

ON THE CAUSE AND PREVENTION OF DEATH FROM CHLOROFORM.

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CHLOROFORM, like other medicines which relieve or prevent pain, is capable of causing death, if its action be carried too far. When a certain quantity of it is present in the blood, sensibility is so far diminished, that surgical operations may be performed without pain; whilst a certain additional quantity has the effect of diminishing sensibility to such an extent, that the necessity for breathing is no longer felt, the respiratory movements cease, and the circulation of the blood is by this means soon arrested. In some cases, as we shall see, sufficient chloroform is absorbed to arrest the action of the heart by its own influence.

When animals, such as dogs, cats, rabbits, and guinea-pigs, are made to respire air containing from three to five per cent. of chloroform, till they cease to breathe—a process which generally occupies ten or fifteen minutes—the heart can be heard to beat, by means of the stethoscope applied to the chest, for a minute or longer after the breathing has ceased; and it often happens that, about the time when the heart's action fails, the animal makes two or three gasping inspirations, that have the effect of restoring the contractions of the heart, which recommence with great rapidity. If the animal has been withdrawn from the chloroform, these gasping inspirations have generally the effect, when they occur, of thoroughly reestablishing both the breathing and circulation; but, if it is made to breathe the chloroform during these gasps, the action of the heart is again arrested, and the natural breathing does not return.

When the same kind of animals are made to respire air charged with upwards of eight per cent. of vapour of chloroform, death occurs with great rapidity, and in a different manner from that just described. The action of the heart ceases about the same moment as the breathing—in three instances, indeed, it has ceased before the breathing; and, although gasping inspirations have several times occurred after the chloroform was withdrawn, it has rarely happened that these inspirations have had the effect of restoring the heart's action.

I have observed the manner in which the breathing and circulation ceased in twenty-nine instances, with the stethoscope applied to the chest of the animal, when the quantity of chloroform in the air they breathed was known; but the following three experiments will suffice to show the different ways in which death occurs under the influence of chloroform, according as its vapour is more or less diluted with air. I may here remark, that the results of the experiments mentioned in this paper, can be applied with great propriety to elucidate what occurs in the human subject, both on account of the exact similarity between the effects of chloroform on the lower mammalia and on man, when confined within safe bounds, and also from the close resemblance of the phenomena caused by the less diluted vapour, to what has been described as occurring in the accidents to patients.

EXPERIMENT I. A young but full-grown cat was placed in a glass jar, of the capacity of 1,600 cubic inches, and a fluid drachm of chloroform was introduced, by a portion at a time, through a tube in the cover of the jar. As twenty-five minims of chloroform produce twenty-six cubic inches of vapour, the atmosphere which the cat had to breathe contained nearly four per cent. of vapour, and the jar was moved about, to ensure the uniform mixture of the vapour with the air. In five minutes, the cat became insensible, and lay breathing naturally. In about ten minutes more, the breathing became very feeble, and it ceased altogether in about another minute, or sixteen minutes after the cat commenced to breathe the chloroform. It was immediately taken out and laid on a table, and the stethoscope was applied to the chest. The heart could be heard beating distinctly at first, but the pulsations became slower and feebler, and in about a minute they could be no longer heard. Just at this time, however, the cat took a gasping inspiration, and immediately the heart was heard to beat in a most rapid manner. The gasps were repeated, and the action of the heart became less rapid, but stronger. In a little time, both the breathing and the action of the heart became natural, the cat remaining, however, insensible for some minutes.

EXPERIMENT II. A cat, about the same size as the last, was put into the same jar, and the same quantity of chloroform was introduced. It was removed at the end of four minutes, when it was so far insensible as to offer no resistance. Being laid on the table, it was made to breathe air charged with ten per cent. of vapour of chloroform from a bladder. Twenty-five minims of chloroform were put into the bladder, which held 250 cubic inches, and it was filled up with the bellows. A portion of another bladder, which was attached to the stop-cock, was made to surround the head of the cat, and it consequently breathed to and from the bladder. In half a minute it was quite insensible: in about half a minute more the breathing became difficult, and the sounds of the heart less distinct. The breathing became gradually slower, and ceased altogether between three and four minutes after the respiration from the bladder commenced. The sounds of the heart were rather frequent, and scarcely audible, just before the breathing ceased, and they could not be heard afterwards. The chest was opened three-quarters of an hour after death. The lungs were of a pale red colour, everywhere permeated with air; and a small quantity of fluid blood flowed from them on making an incision. The right cavities of the heart were quite full of blood, and the left cavities contained a small quantity.

EXPERIMENT III. A cat was made insensible in the same manner as the two previous ones. As it made strong efforts to get out of the jar, and consequently breathed more deeply, the chloroform took effect sooner; and it was removed and laid on the table, in a passive state, at the end of two minutes and a half. The respiration and sounds of the heart were quite natural. The nose of the animal was placed in the mouth of a metal vessel, lined with bibulous paper, and used as a chloroform inhaler. The inhaler contained chloroform, and was surrounded with water of the temperature of 110° Fahr. The stethoscope was kept applied to the chest whilst the chloroform was exhibited. After four or five inspirations from the inhaler, the heart suddenly ceased to

beat, the breathing still going on. The inhaler was removed as soon as I was satisfied that the action of the heart had ceased, and there were two or three rather convulsive respirations afterwards, and then the breathing stopped; but, between one and two minutes later, there were two or three feeble inspirations, accompanied with motion of the nostrils, but no returning action of the heart could be heard. The chest was opened ten minutes after death. The lungs were quite pale throughout. There was a little clear serum in the pericardium. The heart appeared quite motionless when first observed; but, after exposure to the air for a short time, there were some slight contractions of a few fibres of the right ventricle. The right auricle and ventricle were filled with blood.

The air in the inhaler which this cat breathed, probably contained between twenty and thirty per cent. of vapour of chloroform.

In all the experiments that I have made on animals with sulphuric ether, in which the mode of dying has been observed, the heart has continued to beat after the breathing has ceased. The reason of this is, that the action of sulphuric ether, even when the air contains half its volume of the vapour, is not more rapid or powerful than the vapour of chloroform, when it constitutes but five per cent. of the inspired air.

In order to see more precisely the action of the vapour of chloroform on the heart, when not sufficiently diluted, the chest and pericardium were opened on four occasions, in cats and a rabbit, and chloroform was exhibited by artificial respiration. I was assisted by Mr. Peter Marshall in these experiments, and the following is the account of one of them.

EXPERIMENT IV. A young rabbit, rather more than half-grown, was made insensible by breathing air charged with four per cent. of vapour of chloroform in a large jar. The trachea was then opened, and a tube was introduced and tied. The lungs and heart were then exposed, by making an incision and removing the lower half of the sternum, with the adjoining part of the cartilages of the ribs on each side. The front of the pericardium was also cut away, to expose the heart. Whilst these operations were performed, artificial respiration was kept up by means of a bladder of air attached to the tube in the trachea. The heart contracted vigorously and quickly, and the lungs were of a light red colour. The rabbit was beginning to show signs of returning sensibility, when the bladder of air was changed for one containing ten per cent. of vapour of chloroform. The bladder contained 125 cubic inches, and twelve minims of chloroform were put in before it was filled with the bellows. Three or four inflations of the lungs only were made, when I perceived that the heart was beginning to be affected, and I changed the chloroform for a bladder containing only air. These three or four inflations of the lungs with chloroform, had the effect of causing the right cavities of the heart to become distended with blood, and its pulsations to become much slower. In two or three minutes, however, the action of the heart was quite reestablished by the artificial respiration, the pulsations being vigorous and frequent, and the ventricles being apparently emptied at each contraction. The bladder charged with ten per cent. of chloroform was again attached, and artificial respiration was made with it. The right ventricle began

almost immediately to become distended; and, by the time that eight or ten inflations of the lungs had been made, the contractions of the heart were very slow and feeble. Artificial respiration with air was resumed, but without the effect of restoring the action of the heart. The lungs were observed at the time when the right ventricle was becoming distended, and it was noticed that their colour was unchanged. They afterwards became paler, as the artificial respiration was continued after the ventricle had ceased to empty itself. No contractions of the diaphragm were observed after the first inflation of the lungs with chloroform, and the rabbit did not gasp at any time; whilst the cats had been observed to make a few gasping efforts at inspiration, at the time when the heart's action was ceasing.

The circumstance of the lungs not changing in colour at the moment when the right ventricle was becoming distended, which was observed in the cats as well as in the rabbit, shows that the distension arose from the failure of the contractile power of the heart, and not from impediment to the pulmonary circulation; for, in the latter case, the lungs would have become congested, and of a deeper colour. In one of the cats, it appeared to me that the left, as well as the right ventricle, was distended with blood; but this distension of the left ventricle did not continue.

There is no reason to believe that any of the accidents from chloroform have arisen from the continued exhibition of the vapour well diluted with air. On the contrary, the sudden manner in which the alarming symptoms came on in every case, shows that they were produced by the respiration of air containing not less than eight or ten per cent. of the vapour; and, from the history of the cases, it is most probable that the heart was disabled, in most instances, by the direct action of the chloroform. No systematic means were taken for properly diluting the vapour with air, in any case in which death has happened. The chloroform was exhibited on a handkerchief, or towel, or piece of lint, in all the cases but three; and, in two of these, it was not applied by a medical man. In order to show how easily accidents may happen with chloroform, I must beg attention to a few circumstances connected with its physical as well as physiological properties. On a former occasion, I showed,¹ both from experiments on animals, and the amount of chloroform consumed in inhalation, that the average quantity of it in the blood of an adult patient, when insensible to the surgeon's knife, is about eighteen minims, and that, if twice that amount were present in the blood, it would suffice to cause death, even if it were uniformly distributed. Now thirty-six minims of chloroform, when in the form of vapour, only occupy thirty-seven and a half cubic inches, or very little more than a pint. It is true that the vapour of chloroform does not exist in a separate state at the ordinary temperature and pressure of the atmosphere; but air, when saturated at 60°, contains rather more than twelve per cent. of the vapour; and, supposing the air to contain ten per cent., which it does when the chloroform dew point is at 55°, the thirty-six minims would be contained in 375 cubic inches of air, more than half of which might possibly be in the lungs at one time.

¹ Medical Gazette, vol. xliii, p. 414.

The quantity of blood contained in the adult human being, has been estimated by M. Valentin to average thirty pounds; and the thirty-six minims of chloroform, mentioned above, is only one minim and one-fifth, or one cubic inch and a quarter of vapour, for each pound of blood measuring about twenty-seven cubic inches. Consequently, if a pound or two of blood should be impregnated to this extent with chloroform, and sent to circulate in the nervous centres, the respiration might cease before the remainder of the blood should be equally charged with vapour. Moreover, I ascertained that a little more chloroform than this, viz., one-eighteenth part as much as the blood will dissolve, or about a cubic inch and a half of vapour to each pound of blood, has the effect of stopping the contraction of the heart by its own influence.¹ Now, 100 cubic inches of air, containing ten per cent. of vapour, if present in the air cells of the lungs, might yield this amount of chloroform to two or three pounds of blood, and still retain from five to seven per cent. It is easy to perceive, therefore, that death might be caused by a very small quantity of chloroform, if it were inhaled in a concentrated state; and, indeed, in the Experiment No. IV., on the rabbit related above, the action of the heart was arrested by three or four inflations of the lungs in so short a time, that only a portion of the blood in the body could have become impregnated with the chloroform. The necessity of having the vapour sufficiently and systematically diluted with air, must, therefore, be evident. By such a plan, it is true, the patient cannot be made insensible in so short a time as was recommended by Dr. Simpson on the introduction of chloroform. Three or four minutes must be occupied in gradually and equally charging the blood with the requisite amount of vapour, but it is time well expended on the safety which it ensures.

The quantity of chloroform contained in the air the patient breathes during the use of the handkerchief, depends on the amount of surface wetted by the chloroform—on the proportion of air which comes in contact with the wetted surface, or passes into the lungs without this contact—on the extent to which the handkerchief is now warmed by the breath, now cooled by the evaporation, and on the force with which the inspired air impinges on the surface of the handkerchief moistened with chloroform. It must be evident, therefore, that the amount of vapour contained in the air the patient breathes is very uncertain; and when it is stated that the agent has been administered in exactly the same manner in two cases in which the handkerchief has been employed, it would be more correct to say that it was exhibited in an equally uncertain way in each instance; and the difference in the result should be attributed rather to the want of uniformity in the method employed, than to a difference of susceptibility in the patients: for in administering chloroform by a uniform method, I find very little difference in the susceptibility of persons to its chief effects, whatever variety there may be in the symptoms they evince previous to becoming insensible.

It will be remembered that Dr. Simpson recommended the general use of undiluted chloroform very quickly after its existence was made known to him by Mr. Waldie, and that amongst the advantages which

¹ Medical Gazette, vol. xliii, p. 415.

he stated that chloroform possessed over sulphuric ether was this, that it requires no particular apparatus for its administration. There can be no doubt that this was a great error. Chloroform being more powerful, when inhaled, than any other agent which has been used in a similar manner, except bisulphuret of carbon and hydrocyanic acid, particularly requires mechanical means for its regulation; but the high position of Dr. Simpson, and his previous services in this department, more particularly in being the first to administer ether in labour, gave his recommendations very great influence; the consequence of which is, that the practice of anæsthesia is at present probably in a much less satisfactory state than it would have been if chloroform had never been introduced. There are a few patients who submit now to the pain of operations, and many who inhale chloroform not without considerable fear; whilst, if we had been confined to the use of sulphuric ether, which is incapable of causing sudden death without giving distinct and timely warning, there can be no doubt that confidence in it would before this have been universal. I do not propose, however, that we should return to the use of sulphuric ether; for chloroform possesses certain conveniences of which it is easy enough to avail ourselves, whilst we disarm it of danger. To do this, all that is required, is to ensure that its vapour shall be sufficiently diluted with atmospheric air: not, be it remembered, for the purposes of respiration, as the physical properties of chloroform ensure this; but in order to prevent its absorption into the blood with such rapidity, that there is no time to watch its effects.

There are two ways of effecting with certainty the sufficient dilution of the vapour with atmospheric air: the first and best, is to employ a suitable inhaler; the second, is to dilute the chloroform with rectified spirit of wine before pouring it on a handkerchief or sponge.

In the apparatus which I usually employ, the air which passes over the bibulous paper, when the patient breathes in the usual manner, takes up between five and six per cent. of the vapour of chloroform. I have ascertained this by weighing the inhaler before and after passing a measured quantity of air through it, in the way in which it passes in ordinary respiration, the loss of weight denoting the amount of chloroform which had evaporated. The apparatus is, besides, provided with valves, by means of which the air thus charged with chloroform can be still further diluted to any extent desired; and I always commence the inhalation with air containing very little chloroform, gradually increasing the quantity of vapour, and usually diminish it again as the insensibility attains the desired point, or at any time when the breathing is deeper and quicker than usual.

As regards the dilution of chloroform with spirit, this is the form in which it was first used for inhalation under the name of chloric ether, which is a tincture of chloroform in rectified spirit of wine, containing from twelve to eighteen per cent. of the active ingredient. Dr. Bigelow of Boston, U.S., had tried this preparation, but Mr. Jacob Bell was the first to use it with success. It was occasionally employed in St. Bartholomew's Hospital, and in the private practice of Mr. Lawrence, but did not come into general use on account of its expense and the uncertainty of its action. It is only capable of yielding between one and a half and two per cent. of vapour of chloroform

at the commencement of inhalation, and much less afterwards. I do not think that it would be possible to kill a person by the inhalation of chloric ether if it were attempted, but it is tedious and uncertain in its effects; and if we wish for a preparation of chloroform that can be given safely and effectually with no other apparatus than a handkerchief, it must be something between pure chloroform and the so called chloric ether. One part by measure of chloroform to two of spirit, as recommended by Dr. Warren of Boston, U.S., and called strong chloric ether by him, answers generally very well, but he found it to fail in a few instances in the way in which he employed it. I believe that equal parts by measure of chloroform and rectified spirit, would not fail in any instance to cause insensibility, if judiciously employed on a handkerchief or sponge, and that it would not be liable to cause accident. Certainly the care which has sufficed to limit the deaths from undiluted chloroform, when thus employed, to about eighteen, would have been more than sufficient to prevent them altogether, if the chloroform had been diluted with an equal measure of spirit.

When chloroform thus diluted is first poured on a handkerchief, it is capable of yielding only a little more than half as much vapour to air which is brought in contact with it, as it yields in the undiluted state. As the process of inhalation continues, it yields less and less vapour, a weaker solution being left on the handkerchief. But by adding more of the mixture, the process goes on as at first. It is some little disadvantage that a combination of chloroform and spirit does not yield a uniform amount of vapour throughout the process of inhalation; but this is not of much consequence in using a handkerchief or sponge—the only method in which it is recommended—for this plan of administering chloroform does not admit of regularity or uniformity under any circumstances. During the removal of tumours of the maxillary bones and other operations on the face, in which I could not continue to employ the inhaler, I have been in the habit for the last three or four years of using chloroform diluted with an equal measure of spirit on a sponge, whenever I was aware beforehand of the nature of the case, and had time to be provided with it. At other times, I have poured only fifteen or twenty minims of chloroform on the sponge at once. The spirit is not at all irritating to the air passages, and its effects would not be injurious if it were inhaled in larger quantity; but owing to its small volatility as compared with chloroform, the patient does not inhale more than a few minims of it in the course of an operation, the greater part remaining behind on the handkerchief or sponge. I have often given chloroform thus diluted on a sponge or handkerchief to make animals insensible during physiological experiments, without ever meeting with the accidents which so frequently happen in giving undiluted chloroform to animals in the same manner.

The two following experiments show the great difference in action between undiluted chloroform and chloroform diluted with spirit, when given on a handkerchief, to the extent of causing death.

EXPERIMENT V. A cat was made insensible by breathing air containing four per cent. of vapour of chloroform for five minutes in a large glass jar. It was then taken out and laid on the table, and a folded handkerchief, on which two fluid drachms of chloroform had

just been poured, was applied so as to inclose its nose, without, however, interfering with respiration. The stethoscope was at the same time applied to the chest. At the time when the handkerchief was applied, the breathing and sounds of the heart were natural. The cat had not taken more than five or six inspirations after its application, however, when the breathing became sonorous and laboured, and the sounds of the heart became less distinct; and after two or three inspirations more, the heart could be no longer heard. At this moment the handkerchief, which contained nearly as much chloroform as when applied, was removed from the nose, and the cat made twelve or thirteen deep and gasping inspirations afterwards, which occupied about half a minute, but they did not restore the action of the heart. The chest was opened eight minutes after death. The lungs were quite pale. The right cavities of the heart were very full of blood. There were very feeble contractions of the right auricle, but none of any other part of the heart. On the descending cava being cut near the auricle, a quantity of blood flowed, and after this, together with the exposure to the air, some very feeble contractions of the right ventricle were observed. The left ventricle of the heart, when opened on the following day, was found to contain very little blood.

EXPERIMENT VI. Another cat was made insensible in the same way as the last, and being laid on the table, and the stethoscope applied, it was found that the breathing and the action of the heart were natural. Two fluid drachms of a mixture of chloroform with rectified spirit, in equal volumes, were poured on a handkerchief, which was applied round the nose, as in the previous experiment. In about a minute after the handkerchief was applied, and when the cat had taken about thirty inspirations, the breathing became laboured and sonorous, and the action of the heart became very rapid. The heart's action next became slow, the breathing continuing of the same character. In about half a minute longer, the pulsations of the heart became more frequent and distinct, but the breathing at the same time became slow and feeble, and it ceased about three minutes after the handkerchief was applied. The sounds of the heart could be heard for about a minute after the breathing ceased. The chest was opened a quarter of an hour after death. The lungs were of a bright red colour, and contained a moderate quantity of blood. The right auricle was contracting regularly and vigorously, but the other parts of the heart were not contracting, till on making an opening in the vena cava, which relieved the distension of the right ventricle, it began to contract, but less frequently than its auricle. The left ventricle of the heart was about one-third filled with blood.

In another experiment on a cat, with chloroform diluted in the same manner, 130 pulsations of the heart were counted after the breathing had stopped; and then, when the heart's action had nearly ceased, the breathing recommenced by gasping inspirations, which had the effect of causing the heart to beat again with great rapidity; but, as the chloroform was kept applied, the breathing and circulation soon ceased altogether.

The following list contains, I believe, all the cases on record in which death has been caused by the administration of chloroform. I have not included three or four deaths which have happened to persons who

have poured chloroform on a handkerchief, and inhaled it when no one was present; for an accident is so natural a consequence of such a proceeding, that these cases do not come within the scope of this paper. The appearances met with after death in two of them will be noticed, however, further on.

1. January 28, 1848. Hannah Greener, aged 15, near Newcastle. Toe-nail operation.

2. Feb. 23, 1848. Mrs. Simmons, Cincinnati, U.S. Extraction of teeth.

3. March 1848. Patrick Coyle, America. Operation for fistula in ano.

4. A young woman at Hyderabad, in Hindostan. Amputation of the distal phalanx of a finger.

5. May 1848. Madlle. Stock, aged 30, Boulogne. Opening an abscess.

6. 1848. Charles Desnoyers, aged 22, Hôtel Dieu de Lyon. Transcurrent cauterisation of diseased wrist.

7. Dec. 1848. Young gentleman at Govan, near Glasgow. Intended toe-nail operation.

8. Jan. 19, 1849. John Griffith, seaman, aged 31, New York Hospital. Removal of hæmorrhoids.

9. Jan. 24, 1849. J. Verrier, aged 17, Lyons. Intended amputation of finger.

10. Feb. 20, 1849. Samuel Bennett, labourer, Westminster. Amputation of toe.

11. Aug. 23, 1849. Madame Labrune, Langres, France. Intended extraction of tooth.

12. Oct. 10, 1849. John Shorter, aged 48, St. Thomas' Hospital. Toe-nail operation.

13. Nov. 1849. Girl named Jones, Shrewsbury. Removal of eyeball.

14. Young lady, Berlin. Intended extraction of tooth.

15. Feb. 1850. Artilleryman on board ship in the Mauritius. Amputation of last phalanx of middle finger.

16. June 1850. Alex. Scott, aged 34, Guy's Hospital. Removal of portion of hand.

17. Sept. 20, 1850. James Jones, aged 24, Cavan Infirmary, Ireland. Intended amputation below the knee.

18. April 1851. John Holden, Stepney Workhouse. Intended operation on penis.

19. June 10, 1851. Madame Simon, aged 36, Strasbourg. Extraction of teeth.

20. July 8, 1851. Thos. Hutton, a mulatto, aged 45, Dreadnought Hospital Ship. Extirpation of testis.

21. Oct. 1851. Elizabeth Hollis, aged 37, Chipping Norton, Somerset. Intended operation for cancer of os uteri.

The above list contains two or three cases that have not appeared together in any previous table, whilst, on the other hand, I have excluded some deaths that have been attributed to chloroform, either because the fatal event was clearly due to something else, or because there are no means of deciding the point.

In a table given by Dr. Bouisson,¹ the death of a child, aged twelve years, during amputation of the leg, at the hospital at Madrid, is given. But this is an operation which is sometimes preceded or accompanied by circumstances which may be fatal; and as the published particulars are not sufficient to enable me to decide, I have excluded it. Three of the insurgents who were wounded in Paris, in June 1848, died during operations in which chloroform was administered. Two of the operations were amputation at the hip-joint, and the third was amputation at the shoulder. As the operators do not attribute the deaths to chloroform, there is no reason why others should do so. The death of a patient of M. Roux has been attributed, not by that surgeon but by others, to chloroform, although it is quite certain that this was not the cause. A woman had a cancerous tumour of the breast removed under the influence of chloroform; and, after she became conscious, M. Roux performed a protracted operation for the removal of some glands from the axilla, without the chloroform, and whilst the patient was sitting up to have a bandage applied, she fainted, and was dead. A death which occurred in the practice of Mr. Robinson, the dentist, I consider was not due to chloroform, because the patient showed none of the symptoms of its effects, and because the inhaler which was employed had not been approached nearer than an inch from the patient's face, whilst it might be held at that distance for a week without causing insensibility, much less death. On a former occasion² I expressed an opinion, that death was caused by syncope from mental emotion, occurring in a patient with great organic disease. Since that time, I have been present with Mr. Marshall, of Greek Street, at the *post-mortem* inspection of the body of a woman who died suddenly of fright, in consequence of a fire in the next house to that in which she lived, in Crown Street, Soho. We found in that case exactly the same diseases as in Mr. Robinson's patient, viz., fatty degeneration of the heart, and great enlargement of the liver, displacing the viscera of the chest. Dr. Aschendorf has attributed to chloroform³ the death of a child a year old, from whose face and neck he extirpated a large nævus, which extended from the zygoma to the os hyoides, and from the external auditory meatus to the maxillary fossa. No one else had been willing to undertake its removal. The operation lasted eighteen minutes, and only nine drops of chloroform were used in all. The child died suddenly at the end of the operation. As no chloroform had been applied for eight minutes before death, and then only three drops, it is quite impossible that this agent could have been the cause of the fatal result, and it only seems curious that the operation did not suggest itself to Dr. Aschendorf, as affording a sufficient explanation of the event.

(To be continued.)

¹ *Traité de la Méthode Anæsthétique*, p. 398.

² *Edinburgh Medical and Surgical Journal*, No. 180.

³ *CASPAR'S Wochenschrift*, September 6, 1850.