; and while such fear may not be solidly grounded, yet, as it exists, he cannot do otherwise than give expression to it. At this day it were certainly idle to attempt to deny that many deaths, a great many, have resulted from the use of chloroform; and a large proportion of these accidents have happened in the hands of eminent and skilful men, and where every possible scientific precaution had been taken.

Again, the accidents have seldom if ever been traceable to an overdose of the agent; the deaths have never occurred from narcotism, but from a direct and unforeseen paralysis of the heart. The author has not overlooked the fact that fatal results happening while chloroform was being used might not be owing to the agent. Certainly there are cases enough on record justifying such a conclusion,—cases with which every surgeon must be familiar; but, on the other hand, there are instances of such doubt, or perhaps it is better to say, of such certainty, that one may incline to err on the side of discretion.

Treatment of chloroform narcosis relates with restoration of the abeyant circulation. To this end a cloth wrung out in cold water is to be slashed over the chest. Inhalations of ether may be given. The head is to be placed on a lower level than the body. Artificial respiration is to be maintained. Tickling the nostril is a favorite means.

In the *Vierteljahresschrift für Gericht. Med.*, Dr. Wachsmuth, of Berlin, makes the important statement that if one-fifth part of oil of turpentine be added to chloroform, the latter can be administered to the fullest anæsthesia without the slightest risk, as the turpentine prevents, by its stimulating properties, the pulmonic paralysis, which is the proximate cause of death in fatal chloroform narcosis.

Apparent death from chloroform has found remedy in turning the patient for a few moments head downward. The author has had occasion to practise this, and it has proved successful; it applies as well to ether syncope. Artificial respiration, continued for from half to a full hour, is on record as proving restorative. Nitrite of amyl, ten drops poured on a cloth and applied to the nostril, is an antidote. Look to the tongue; if this be fallen back pull it forward. Give fresh air. Fan the patient. Use smart strokes of a battery. Dash cold water over the face. Rub briskly the extremities. Blow in the ear. Insert a lump of ice in the rectum.

Nitrous Oxide Gas.—The frequency with which this agent is now used, and the immunity from accident indorsing its employment, has begotten acquaintance with and confidence in it on the part of the people at large. Application of it is with minor and quickly-performed operations. Dentistry proper, as it relates to tooth extraction, is particularly served by it.