Dawson (W. W.)

Chloroform Deaths.

By W. W. DAWSON, M. D.

SURGEON TO CINCINNATI HOSPITAL.

ROBT. CLARKE & CO., PRS., CIN.

CHLOROFORM DEATHS.

Twelve Unpublished Cases.

Comparison Between Chloroform and Other Anæsthetics.

Rate and Cause of Death.

MODE OF ADMINISTRATION—MEANS OF RESUSCITATION.

By W. W. DAWSON, M. D., Surgeon to Cincinnati Hospital.

"He laughs at scars who never felt a wound," is an old and significant saying, uttered long before anæsthetics were thought of, or at least realized; it is, however, peculiarly applicable to those who have never met with an accident in the use of these agents. A gentleman may go on for years, for half a score and more of years; he may give chloroform thousands of times, as did the celebrated Simpson, and many others equally renowned, equally skillful, and never meet with an unfortunate case; but suddenly and unexpectedly that case comes, as it did to the distinguished

discoverer of the anæsthetic properties of chloroform; and when it does come, it comes with a pronunciation distinct, startling, arresting, a pronunciation calculated to arouse in him the deepest interest, the most profound reflection, the most earnest inquiry. The question immediately presents itself: Could this have been prevented?

In his lecture on "Death from Chloroform," Dr. Benjamin W. Richardson, of London, says: "The time is fitting for a careful study of the important question before us, for deaths from chloroform seem to be—I do not say they are—seriously on the increase, and the hearts of the boldest are in some fear whenever they summon the agent to their aid." There can be no doubt that the mortality of chloroform is increasing, and what Dr. Richardson speaks of as a probability, is an unquestioned fact. The statistics of chloroform are defective, imperfect, far from complete. In a few weeks—since the 13th of October last, the date of my unfortunate case—I have collected, with but little trouble, the history of twelve hitherto unpublished cases, most of them having occurred in this vicinity.

General and Local Anæsthesia are the means presented to the surgeon when about to perform an operation. The latter, local anæsthesia, can claim for itself entire safety; that it may be applied without the slightest danger is patent to all; but, unfortunately, it has so limited a range in its application, that it can only be used for the most insignificant operations—operations involving small and superficial regions. Apparent as this seems to be, it was not without surprise that a case—a painless case—of Ovariotomy was reported a few years ago, in which Richardson's apparatus was employed for the production of the anæsthesia. A duplicate of this case has not been published. Until local anæsthesia is brought to a greater perfection, general anæsthesia, with its dangers, must be accepted.

Dr. B. W. Richardson, the author of local anæsthesia, in the lecture upon this subject, already referred to, says: "In the outset of our work, I think it best we should honestly admit this truth, that whatever our admiration may be of the scientific advancements which have in our day been made for the relief of pain during surgical operations, we are bound to season the admiration with the disagreeable knowledge that the blessing we confer on humanity, when we resort to the application of general anæsthesia,

is not unmixed with danger and sorrow. At present we are forced to know, for example, that the administration of this, the most common agent employed for anæsthesia—chloroform—is attended with a certain fixed mortality. We are bound, therefore, to consider whether that mortality is necessarily to remain; we are bound to inquire if the mortality be an essential part of the administration; and, if so, we are bound further to ask whether the general value of the agent is commensurate with the special evil. It has been urged that if any other medicinal agent than chloroform had caused as many deaths, it would long ere this have been ruthlessly expunged from practice. The assertion is true and untrue; true, on the argument that an agent of doubtful usefulness, or of limited usefulness, produces a certain evil; untrue, on the argument that an agent of certain and most extended usefulness produces an occasional evil. But chloroform is an agent which is of certain and most extended usefulness; therefore the argument against chloroform, when carried to the expulsion of it because of its evil, is untrue.

"Behind all these remains the inquiry whether we ought to accept the necessity of danger from general anæsthesia at all. Can we avoid every danger and supply every good? Perhaps we can not; we ought nevertheless to try so to do, and perhaps we may succeed. In endeavoring to avoid danger we have two lines of research before us. We may inquire whether we can so reform the anæsthetic process altogether as to insure success; we may inquire whether we can so master the effects of anæsthetic agents that we can use *any* with perfect safety, and especially *that* agent *chloroform*, with which the world and the profession are most familiar. I, for one, have trodden both these lines of research. I have introduced new methods, which, I have hoped, would conduce to safety in anæsthesia. I have studied much to make *local* anæsthesia a ready and perfected process, and, on the whole, I have reason to be satisfied with the results which have fallen to me. In science, however, it is quite hopeless in any man to harbor a prejudice or ignore natural truth; and so I am open to confess that, however we may yet perfect the only perfectly safe—I mean the *local*—method of abolishing pain, we shall still often require a general anæsthetic."

For general anæsthesia we have a number of agents which we may call to our service. At the head of the list stands *Chloroform;* then comes *Ether, Nitrous Oxide, Bichloride of Methylene, Tetrachloride*

of Carbon, the "*Vienna mixture*" consisting of one part of chloroform and six of absolute ether and other combinations of ether and chloroform, varying in the relative proportion of the two agents. The late Dr. Mussey used them in the proportion one part of the latter to two of the former; others again mix them equally. Unfortunate cases, "accidents," if you please, have followed the use of all of these anæsthetics. Chloroform leads them all in popular and professional favor, as it does in the number of its victims.

RATE OF DEATH FROM ANÆSTHETICS.—From an article on "The Relative Dangers of Anæsthesia by Chloroform and Ether, from statistics of 208,893 cases,"* I am enabled to present the subjoined table:

Sulphuric Ether	1 death to	23,204	administrations.
Chloroform	1 "	2,723	"
Mixed Chloroform and Ether	1 "	6,588	"
Bichloride of Methylene	1 "	7,000	"
Nitrous Oxide	No deaths in	75,000.	

These are startling figures, and while they are, no doubt, too favorable for ether and nitrous oxide, they hardly present the fatality of chloroform.

In discussing the rate of mortality, Dr. Richardson says: "When I was engaged in writing the medical history of England for the *Medical Times and Gazette*, in the years 1864 and 1865, I visited, in turn, eight hospitals, viz: Norwich, Lynn, Stafford, Wolverhampton, Newcastle-under-Lyne, Brighton, Birmingham, General Hospital and Birmingham Queen's Hospital. From the books of these institutions I collected, personally, the number of administrations of chloroform in each institution from the first, in 1848, and before I arrived at a death, I recorded no less than 17,000 administrations. Now, one death in 17,000 cases reduces the mortality to a nominal value, and if this experience were supported by all experiences, we need trouble ourselves little for any better agent than chloroform. But mark the result of the five years' subsequent experience in the very same institutions.

*We find this interesting and valuable article in the *Richmond and Louisville Medical Journal*, under the "Eclectic Department," and regret that the name of its accomplished author is not given.

Since 1864 there have been in these hospitals 7,500 administrations, with 6 deaths, or 1 death in every 1,250 cases. After I had visited the hospitals above named, in 1864, I visited in the same and following year six other hospitals, viz: at Lincoln, Bath, Oxford, Cambridge, Reading and Nottingham. In these I collected the facts of 7,900 administrations, from the year 1848, with a result of 3 deaths, or 1 in 2,633 cases. In these same hospitals, in the subsequent five years, there have been 2,762 administrations with the result of 1 death.

"If, finally, in relation to these large hospital's statistics, we put all the facts together, we find that in the twenty-one years, from 1848 to 1869, inclusive, in the thirteen hospitals named, there were 35,162 administrations of chloroform with a proportion of 11 deaths. I believe this to be the largest reliable series of cases of administration as yet collected, and I know it to be just. Doubtful cases of death from this agent there are none, and in every case a qualified and competent practitioner was the administrator.

"If from individual and general Hospital experiences we pass to the experiences of particular Hospitals, we find, again, the widest difference of results from chloroform administrations. Some Hospitals, like some individuals, are fortunate, some unfortunate. There are before me the statistics of two Hospitals so alike that we might call them twins; they have the same average of patients, the same average number of administrations a year, the same precise length of experience. In one of these, in twenty-one years, there have been 1,575 administrations without a death; in the other the mortality has been 1 death in 525 cases. I could multiply these illustrations were the labor necessary. It is not necessary. My preliminary purpose is fulfilled if I have proved that, in the face of the facts of frequent runs of so-called good luck, by particular men, or in groups of Hospitals, or in particular Hospitals, there is, under the most favorable aspect of chloroform, a given mortality, which, up to this moment, seems to be a necessary mortality, just as there is a mortality from accidents and acute diseases like fevers. The mortality is, moreover, considerably greater than is known, for cases occur constantly which are not recorded. I compute favorably from the facts given above that the rate of mortality is as one in 3,500 administrations of chloroform (I think it really is greater, and that 1 death in

2,000 to 2,500 administrations would be nearer the truth); but even at this rate we have no other remedial agent which approaches chloroform in point of danger."

Appalling as these statements are *chloroform is still, and will, without doubt, continue to be, the favorite with the great majority of the profession.* The small quantity necessary, its prompt action, the profound anæsthesia which it produces, the ease with which this insensibility may be prolonged for hours, if desirable, gives chloroform an advantage over all agents yet presented: indeed, sulphuric ether is, so far, its only rival.

Sulphuric Ether.—The objections to sulphuric ether as an anæsthetic are many. The time necessary to produce anæsthesia is much longer than that required by any other agent; the mental excitement is very great, the muscular convulsions are very violent, the quantity essential to produce and keep up the insensibility is large; indeed, in some operations, and especially in those about the mouth, it is impossible to employ the ether after the beginning of the operation. I witnessed a marked example of this recently. My friend, Prof. W. H. Mussey, in the Cincinnati Hospital, removed the left superior maxillary. He rendered the man insensible by ether, but after the incisions necessary to detach the skin his patient was perfectly conscious, and had to be left so until the completion of the excision. The agony was fearful, but it could not be prevented. In such a case a few drops of chloroform applied to the nose occasionally would have kept up complete anæsthesia, but this could not be done with an agent requiring both time and quantity to make its impression.

Upon the advantages of ether, and its manner of killing, I present the following from Prof. Gosselin, *Bulletin Général de Thérapeutique*, 1868, *Medical Compendium*, 1869:

"Ether presents certain advantages over chloroform. Anæsthetic syncope is less frequent with it than with the latter, but the following case which has happened under our eyes shows that death may be caused by it. A man came into the wards suffering from luxation of the thigh, with fracture, and also a fracture of the arm of the opposite side. So far from being in a state of stupor, he was in a condition of exalted sensibility, and complained bitterly of the intense pain at the position of the luxation. What

was to be done? It was necessary to relieve the luxation on account of the agony caused by it. The fractured thigh forbade its being done without an anæsthetic. It was, therefore, resolved to employ one, and ether was cited as the safer.

"Anæsthesia was readily produced, and the luxation reduced. The patient, however, did not return to consciousness, and the pulse began to fail, although respiration continued normal.

"The possibility of anæsthetic syncope immediately occurred to us. Cold water was dashed upon the face of the patient, and he was switched somewhat; artificial respiration was also practiced, although the respiratory movements were normal (! W. W. D.) Under the influence of these stimulants the pulse increased so as to be very perceptible, but consciousness did not return, and the respiration became hurried. Then the face grew blue, the lips violet, and the whole anterior portion of the chest cyanosed. The breathing continued stertorous for half an hour longer, when the patient died.

"The autopsy did not reveal anything of moment. The brain was healthy; the left cavities of the heart gorged with black blood; the lungs congested, and the bronchial tubes a little frothy. The autopsy only showed that the immediate cause of death was asphyxia. But its cause? Is it necessary to admit an alteration of the blood by an absorption of the vapor, and a consequent obstacle to oxygenation, or to asphyxia by alteration, which received a sufficient quantity of blood in the lungs, but which was not able to assimilate it? Was it not rather an asphyxia caused by paralysis of the lungs, similar to that seen by Dupuytren and Provencal upon cutting the pneumogastrics?"

Dr. W. H. Mussey, in the CINCINNATI LANCET AND OBSERVER for January, 1861, reports a death from sulphuric ether.

And still further, as damaging to the record of ether, I introduce the following (*Medical Compendium*, 1868):

"It is stated in the *British Medical Journal* for July 20, 1867, p. 48, that Lyons is the only city in France, and Boston in the United States of America, where chloroform is laid aside and ether preferred as an anæsthetic. A death having taken place this summer at Lyons, in a woman of delicate constitution, under anæthesia, while an orthopedic apparatus was being adjusted to her foot to correct some deformity, the fact gave occasion to a discussion at the Academy of Medicine in that city. It then appeared that, since the resolution had been come to, under a

certain predominance of opinion, to adhere to the use of ether, *no less than seven deaths had occurred under anæsthesia at Lyons;* whereas, in Paris, during the fourteen years that chloroform has been in use, over a much wider range of cases, *the same figure expresses the total number of casualties, for they have been no more than seven.*"

Dr. Walter Burnham, in the *Boston Medical and Surgical Journal*, December 8, 1870, reports a death from sulphuric ether. It occurred in the army in 1862. The patient was a soldier; had been wounded in the knee, and was placed on the table for amputation. He was a stout-built German; pulse 80; had no symptoms indicating either exhaustion or shock. It required about ten minutes to render him entirely insensible. While the tourniquet was being applied, he showed some signs of returning consciousness. The ether was again applied for a few seconds, when, on complete anæsthesia being manifest, Dr. B. removed the towel from his face. The surgeon in charge directed Dr. B. to "crowd that ether." After one or two more inspirations the patient ceased to breathe. Dr. B. says "there was no hemorrhage, or any other apparent reason for his death. Very soon after he began to inhale the ether, his pulse was noticed to grow feeble."

The editor of the *Boston Journal* heads the page over this case with "Alleged Death from Sulphuric Ether," while Dr. B. styles his history "Death from the Effects of Sulphuric Ether." The editor adds, in brackets, "in an overdose," and asks the question, whether this death was from the *use* or *abuse* of ether. No unprejudiced reader can avoid the conclusion that Dr. Burnham is right, and this death is fairly attributable to the use of ether.

The statistics heretofore presented are, as I have already suggested, too partial; on the question of safety they place ether too far in advance of chloroform. Were it possible to collect the casualties of ether, they would largely, very largely, exceed 1 in 23,204.

Nitrous Oxide.—The table quoted, gives 75,000 administrations without one death; this is undoubtedly an error. In 1862, a death was reported. The patient died within an hour after inhaling the gas; it is said, however, that he had consumption and was near his end. The Colton Association have now given the gas about 100,000 times, and the accident referred to is the only one which has followed the use of this agent. Its safety depends

on the fact that persons are kept under its influence but for a moment. Protract its administration as we do chloroform and ether, and its victims would far outnumber those of all the other anæsthetic agents combined. No surgeon or physician who has stood by and witnessed a dentist give nitrous oxide for the extraction of teeth, would be willing to hazard any individual under the full influence of this gas, for an operation which would last *one-half minute.* The appearance of the person while inhaling, as he is pushed beyond the point of excitement, to a condition of insensibility, is fearful; the pulse is quick, the breathing labored, the vessels of the face and neck are turgid, the face assumes an ashy hue; indeed, the whole aspect is one of danger. The relief which the sudden subsidence of these alarming symptoms, and the return to consciousness of the patient gives, can only be felt, but not described by the looker on. "It can not be too widely understood," says Richardson, "that protoxide of nitrogen is not an *anæsthetic* in the true sense of the word, but an *asphyxiating agent; that its effects are identical with those of poisoning by carbonic acid gas.*" I may add that in those surgical operations performed under its influence, the patients were merely intoxicated—not insensible.

For a momentary operation, such as the extraction of a tooth, this gas, powerful as its impression is, seems to be by far the safest agent. The erect position usually taken for the extraction of teeth, is, as we shall see farther on in this paper, a dangerous position for the administration of chloroform.

Bichloride of Methylene.—The only death so far by bichloride of methylene is reported in the *British Medical Journal*, May, 1870. The patient was a stout man of 40 years, and was placed on the table in Guy's Hospital, for an iridectomy in each eye. One drachm of the methylene was used, but the mode of its administration is not given. The muscular convulsions were violent, and "he became very bluish in color" before anæsthesia was produced. The methylene was removed before the operation was commenced. "The operation on the right eye was completed, and then the left eye was operated upon. During the second operation, the patient's appearance was normal; there was no blueness; and when the incision was made, he flinched and showed distinct signs of pain. The eyes were bound up and the patient left on the couch, while one of the assistants noted down the nature of the

operation. About three minutes had elapsed when it was noticed that the respiration was shallow and catching. On touching the radial pulse, it could not be felt. The color was normal; except at the angles of the mouth, which were blue. The patient was immediately turned on his left side. There were a few gasping inspirations, then all ceased, the patient remaining pale. For about ten minutes the galvanic current, and for about an hour, artificial inspiration (Sylvester) were employed without success.

Post-mortem examination. All parts were perfectly healthy, except the heart and lungs. The muscular structure of the heart was quite healthy; there was no undue proportion of the fat; the walls were strong; the valves healthy; on the surface of the left ventricle were small spots of ecchymosis, of the size of pin's heads, about twenty in number. There were none on the right ventricle; the left ventricle was empty and contracted; the right contained some fluid blood; the lungs were congested; the blood was fluid and of dark color."

How like a chloroform history this sounds? Displace methylene and place chloroform in its stead, and the record would faithfully describe scores of the deaths by chloroform, which may be found scattered through the medical journals of the day, with the single exception of the "small spots of ecchymosis" on the surface of the left ventricle, these have not been observed in any fatal case of chloroform which I have examined. The condition of the cavities, the empty left ventricle, the congested lungs, and the fluid and dark color of the blood generally resemble, very closely, what was found in my unfortunate case, that of Bridget Henry. The heart in the methylene case could hardly be called a diseased one, the ecchymosed spots were evidently due to the anæsthetic, and so also the congestion of the lungs. *Methylene chose, as we see, for its first victim, a man in vigorous health.*

Tetrachloride of Carbon.—Prof. E. Andrews, of Chicago, gives the conduct of this new candidate for favor, as an anæsthetic when put upon trial. He says (I quote from *Medical Compendium*, 1869): "Nothing remarkable occurred at first, but after the lapse of a few minutes the assistant, whose duty it was to watch the pulse, observed that it increased suddenly in frequency, so that in a short time he was unable to count it. At the same time the patient, who was not yet unconscious, complained of a violent pain, as of cramp, in the vicinity of the heart, and after a moment more the

pulse and respiration both suddenly ceased. The patient's head was spasmodically drawn backward, the countenance looked pale and deathly, and the pupils of the eyes dilated until the iris could scarcely be seen. Artificial respiration was at once commenced, and strong aqua ammonia was rubbed in the nostrils, under which treatment, the patient revived again, although to all appearance almost dead. The anæsthesia was then completed by concentrated sulphuric ether, without further accident, and the carious bone excised in the usual manner. I do not think that there remained any prolonged unfavorable effect after the use of the tetrachloride, but the sudden advent of such urgent and dangerous symptoms made a strongly unfavorable impression on my mind, for the patient was much nearer death than I ever saw one go under ether. I certainly shall not venture on the use of the article again, unless very extensive experience by others demonstrates its safety."

Sir James Y. Simpson, who introduced this agent to the profession as an anæsthetic, although I believe it had been previously used as such by others, in an article in the *Medical Times and Gazette*, for 1865, states that it requires a longer time to produce anæsthesia with it than it does with chloroform, that the patient is longer in recovering from its effects, and that its depressing influence on the heart is greater.

THE VIENNA AND OTHER MIXTURES OF CHLOROFORM AND ETHER, are claimed by some to be more safe than chloroform alone, but as these agents are of different physical characters, specific gravity, density, and as their union is a mere mechanical one, it is apparent that we get the first effects from the lighter ether and the heavier chloroform keeps up the process. It would be more rational if there is safety in the two, to give them separately, that is, make the first impression by ether and continue it by chloroform.

CASES.

CASE 1.—*Death by Sudden and Continued Contraction of the Heart.*—Bridget Henry, Cincinnati Hospital, Oct. 13th, 1870. Surgical clinic of W. W. Dawson, M. D. Reported by R. J. Clark, M. D., resident physician.

"Bridget Henry, admitted July 7th, 1870, aged 38, married, housewife; states that during the autumn of 1869, a swelling appeared on the dorsum of the right foot, this swelling gradually became larger and was quite painful. She consulted a physician of this city, and he opened it with a bistoury, hemorrhage ensued—

the tumor gradually diminished in size, and did not give her much trouble until March, 1870, when a dark colored tumor made its appearance in the site of the first swelling. This tumor has gradually increased in size up to the present time, and has been attended with considerable pain. She has been an habitual drinker for several years, and was once treated for *mania a potu*. Present condition—She is a woman of above medium size, fleshy, dark hair and eyes, abdomen enlarged to about size of third month of pregnancy, has a dark colored tumor, fungus hæmatodes, on the dorsum of right foot, involving the bases of two of the toes; it is soft to the touch and is about size of an English walnut, it frequently bleeds, especially when touched. She has not menstruated for three years, is the mother of three children.

On July 28 the tumor was removed by a ligature applied to its base and desiccated sulph. zinc applied to the stump. During this time it was necessary to give the patient large doses of morphia to ease pain and procure rest.

Sept. 10. Attention was again called to the tumor in the abdomen, it was examined and supposed to be a fibroid of the uterus. The heart and urine were also examined and nothing abnormal found. Pulse from 70 to 80.

Sept. 12. Stopped morphia and ordered chloral hydrate to be given in doses of ʒ ss every hour until sleep.

Sept. 20. Stopped chloral and resumed the use of morphia as it seemed to control the pain better.

Oct. 13. Patient taken before the class, placed under chloroform and the foot removed by Syme's operation. Before the operation was completed the patient suddenly died. She had passed easily under the influence of the chloroform, and in about one minute and a half after becoming insensible, she ceased to breathe. Breathing and pulse fair up to the very instant when both were arrested. Persistent efforts were made to restore her, but without avail. Artificial respiration, electricity, &c. The amount of chloroform used was 75 minims; a portion of the same chloroform was tested and found to be pure.

An *Autopsy* was made ten hours after her death. Scalp found congested and injection of the arachnoid; small amount of fluid in each ventricle; veins of lateral ventricles and septum lucidum distended with blood; entire brain substance more moist than normal. The lungs were engorged, but beyond this presented nothing peculiar.

Heart—Cavities empty, almost entire right ventricle covered with a layer of fat, valves of right side transparent and flexible, a band of calcareous matter about ¾ of an inch in length, extending from near the base of the mitral to within a short distance of one of the semilunar valves; aortic valves slightly thickened, all valves at left side flexible and apparently competent. The muscular substance of the heart was in a state of fatty degeneration.

Kidneys—Left one weighed ℥vj., capsule thin and readily de-

tached, cut section granular, line of separation between cortex and pyramids distinct. Right one weighed ℥ iijss., capsule thickened and closely adherent, cut section granular very little pyramidal structure, cortex ⅝ inch thick.

Liver—Weight 78℥; substance fatty.

Uterus—One large and one small fibroid tumor were found developed in the uterine walls. Dimensions of largest one, 6 inches in length and 5 inches in transverse and antero-posterior diameters, small tumor about 2½ inches in its diameter, walls of uterus presented appearance of an advanced stage of pregnancy.

Blood was fluid throughout the body."

It will be noticed in this case that there was a simultaneous arrest of the heart's action, and of respiration, and with all our efforts at resuscitation—*artificial respiration being kept up for one hour and three-quarters*—there was not the slightest indication of a return to life; the lungs were alternately filled and emptied, but *the heart remained still, motionless.* The blight here was through the lungs, directly upon the heart, producing a *sudden and continued contraction*, as shown by the empty condition of the cavities. Had this been by a sudden contraction of the pulmonary arterial vessels, by which the blood would have been driven back upon the heart, the lungs, as suggested by Richardson, would have been found blanched and the right heart filled with blood. In this way, death, without question, frequently occurs in a dilated right heart or in a fatty heart. The sudden regurgitation of the blood through the pulmonary artery, by which the right ventricle is flooded, distended and paralyzed, takes from the organ the power to contract, death is inevitable. Bridget Henry, although her heart was in a state of fatty degeneration, did not die in this way, the cavities in her case, as we have seen, were entirely empty.

Dr. E. A. Clark, in the *Humboldt Medical Archives*, reports a case where death resulted in the same manner that it did in the case of Bridget Henry. The *post-mortem* showed the heart, lungs and brain healthy, but the cardiac cavities were empty, showing that the first damaging effect of the chloroform was upon the heart, causing *a positive and unyielding contraction.* This view is supported by the fact that after the patient had been placed on his back with his head lowered and cold water dashed in his face, "three or four long inspirations" were taken, "without, however, affecting the circulation in the least." Dr. Clark says, "this (artificial respiration) was continued without any relaxation for an hour and forty minutes, but without in the least reviving the ac-

tion of the heart, which, I am confident, never beat again from the moment that natural respiration ceased; he was dead from that instant."

CASE 2.—*Death of an Intemperate Man before the Completion of an Amputation of the Leg.* Dr. E. Ashton, of Lima, Ohio, reports this case, as follows:

"Sometime in the month of January, 1857, a man named Boston Ike, a notorious drunkard, bought a jug of liquor in the evening, and started for his home on the line of the D. & M. R. R., then in process of construction. On the following morning he was found, by his friends, lying beside a stump and badly frozen. I did not see him for several weeks, when I was called to amputate both lower extremities. Both feet had sloughed off above the ankle; he was much emaciated and suffering from an irritable cough, the latter the result, no doubt, of that night's exposure. Seeing the condition of the man, I objected to giving him chloroform; but his fear of the operation and unwillingness to have it performed without being rendered insensible to pain, were so great, that his attending physician urged its administration. Dr. Curtis administered the chloroform from a sponge held in the hand. He seemed to have some little difficulty in inhaling the vapor, but after a few inspirations, he had no further difficulty, and passed quietly and fully under its influence. I proceeded to perform the operation, but had barely completed the incisions and was about to use the saw, when my attention was called to the patient; from his expression and the character of his breathing, I saw that all was not right. Upon dropping the saw and placing myself beside my patient, I felt his pulse at the wrist; his breathing, however, ceased instantly, and all efforts to re-establish it were in vain."

The prostration and emaciation in such a case as this, where both feet have been lost by gangrene, the result of frost, is necessarily very great. I saw, some years ago, Dr. Thomas Wood operate under chloroform, in a case very much like Dr. Ashton's; both feet had been lost by exposure to cold; the patient, an old man of about sixty, was thin, worn and wasted by long suffering; but he slept like an infant in its mother's arms, while Dr. Wood worked up the stumps. Emaciation merely is no bar to the use of chloroform; but emaciation in connection with the excessive and long-continued use of alcohol, renders the hazards of the anæsthetic much greater.

CASE 3.—*Death after Amputation of the Thigh. Second Administration of Chloroform.* Reported by Dr. J. W. Hadlock.

"During the month of September, 1865, at Idaho City, Mr. R., a stout, robust, vigorous man, of good habits, became engaged in a

personal difficulty, during which he received a shot from a large sized Colt's navy revolver, about the middle of the thigh, the ball fracturing the femur to considerable extent. An effort was made to save the limb, but after six day's trial, in that direction, it became evident that it must be removed. The day previous to the amputation, the patient was placed under chloroform and a thorough examination of the injury made. This examination lasted some minutes, the patient coming from under the anæsthetic without any unpleasant symptoms. The following day the operation was made at the junction of the upper and middle thirds of the thigh. The patient went under the influence of the chloroform in an easy and quiet manner, but just as the flaps were being brought together, Dr. Bell, who was attending to the chloroform, remarked: 'This man is dying,' and after two or three faint gasps, he stopped breathing. Efforts at resuscitation were made, but were of no avail. I make this record from memory, and can not now remember whether the heart's action ceased simultaneously with the breathing. The patient was not reduced or emaciated, but was in a good condition for an operation."

This case evidently belongs to Dr. Reeve's 6th class, viz: "Cases in which every precaution seems to have been observed, and no explanation of the death can be given in the present state of our knowledge."*

CASE 4.—*Death while the Anæsthesia was but Partial, patient in an erect position for the Extraction of Teeth; had taken it frequently to complete insensibility.* Reported by Dr. J. G. Wilson, Washington C. H., O.

"On September 29, 1870, Dr. Hamilton called on me to administer chloroform to Mrs. Col. Garris, who had come to his office to have eight teeth extracted. I met Col. Garris at the foot of the stairs leading to Dr. H.'s office, and he requested me not to put his wife fully under the influence; to give her only enough to allay pain. I found her sitting in the dentist's chair. I asked her if she could stand it to have her teeth extracted without being insensible? She answered: 'I expect I can, but I am not afraid of chloroform; I have taken it a hundred times, and I could have taken it myself to-day, without sending for you, but they would not allow me to do so.' I gave it on a napkin, held from 1½ to 2 inches from the mouth, and after inhaling the vapor two or three minutes, she said: 'If the dentist is ready I am.' When Dr. H. introduced the forceps, she caught his hands; I removed her grasp to mine, and she held my hands firmly. When the tooth was drawn

* On the causes of death from chloroform, with an analysis of the reported total cases from the inhalation of that agent, and an endeavor to classify them by J. C. Reeve, M. D.—*American Journal of the Medical Sciences*, 1867.

she screamed so as to be heard across the street. As Dr. H. was about to engage another tooth, she caught his hand, and said: 'Hold on till I take more chloroform.' Dr. H. stepped back and I saw she was fainting. I laid her on the lounge. I could not detect either pulse or heart action. She continued to breathe at long and still longer intervals, blowing out the lips at each expiration. Her breathing reminded me of persons that I have seen die of apoplexy. Mrs. G. was 39 years of age, the mother of eight or nine children—of delicate health and very nervous. The pulse, before the administration, was 80; under the chloroform, it fell to 70. The amount of chloroform used did not exceed one drachm. It was procured from Allen & Co., Cincinnati, O., and on being tested, was found to be pure. I had used it before, and frequently since. Artificial respiration, electricity, cold water and stimulating enema were used."

As supplementary to this report, I may mention some facts in reference to the chloroform history of Mrs. Garris, as given by Dr. Stewart, of Bloomingsburg, Ohio, at the Cincinnati Academy of Medicine during the present session. Dr. S. stated that he had known Mrs. G. all her life, had given her chloroform in all her labors except the last, when it was given by Dr. Wilson; that *he had kept her under its positive influence* 12 *hours during her first confinement.* That he had given it to her on three different occasions for the extraction of teeth, and always with the happiest effect and with the best results. He expressed the opinion that if chloroform had been pushed to complete insensibility at its last administration, that the termination of the case would have been different.

Upon the question of the comparative safety of partial and complete anæsthesia, the following, taken from the paper of Dr. Reeve already referred to, is pertinent: "Attention was first called to the probability that death, under chloroform, might be explained by the depressing effects of the surgical incisions upon the heart's action by Mr. Bickersteth, as long ago as 1853. 'He relates three instances in which the pulse suddenly ceased on the first incision by the surgeon, and commenced again in a few seconds, the breathing going on naturally all the time. All the three cases were amputation of the thigh.' Snow has never observed this change in the heart's action, although he says he has carefully watched for it, and he explains the cardiac irregularity by the direct effect of chloroform, its occurrence being just at the time when anæsthesia is at its hight. The next investigator of this subject was M. Vigoroux, who presented his views to the Academy of Sciences. He started from the fact that a painful impression upon the sensi-

tive nerves influences the heart by reflex action in a manner exactly similar to a direct excitation of the par vagum, retarding or even arresting suddenly its movements. He first attempted a solution of the question, whether this influence of the external sensory nerves upon the heart's action was exerted during anæsthetic sleep, and decided it in the affirmative. As we have not access to the detail of his experiments we cannot decide how justly this decision was made, but his further conclusions shake confidence in him entirely; they were that the influence mentioned not only exists, *but is augmented*, and that a majority of the deaths under chloroform could be attributed to this cause! M. Perrin, to whom we are chiefly indebted for a knowledge of M. Vigoroux's doctrines, disposes of these assumptions most effectually by calling attention to the number of deaths which have occurred before the operation began—35 out of 65! But M. Perrin investigated the subject for himself, and from reason and the careful examination of eight cases of operation under chloroform, concludes that it is only during the period of partial anæsthesia that this influence of external excitation upon the heart's action manifests itself while during complete anæsthesia it is abolished. 'To admit any reflex action whatever after sensibility to mechanical irritants is abolished, would be to admit an effect without a cause.' Mr. Bickersteth also expresses his conviction that accident in this way is less likely to occur when the anæsthesia is profound. Mr. Lister saw a patient die when partially under the influence of chloroform, and expresses the opinion that he would have passed safely through the operation had the influence been complete. This, then, brings us to a point at which the doctrine becomes of the highest practical importance; it forces upon us the question, Is partial anæsthesia more dangerous than complete? A question beside which the mode of death, simply considered as such, becomes insignificant. In support of the affirmative, we have seen that there is considerable respectable authority."

In his collection of cases, in the section bearing on partial and complete anæsthesia, Dr. Reeve introduces the following one which has a remarkable resemblance to that of Mrs. Garris. "A lady, San Francisco, (*Boston Medical Journal*, May 19th, 1864). The patient was seated in a dentist chair, and was 'much excited, by fear of the instruments. At a period when anæsthesia was manifestly incomplete as she seized the dentist's hand and removed it from her face, the tooth was extracted; 'but the jaws *immedi-*

ately after became clenched, and her head thrown back,' the breathing was arrested and death rapidly ensued."

CASE 5.—*Death of a Boy* 14 *years of age. Second Administration. Mental Depression.* Reported by Dr. A. T. Davis, of Wilmington, O.

"Chas. Pendry, a healthy industrious boy, had his thigh fractured Dec. 23d, 1869. Was suffering great pain when I saw him two hours after the accident; gave him chloroform while examining and dressing the fracture. On the 9th of April following, while loading a sled he fell with some heavy boards across the lame thigh, and refractured it at the same point. When I saw him two hours after, he was very despondent and said he should die, but in all respects appeared to be in good condition. He would not, as when first injured, permit me to touch him without chloroform. I gave it; he speedily came under its influence, I examined the fracture and left his bedside to prepare bandages. He slept about 15 minutes and woke in great pain, and remained awake about 20 minutes. I then examined his pulse and appearance, all seemed right. I again applied the chloroform, and in two or three minutes as he began to pass under its influence, I handed the towel to an assistant; just as I did this I put my fingers on the wrist and found no pulsation; the chloroform was immediately withdrawn, but the heart remained still. The breathing during the administration of the chloroform was a little stertorous, but only such as is often seen in anæsthesia. He breathed ten or twelve times after the arrest of the heart's action. Insufflation and all other means of resuscitation at command, were used, but without effect. The quantity of chloroform used did not exceed 2½ drachms."

The death in this case was evidently by the heart, the mental depression as he was anxious to have the chloroform could not have had much, if anything, to do with the fatal result. In the absence of *post-mortem* revelation it must be mere conjecture whether death in this case was by sudden and continued contraction, or by paralysis of the heart.

CASE 6.—*Death of a robust man after Complete Anæsthesia had passed sufficiently for him to answer a question.* Surgical Clinic of Dr. Thos. Wood, Commercial Hospital, 1865. Reported by Dr. Chas. O. Wright.

"The patient upon whom Dr. Wood operated for fistula in ano, was a man of plethoric habit and aside from the fistula, was in apparent good health. It was with some difficulty that we could bring him under the influence of the chloroform. For at least *one minute* before the completion of the operation I had ceased the administration. After the Doctor had finished the operation and

was about washing his hands, the patient having answered one or two interrogatories, and the order had been given to remove him from the amphitheater, he was seen to gasp. Dr. Wood immediately seized the tongue, drew it forward, and the patient breathed. Dr. Wood turned to the class and was explaining to them the condition of things, when, turning round and noticing the patient again gasping, he again seized the tongue, artificial respiration was established; but in vain, he never breathed afterward. At least *three* minutes elapsed from the time we ceased administering the chloroform before unfavorable symptoms were observed.

Post-mortem.—Rigidity well marked; suggillation lighter color than usual; scalp full of dark and thin blood; dura mater engorged, serum beneath arachnoid, coagulated lymph upon both surfaces of the membranes; fine threads of lymph passed from the lateral and under surfaces of the medulla oblongata to the cerebellum; in the lateral ventricles a small quantity of serum tinged with blood; the chloroid plexus pink and adherent to the thalami optici; the veins on floor of ventricles distended; threads of lymph passed from floor to roof of lateral ventricles; velum interpositum covered with firmly adherent lymph; puncta vasculola in right cerebral hemisphere more numerous than usual; surface of medulla oblongata much congested. Considerable fat on external surface of pericardium, on its inner surface about the roots of the great vessel were numerous small deposits of soft caogulated lymph. Heart had about the usual amount of fat on its surface, walls normal, cavities empty; valves healthy. The right pleural surfaces adherent over the greater part of their extent and the lobes united by false membrane; the lobes of left lung united, but pleural surfaces free; epiglottis and mucus membrane of larynx were dusky, but little fluid in the bronchia; entire upper lobes of both lungs dark colored and gorged with blood; the same condition existed in the lower posterior portions; the anterior portions were emphysematous. The blood in all parts very thin, dark, and no coagula."

CASE 7.—*Death of a Lady—Retching and Vomiting commencing with the administration of Chloroform, were arrested during complete Anæsthesia, began as soon as the patient was aroused, and continued for six days.* Reported by Dr. Thos. Wood.

"Mrs E., about 26 years of age, had received laceration of the perinæum in child-birth about four years previous to my attendance on her. The laceration extended back so as to impair, but not entirely destroy the integrity of the sphincter ani, but the control of the sphincter vagina was so much impaired as to allow a descent of the folds of the vagina and bladder, and a dropping of the uterus below its natural position. From this unnatural state of things, she became nervous and debilitated, and was the victim of constant pelvic distress. For her relief I performed the

usual operation, pairing off the cicatrized surfaces and drawing them together by silver sutures. I operated on the 10th of March, 1870, and six days after she died. The chloroform was administered by Dr. Charles Woodward. *The first inhalation produced retching*, followed by vomiting before insensibility was produced. The operation lasted about half an hour. As soon as she became sensible the vomiting was immediately resumed and continued, when there was anything in her stomach to eject, until her death. When her stomach was empty she was either retching or making an effort to resist it. In twenty-four hours she became delirious and tremulous, the pupils dilated, the capillary circulation deficient, the surface livid."

Here we see a new manifestation of chloroform, a pernicious influence on the stomach producing persistent, uncontrollable and fatal vomiting. In all the cases published I have discovered none like this. The poisonous effect of the chloroform seems to have spent itself on the gastric branches of the par vagum.

CASE 8.—*Death of a Man having Delirium Tremens and Fracture of the Humerus.* Commercial Hospital Service of Dr. George C. Blackman.

"The patient was a man aged about 30, of good muscle. He came into the hospital with a fractured humerus and was seized with delirium tremens. So violent was he that it was necessary to give him chloroform to dress the broken arm. He died during the dressing."

This case illustrates the peril of administering chloroform to inebriates.

CASE 9.—*Death of a Young Man three quarters of an hour after the Administration of Chloroform had been suspended.* Commercial Hospital, 1857. Service of Dr. Geo. C. Blackman. Reported by N. J. Sawyer, M. D.

"The patient was a young man about 18 years of age, anemic, very much emaciated with a pale, bloodless countenance, feeble pulse and extreme general debility. On the front aspect of the right thigh, and over the track of the femoral artery, was a swelling of considerable extent, and about which there was a difference of opinion among those who examined it, as to whether it was an abscess or an aneurism. Dr. Blackman, the attending surgeon, came to the conclusion that the tumor contained pus only, and having decided on this after making his usual morning visit, he returned to the hospital in the afternoon to perform the required operation. I being on duty in the surgical wards at the time, he requested me to give the chloroform, and stood by while it was being administered. Dr. Blackman, myself and two nurses

were the only persons present. The patient lay on his bed, with the head and shoulders slightly elevated, and was soon under the influence of the anæsthetic without having manifested the least symptom contra-indicating its use. There was no vomiting either during, or after, its administration. The patient simply went quietly asleep. Dr. Blackman made an incision toward the outer edge of the sac, and went down to the bone; but no pus making its appearance, he declined using further efforts to find it. The patient fully revived, as we supposed, from the effects of the chloroform, and talked in his usual manner, giving directions about the bandages, the position of the limb, etc.

"The administration of the chloroform, the operation, the revival of the patient to his ordinary condition and the complete possession of his faculties, occupied about twenty minutes. I remained until there seemed no further need of my presence, but happening to look back as I passed out of the door, I saw the patient had raised himself to a sitting posture in the bed. Supposing he would lie down again in a moment, I gave the circumstance no attention. In about three-quarters of an hour after leaving the ward, a nurse summoned me in haste, saying 'Run up, quick, that man is dying!' As I reached the patient's bed-side he gave but one gasp, and was dead. The ordinary means for resuscitation were applied when it was too late, and, of course, in vain.

"The *post-mortem* revealed the fact that the swelling was an abscess, containing about a quart of pus, and that the incision had missed the sac about a quarter of an inch.

"Dr. L. M. Lawson examined the abdominal and thoracic viscera, and the brain. The appearances presented were such as might be expected in an extreme case of anæmia. The right cavities of the heart, however, were found to contain such a quantity of coagulated fibrin that Dr. Lawson remarked it was a wonder the organ could have performed its functions at all; and the conclusion arrived at was, that extreme depression following from the over-excitement produced by the chloroform, superadded to the impediment to the pulmonary circulation, and to the action of the heart from the deposition of fibrin in its right cavities, had caused the death of the patient."

We can hardly convict chloroform of the death in this case. The boy recovered so as to raise up in bed. It was in this erect position that the syncope occurred which destroyed him. The clots here, too, are unusual. In the large majority of cases the blood is found in a fluid condition.

CASE 10.—*Death of a Soldier to whom Chloroform was given for an operation for Fistula in Ano.* General Army Hospital, Nashville, Tenn. Reported by F. Seymour, M. D.

"A. B., about 30 years of age, a soldier, had fistula in ano, and,

although the operation was a trifling one, yet he insisted on an anæsthetic. He was taken into the operating room, and placed upon the table. A full supply of air was circulating, the windows and doors being open. Dr. J. R. Weist, of Richmond, Ia., administered the chloroform; it was done with skill and care. After a few deep inspirations, he commenced struggling, and his features becoming somewhat livid, the chloroform was suspended. In a few seconds the chloroform was again administered, and he seemed to pass under its influence kindly. Just then my attention was called from him for a moment, when, hearing an exclamation, I turned around, and his breathing had ceased. The mouth was forced open, the tongue seized and drawn forward, water was dashed in his face; Marshall Hall's ready method was immediately resorted to, and mechanical inspiratory movements were induced quickly; but all efforts combined for nearly an hour were unsuccessful. No *post-mortem*. The heart and lungs were carefully examined, and found healthy before the use of the anæsthetic."

The folly of the dogma that *whenever an operation is justifiable, chloroform is justifiable*, or, as Syme puts it, *a case for operation is a case for chloroform*, is peculiarly illustrated in this instance. The operation for fistula in ano is one of the most painless. No person should be subjected to the dangers of chloroform for a cutting so insignificant, and particularly in view of the fact that most deaths, so far, have attended trivial operations. This case was not reported to the Surgeon-General's office.

CASE 11. *Death of a Lady placed under Chloroform for the Extraction of Teeth; position recumbent; had taken Chloroform before.* Reported by Dr. D. C. Rathburn, Middleport, O.

Mrs. Black died in 1865. She was a person of nervous temperament, delicate health, but of no organic disease. Before taking chloroform she seemed agitated, pulse about 100. She had taken chloroform once before for dental purposes. Her position was recumbent, before a large open window. The chloroform was administered by folding a handkerchief in the form of a cone, and, saturating the apex, applied it to one nostril only. The amount used was about three drachms and a half. She never lost consciousness, but would indicate by a wave of the hand that she was ready. This she did until the last of three fangs had been removed, when, as quick as thought, a deathly pallor came over her countenance, indicating syncope or death. I immediately applied my ear over the heart; it was still. She had died without a struggle. No time was lost in drawing out the tongue, and in inflating the lungs by the application of my mouth to hers, compressing the chest after each inflation. Artificial respiration was thus kept up for one hour."

This would seem to be another death from partial anæsthesia.

CASE 12.—*Death of a Man having Paralysis; had taken Chloroform frequently.* Good Samaritan Hospital. Reported by Dr. DeCourcy.

"Geo. Davis, colored, aged 29. Admitted with complete paralysis of upper and lower extremities, resulting from an injury, May 5, 1869. It was necessary to put him under chloroform each time his bed was changed, owing to enormous bed sores. He bore chloroform well, and had taken it quite a number of times, but on September 29, 1869, while that agent was being carefully administered to him, as usual, by one of the resident physicians, his pulse and respiration suddenly ceased. The chloroform had been gradually administered to him less than two minutes, on that occasion. Every effort at resuscitation failed."

CAUSE OF DEATH.—*The heart* is the organ most frequently smitten in death by anæsthetics. This is certainly true of chloroform, whose career has been more carefully studied than that of any other agent of this class. In most of the cases reported it will be found that the failure of the pulse was followed by failure of the lungs. In the majority of cases the heart is paralyzed; in many, and such a one is Case 1st, the chloroform stimulates the heart to a positive, unrelenting, fatal contraction; in others the organ is broken in force and deprived of the ability to contract by the rush of blood upon it from the lungs. "Twenty years ago," says Richardson, "it was assumed that in nearly every fatal case death was owing to cessation of the heart, and we are indebted to Dr. Sibson for a very acute and admirable suggestion explaining the cause of the suddenness of the death. The heart, said he in effect, for I forget his exact words, first feeds itself with blood by its coronary system of vessels. It receives, therefore, into itself the first impression of every stroke of itself. If the blood with which it is fed is normal, it is first fed by it; if the blood is abnormal it is first injured by it; and so when the blood of the left side is charged with chloroform the heart is the organ primarily influenced by the agent."

The lungs, next in frequency, are the organs fatally impressed. The chloroform coming in contact with the pulmonary branches of the pneumogastric, paralyzes them, respiration ceases, while the heart continues, for a limited time, its action. The second case reported illustrates the toxic influence of chloroform upon the lungs.

The stomach, in Dr. Wood's case (Case 7 of this collection), was primarily and fatally affected by the chloroform. The first inhalation stimulated the gastric branches of the par vagum; the anæthesia, which lasted half an hour, so disordered them that vomiting and retching ceased only with the life of the patient on the sixth day.

The tongue, formerly more frequently than now, by falling back caused death by mere mechanical obstruction. It belongs to voluntary life, and when the anæsthesia becomes profound the muscles of which it is composed, and which give it form and hold it in position, are relaxed; it falls into the isthmus, closes the air passages; apnœa is the result. The recumbent position favors danger from the falling tongue.

The brain is occasionally overcome by the toxic influence of chloroform. The chloroform narcosis is prolonged, pushed too far (but who can give us the limit), and the patient dies in a comatose state.

THE MANNER OF DEATH.—This may be *sudden*, *gradual* or *secondary*. Most deaths, as will be observed by an examination of all records, were sudden—in a moment the patient died. Bridget Henry had a fair pulse and regular respiration up to the very instant when both ceased. In a few cases the death was *gradual*, the fatal result seems to have been delayed, the heart and lungs showed feebleness of action, then were arrested; in a moment respiration and pulsation were resumed, but only to be followed by cessation, and thus arrest and resumption of these vital functions alternated, sometimes for minutes, sometimes for hours, before the death of the patient. Dr. Wood's case peculiarly illustrates *secondary* death from chloroform. Aroused from the complete anæsthesia the patient at once resumed the vomiting which had been inaugurated by the first inhalation of the vapor, and which terminated her life on the sixth day.

WHAT CAN BE DONE TO PREVENT THESE ANÆSTHETIC DEATHS?—The first question which presents itself under this head, is, *What cases should be excluded*—shut out from the use of chloroform? Dr. Richardson places himself thus: "I believe I know of one condition of body which may be diagnosed as specially dangerous for chloroform, and there my knowledge is brought to an end. This unfavorable condition is present when careful diagnosis shows the

existence of a *weakened and dilated right side of the heart*, with enlarged hemorrhoidal veins, varicose veins of the lower extremities, and large, full, yet not tense veins in the lower part of the body. In the body, thus circumstanced, we may be certain that the right side of the heart, which is the most important organ to be sustained in action under chloroform, is already half dead, and will readily succumb if subjected to further injury. * * * If I have one further misgiving, in respect to dangerous cases, it relates to cases of kidney disease with albumen in the urine, and disposition to uremic sleep. Here, however, the misgiving is based on theoretical reasoning alone, and is greatly negatived by the knowledge we have acquired from practical observation."

From the fact that so many chloroform *post-mortems* have revealed *fatty degeneration of the muscular structure of the heart*, almost all writers exclude persons with this affection; but who can diagnose a fatty heart? *Writers* exclude these cases, but *practitioners* give them chloroform, nevertheless. We can only suspect fatty degeneration of the heart; we can not definitely diagnose it. Da Costa says, "There is as yet no sign discovered by which we can say that the dangerous disorganization of the muscular fibers of the heart is in progress. We may, however, suspect it, if the signs of weak action of the heart, feeble impulse, and ill-defined sounds, coexist with a pulse permanently slow or permanently frequent and irregular, and be met with in a person who is the subject of a wasting disease, or who has arrived at a time of life at which all the organs are prone to undergo decay." Bridget Henry had a malignant disease of the foot—it was local—painful, but had not wasted her. She was plump; had fat in abundance. She had a regular pulse of fair force and volume, and a cardiac impulse normal, and yet the *post-mortem* showed what had not been even suspected, much less diagnosed, a fatty heart.

Arthur Ernest Sansom, M. D., in his valuable work on Chloroform, its Action and Administration, thus writes: "The general lesson inculcated, would seem to be this: that in cases of marked fatty degeneration of the heart, chloroform should not be administered; that in cases wherein a debility of the heart is suspected, unusual care should be exercised to administer a free dilution, so that the heart should not be paralyzed by the sudden shock of an influence which it can not withstand. * * * * What are the principles of diagnosis? Of the first class, viz: fatty degeneration,

the following are the most important points: The previous history of tendency to faintings, the occurrence of occasional dyspnœa from congestion of the lungs; the indication of atheroma of the arteries; feebleness, and especially intermission of the pulse; the impulse of the heart, found on stethoscopic examination, to be feeble in proportion to its size; the countenance showing a certain yellowness of hue, and a congested state of the capillary vessels of the cheeks; the occurrence of *arcus senilis*. If the occurrence of these signs should give rise to the diagnosis that there is a fatty degeneration of the heart, we are not justified in giving chloroform."

Bridget Henry had had no "faintings," no "dyspnœa from congestion of lungs," no "indication of atheroma of the arteries," no "feebleness, and especially intermission of pulse." The impulse of the heart was not found "feeble in proportion to its size;" the countenance did not show a "yellowness of hue, and a congested state of the capillaries of the cheeks;" nor was there "arcus senilis." And yet, as we have seen, hers was a well developed case of fatty degeneration of the heart.

Equally unanimous are writers and observers on excluding from chloroform *hard drinkers* and persons laboring under *delirium tremens*. One of Dr. Blackman's cases (Case 8), and Dr. Ashton's case (Case 2), belong to the class in which the risks are great. Bridget Henry's ante-hospital history, which I have but recently learned from Dr. Maley, who was her family physician for eight years, and who has informed me that she was an unusually hard drinker, and had had delirium tremens six times, would have excluded her, if this rule is made positive, although it must be remembered that from the time she entered the hospital, July 7th, until the day of her death, October 13th, she did not drink anything, and during this period her health was fair. She suffered only from the painful condition of her foot.

Dr. Sansom noticed in these cases "a great primary resistance, prolonged muscular agitation, hyperæsthesia rather than anæsthesia, violent endeavors to assume the erect posture, and, after a considerable time, sudden change to deep insensibility, clammy perspiration, complete relaxation, snoring respiration, and feeble pulse."

In Dr. Ashton's case, and in that of Bridget Henry, there was no resistance, but neither were suffering from recent alcoholism—long intemperance had damaged the heart in both cases—and in

both death was sudden, by the heart, rather than by a toxic effect upon the nerve centers, the direction from which death often comes to the intemperate.

Prof. Gosselin, in discussing the contra-indications to the use of chloroform, cites *nervous shock after severe injuries*; he would rule out these cases. Now, it is an undoubted fact, in the face of all that is said of the depressing, paralyzing effect of chloroform upon the heart, that it *does often increase* cardiac action. I witnessed this recently in the Cincinnati Hospital. A little boy was brought in with the arm crushed to the shoulder; amputation at the joint was necessary. He was fearfully mangled and greatly prostrated, but under the influence of chloroform his pulse increased in force and frequency. Dr. Stewart, at the Academy of Medicine, reported a similar case where the action of the chloroform was that of a decided cardiac stimulant. The experience of giving chloroform in the cold stage of intermittents looks in the same direction; here is a shock, a collapse to a degree—the heart is oppressed, its action imperfect, chloroform acts as a stimulant, the shock is broken and the chill is of short duration. Prof. C. G. Comegys, in the *Western Journal of Medicine*, 1868, gave his experience with chloroform in intermittents. He treated one hundred cases in the Cincinnati Hospital, giving chloroform on the supervention of the chill; "and," says he, "in every case complete relief is obtained in from three to five minutes." "In the condition of shock, or of great depression, as after hemorrhage, the careful administration of anæsthetics diminishes the risk of an operation." (Report to Royal Medical and Chirugical Society.)

Persons in great fear and dread of an operation, although they can not be excluded, should have anæsthetics exhibited to them with great caution and care. Bridget Henry belonged to this class. The position of the physician under such circumstances is embarrassing in the extreme. An operation is essential to the preservation of life, and yet his patient is nervous, and what is worse, has a fear of and an aversion to that operation. The non-professional can not appreciate this situation.

The conclusion of the whole matter in regard to exclusion, is, that *we can only decline persons with a dilated right heart and those laboring under delirium tremens.* To these Richardson is disposed to add those persons who are disposed to uremic sleep.

We may do much in securing safety, by attention to the proper position of the patient, the condition of the stomach,

the temperature of the room, the appliance for and the manner of administering the vapor.

When we reflect that the large majority of persons die of syncope, there should be no question about the recumbent position being the most safe for the administration of anæsthetics. Sansom says: "The rule should be, let the patient observe the recumbent posture, unless the exigencies of the operation point otherwise. The tendency to syncope is greater in the erect and setting position than it is when the body is horizontal. The pulse in the latter condition is more slow and quiet; thus, though it may be seventy in the former position, it will frequently sink to sixty-five or even sixty, in the latter. The reason, therefore, that the recumbent position is to be preferred is, that the circulation is more steady and the tendency to faintness is less." Richardson says: "The sitting position is certainly unfavorable for the heart, and the perfectly recumbent position is unfavorable in many ways. It interferes with free respiratory power, it allows fluids accumulated in the mouth to fall back to the throat, it allows the tongue to fall back, and when vomiting happens to come on it enforces the necessity for raising the body. For all these reasons the semi-recumbent position is the best, as it is the most convenient. To this recommendation as to the position, it is essential to add another, viz: to keep the body from the beginning to the end of the administration in the same position, without any upward or downward movement."

This recommendation by Dr. Richardson, of the semi-recumbent position is certainly erroneous in principle. It is not an easy position, it is a restrained one and does not favor the free use of the lungs as well as the recumbent, nor is it so convenient to the administrator or to the operator. The recumbent should never be abandoned for any other position, except when, as Sansom says, the exigencies of the operation point otherwise.

Upon the question of *position* the case reported by Prof. M. B. Wright, at the Academy of Medicine, during the present session, is peculiarly striking. That lady had taken chloroform, since its introduction, in all her labors and they have been many. She was the second female in Cincinnati who took it in parturition. She commences its use always on the first appearance of pain, and often before Prof. Wright's arrival she is fairly under its influence. In labor it has always acted admirably, producing no unpleasant symptoms of any kind, but on several occasions, when she inhaled

it in a dentist's office for the extraction of teeth, the symptoms were of the *most alarming character.*

Chloroform should not be given while a meal is undergoing digestion; the stomach should be free from food, and if vomiting occurs it should rather be encouraged than restrained; from *three to four hours* should elapse after a meal before the anæsthetic is given.

Should spirits be given before the administration of chloroform? The practice of physicians varies very much on this point. Some give it, others do not; my own impression is, that it should never be omitted; it encourages the strong, and strengthens the weak.

On the means of counteracting the toxic effect of chloroform and ether, Dr. Sansom (*Medical Times and Gazette*, April 28, 1870), suggests that *when one agent seems to be depressing the patient, another should be substituted.* Unfortunately, however, most of these persons die without giving any sign of depression; the heart or lungs, or both are suddenly smitten while respiration is regular, and the pulse shows fair force and volume; there is no time to displace one anæsthetic, which is acting badly, for another which may act kindly. The most rational course, when depressing effects are noticed, would be to withhold entirely, on that occasion, at that particular time, anæsthetics, and allow the patient to recover completely from all effects of the drug; then the substitution of one for another might be made.

Dr. Sansom also speaks highly of Claude Bernard's recommendation to give a *subcutaneous injection of morphia in persons of feeble heart, and in those given to habitual intemperance*, but in this connection we must remember that this use of morphia is not entirely benign. Dr. Alonzo Clark reported a death, a few years ago, from a subcutaneous administration of morphia, and I am aware of another death from the same cause. It occurred in this State recently. The subject was addicted to drinking, and the morphia was used while he was in a debauch. Claude Bernard thus recommends, for the correction of the dangers of one agent, another agent equally potent for evil.

Mode of Administration.—Appliances for the administration of chloroform range from Morton's Inhaler, by which chloroform alone was admitted to the lungs, to Snow's apparatus, with which the patient receives but 4 per cent. of the anæsthetic. Just here, before discussing the various modes of administration, I may

make the remark that, although for the last few years the tendency has been to great dilution of the vapor by the means of apparatus, as essential to safety, yet the deaths seem to have been on the increase, and I doubt whether there is advantage in any of these appliances. It appears folly to talk about the positive safety of dilution when a vapor of from 3 to 4 per cent. kills, and kills in the same manner that chloroform pure, unmixed with air, does. Mrs. Simmons, the second victim of chloroform (Cincinnati, February 23, 1848), who inhaled pure chloroform from Morton's Inhaler, seems to have died in precisely the same way as did those who have perished under Snow's apparatus.

Snow's Apparatus.—"The essentials are a metallic vessel in which chloroform is contained, and through which air passes, thus carrying the chloroform-vapor along with it; a tube which conveys a mixture of chloroform and air to the face-piece, and a flexible mask, fitting over both nose and mouth." From 3 to 5 per cent. of chloroform is mixed with the inspired air. The inventor of this instrument contended that it rendered chloroform perfectly safe, and although never meeting with a fatal case, he had some narrow escapes, his patients being in very great danger. Other gentlemen of equal skill, however, were not so fortunate in the use of his apparatus; they lost cases, although following "the method and practice of Snow."

Clover's Apparatus.—"Is a bag for containing the anæsthetic mixture; secondly, an arrangement for filling the bag with a certain proportion of chloroform and air." This is an expensive apparatus; it is large, unwieldly, and requires time to manufacture the anæsthetic atmosphere. It certainly will never come into general use.

Sansom's Inhaler.—"The receptacle for the chloroform is a small metallic cylinder; its hight about three inches, its diameter about an inch and a half. It is filled with blotting paper, loosely crumpled, or, what is better, a rolled piece of lint; at the top it is provided with a freely perforated plate, for the admission of air, and for the introduction of liquid chloroform. An exit tube passes at right angles from this receptacle, it being attached a little above the center, so that a cup may be kept for the retention of any liquid chloroform which may be more than sufficient to moisten the blotting paper or lint. Thus arranged, a direct current of air in inspiration passes through the apertures over the chloroform,

and of course carries the vapor along with it." "Simplicity, compactness, and portability," characterize this instrument.

Sir James Y. Simpson's Method.—This may be given in his own words, taken from the history of his first fatal case: "I chloroformed the patient. In doing so, I placed a single layer of towel over the nose and mouth, leaving the eyes exposed, and dropped the chloroform upon the towel." Sir James, "from first to last, reasoned against complicated methods of administration."

Cincinnati Hospital Method.—This resembles the simple plan of Sir James Simpson. A piece of old muslin, about six inches square, is placed over the nose and mouth, and the chloroform dropped upon it. This insures a free admixture of air—through the interstices of the muslin and beneath it, for it is held a short distance from the face.

U. S. Army Method.—Upon a folded towel, from a towel fashioned in the shape of a funnel, or from a single layer of lint. Out of 80,000 administrations, but eight deaths are reported.

Skinner's Inhaler.—Skinner, of Liverpool, has the best and most simple apparatus. It is a piece of flannel stretched over a wire frame in the shape of a shallow ladle; the concavity is held over the nose and mouth while the chloroform is dropped upon the convex surface.

Anæsthesia should be produced slowly.—All observers agree upon this, no difference what method of administration is adopted.

How far may chloroform narcosis be carried?—This is a difficult question to answer, as some die in an instant, with almost the first inspiration, while others sleep under it for hours and awake refreshed. Dr. Reeve criticises severely the administration of chloroform in Dr. Krause's case (Cincinnati, 1860)—the length of the anæsthesia, *half an hour*, and the quantity used, *one and a half ounces*. He says, "The operator in this case has followed his patient to 'that undiscovered country' some years ago; the cause of science need not, therefore, suffer on account of sparing the feelings of parties interested. That death should follow such a use of chloroform as here detailed can not be surprising. Were there no facts to sustain the proposition, that there is danger in a too prolonged administration of the remedy, reason would surely indicate it. The analogy between the action of anæsthetics and alkohol is very striking, and if a man sit and tipple wine or spirits all night long it would not surely be surprising, that when thus

charged with intoxicating fluids, a small additional draught should send him promptly under the table into a fit of prolonged stupor; just so with chloroform; if the tissues have become permeated and soaked, as it were, with the potent remedy, what more could be expected than dangerous symptoms from a sudden, although very slight increase of the dose."

This criticism is not only too severe, but I think it is hardly just. The anæsthesia was partial for 25 of the 30 minutes employed, for Dr. Krause says, "I finally proceeded with the operation after having three or four times desisted from it on account of the patient's restlessness whenever the lid holders were applied." Here is indubitable evidence that the chloroform was not pushed rapidly—that it *was given slowly*—but it may be said that it was given too slowly, but how often do we see patients resist chloroform for ten, fifteen or twenty minutes. Dr. Krause's patient resisted it for twenty-five minutes. He was only in a *profound sleep* 5 minutes when dangerous symptoms arose. In regard to the quantity used, it is a well known fact that when chloroform is poured upon a folded towel, three-fourths of it is lost in the tissues of the cloth. One and a half ounces under such circumstances was not an intemperate use of the agent. If this was too prolonged an administration of chloroform, what will Dr. Reeve say of those parturition cases where the remedy is given for hours? A physician tells me that he kept his wife under it for 18 *hours*. Dr. Stewart kept up positive anæsthesia 12 *hours* in Mrs. Garris, who, as we have seen, afterward died before she had taken enough to render her insensible. Who has not seen profound insensibility maintained *for two hours and more* in difficult and prolonged operations?

It is difficult to get rid of the idea that there is an idiosyncrasy, that there are some persons and some conditions of the system inimical to anæsthetics; who those persons are, or what those conditions are, can not be determined in the present state of our knowledge. Sansom "eliminates" some "of the elements of the so-called idiosyncrasy inimical to chloroform," yet the fact still remains that healthy and comparatively healthy persons die, and die under the most careful and skillful administration.

Means of Resuscitation.—*Artificial respiration is the only reliable means of resuscitation.* Stimulants to the nose, cold water dashed in the face, flagellation, stimulants per anum, etc., may be

of some avail in persons who show dangerous symptoms while the anæsthesia is yet partial, but when life is suspended, or about to be suspended in complete anæsthesia, a resort to them is even worse than useless. When the knife is unfelt, or the actual cautery sears its way unheeded, what impression can such agents make?

The following taken from "The report of the Committee appointed by the Royal Medical and Chirurgical Society to inquire into the uses and the physiological, therapeutical, and toxical effects of chloroform, as well as the best mode of administering it, and of obviating any ill consequences resulting from its administration," is conclusive.

"Of the different means available for restoring animation (experiments on animals), suspended under the influence of anæsthetics, there was but little difficulty in distinguishing artificial respiration as both the most efficacious and the most easily applied. * * * * * * *

"The action of electro-galvanism and electro-magnetism is very decided, and many recoveries were effected with them in circumstances as unfavorable as those in which artificial respiration proved successful. In aid of that most valuable operation, either of them may doubtless be of service; but the habitual resort to them in desperate cases would too often involve a fatal loss of time.

"In several instances in which a needle inserted in the heart had ceased to indicate any movement of that organ, the application of an interrupted and weak current of electro-magnetism or electro-galvanism to the needle, restored the cardiac pulsations; and in some cases, even without the aid of any other artificial means the animals recovered. The Committee, nevertheless, can not but regard these restoratives agencies as practically of secondary importance, both because the requisite apparatus for employing them can rarely be at hand, and, still more, because the results of their application are neither so regular nor so certain as that of artificial respiration."

Ante-dating these experiments of the Royal Society with the electro-magnetic current, are those made by Dr. H. Culbertson with the same agent. (Prize Essay Ohio State Medical Society, 1862.) Dr. Culbertson succeeded in restoring a pig after the heart had ceased to beat by applying insulated pins to the diaphragm on opposite sides.

Positively contradictory to the results attained by the Royal Society's Committee and by Dr. Culbertson is the statement,

founded on experiments also, of M. M. Onimus and Legros. (Journal of Anatomy and Physiology, 1868.) These gentlemen say: "Interrupted currents of electricity should not be used, as they diminish and even stop the respiration and cardiac movements."

In the presence of authority so respectable and competent, and so contradictory, the comparative value of constant and interrupted currents, must remain for the present a question *sub judice.*

Warmth and friction are important adjuncts to the means of resuscitation. Dr. Sansom says: "The next desideratum is warmth. In the case of persons apparently dead from drowning (cases which have much in common with those of threatened death from chloroform), Dr. Christian has stated that warmth is an immediate and powerful excitant, and that frequently those in whom respiration had ceased, on being put into a warm bath, gave signs of return of breathing. In one most remarkable case warmth and friction, persevered in for eight and a half hours, restored life." "It ought certainly to be borne in mind that the practice of the Royal Humane Society, whose rules may be summed up in one word—warmth—has been eminently successful."

In conclusion, I introduce another quotation from the Report of the Committee of the Royal Society on the time for and the manner of employing artificial respiration.

"It is of the most pressing importance that *artificial respiration should be commenced the moment* alarming symptoms exhibit themselves. The delay, even of a few seconds, will doubtless, in some cases, destroy the only chance of life. Artificial respiration should be practiced in the manner known as Dr. Sylvester's method, and as recommended by the Committee on Suspended Animation. Those who are conversant with the use of the bellows adopted to artificial respiration by Dr. Marcet, may effect a yet more perfect and deep artificial breathing; since by means of it a much larger quantity of air may be made to enter and leave the lungs, and one chief object, that of eliminating the chloroform may be speedily accomplished.

For the same reason, mouth to mouth insufflation is a most valuable method of resuscitation. By it several good recoveries have been effected, a large quantity of nearly pure air being blown into the chest at each insufflation. In all cases in which it is employed the nostrils should be closed, and the larynx should be pressed against the spine to prevent the escape of air down the œsophagus."