

**Report of the committee appointed by the Royal Medical and Chirurgical Society to inquire into the uses and the physiological, therapeutical, and toxic effects of chloroform, as well as into the best mode of administering it, and of obviating any ill consequences resulting from its administration.**

### **Contributors**

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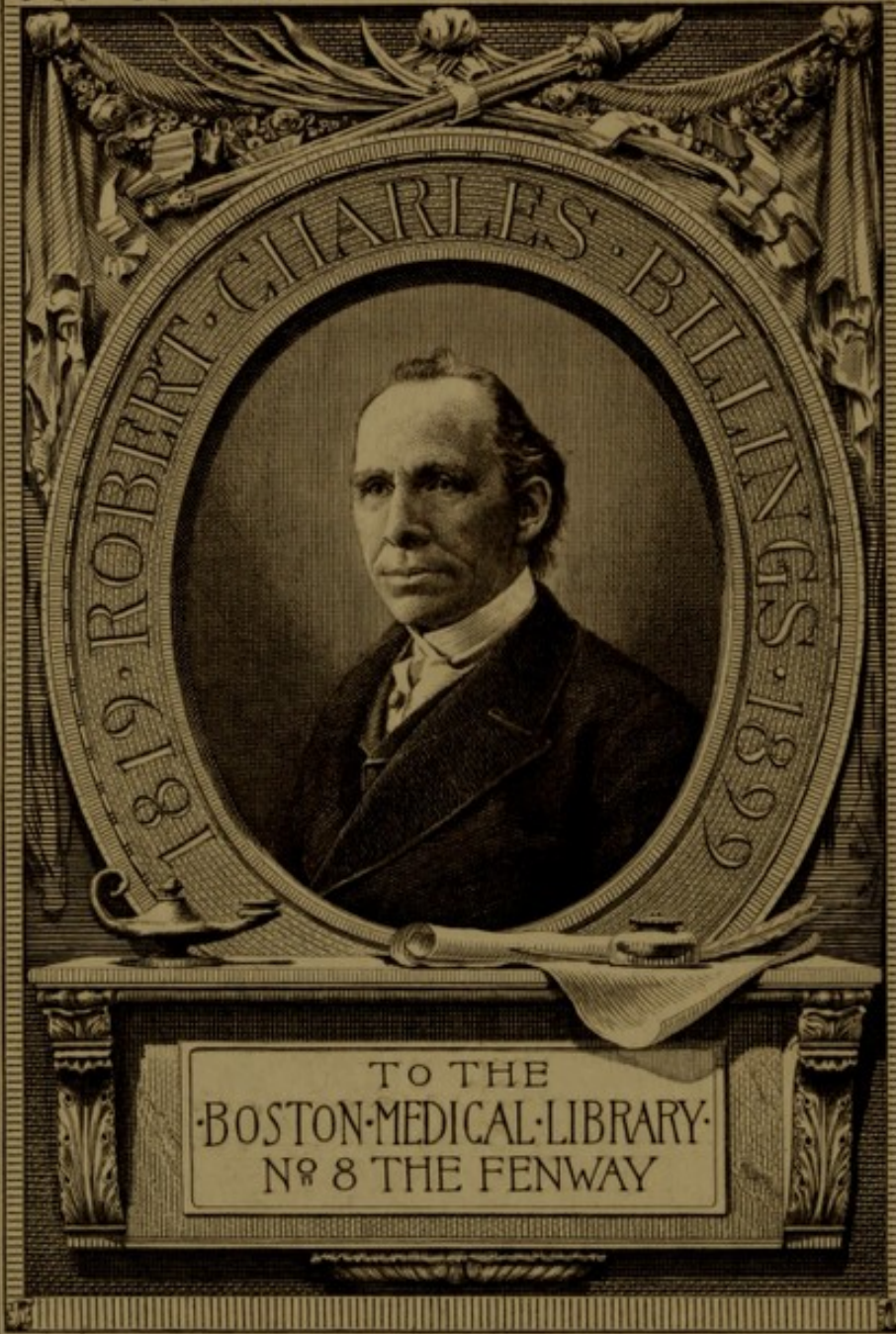
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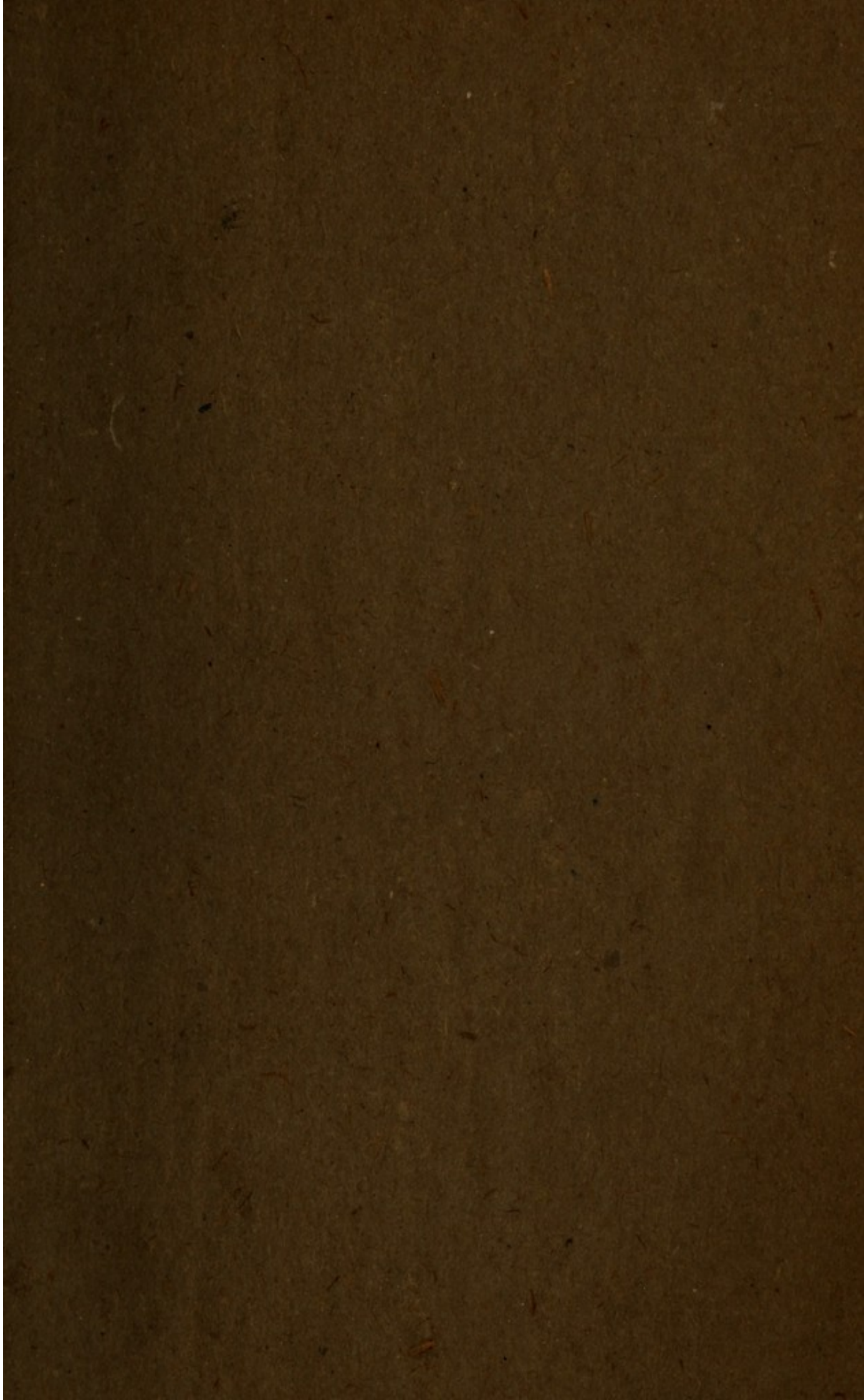


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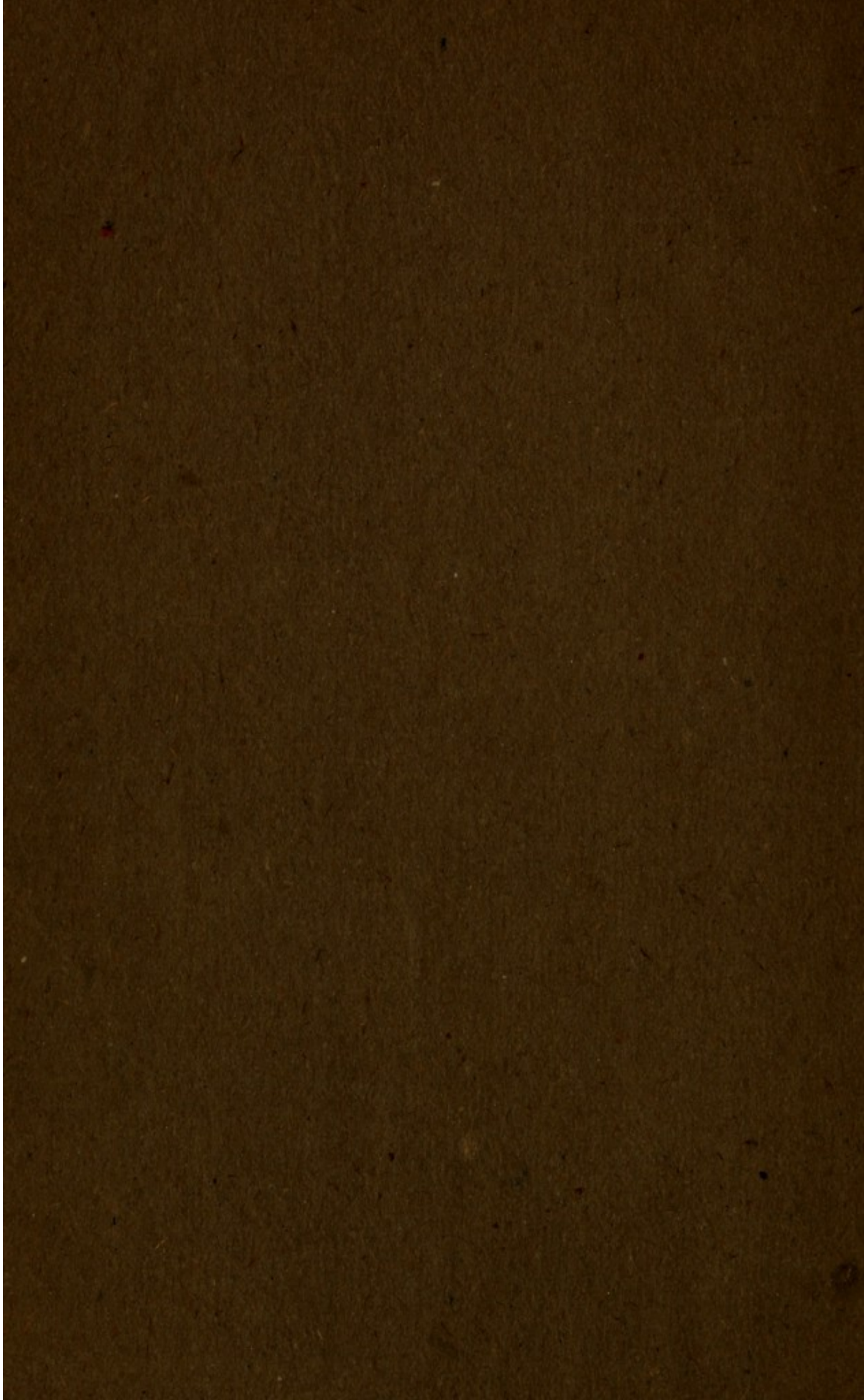


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Report of the Committee

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 INTO THE BEST MODE OF ADMINISTERING IT, AND  
OF OBVIATING ANY ILL CONSEQUENCES RESULTING  
FROM ITS ADMINISTRATION.

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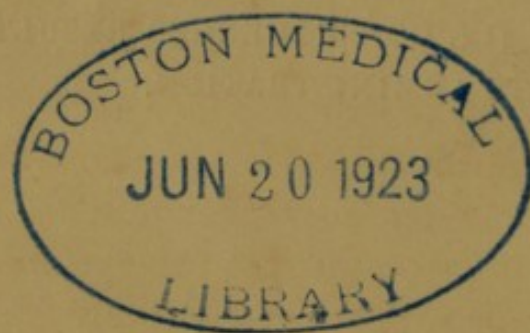
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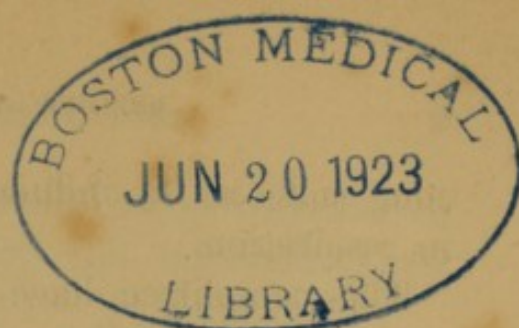


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IN laying their report before the Council of the Society, the Committee on Chloroform desire to state that they have made comparatively little reference to the medical portion of the subject. This is not due to their thinking the medical uses of chloroform of little importance, but to the fact that but few replies to their inquiries upon this subject have been received.

In view of the great extent of the questions submitted to their consideration, the committee directed their attention to such points as appeared to them of chief practical importance. Thus, their observations respecting the action of chloroform on the nervous system, and their remarks on some other points, are less full than would have been desirable, had the committee regarded such details as of equal importance with those specially elected for investiga-



tion, such as its influence on the action of the heart and on respiration.

The committee have chiefly confined their physiological report to observations which they have themselves made. Without overlooking or neglecting the labours of former investigators, they have endeavoured rather to furnish an accurate account of experiments which they have observed carefully and together, and to compare the results thus obtained and agreed upon, with the phenomena of cases in which death or peril of life has arisen from the inhalation of chloroform in the human subject.

### *How Chloroform arrests Animal Life.*

In order to observe the manner in which animal life is destroyed by the inhalation of chloroform, a series of experiments (chiefly in dogs) were made, in which various proportions of chloroform vapour in atmospheric air were respired. The experiments with the more dilute forms of the vapour were conducted by means of Mr. Clover's apparatus, in consequence of the exactness with which the quantity of chloroform administered through it can be regulated. The effect of air impregnated with from 1 to 15 per cent. of the vapour was thus observed. When the results produced by chloroform in the strongest possible dose were under investigation, an inhaler was used in which the temperature of the chloroform was raised to about  $150^{\circ}$ , and its evaporation was thereby much accelerated. By this method the air inhaled was charged with at least 40 per cent. of the vapour.

In the first experiments the chloroform was administered, as in the human subject, either by a closely fitting inhaler or by a saturated cloth. As, however, in these experiments the breathing was sometimes arrested, apparently by spasm about the throat, it became necessary to compare the results obtained from natural breathing with those produced by administering the chloroform through an aperture in the trachea.



In the first instance attention was chiefly directed to the order of cessation of the pulse,<sup>1</sup> the respiration, and the action of the heart.

It was found that the duration of animal life was inversely proportionate to the strength of the agent; the more concentrated the vapour the shorter the duration, and the more diluted the chloroform the longer the continuance of life. Insensibility could be induced and maintained when the air inhaled contained no more than 1 or 2 per cent., and the inhalation might be continued for a very long time without apparent danger to life.

The *strongest doses of chloroform* inhaled through the mouth and nostrils caused the pulse and respiration to cease nearly simultaneously (in from 1 min. 20 sec. to 1 min. 45 sec.), whilst the heart's action continued for a short time subsequently (from 3 min. 10 sec. to 5 min. 30 sec.).

If, in place of respiring the chloroform by the natural channels, vapour of the same strength was inhaled through an aperture below the glottis, death ensued much more rapidly, and the heart, as a rule, ceased to beat several seconds before the final arrest of the respiratory movements. The average duration of the pulsations of the heart was 16 sec., whilst the respiration ceased at 32 sec. Owing to the rapid and tumultuous course, and the early termination of these experiments, the exact moment at which the pulse ceased to be perceptible could not be noted with accuracy.

With *moderate* or with *small doses* little difference was observed, whether the chloroform were inhaled above or below the glottis. Generally, but *not always*, it happened that the respiration ceased a few minutes (from 3 to 7) before the arrest of the action of the heart.

In the majority of cases the pulse stopped before the respiration, and in all instances the action of the heart could be distinguished for some time after the pulse had ceased to be felt.<sup>2</sup>

<sup>1</sup> In the femoral artery.

<sup>2</sup> Appendix A, Table 1.



*Effect of Chloroform on the Heart.*

It has been observed, in all instances of poisoning with the smaller doses of chloroform, that the pulse is imperceptible for some time before the heart ceases to beat.

From this it is plain that the heart becomes enfeebled before its contractions finally cease. The extent of this failure of the force of the heart's action was marked by the hæmadynamometer.

The results of the experiments made with this instrument being remarkably uniform, the conclusions to which they point deserve attentive consideration. The instrument, having been set at zero, was connected with the femoral artery. The mercury at once rose, indicating the pressure of blood in the vessel. A double pulsation was then observed—a greater one, corresponding with the movements of respiration; and a lesser oscillation, timing with the pulsations in the arteries. The point at which the mercury stood after the hæmadynamometer had been connected with the artery having been noted, the first and immediate effect of the administration of chloroform was to cause the mercury to rise. This sudden elevation of the mercury was observed in nearly all instances, but was much more strongly marked in some cases than in others. Its extent could not be accurately measured, but it was sometimes as much as one and a half inch. The elevation was, however, of very short duration, seldom continuing for more than a fraction of a minute, and at the end of this period the mercury commenced to fall. The rise of the mercury (usually) corresponded to the period of struggling, and, no doubt, to a great extent, depended upon forcible expiratory efforts. A certain amount of elevation, however, was observed in cases in which there was but little struggling. This early elevation of the mercury in the hæmadynamometer must, therefore, on the whole, be considered to indicate that the immediate effect of small doses of chloroform on the heart is to stimulate its action.



After this transient rise of the mercury a gradual fall was noticed, and it sank lower and lower as the influence of the chloroform augmented. This falling of the mercury, however, as will be presently seen, was liable to certain interruptions. Thus, in Exp. XX, before chloroform was given, the mercury ranged from 9 to 14.<sup>1</sup> After the usual temporary use it had fallen in 3 min. to from 6 to 8·5. Then, after many variations, it gradually fell, till at 25 min. 45 sec. it ranged only from 2·4 to 2·6; and, at length, when all movement had ceased, the mercury stood at 2·1.<sup>2</sup>

Moreover, it was observed that the mercury did not subside steadily and uniformly from the commencement of the inhalation of the chloroform till the time at which the heart ceased to beat; but that there were both slight variations and also many periods at which the heart's contraction recovered its former force. If these revivals of the heart are observed in the tables (Exp. XX), they will be seen generally to follow the periods at which the respiratory movements had been diminished. In other words, it appears that if the respiration becomes slow and shallow, the force of the heart's action returns. The reason of this is obvious: by the failure of the respiration the introduction of the poison into the system is lessened, and the heart revives.

A still more striking circumstance was noticed when the force of the heart's action was fully under the influence of chloroform. If, at that moment, the respiration of fresh air was permitted, the mercury at once rose, and the heart in a short time recovered much of its force. Upon renewing the inhalation of the chloroform, the mercury promptly sank again. This experiment could be frequently repeated, and with each admission of fresh air there was revival, and with each repetition of the administration of chloroform there was depression of the action of the heart. (Exp. XXXIII.)

<sup>1</sup> Centimètres.

<sup>2</sup> Appendix A, Table 4.



*Movements of the Heart after the Rhythmic Contractions  
have ceased.*

Upon carefully watching the state of the heart, it was ascertained that it not unfrequently retained some power of movement after the cessation of its regular action. In many instances these movements were prolonged for several minutes after the death of the animal; in others the heart appeared to have been at once paralysed; and, although it was exposed as quickly as possible after death, its movements had entirely ceased.

There are fourteen observations bearing upon this point. In six of these the heart was exposed in periods ranging from 3 min. to 6 min. 55 sec. after the cessation of the heart's regular contraction, and all movement was found to have ceased. Of these cases, the strongest form of chloroform had been employed in three, in two others 10 per cent., and in the sixth 5 per cent.

On opening the chest after death, in five other instances pulsation was found to have ceased, but rhythmic contractions recommenced after laying open the pericardium. These continued for some little time, their duration ranging from 4 min. to 15 min. 30 sec. In two of these cases, chloroform had been given in the strongest form, in two 5 per cent., and in the other  $2\frac{1}{2}$ . The instances in which the pulsations of the heart continued longest (12 min. 40 sec. and 15 min. 30 sec.) were the two in which the strongest form of chloroform had been administered.

In three other cases rhythmic contraction of portions only of the heart was observed when the chest was opened after death. In these instances the period during which the movement continued varied from 3 min. to 13 min. 15 sec. Of these cases two had inhaled 10 per cent., the third 5 per cent. Here, also, it was noted that the longest duration (8 min. and 13 min. 15 sec.) of the muscular contraction occurred in the cases in which a strong form (10 per cent.) had been employed.



From these results it seems fair to conclude—*first*, that in many instances all movement of the heart is arrested very soon after its regular action has ceased. *Secondly*, in a few cases imperfect contraction may continue for some minutes after the stoppage of the normal movements. Even in these cases the movements of the heart do not continue so long as they are observed to do when life is destroyed by asphyxia. *Thirdly*, in many instances the heart is so far amenable to the action of stimuli that exposure to the air occasions an imperfect renewal of its beat.

Moreover, the effect of chloroform upon the heart varies remarkably with the strength of the vapour employed. It does not appear from these results that strong chloroform causes a more permanent stoppage of the heart's action than the milder form of this agent. Doubtless it may be that, in cases of poisoning by a strong dose of chloroform, the amount which finds its way into the blood is actually smaller than if a weaker vapour had been inhaled through a longer period. The heart in the former case may stop quickly, and yet, to a certain extent, be capable of recovery; whereas in the latter case, although continuing to beat for a longer time, it may at length be so overpowered with the poison as to be unable, after once ceasing, to resume its pulsations.

#### *Effect of Chloroform on Respiration.*

When the concentrated vapour of chloroform was inhaled through the mouth its immediate effect was to arrest respiration. This result depended upon a spasm of the fauces and glottis (see page 332), which was induced by the direct action of the vapour on these parts. The arrest of respiration, however, lasted but a short time, frequently only a few seconds, and actual inhalation of the chloroform then commenced. When smaller doses (under 6 per cent.) were administered, or as soon as the first irritation of the fauces produced by a stronger dose had subsided, and



breathing was resumed, respiration was found to be much quicker than before the inhalation commenced. The inspiratory efforts were at first deep, but by degrees they became more and more shallow. With this loss of depth the respirations for awhile retained their unnatural frequency, but after a time they became less frequent than natural.

The depth of the respirations became less and less, and after the stage of perfect insensibility was reached the amount of air entering the chest was extremely small. If the inhalation was still persisted in the movement was at last completely arrested.

This arrest of the respiration is not necessarily final; on the contrary, it frequently happened, and more especially if the amount of vapour inhaled had been small, that after some twenty or forty seconds the respiration recommenced.

If the vapour was still allowed access to the air-passages the respiration again quickly ceased. The breathing might hereupon be renewed a second time; and even a third time these phenomena might be repeated before actual death ensued.

This natural effort at recovery from chloroform poisoning is by no means an exceptional circumstance; indeed, it appears to be the rule in all cases in which a small percentage of chloroform is used. Hence it follows that if respiration ceases during the inhalation of a small percentage of chloroform vapour the removal of the vapour will in many cases permit of a complete recovery.

The explanation of this recovery of the respiration appears to be the following.

The entrance of additional chloroform is virtually interrupted by the stoppage of the respiration, whilst that which is already in the blood is gradually dissipated; the influence of the agent thus sinks to a degree which is no longer incompatible with the performance of the act of respiration.



*The effect of division of the Pneumogastric Nerves in Animals already under the influence of Chloroform, and the effects of Chloroform in Animals in which these nerves have been previously divided.*

In order to ascertain the effect of inhaled chloroform on the heart, apart from the influence exerted upon that organ through the pneumogastric nerves, the following observations were made.

It is well known that if, in a healthy animal, one of the pneumogastric nerves be divided, very little immediate effect is produced. If both nerves be severed the number of the respirations is at once reduced by about one half, and the frequency of the heart's action is increased in an inverse ratio. Should the animal be young, death generally ensues quickly, not as a direct effect of the divisions of the nerves themselves, or as a consequence of the interruption of their influence upon the lungs and heart, but from suffocation, caused by the falling in of the parts paralysed, such, for example, as the larynx. In adults this suffocation does not take place, and the parts about the larynx being rigid, life may be prolonged for several days, or, indeed, indefinitely.

If, now, an animal is placed under the influence of chloroform before the nerves are divided, these phenomena became modified, and are even in some cases absent. The respiration became only slightly less frequent than before the division of the nerves, and sometimes there was no perceptible alteration of the number of respirations. The pulse, however, became extremely rapid, though even thus it failed to reach the rate observed in cases in which the animals had not taken chloroform. In like manner, if chloroform was inhaled after division of the pneumogastri-  
cs, the discomfort of the animal was manifestly relieved, the breathing became more frequent and easier, and the chloroform appeared to bring about greater toleration of the loss of the function of these nerves.



*Action of Chloroform on the Glottis and Fauces.*

During natural respiration it may be seen that the epiglottis is raised with each inspiration, and that the vocal cords are separated to nearly twice their previous distance from each other. It may also be observed that slight mechanical irritation of the epiglottis or of the cords produces no effect.

When dilute chloroform vapour (5 per cent. or less) was blown upon the fauces or cords, very little inconvenience ensued, and the animal continued to breathe in a natural manner.

If, however, air saturated with chloroform was employed, an instant and violent effort at deglutition was produced; with this effort the whole pharynx was seen to become contracted, the larynx advanced, and the epiglottis became hidden by the act of swallowing. This act was repeated many times (the use of the strong vapour being continued), but it gradually became less vigorous, and after about a minute it ceased, the animal by this time generally passing under the influence of the chloroform. The epiglottis then became fixed; it projected forwards, both during expiration and inspiration; and the vocal cords approximated at each expiration.

If the vapour was still administered the epiglottis was seen to move slightly with each inspiration, and at length, as the animal passed fully under the influence and stertorous breathing commenced, the epiglottis flapped backward and forward with each expiration and inspiration.

If, on first administering the strong vapour, the epiglottis was gently raised, so as to expose the glottis to view, no spasm or contraction of the glottis itself could be observed.

In order to discover how far these conditions depended upon the direct action of chloroform, the same agent was administered by the trachea, and the movements of the fauces and glottis were watched from above. It was found that there was generally a single effort at deglutition;



after that a tremulous movement of the soft palate and of the parts around; and then, as the animal passed more fully under the influence of the chloroform, the epiglottis fell.

If, after division of the pneumogastrics in the middle of the neck, chloroform in a strong form were administered by the mouth, the same efforts at swallowing were observed, but they were not so frequent or so perfect as in an animal with the nerves undivided.

### *How Ether arrests Animal Life.*

In order to compare the effect of ether with that of chloroform, this agent was employed in a similar manner to that described in the previous observations.

The phenomena produced by ether in the strongest and in the more dilute form are not essentially different; by either of them animal life may be destroyed; and, as in the case of chloroform, the extinction of life is proportioned in rapidity to the concentration of the vapour.

It was found that there was a general similarity in the results of experiments with ether and of those with chloroform, but that ether was much the weaker agent of the two. Effects produced by ether in a strong and by chloroform in a dilute form were accordingly somewhat similar.

Whilst, however, this general similarity may be traced in the action of ether and of chloroform, there is an important contrast in their influence on the heart. Chloroform depresses the action of that organ, and frequently kills by inducing syncope. Ether, on the other hand, exerts but a very slight depressing influence on the force of the heart's action.

Hence death, when produced by ether, is almost invariably due to the failure of the respiratory movement, and the heart is generally found to continue its pulsations for some time after the respiration has ceased.

With the strongest form of ether death takes place more rapidly if the agent is given by the trachea than when it is



breathed naturally, and in nearly all cases the respiration ceases for some time before the heart stops.

The average time at which the pulse ceased to be felt when the inhalation was carried on through the trachea was 2 min. 43 sec.; the respiration at 1 min. 48 sec.; the heart at 3 min. 57 sec.

Ether of the same strength, given by the mouth, caused the respiration to cease at 3 min. 27 sec.; the heart at 4 min. 15 sec.

The only case (in the experiments performed) in which the heart ceased before the respiration was one in which the ether vapour, in its strongest proportion, had been administered by the muzzle; and in this case slight respiratory efforts continued for 1 min. 15 sec. after the heart had ceased to beat. In this exceptional instance the force of the heart's contraction was well kept up till within a few seconds of its final failure.

With the more diluted ether vapour (10 to 25 per cent.) animal life was generally destroyed if the inhalation were continued for a sufficiently lengthened period, and death ensued in from forty to sixty minutes.

Some animals seemed to possess great power of resisting the action of ether; and in one case 15 per cent. of it was administered to a dog for more than one hour without producing any indication of approaching death, and the animal eventually recovered.

When death did ensue the same sequence of phenomena was observed as when that event was brought about by the stronger vapour, *i. e.* the failure of respiration preceded that of the heart's action. The average interval between the cessation of the respiration and of the heart's movement being 2 min. 3 sec. When the moment could be discerned at which pulsation ceased in the arteries, it was found that the pulse was arrested some few seconds before the respiration.



*Effect of Ether on the Heart.*

The essential difference between the action of chloroform and ether is to be found in the effect produced upon the heart. The first operation of both agents is to stimulate the heart and to augment the force of its contractions; but after this chloroform depresses the cardiac action, whereas ether appears to exert but little influence upon the muscular movement of that organ.

The first or stimulating effect of ether is both less sudden and more sustained than that of chloroform, and for some time the heart goes on beating with more than its natural force. Sometimes, indeed, even after insensibility has been induced, the mercury in the hæmadynamometer stands higher than before the administration of the ether. This vapour may therefore be regarded in a certain degree as a stimulant to the force of the heart's action.

Moreover, during the insensibility, the pressure of blood in the vessels is well maintained up to the moment when death is imminent; and then with ether the mercury only falls after there has been manifest failure of the breathing, whereas with chloroform the mercury generally falls even during the proper performance of the respiratory function.

It is necessary to state that there is considerable difficulty in comparing the result produced by these two agents, as the stupor arising from chloroform is so much more profound than that induced by the weaker agent.

*Effect of Ether on Respiration.*

As with the stronger forms of chloroform vapour, so also with the stronger forms of ether vapour, administered by the mouth, there is a temporary arrest of respiration; but in the case of ether this is less marked.

With small per-centages of ether vapour there is no actual arrest of the breathing, although the inhalation of it in those qualities causes the number and the depth of



the respiratory efforts to be diminished. After a short time the respirations become slow and full; and next, while their frequency rises, the range of their movement is reduced. At a later period the respirations become more frequent and shallow; by degrees the external muscles of respiration cease to perform their office, and the air enters only with the movement of the diaphragm. After a time the diaphragm also is still, and the breathing is completely arrested.

As in the case of chloroform, this cessation of respiration may not be final; and, indeed, with the weaker forms of vapour it seldom is so. In the course of some seconds respiration recommences; and, if the etherization be continued, the same phenomena may be repeated before death actually occurs.

*Post-mortem Appearances in the Animals poisoned with Chloroform.*

As a general rule, all the cavities of the heart were found to contain more than the natural quantity of blood, and those on the right side were much more full than those on the left.

These points were especially noticed in eighteen cases, and in all of them the right cavities were more or less distended; while those of the left side were filled (but to a less degree than the right) in fifteen. In two of the remaining instances (in which 5 per cent. of chloroform had been inhaled) there was but little blood in the left cavities, and in the third and last they were nearly empty. Extreme distension of the left cavities with blood was met with in three instances (all 10 per cent.); but the right side of the heart, although filled in all the cases, was noted as being tensely filled in six instances.

The *blood* itself was generally liquid; but in several instances well formed and large, but not very firm, coagula were observed. In all these observations the animals were examined a few minutes only after death.

The colour of the blood on the two sides of the heart was



noted in thirteen cases. That on the right side was much darker than the blood on the left in seven instances; it was slightly darker on the right in two. In three there was no perceptible difference in the colour, whilst in the remaining one the blood was much darker on the left side than on the right.

Moreover, these variations in the colour of the blood did not appear to depend upon the amount of chloroform which had been used. In the single example in which the blood on the left side was the darker 40 per cent. had been employed. Of the three in which the colour on the two sides was the same 40 per cent. had been used in one, and in the others 5 per cent. Of the two cases in which the blood on the right side was slightly the darker, one was an example of the inhalation of 10 per cent., and the other of 40 per cent. In the remaining instances, in which the hue of the blood was much deeper on the right side, the strength of the chloroform vapour had varied from  $2\frac{1}{2}$  to 40 per cent.

The prevailing colour of the blood was a brownish-red. Its hue, on the right side, was in all cases dark, and in some was very deep. On the left side it was, in most instances, of a brighter tint than that in the right chambers, but in some the colour was a deep purple.

*Microscopical characters of the blood.*—The blood was in six instances examined by the microscope immediately after death. The result of these examinations showed that the blood-corpuscles have a tendency to become crenate, and that they do not collect so much in rouleaux as blood from a healthy animal.

In two of these cases no difference was observed in the blood taken from the opposite sides of the heart. In three more the characters of crenation of the outline and of non-isolation of the blood-corpuscles were more marked in the blood from the right side of the heart; in one of these instances, however, the blood from the left side was perfectly natural in appearance, the corpuscles being well formed and bi-concave. In the sixth case the blood-corpuscles from



the left side were slightly crenate, but were natural in their characters on the right.

The last instance was one in which 40 per cent., the others in which  $2\frac{1}{2}$  or 5 per cent., had been inhaled.

*Lungs.*—In some few instances the lungs contained more than the natural quantity of blood, and were consequently rather dark in colour; but in the majority of cases they were bright and florid.

Extravasations of blood had, in many instances, occurred. The amount of these hæmorrhages was very variable, there being in some cases only slight specks of ecchymosis beneath the pleura at the edge of the lung, whilst in others there were large and numerous patches of pulmonary apoplexy. Although this condition was often found where but small per-centages (5 per cent.) of chloroform had been inhaled, the most marked examples were those in which the vapour had been given in its strongest proportions.

It should be added that artificial respiration had been resorted to in a few of these cases; many of the most marked examples of pulmonary hæmorrhage, however, were those in which no attempts at resuscitation had been made.

*Liver, spleen, and portal system.*—Some congestion of the liver and spleen, and distension of the portal vessels, were almost always observed. The amount of it varied extremely, and did not appear to depend upon any condition of the experiments. It certainly bore no proportion to the amount of chloroform which had been employed.

*Brain and its membranes.*—The head was examined in six cases some hours after the death of the animal. The chest had not been opened. In all of these the vessels on the surface of the brain were found full of blood, whereas those in the interior of the cerebral substance contained no more blood than usual.

From these facts it is clear that, although there may, in



certain cases, be an impediment to the free circulation of the blood through the lungs, yet the appearances after death has been caused by chloroform are very different from those observed when life has been destroyed by asphyxia. In death from chloroform all the cavities are distended, and the cases are only exceptional in which the left side is empty. The rule, however, is alike in both—that the cavities of the right side contain more blood than those of the left.

It may be stated that after-death appearances in man have been recorded in but a small number of cases, and that no satisfactory conclusions can be drawn from the accounts thus given. The results obtained by examining animals immediately after death from chloroform offer the best post-mortem evidence which can be at present obtained.

#### *Means of avoiding Accidents with Chloroform.*

One hundred and twenty-three cases have been collected<sup>1</sup> in which death could be positively assigned to the inhalation of chloroform.

Even this large number is probably far short of the aggregate mortality which must have been due to its use in various parts of the world. Many of the deaths, moreover, happened during trivial operations, which, without chloroform, are not attended with risk to life. Added to these, there are cases still in which life is placed in imminent jeopardy during the administration of chloroform, although it is not actually lost.

Facts so important have led the committee to give their anxious attention to devise or adopt means for obviating such accidents.

Attention is therefore directed—1st, to the agent employed ; 2ndly, to the method of administering it.

#### *1. Effect of the mixture of Chloroform and Ether.*

If a mixture composed of from 2 to 4 per cent. of chlo-

<sup>1</sup> Appendix B.



reform vapour and 98 or 96 per cent. of atmospheric air be inhaled, there is little or no risk to life.

In some cases it is indispensable to employ as much as  $4\frac{1}{2}$  or even 5 per cent. of the vapour. But if a larger dose (one 10 per cent.) be inhaled, alarming symptoms are liable to supervene. At times, even with every care, and with the most exact dilution of the vapour, the state of insensibility may in a few moments pass into one of imminent death.

It is therefore extremely desirable to obtain an anæsthetic agent which shall be capable of producing the requisite insensibility, and yet is not so dangerous in its operation as chloroform.

Ether, to a certain extent, fulfils these conditions, but its odour is disagreeable, it is slow in its operation, and gives rise to greater excitement than chloroform. The committee therefore concur in the general opinion which in this country has led to the disuse of ether as an inconvenient anæsthetic.

In the absence of any known substance possessing the required qualities various mixtures of chloroform and ether have at different times been resorted to. It might be expected that a mixture of these bodies would combine most of the required properties, and be at once more active and compendious than ether and less energetic than chloroform.

The known differences in the actions of the two anæsthetics suggest that, in a mixture of them, the more dangerous properties of chloroform would be neutralized or reduced by dilution.

This might particularly be inferred from the influence which they respectively exert on the heart's action; the one depressing it almost from the first, the other sustaining or but little diminishing its force. These expectations would be further confirmed by the opposite effect which the two agents produce when mixed with the blood.<sup>1</sup>

<sup>1</sup> In a recent paper, read before the Royal Society, Dr. Harley has described the effects produced by the admixture of chloroform and ether with the blood. He states that in the first place chloroform



In accordance with these considerations, the committee conducted experiments with mixtures of the agents combined in the following proportions by measure :

Mixture A.—Alcohol, 1 part ;<sup>1</sup>  
Chloroform, 2 parts ;  
Ether, 3 parts.

Mixture B.—Chloroform, 1 part ;  
Ether, 4 parts.

Mixture C.—Chloroform, 1 part ;  
Ether, 2 parts.

The first of these mixtures (A) was proposed several years ago, and employed by Dr. Harley.

The second and third are mixtures which it is believed have been extensively used in America.

It was found that the physiological effects of the mixture B were very similar to that of simple ether ; an animal might inhale it for forty or fifty minutes, even in a tolerably strong form (15 per cent.), without destroying life.

The mixture, however, was open to the same objections as ether itself, the chief of which was the slowness of its operation. The length of time necessary to produce anæsthesia with it was so great as practically to preclude its employment.

diminishes the power of the constituents of the blood to unite with oxygen and give off carbonic acid, whereas sulphuric ether neither diminishes the absorption of oxygen nor the exhalation of carbonic acid by blood.

In the second place, chloroform has not nearly so powerful an effect in destroying the red blood-corpuscles as ether ; the latter rapidly dissolves the cell-walls and sets the contents free.

In the third place, ether has a much more energetic effect in causing the constituents of the blood to assume a crystalline form.

Lastly, ether prevents the blood from assuming an arterial tint when agitated with air, while chloroform does not prevent the occurrence of this normal change in colour.—‘Proc. Roy. Soc.,’ p. 159, 1864.

<sup>1</sup> The sp. gr. of the liquids used in making this mixture are—

Alcohol	.	.	.	.	.	.	838
Ether	.	.	.	.	.	.	1497
Chloroform	.	.	.	.	.	.	735



When a sufficient quantity of this mixture was given to destroy life, the respiration was observed to cease some time before the heart's action. The force of the cardiac beat, moreover, as indicated by the hæmadynamometer, was well maintained throughout the period of anæsthesia.

The mixtures A and C were very similar to each other in their action. This quite accorded with the fact that the proportion of chloroform was the same in both. The mode of their action, moreover, was intermediate between that of ether and that of chloroform.

It was found in the human subject, as well as in animals, that insensibility might be induced by means of them with sufficient rapidity; that is to say, in from four to eight minutes in animals, and in from ten to fifteen minutes in man.

And, further, it was ascertained, in animals, that inhalation of the vapour in a strong form might be continued for thirty or forty minutes without destroying life. Indeed, it was only upon employing a concentrated form of the vapour, and after prolonged endurance of its action, that death ensued.

In nearly all the experiments in which the animal was at length destroyed the respiration ceased some little time before the heart's action; and in nearly all, including those even in which a strong vapour had been employed, there were temporary suspensions of the respiration, followed by recovery, such as have been described as produced by the inhalation of diluted chloroform vapour.

These mixtures exercised a much less depressing effect upon the action of the heart than chloroform alone. In this respect, again, the mixtures appeared to combine the qualities both of ether and of chloroform; it being clear that, at the same degree of insensibility, the depression of the heart's action was less with either mixture (A or C) than with chloroform.

These considerations tend to establish the fact that a mixture of ether and chloroform (such as A or C) is as



effective as pure chloroform, and a safer agent when deep and prolonged anæsthesia is to be induced, while at the same time it is sufficiently rapid in its operation to be convenient for general use.

It is quite possible that at some future time an anæsthetic may be discovered which will fulfil the required conditions yet more perfectly than either of these mixtures. In the mean time the Committee suggests that both of them should be more extensively tried than they have hitherto been in this country. Of the two mixtures preference is, in the opinion of the committee, due to A, on account of the uniform blending of the ether and chloroform when combined with alcohol, and probably the more equable escape of the constituents in vapour.<sup>1</sup> The alcohol which it contains probably stimulates and sustains the action of the heart.<sup>2</sup>

## 2. *Mode of Administration.*

The several effects produced by the administration of chloroform, as well as of other anæsthetics, are tolerably uniform if the same strength of vapour be employed; and there is much reason to suppose that the irregularities attributed to it have been in a great measure due to the uncertain degree of its concentration. Experiments upon

<sup>1</sup> The mixtures A and C have been tried, at the request of the committee, in about seventy cases in the London hospitals, and the evidence of this limited experience tends to show that they may be given with safety and with complete effect, although they take a longer time than chloroform (ten to fifteen minutes) to procure anæsthesia.

<sup>2</sup> Ether is a more volatile fluid than chloroform, and in a mixture of the two the ether evaporates more quickly than the chloroform. The relative rates of evaporation of the two was observed by placing a known quantity on a cloth and exposing it to the air; it was then found that the per-centage lost was, after exposure, for

3 minutes, ether, 89 parts ; chloroform, 75 parts ;
15       "       "       93       "       "       85       "

The fact that the constituents of a mixture escape in somewhat unequal proportions is proved by observing the sp. gr. of mixture before and after exposure, and it was found in all cases that after exposure the sp. gr. was, to a certain extent, increased, proving ether had escaped before chloroform.



the lower animals, however, equally with observation on man, prove that there is but a narrow limit between that strength in which the vapour may be safely inhaled and that which is likely to produce alarming symptoms, if not death. But whether the hazard originates in natural or in accidental causes, the conclusion must be the same—that it is extremely desirable to adopt a method of administration by which the quantity of the vapour actually being inhaled may be graduated.

The results of the experiments which have been detailed show that it is as desirable to measure accurately the strength of the vapour as to weigh the dose of a medicinal agent administered by the mouth.

The only apparatus at present known to the committee which fulfils the necessary conditions is that contrived by Mr. Clover, which appears to afford the greatest, if not absolute, safety in the administration of anæsthetics. At the same time the apparatus is open to objections, the chief of which is that it is not very portable, and, requiring some amount of experience in its use, it must frequently happen that chloroform, or an anæsthetic, must be administered when it is not available.

In the absence of an apparatus by which the proportion of chloroform vapour can be accurately graduated, the plan of administering the anæsthetic on a handkerchief or lint appears to be the least open to objection. This method ensures a sufficient mixture of atmospheric air with the vapour; and, if the handkerchief be held at a proper distance (one and a half inches from the mouth), there is but little fear of the air becoming impregnated with a dangerous proportion of vapour.

### *Resuscitation.*

In the investigation of this subject the committee directed their attention especially to the following points:—  
A. (1) The period within which resuscitation may generally be accomplished. (2) The latest period at which resuscitation is possible. In reference to this latter point,



it was especially the object of the committee to ascertain to what extent the capability of resuscitation was regulated by the state of the respiration and of the heart's action.

B. It was attempted to distinguish the difference in the capability of resuscitation exhibited by animals poisoned by large and by small doses of anæsthetics respectively; and (C) also the differences in the power of reviving animals destroyed by pure chloroform and those poisoned by a mixture of chloroform and ether.

D. The comparative value of (1) artificial respiration, (2) the artificial respiration of oxygen, (3) galvanism.

There are many difficulties in arriving at very precise conclusions upon the subject of resuscitation. In the first place, it is by no means certain that the animals in which attempts at resuscitation were made would not have recovered without the artificial means of restoration. This will be seen to follow from what has been said of the mode in which death was brought about by moderate doses of chloroform and other anæsthetics. The respiration in most instances ceased, or nearly ceased, some time before the respiratory movements were finally arrested. After these periods of apparent death the respiration was usually restored; and this kind of flickering between life and death might be repeated twice, or even oftener, before the actual death. Attempts at resuscitation in such cases, soon after the interruption of the respiration, would gain for the artificial means which were used the credit of the recovery, whereas that event would really have occurred had they not been employed. It is accordingly proper not to attach too much importance to those instances of presumed resuscitations which have followed soon after the arrest of the respiration. In cases, however, in which natural breathing had ceased for a period of sixty seconds recovery without some artificial means of resuscitation would have been extremely improbable. On the other hand, where attempts to resuscitate have been postponed till after the cessation of the heart's action, it is right to attribute the recovery to the means employed, as in these instances it is



extremely doubtful if the revival could have occurred without some artificial means of effecting it.

A further obstacle in the way of rightly estimating the experiments in resuscitation arises from the extreme difficulty of obtaining precisely parallel observations. It has been stated that chloroform, and other anæsthetics, in moderate doses, cause death by enfeebling and paralysing the action of the heart, and that in most instances the respiration is the first to cease. While, however, at the time of the final respiration the heart's action is invariably enfeebled, in some cases it continues regular, with a steady beat, and gives rise to distinct pulsations in the arteries of the limbs; in other instances it is feeble, irregular, even intermitting, and its pulsations are imperceptible in the arteries.

From this it will be seen that two animals may be poisoned at the same period, and with equal doses of chloroform, and yet their positions shall be very different as regards the prospect of recovery; the one is hopelessly overpowered by the poison, the other easily recoverable. The frequent occurrence of differences so great renders the study of this subject one of much difficulty, and suggests the need of great caution in estimating the results of experiments.

The following appear to be the positive results which may be deduced from the experiments undertaken by the committee:

The simple failure of respiration whilst the circulation remains good almost always betokens a recoverable condition; some such cases would doubtless revive spontaneously, and a still greater number with the aid of the usual means of resuscitation.

If, after respiration has ceased, the heart continues to beat with regularity and with sufficient force to cause perceptible pulsation in the arteries, recovery with the ordinary means of resuscitation is probable; but if the heart has either altogether ceased to beat or has become irregular, and there be no arterial pulsation, then restoration by any



means is doubtful; even in these cases, however, under certain conditions, it is not absolutely impossible.

The failure of the circulation to any considerable extent always involves extreme peril; yet recovery is sometimes possible, even when the heart has actually ceased beating.

In these instances it does not appear of decisive importance whether the respiration has continued up to the time of this cessation or not. After the heart has stopped, however, recovery is but just possible, and is by no means the usual result of attempts to resuscitate. That which appears chiefly to regulate the result is the condition of the heart prior to its final contraction. When it has been acting with irregularity and feebleness for some time, the eventual recovery is rare; but if its action have continued strong up to the moment of its cessation, recovery is probable. From this it follows that a recovery is more likely to occur in an animal quickly poisoned with a large dose, than in one in which the heart's action has been enfeebled by the long-continued inhalation of a small dose. The explanation of this difference has been referred to before.<sup>1</sup>

In the experiments with mixtures of chloroform and ether the same observations held good, as far as the cases of insensibility induced by the small doses of chloroform.

*The comparative value of different Methods of Resuscitation.*—Of the different means available for restoring animation, 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 cold douche or continuous stream of water on the head was so manifestly inferior to this method in its restorative powers, that only a few experiments were performed with it.

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

<sup>1</sup> Page 329.



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, cannot but regard these restorative 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.

The experiments on resuscitation were attended with opposite results, according as the animal had been poisoned by large or by small doses of chloroform. Those poisoned by a large dose were, as has been already shown, more easily recoverable than those killed by a small one.

Practically, however, it must be remembered that poisoning by a small dose is altogether an exceptional circumstance, and presents conditions which are amply guarded against in the human subject. An animal, under such circumstances, would have been on the verge of death for some time before the actual cessation of the heart's action. Upon the first appearance of such symptoms in the human subject the inhalation would be promptly discontinued. It is with a large dose, on the contrary, that the symptoms of approaching death come on suddenly and without warning.

*The effects of the treatment with oxygen gas* will be seen on reference to the table of experiments; although acting sufficiently well, it is an agent which does not admit of practical application.

*Resuscitation in the Human Subject.*—From experiments on animals, and also from a consideration of cases of accidents with chloroform in the human subject, the committee is



strongly of opinion that the first and most important means of resuscitation is artificial respiration. Certain other methods may prove of service in aid of that, as the principal one; but they are all objectionable, in so much as they delay the commencement of the 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 practised in the manner known as Dr. Silvester's method, and as recommended by the Committee on Suspended Animation. Those who are conversant with the use of the bellows, adapted 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 to 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.

With reference to the employment of galvanism, it may be noticed that the most powerful effects were those produced when galvanism was applied to the neck; and little difference was observed whether the poles were laid on opposite sides of it or, one being placed on the front of the neck, the other touched the lower part of the chest.

The power of the agent was increased by connecting one of the poles of the galvanic coil with a needle inserted into the diaphragm. In several instances, in which even the heart had ceased to move, striking results were obtained by applying the galvanism directly to a needle in the heart, the



other pole being in contact with some exposed portion of the integument.

Galvanism requires to be used only in a very moderate intensity, and it is necessary to employ it in an interrupted current, and to leave frequent intervals of repose. Strong and continuous currents appear rather to exhaust than to restore muscular activity.

### *Physiological Conclusions.*

The sequence of the phenomena produced by chloroform inhalation in animals is similar to that observed in man; and, if the same per-centage of the agent be administered, the results produced are nearly uniform.

*Chloroform* at first increases the force of the heart's action; this effect is slight and transient.

When complete anæsthesia is produced by chloroform, the heart in all cases acts with less than its natural force.

The strongest doses of chloroform vapour, when admitted freely into the lungs, destroy animal life by arresting the action of the heart.

By moderate doses of chloroform the heart's action is much weakened for some time before death ensues; respiration generally, but not invariably, ceases before the action of the heart, and death is due both to the failure of the heart's action and to that of the respiratory function.

The danger attending the use of chloroform increases with the degree of stupor it induces.

Apparent irregularities in the action of chloroform mainly depend on the varying strength of the vapours employed, on the quality of the chloroform, and on the constitution of the patient.

*Ether.*—The action of ether is similar in many respects to that of diluted chloroform.

The vapour of ether at first increases the force of the



heart's action, and this effect is both greater and of longer duration than that observed with chloroform.

The stimulation is followed by a depression of the force of the heart's action ; but, at the same degree of insensibility, ether does not depress the action of the heart to the same extent as chloroform.

Ether destroys animal life partly by enfeebling the action of the heart, but chiefly by arresting the movements of respiration.

The energy with which chloroform acts, and the extent to which it depresses the force of the heart's action, render it necessary to exercise great caution in its administration, and also suggest the expediency of searching for other less objectionable anæsthetics.

The slow and uncertain action of ether renders this agent an inconvenient anæsthetic ; and, though it is capable of producing the requisite insensibility, and is less dangerous in its operation than chloroform, the committee concur in the general opinion which, in this country, has led to the disuse of ether.

A mixture of ether and chloroform is as effective as pure chloroform, and a safer agent when deep and prolonged anæsthesia is to be induced ; though slow in its action, it is sufficiently rapid in its operation to be convenient for general use.

A mixture composed of ether three parts, chloroform two parts, alcohol one part (by measure), is to be preferred, on account of the uniform blending of the ether and the chloroform when combined with alcohol, and the more equable escape of the constituents in vapour ; and the committee suggest that it should be more extensively tried than has hitherto been the case in this country.

*Fauces and glottis.*—If concentrated chloroform vapour be suddenly administered by the mouth, a spasm of the fauces is induced, which lasts for some seconds ; afterwards, when the animal has inspired, the phenomena of asphyxia are, for a time, associated with those of chloro-



form poisoning, and death is finally induced as by dilute chloroform.

If partial insensibility be first induced by weaker chloroform, no spasm of the fauces ensues upon the sudden administration of the concentrated form of the agent.

*Resuscitation.*—Artificial respiration is the most certain means of restoring life after poisoning with anæsthetics.

Resuscitation may generally be accomplished by artificial respiration, after natural respiration has ceased, provided the heart continue to act.

Resuscitation may *sometimes* be accomplished by artificial respiration even after the cessation of the heart's movements; but this result is exceptional.

Galvanism resuscitates within the same limits as artificial respiration, *i. e.* with tolerable certainty, in cases in which the respiration only has failed, and sometimes after all movement of the heart has ceased. It is, however, far less to be relied on than artificial respiration.

Animals quickly rendered insensible by a strong dose are more easily recovered than those which have been gradually narcotized, even by a small per-centage of the anæsthetic.

#### *Rules relating to the Administration of Chloroform.*

Chloroform should on no account be given carelessly, or by the inexperienced; and, when complete insensibility is desired, the attention of its administrator should be exclusively confined to the duty he has undertaken.

Under no circumstances is it desirable for a person to give chloroform to himself.

It is not advisable to give an anæsthetic after a long fast, or soon after a meal, the best time for its administration being three or four hours after food has been taken.

If the patient is much depressed there is no objection to his taking a small quantity of brandy, wine, or ammonia, before commencing the inhalation.



Provision for the free admission of air during the patient's narcotism is absolutely necessary.

The recumbent position of the patient is preferable; the prone position is inconvenient to the administrator, but entails no extra danger. In the erect or sitting posture there is danger from syncope. Sudden elevation or turning of the body should be avoided.

An apparatus is not essential to safety if due care be taken in giving the anæsthetic. Free admixture of air with the anæsthetic is of the first importance; and, guaranteeing this, any apparatus may be employed. If lint, or a handkerchief, or a napkin, is used, it should be folded as an open cone, or held an inch or an inch and a half from the face.

Chloroform should invariably be given slowly. Sudden increase of the strength of the anæsthetic is most dangerous. Three and a half per cent. is the average amount, and  $4\frac{1}{2}$  per cent., with  $95\frac{1}{2}$  of atmospheric air, is the maximum of the anæsthetic which can be required; given cautiously at first, the quantity within this limit should be slowly increased according to the necessities of the case, the administrator being guided more by its effect on the patient than by the amount exhibited.

The administrator should watch the respiration of his patient, and must keep one hand free for careful observation of the pulse.

The patient who appears likely to vomit whilst beginning to inhale the anæsthetic must be at once brought fully under its influence, and the tendency to sickness will then cease.

The occurrence, during the administration of an anæsthetic, of sudden pallor, or of sudden lividity of the patient's countenance, or sudden failure or flickering of the pulse, or feeble or shallow respirations, indicates danger, and necessitates immediate withdrawal of the anæsthetic until such symptoms have disappeared.

On the occurrence of these symptoms, and especially if they should become so urgent as to threaten death from failure of



respiration, of heart action, or of both together, the following rules of treatment are to be observed:—

Allow free access of fresh air, pull forward the tongue and clear the mouth and fauces, keep or place the patient recumbent, dash cold water on the face and chest, and aid the respiratory movements by rhythmical compression of the thorax.

In the more threatening cases commence instantly<sup>1</sup> with artificial respiration, whether the respiration has failed alone or the pulse and the respiration together.

Galvanism may be used in addition to artificial respiration, but the artificial respiration is on no account to be delayed or suspended in order that galvanism may be tried.

Few, if any, persons are insusceptible of the influence of chloroform, from two to ten minutes being required to induce anæsthesia. The time, however, varies with age, temperament, and habits.

The mixture of chloroform, ether, and alcohol, should be given in the same way as chloroform alone, care being taken, when lint or a handkerchief is used, to prevent the too free escape of the vapour.

#### *Use of Chloroform in Surgical Operations.*

With heart disease the anæsthetic may be given in any case which requires an operation, although when there is evidence of a fatty, weak, or dilated heart great caution is demanded. Valvular disease is of less importance.

In phthisis, when an operation is unavoidable, anæsthetics may be given with impunity.

For all operations upon the jaws and teeth, the lips, cheeks, and tongue, anæsthetics may be inhaled with ordinary safety. By care and good management the patient may be kept under their influence to the completion of the

<sup>1</sup> 'Med.-Chir. Trans.,' vol. xlv, p. 491.



operation. In these cases blood, as it escapes, if not voided by the mouth, passes into the pharynx. If any small quantity finds its way through the larynx, it is readily expelled by coughing. In operations upon the soft palate, fauces, pharynx, and posterior nares, if sudden or severe hæmorrhage is likely to occur, it is not advisable to induce deep insensibility. In cases requiring laryngotomy and tracheotomy anæsthetics may be employed with safety and advantage.

For operations upon the eye, involving the contents of the globe, the use of anæsthetics is open to objection, on account of the damage which the eye may sustain from muscular straining or vomiting. If employed, profound insensibility should be induced.

In operations for hernia, and in the application of the taxis, anæsthetics act most beneficially. For most operations about the anus profound anæsthesia is positively demanded.

In the condition of shock or of great depression, as after hæmorrhage, the careful administration of anæsthetics diminishes the risk of an operation.

In all cases other than those specially referred to it is sufficient to state, so far as a mere surgical operation is concerned, anæsthetics may invariably be administered.

The continuous vomiting occasionally induced by and following upon the inhalation of anæsthetics may be injurious by consequent exhaustion, as well as by mechanically disturbing the repair of a wound. With this reservation, they do not appear to interfere with the recovery of patients from surgical operations.

*Statistics.*—The results of 2586 capital operations performed before, and of 1847 performed since, the introduction of anæsthetics, collected from all authentic available sources,<sup>1</sup> show that anæsthetics have in no degree increased the rate of mortality.

<sup>1</sup> Appendix D.



*Use of Chloroform in Obstetric Practice.*

## A.—IN NATURAL LABOUR.

The careful administration of anæsthetics during labour is not attended with special danger, there being no well-authenticated instance of sudden death recorded, either in this country or abroad, so far as is known to the committee, where they have been given by a medical practitioner; but the occasional occurrence of unfavorable symptoms demands the exercise of caution during their employment.

An anæsthetic given so as to produce deep insensibility will, in many cases, suspend both uterine contractions and the auxiliary powers of parturition, and this may be turned to account in turning and in instrumental deliveries.

Administered in a moderate degree, and under proper regulation, it occasionally protracts labour by weakening the expulsive powers, but in a large proportion of cases it does not do so.

It has a decidedly beneficial effect in promoting dilatation of the maternal passages.

Its employment in natural labour does not predispose to puerperal convulsions, apoplexy, or other like complications, on the part of the mother.

If used injudiciously, it may increase the number of cases in which instruments must be ultimately employed, but no such result is likely to follow its judicious employment.

The balance of opinion is nearly equal as to whether it predisposes to imperfect contraction of the uterus after delivery, and thus leads to post-partum and secondary hæmorrhage.

As a rule, it has no such after-effects on the nervous or vascular systems of the mother as to retard her convalescence, or render her more liable to any of the forms of puerperal disease. Many physicians believe that it rather favours subsequent convalescence. A small minority holds a contrary opinion.



It has no tendency, from its after-effects, to interfere injuriously with the function of lactation.

With very rare exceptions, and those doubtful, it has no injurious influence on the child.

#### B.—IN ABNORMAL LABOUR.

Anæsthetics may be employed with advantage in various obstetrical operations, as turning, forceps, craniotomy, and extraction of retained placenta, rendering the patient passive in the hands of the practitioner, favouring relaxation of rigid tissues, lessening the suffering of the patient, and favouring convalescence by reducing the effect of shock and exhaustion. In many cases of turning, deep anæsthesia offers the additional advantage of suspending uterine contraction, and thus greatly facilitates the necessary manipulations; and in instrumental delivery generally it may be remarked that, unless anæsthesia be properly induced, the administration of chloroform is likely to prove more hurtful than useful, by rendering the patient less manageable.

It is not, as a rule, however, advisable to give anæsthetics during obstetrical operations, if the patient is much enfeebled by hæmorrhage; and if so given, they ought to be accompanied by the use of stimulants.

Anæsthetics may be employed advantageously to check the paroxysms in puerperal convulsions; but in the majority of instances their use will not enable the practitioner to dispense with other aids, such as bleeding, the omission of which may be neither prudent nor proper.

#### C.—RULES RELATING TO THE ADMINISTRATION OF CHLOROFORM.

There are no reasons for giving preference to ether over chloroform, the latter being much more desirable in obstetrical practice generally, the only exceptions being those in which chloroform notably disagrees.

In addition to those given for the administration of anæsthetics in ordinary cases, it is generally desirable to



observe the following rules during their administration in labour, subject to modifications at the discretion of the practitioner.

In natural labour begin to give them generally at or after the termination of the first stage; but they may be given earlier if the first stage is unduly painful, or if the os uteri resists dilatation.

Give them only during the pains, and withdraw them in the intervals.

When the foetal head bears on the perinæum give them more freely, to promote relaxation and relieve the increased pain.

Withdraw the anæsthetic immediately after the child is expelled.

If the patient is depressed, or the pains are sluggish during its administration, an occasional stimulant may be administered.

In cases where it seems to interfere with the progress of labour it may be necessary to suspend its use for a time and re-apply it after an interval, or even to withdraw it altogether.

In turning and instrumental deliveries deep anæsthesia must be induced, as in surgical operations, and the administration should then be entrusted to a competent person, whose sole duty should be to attend to it.

In midwifery a special inhaler for its administration is not generally necessary or desirable; a handkerchief or towel, so folded as to prevent blistering of the face and to allow free admixture of atmospheric air, being sufficient for the purpose.

#### D.—USE OF CHLOROFORM IN DISEASES OF WOMEN AND CHILDREN.

In the treatment of diseases of women an anæsthetic may be employed to facilitate diagnosis in very sensitive patients, or where a complete examination cannot be made without inflicting much pain. In cases of spurious pregnancy and phantom tumours, by relaxing the abdominal parietes, it may assist in demonstrating their true character, and, acting



in the same way, it may help to define more accurately the character and relations of other abdominal and pelvic tumours, or to detect feigned disease.

As a therapeutic agent, the inhalation and external application of chloroform in the form of a liniment may be usefully employed to allay pain in some cases of severe dysmenorrhœa, neuralgia, and the like.

There is accumulated testimony in favour of chloroform inhalation proving serviceable in various spasmodic diseases of women and children, as whooping-cough complicated with convulsions, spasmodic croup, epileptic seizures, and some other forms of convulsions in children, hysterical convulsions, epilepsy, and various muscular contractions in women.



## APPENDIX A.

## SELECTED EXPERIMENTS (1).

TABLE showing the order of cessation of the respiration and heart's action in dogs subjected to the inhalation of chloroform vapour by the mouth and nostrils.

Strength of vapour.	Insen- sibility.	Pulse ceased.	Heart ceased.	Respira- tion ceased.	Remarks.
Strongest, on towel.	m. s.	m. s.	m. s.	m. s.	
I.	...	...	5.20	3.30	
II.	...	...	5.30	5.0	
LXVIII.	2.15	...	4.30	3.35	
LXIX.	...	...	5.5	4.15	
LXXVII.	1.30	...	7.15	6.0	
LXXX.	2.0	...	14.55	14.30	
LXXXI.	1.50	...	8.0	6.45	
40 per cent.					
III.	0.45	...	3.30	1.20	
IV.	1.0	...	4.45	1.45	
XXII.	1.5	1.30	3.10	1.30	
10 per cent.					
VI.	1.45	...	7.0	6.15	
XXIII.	1.40	12.40	15.5	14.55	
7½ per cent.					
LXXXV.	2.0	...	9.45	9.15	
5 per cent.					
LXXII.	4.15	...	30.15	27.20	
2 per cent.					
XXIV.	8.45	...	...	...	Recovered. Chloroform re- moved after fifty-six mi- nutes. 128 minims of chloroform inhaled.
1 per cent.					
XXVI.	4.45	...	...	...	Recovered.
XXVII.	...	...	...	...	Recovered. The inhalation discontinued after twenty minutes, the animal still partly sensible.



TABLE showing the order of cessation of the respiration and of the heart's action in dogs subjected to the inhalation of chloroform vapour administered through an opening in the trachea.

Strength of vapour.	Pulse ceased.	Heart ceased.	Respiration ceased.	Remarks.
40 per cent.	m. s.	m. s.	m. s.	
X.	0.20	0.20	0.35	
XI.	0.15	0.15	0.15	
XII.	...	0.14	0.45	
14 per cent.				
VII.	4.5	5.15	2.5	Artificial respiration on cessation of natural.
VIII.	2.0	...	...	Recovered. Allowed to respire fresh air.
IX.	4.30	7.15	6.15	
10 per cent.				
XIII.	1.15	11.45	4.30	Artificial respiration.
XIV.	0.50	3.0	3.0	
XV.	1.0	5.0	1.15	
5 per cent.				
XVI.	1.15	8.0	5.0	
XVII.	18.14	25.0	18.14	Inhalation interrupted.
XVIII.	18.0	21.0	17.45	
XIX.	5.15	...	...	Artificial respiration.
2½ per cent.				
XX.	26.40	26.40	27.30	

TABLE showing the order of cessation of the respiration and heart's action in dogs subjected to the inhalation of the mixtures.

Mixture. Strength.	Mode of administration.	Insensibility.	Pulse ceased.	Respiration ceased.	Heart's action ceased.	Remarks.
		m. s.	m. s.	m. s.	m. s.	
57. A. Strongest	Trachea	...	...	2.10	2.20	
58. A. Strongest	Trachea	...	0.15	0.55	5.25	
59. A. 10 p. cent.	Muzzle	3.45	...	19.15	19.45	Hæmadynamometer
60. B. 15 p. cent.*	Muzzle	8.15	...	45.55	52.20	Hæmadynamometer (*strength increased) experiments.
62. B. 15 p. cent.	Muzzle	5.0	...	...	...	Continued 51 m. Re-
63. B. Strongest	Muzzle	...	...	1.15	1.30	[covery.
84. C.						
85. C. Strong	Muzzle	...	...	18.30	20.30	
73. C. Strongest	Muzzle	2.45	...	14.10	15.45	
74. A. Strongest	Muzzle	1.35	...	21.15	21.20	
75. A. Strongest	Muzzle	9.15	...	...	53.45	[ment.
76. A. Strongest	Muzzle	2.15	...	...	...	Resuscitation experi-



## SELECTED EXPERIMENTS (2).

TABLE showing the effect of chloroform inhalation on the heart's action and on the respiration.

Experiment XXIII.—10 per cent. (240 minims in 2400 inches of air), administered by the muzzle.

Time.	Pulse.	Respira- tion.	Move- ment.	Heart.	Remarks.
m. s.					
...	25	6	5—10	...	
0.0	...	...	...	...	Chloroform commenced.
0.15	...	1	...	...	
0.45	19	?	...	...	Struggling since the commence- ment; doubtful if any respi- ration.
1.0	...	5	...	...	
1.15	25	6	...	...	Expiratory cries.
1.30	...	10	...	...	
1.40	...	...	...	...	Insensible.
1.45	19	7	...	...	Still moaning.
2.0	...	5	...	...	Stertor.
2.15	Very feeble	...	3	...	
2.30	...	9	2	...	Stertor; pulse hardly perceptible.
2.45	...	...	...	...	Needle inserted in chest.
3.0	...	6	...	...	Very little air enters chest.
3.15	0	5	<1	...	
3.30	...	11	...	...	Respiratory efforts, with some sterter; no air enters.
4.0	...	5	...	...	
4.15	19	...	...	...	Pulse returning.
4.30	...	10	3	...	Stertor.
4.45	23	5	3	...	
5.0	...	5	4	...	
5.15	25	3	5	...	
5.30	26	5	5	...	Stertor still continues.
6.0	...	7	2	23	
6.15	29	7	1	23	
6.30	...	7	2	...	Stertor continues.
6.45	45	...	...	...	
7.0	...	7	...	...	
7.15	29	8	1	...	Pulse stronger.
7.30	...	5	...	...	
7.45	33	...	...	...	
8.0	...	14	...	41	
8.15	32	12	...	...	No air enters.
8.30	...	14	...	...	
9.0	...	12	...	...	Still no air enters.
9.15	25	...	...	...	
9.30	...	12	...	...	Ditto.
10.30	...	...	...	...	



*Experiment XXIII (continued).*

Time.	Pulse.	Respira- tion.	Move- ment.	Heart.	Remarks.
m. s.					
10.45	32	13	...	...	
11.30	...	19	..	...	
12.0	...	18	...	...	
12.15	...	11	...	...	
12.30	...	20	...	...	
12.40	0	...	...	...	Pulse has again ceased.
13.0	...	34	...	...	Respiration shallow, expiratory.
13.15	...	...	...	23	
13.30	...	12	...	...	
13.45	...	...	...	30	
14.0	...	15	...	30	Respiration noisy.
14.30	0	...	...	26	
14.55	...	...	...	...	Respiration ceased.
15.0	...	...	...	14	
15.5	...	...	...	...	Heart ceased.

## SELECTED EXPERIMENTS (3).

TABLE showing the effect of chloroform inhalation on the number of the pulse and on the number and depth of the respiratory movements.

*Experiment XVIII.*—5 per cent., by the trachea. Before the chloroform was administered the pulse 20, respirations 3.

Time.	Pulse.	Respira- tion.	Move- ment.	Remarks.
m. s.				
0.0	...	...	...	Chloroform given.
0.30	21	2	10	
0.45	28	3	12	
1.0	27	3	...	
1.15	25	4	10	
1.30	27	7	4	
1.45	30	28	...	Respiration expiratory.
2.0	24	...	...	
2.15	...	13	...	Pulse intermitting. Needle inserted through heart.
3.0	...	5	...	
3.15	28	7	3	
4.0	29	9	4	
5.0	26	11	...	
7.0	36	13	...	
8.0	28	12	...	
9.0	29	11	...	
10.0	28	13	2	
11.0	22	7	...	
12.0	15	6	...	
12.15	25	6	1	
12.30	...	5	...	
12.45	...	5	2	



*Experiment XVIII (continued).*

Time.	Pulse.	Respira- tion.	Move- ment.	Remarks.
m. s.				
13.0	28	6	...	Respiration irregular.
13.15	27	5	...	
13.30	...	5	...	A pause between each respiration.
13.45	31	4	...	
14.0	...	4	1	
14.15	28	4	2	
14.45	...	3	1	
15.0	25	5	...	
15.15	31	7	...	
15.30	23	7	...	
15.45	31	6	3	
16.0	...	8	...	
17.30	24	11	...	
17.45	30	5	...	Respiration stopped immediately after this.
18.0	27	0	...	
18.15	0	0	...	No pulse; no movement of needle in heart.
18.30	0	0	...	Ditto.
22.0	15	...	...	After a fresh insertion of the needle through heart.
22.30	16	...	...	
23.0	0	0	...	No movement, and none produced by fresh insertion of needles.

TABLE showing the effect of chloroform inhalation on the number and depth of the respiratory movements.

*Experiment VII.*—In this the chloroform (14 per cent.) was administered by the trachea. Before commencing, the respirations were 14 (in 15 seconds), the movement 20.

Time.	Pulse.	Respira- tion.	Move- ment.	Remarks.
m. s.				
0.0	...	...	...	Chloroform administered.
0.35	...	...	...	Violent struggling.
1.5	...	22	30	
1.35	...	26	18	
2.5	...	...	0	Respiration ceased; heart pulsating feebly (observed by means of a pin).
3.35	...	...	...	Artificial respiration with chloroform into lungs.
4.5	24	4	14	Heart beating more strongly; no pulse in femoral artery.
5.15	...	...	...	Heart ceased acting. Artificial respiration with <i>air</i> was then employed, but there was no return of the heart's pulsation.



## SELECTED EXPERIMENTS (4).

TABLE showing the effect of chloroform inhalation on the number and force of the heart's action, and on the number and depth of the respiratory movements.

Experiment XX.—2½ per cent. (60 minims in 2400 inches air), administered by the trachea. Before commencement, pulse 24, hæmadynamometer 9—14 (extreme), respirations 4, movement 8.

Time.	Pulse.	Hæmadynamometer.	Respiration.	Movement.	Remarks.
m. s.					
0.0	...	...	...	...	Chloroform administered.
0.15	21	...	4	10	
0.30	21	...	5	7	
0.45	26	...	3	20	
1.0	29	...	7	5	
1.15	31	11—13	9	7	
2.15	35	11—12	13	...	Respiration irregular.
2.45	34	...	34	...	Respiration expiratory.
3.15	33	6—8.5	35	...	
3.45	32	5—8	...	...	Respiration too rapid to count; shallow.
4.15	35	7—9	28	2	Respiration expulsive.
5.0	33	5—7.5	50	...	Respiratory movement hardly any.
5.30	33	6—8	40	<1	Very shallow.
6.15	33	7.5—9	43	<1	Ditto.
7.0	38	ditto	34	1—2	
7.30	29	ditto	26	1—2	
8.15	20	7—9	22	1	
9.15	29	7—8.5	18	3	Respiration rather deeper.
10.30	31	6.5—8.5	17	...	
11.15	29	6.5—8	15	<2	Action of heart irregular.
12.45	29	6.5—8.5	15	...	A pause between respirations.
14.0	30	6—8	15	...	
15.15	29	6—8	15	...	
17.30	15	4—6.5	12	3	
18.0	16	4—6	11	3	Pulsation very irregular.
18.45	11	4—5	9	2	
19.15	13	3—4.5	13	2	
19.45	12	3—4	15	1.5	
20.15	13	3—3.5	17	...	
20.45	12	2.5—3.5	15	2	
21.15	12	2.7—3.4	19	1	
22.10	11	2.8—3	13	...	Respiratory movement very slight.
23.0	...	2.8—3.2	...	...	Respiration almost ceased.
23.30	11	2.8—3.3	8	<1	Respiratory movement extremely slight.



*Experiment XX (continued).*

Time.	Pulse.	Hæmady- namometer.	Respira- tion.	Movement.	Remarks.
m. s.					
24.0	...	2·8—3·2	0	0	No certain respiratory move- ment.
24.45	10	2·7—3	0	0	
25.15	9	2·2—2·5	0	0	
25.45	9	2·4—2·6	0	0	
26.0	8	...	0	...	Respiration again commenced. Heart stopped.
26.30	5	...	4	...	
26.40	...	2.1	...	...	
27.10	0	ditto	9	7	
27.30	0	ditto	0	0	Pin inserted through heart; no movement of it. No fur- ther sign of life.
27.45	0	ditto	0	0	

## SELECTED EXPERIMENTS (5).

TABLE showing the effect of chloroform inhalation on the heart's action and respiration, and the results produced by interruption of the inhalation.

*Experiment XXXIII.*—In this experiment chloroform of the strength  $2\frac{1}{2}$  per cent. was used (160 minims in 6400 inches). Before giving the chloroform the respirations were 8 in 15 seconds; the force of heart's action, as shown by hæmadynamometer, 11—14.

Time.	Pulse.	Hæmady- namometer.	Respira- tion.	Remarks.
m. s.				
0.0	...	...	...	Chloroform administered by muzzle. Struggling.
0.50	...	11—20	15	
1.5	...	13—16	16	Whining and struggling. Still struggling.
1.20	14	...	14	
1.50	...	11—15	18	
2.5	...	...	15	
2.20	...	...	17	Conjunctiva not sensitive. Insensible. Both pneumogastrics divided. (No struggling for breath.) Respiration deeper.
2.35	17	11—15	...	
2.50	...	11—14	16	
3.20	...	11·5—13	...	
3.50	...	11—12	20	
4.5	...	...	...	
4.20	...	11—12	17	
4.35	...	11—13	24	
4.50	...	11—12·5	19	
5.20	...	11—12	12	
5.50	...	...	13	Pupil half the size it was before the division.



*Experiment XXXIII (continued).*

Time.	Pulse.	Hæmady- namometer.	Respira- tion.	Remarks.
m. s.				
6.5	24	...	12	
6.50	...	...	12	
7.5	...	10.75—11.75	...	
7.20	...	...	12	
7.35	...	...	...	Chloroform removed.
7.50	...	10.5—11	...	
8.5	...	10.5—11.5	7	Respiration deep.
8.35	...	11—12	8	
8.50	25	—13	...	
9.35	38	12—12.5	7	
9.50	...	...	6	
10.5	...	12—13.5	6	
10.50	45	12.5—13	8	No struggling for breath till present time.
11.35	...	...	...	Trachea opened.
11.50	...	—16	10	
12.20	...	14—16	16	
12.35	...	...	...	No struggling for breath.
12.50	...	15—15.5	...	
13.20	...	...	7	
13.35	50	...	7	
13.50	...	...	...	Sensibility returning ; pupil smaller.
14.20	63	14—14.5	...	
14.35	...	...	6	
15.20	...	...	...	Chloroform again administered.
16.5	...	13—13.5	17	
16.20	...	...	15	
16.35	...	13—13.5	11	
16.50	...	12.5—13	...	
17.5	...	...	30	
17.20	36	9.5—10	36	
17.35	...	...	44	Conjunctiva insensible.
17.50	...	9—9.5	...	
18.5	...	...	...	Chloroform withdrawn.
18.20	...	10—10.5	...	
18.35	...	11—11.5	...	
18.50	...	12—12.5	13	Respiration deeper.
19.5	...	12—13	...	
19.20	...	...	13	
19.35	40	13.5—14	13	
19.50	...	14—14.5	20	Conjunctiva still insensible.
20.35	...	...	6	
20.50	...	...	...	Struggling ; returning sensibility.
21.5	...	13—13.5	9	
21.20	...	...	9	
21.50	...	...	...	Chloroform again given.
22.20	41	...	11	
22.35	...	9—9.5	14	
22.50	...	...	11	
23.5	...	8—9	15	



*Experiment XXXIII (continued).*

Time.	Pulse.	Hæmady- namometer.	Respira- tion.	Remarks.
m. s.				
23.20	...	...	19	
23.35	39	8—8.5	39	
24.5	...	9.5—10	26	
24.20	...	...	34	
24.50	...	...	31	Insensible,
25.5	...	...	...	Chloroform removed.
25.35	...	9.5—10	...	
25.50	...	11.5—12	28	
26.5	...	11.5—13	22	Chloroform again given.
26.20	36	...	27	
26.35	28	12.5—13	20	
27.5	29	...	...	
27.20	...	...	15	Chloroform removed.
28.20	...	...	8	
29.50	...	...	...	Chloroform again given.
31.35	...	8—8.5	...	Fully under the chloroform.
33.50	...	...	...	Chloroform poured in trachea.
34.20	0	5—5.5	0	No pulsation in artery; no respiration for the last fifteen seconds.
34.50	...	—4.5	0	Mercury does not move.
35.35	...	...	7	Has again made seven respirations.
35.50	...	...	4	After four more efforts respiration ceased.

TABLE showing the effect of the inhalation of ether vapour  
on the force of the heart's action.

*Experiment LIII.*—14 per cent. given by the muzzle to a small dog.  
Hæmodynamometer connected with femoral artery.

Time.	Pulse.	Hæmady- namometer.	Heart's action.	Respira- tion.	Remarks.
m. s.					
0.0	...	...	...	...	Ether given.
7.0	...	...	...	...	Some struggling and whining.
13.50	...	...	...	...	Cornea insensible.
21.0	...	...	...	...	Hæmodynamometer connected with femoral.
22.0	...	10—14	...	...	Animal perfectly quiet.
26.45	48	9—12	...	8	
29.45	45	9—12	...	13	
30.45	44	9—12	...	12	
35.45	...	9—12	...	12	
37.45	...	...	...	...	Needle inserted in heart.
38.15	...	10.5—12.5	...	...	



*Experiment LIII (continued).*

Time.	Pulse.	Hæmady- namometer.	Heart's action.	Respira- tion.	Remarks.
m. s.					
42.0	...	...	...	...	A second hæmadynamometer connected with other femoral. Readings from the two alike.
43.0	35	11—13.5	...	8	
44.15	38	10—11	...	7	
44.45	...	...	...	0	Respiration stopped.
45.15	20	4.5—5.5	...	1	Respiration again commenced.
45.30	...	..	...	2	
45.45	...	4—6	...	5	
46.15	...	...	...	5	
46.30	26	5—8.5	...	5	
46.45	...	...	...	5	
47.0	...	...	...	5	
47.15	...	...	...	4	
47.30	38	...	...	4	
49.15	43	8—10	...	6	
51.45	17	...	...	2	
52.0	0	1½	...	4	Pulse ceased; no movement in hæmadynamometer; but pulsation (slight) continued in needle in heart.
52.15	0	...	...	4	
52.45	0	...	...	0	
53.0	0	...	7	0	
53.15	0	...	7	0	
53.30	0	...	3	0	
53.45	0	...	2	0	
54.0	0	...	2	0	
54.15	0	...	1	0	
54.30	...	...	...	...	Heart's movement quite ceased.

*The direct action of the Vapour of Chloroform and of Ether on the post-mortem movements of the heart in Frogs.*

In order to observe the effect produced by the action of the vapour of anæsthetics upon the cardiac movements, the hearts of several frogs were removed from the thorax, and, being denuded of pericardium, were exposed to the vapour of chloroform or of ether. The duration of the pulsations was noted, and the results thus obtained were compared with those observed in hearts removed in like manner



and simply suspended in moist air. The observations were as follows :

		a.m.
Exp. 1.—Heart removed from thorax and suspended in moist		
air. Contractions 36 . . . . .	at	9.58
	Contractions 20 in the minute „	10.30
	Heart stopped . . . . .	11.05
Exp. 2.—Heart suspended in air. 22 Contractions 56 . . . . .	„	11.15
	Contractions 22 in the minute „	11.40
	Heart stopped . . . . .	1.50
Exp. 1.—Heart suspended in vapour of ether. Contrac-		
tions 28 . . . . .	„	10.22
	Contractions 24 in the minute „	10.25
	Heart stopped . . . . .	10.31
		(9 minutes.)
Exp. 2.—Heart suspended in vapour of ether. Contrac-		
tions 44 . . . . .	„	11.05
	Contractions 28 in the minute „	11.15
	Heart stopped . . . . .	11.20
		(15 minutes.)
Exp. 1.—Heart suspended in vapour of chloroform. Con-		
tractions 34 . . . . .	„	10.21
	Contractions 20 in the minute „	10.25
	Heart stopped . . . . .	10.27
		(6 minutes.)
Exp. 2.—Heart suspended in vapour of chloroform. Con-		
tractions 36 . . . . .	„	10.54 $\frac{1}{2}$
	Contractions 20 in the minute „	11.3
	Heart stopped . . . . .	11.5
		(10 $\frac{1}{2}$ minutes.)

Thus, both chloroform and ether appear to have a direct action on the heart, destroying its contractile power.

## APPENDIX B.

### ACCIDENTS WITH CHLOROFORM.

#### *Fatal cases of Chloroform Inhalation.*

The cases in which death took place during the inhalation of chloroform, and in which the fatal result was fairly attributable to this agent, are arranged in Table A. The number of cases in this table is 109 (72 males, 37 females).



The first 59 correspond to those collected by the late Dr. Snow. To these, however, have been added the cases numbered 7, 34, 35, 47, and 48, which had not been published when Dr. Snow's table was prepared. Moreover, the cases numbered 8, 29, and 46, although not admitted by him into his table, have also been added, since there seems no doubt that the death in each of them was due to the employment of chloroform. In two of these latter cases there existed fatty degeneration of the heart, which may doubtless have contributed to produce the fatal result, but which did not alone cause it. In the third case death was attributed to mental emotion. This, again, should be looked upon as a subordinate, not as the principal, occasion of death.

This collection of 109 cases cannot be regarded as comprising all the deaths which have taken place from the use of chloroform, since there is good reason to believe that many deaths have happened (especially out of England) which have never been made public. Dr. Snow, in addition to the fifty cases collected by him, alluded to six other fatal cases with which he had become acquainted. One, if not more, of these have since then been published; it has been added to the table now produced.

In table B are included nine cases in which death may have taken place from the inhalation of chloroform; but the fact cannot be regarded as sure, owing either to the imperfect reports or to the agent having been secretly used for the purpose of suicide.

If, however, these nine cases be admitted, together with the five cases of Dr. Snow, and the two classes be then added to those in Table A, the total (123) will represent the number of recorded cases in which death may fairly be attributed to the inhalation of chloroform.

It would be possible yet further to augment this number, by accepting as deaths produced by chloroform certain other instances in which the cause of the fatal result was either imperfectly authenticated or was erroneously alleged to be due to the inhalation of that agent. In all the cases included in the foregoing tables death took place either during or



immediately after the inhalation. Others have been published in which the death was attributed to chloroform, although it did not occur until some hours, or even days, after the inhalation. In nearly all these instances there were other causes (such as the ordinary effects of the operation performed), which might equally be charged with the death of the patient. That the chloroform contributed to produce the fatal result in these instances may be true; yet it is clear that they cannot with justice be included in Table A with the unquestioned cases of fatal chloroform inhalation. There is, indeed, some reason to believe that chloroform may combine with other causes to occasion death at some little time after its inhalation, but on this subject there is little satisfactory evidence. Thus, in Table C are arranged four cases in which death took place some time after the inhalation, in each of which there were other conditions capable of producing death independently of chloroform.

*Age.*—The ages in the fatal cases are as follow :

Under 5 years . . . . .	0
From 5 to 15 years . . . . .	9
„ 15 to 30 „ . . . . .	30
„ 30 to 45 „ . . . . .	32
„ 45 to 60 „ . . . . .	12
Over 60 years . . . . .	2
Not stated . . . . .	24
	—
	109

*Operations for which the Chloroform was administered in the Fatal Cases.*

Amputations . . . . .	16
Dislocations . . . . .	5
Removal of tumours . . . . .	9
Examination of injuries . . . . .	3
Operation on male genito-urinary organs . . . . .	12
„ on anus, rectum, &c. . . . .	7
„ on the uterine organs . . . . .	1
„ on the eye . . . . .	4
For hernia . . . . .	1
Castration . . . . .	4
For necrosis, excision of bones, &c. . . . .	3



Excision of joints . . . . .	2
Forcible straightening of joints . . . . .	3
For application of escharotics . . . . .	6
Plastic operations . . . . .	6
Ligature of arteries . . . . .	1
Sinus in thigh . . . . .	1
Impaction of fæces . . . . .	1
For removal of teeth . . . . .	12
Removal of toe-nail . . . . .	5
For relief of neuralgia . . . . .	2
For delirium tremens . . . . .	2
For maniacal excitement . . . . .	1
Not stated . . . . .	2
Total . . . . .	<hr/> 109

*Mode of Inhalation.*

On handkerchief, towel, or lint . . . . .	55
Lint with sponge . . . . .	5
On sponge . . . . .	7
With the ether-inhaler . . . . .	2
Snow's inhaler . . . . .	5
An inhaler . . . . .	21
Not stated . . . . .	14
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*Period of Inhalation at which Death occurred.*

Under 1 minute . . . . .	10
From 1 to 3 minutes . . . . .	8
„ 3 to 5 „ . . . . .	10
„ 5 to 15 „ . . . . .	23
Over 15 minutes . . . . .	4
Not stated . . . . .	54
	<hr/> 109

The time was in nearly all cases arrived at by estimation, and was not noted by the watch. The results, therefore, above stated can only be taken with much allowance. The general conclusion, however, from the 55 cases in which the period of death is mentioned, is that the



fatal result in 51 cases happened within the first fifteen minutes.

*Stage of the Anæsthesia at which Death occurred.*

Commencing to inhale	.	.	.	.	10
Stage of excitement	.	.	.	.	16
Incomplete anæsthesia	.	.	.	.	24
Fully under influence	.	.	.	.	38
Ditto, operation complete	.	.	.	.	14
Not stated	.	.	.	.	7
					<hr/>
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Or—

Before full effect of chloroform	.	.	.	.	50
During „ „	.	.	.	.	52
Not stated	.	.	.	.	7
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*Mode of Death assigned.*

Syncope	.	.	.	.	56
Syncope during stage of excitement	.	.	.	.	6
Died suddenly	.	.	.	.	6
Died in a fit	.	.	.	.	10
Pulse and respiration ceased together	.	.	.	.	9
Failure of respiration (pulse not noted)	.	.	.	.	6
Failure of respiration (pulse remaining)	.	.	.	.	2
Not stated	.	.	.	.	14
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					109

The mode in which death took place in the human subject corresponds with that observed in the lower animals. In ten cases death happened before the anæsthetic effect of the chloroform had been produced; and in these cases there is reason to believe that the death resulted from the large per-centage of chloroform vapour with which the air was charged. Although thus highly concentrated, the total quantity of the vapour consumed was in some of these cases remarkably small.



Then, again, many of the deaths may be attributed to the sudden inhalation of a dense chloroform vapour when the patient was already partly under the influence of this agent. This was doubtless the case in those instances in which syncope occurred during excitement.

From the very large proportion in which deaths by syncope, and not by failure of the respiration, predominate, the conclusion arises that overdose of the vapour had really occasioned the fatal result. The importance of this conclusion will at once appear from its necessary corollary, that, if efficient means of graduating the per-centage of the chloroform vapour had been adopted, the liability to death in many instances would have been diminished.

Yet it must not be supposed that in all the cases of death by syncope a per-centage of the chloroform vapour had been administered which was inevitably dangerous. In the experiments on animals some died by syncope whilst inhaling much diluted vapour, and in every case the force of the heart's action was much reduced for some time before death. If, as usually happened in the experiments on animals with the diluted chloroform vapour, the respiration gradually failed whilst the heart continued to beat with appreciable force, this constituted a sufficient warning of approaching death, and upon the withdrawal of the vapour recovery at once ensued. Few, if any, deaths have taken place in this manner in the human subject.

If, on the other hand (as sometimes, but rarely, happened), there was sudden failure of the heart's action, the breathing still continuing, death supervened, practically, without warning. This mode of death, which was exceptional in the experiments on animals, is the most frequent in the human subject. And this might, indeed, be expected, since, whilst the experiments on animals were purposely carried on to their conclusion in order that all the symptoms of chloroform poisoning might be observed, man would be guarded by precautions and attention which would commonly secure him from all dangers to life but those which could not be recognised or averted during their approach,



as from the early inhalation of a large quantity of the anæsthetic by sudden and deep inspiration.

It is noted that attempts were made to resuscitate the patient by means of artificial respiration in 49 cases. This, in 23 cases, produced no effect, but in 26 there were efforts at natural respiration. These efforts soon ceased, and the patients died.

The period at which the attempt to resuscitate was made is exactly noted only in a few cases; it may, however, be assumed that artificial respiration was very promptly commenced in the great majority of cases.



TABLE A.—*Fatal Cases of Chloroform.*

No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which death occurred, and time.	Mode of death.
1	Jan. 28, 1848. Reported by Dr. Meggiston, at Winton. Hannah Greener, æt. 15	Removal of toe-nail. Death during operation	Handkerchief. One dram used. Incomplete anaesthesia. Two minutes	Became blanched; spluttered as in epilepsy; made no rally.
2	Feb. 23, 1848. 'Med. Gazette.' Cincinnati. Martha Simmons, æt. 35	Extraction of teeth. Nearly completed	Dr. Morton's ether inhaler. Large quantity used. Fully under influence. Death, three minutes	Arms became rigid. Pulse ceased after being feeble; respiration ceased about the same time. Became livid.
3	March, 1848. Mr. Warren. 'Med. Gazette.' Boston. Patrick Coyle	For fistula	Towel or handkerchief Half a dram used. Anaesthesia incomplete (?). Death, one minute	Showed slight symptoms of feeling pain. The pulse, which was full and natural, sank.
4	May, 1848. Boulogne. Madlle. Stork	Opening a sinus in thigh. Death probably took place before the operation was commenced	Handkerchief. Three drams used. Anaesthesia incomplete Death, one minute	Put up her hand, said "I choke." The face immediately became pale; breathing embarrassed. She foamed at mouth.
5	— 1848. 'Med. Gazette.' Hyderabad. Female, young	Amputation of middle finger. Death probably took place before the operation was commenced	Handkerchief. One dram used. Anaesthesia incomplete. Probably one or two minutes	She coughed a little; then gave a few convulsive movements.



No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which death occurred and time.	Mode of death.
6	May, 1848. 'Med. Gazette.' Hôtel Dieu, Lyons. Charles Des Noyers, æt. 22	Cautery to wrist. Operation commenced	An apparatus. Not stated. Five minutes	Not stated.
7	June 25, 1848. M. Robert, 'Bull. Acad. de Médecine.' Hosp. Beaujon, Paris. Male, æt. 24	Amputation at the hip, for bullet wound. During operation	An apparatus. Death on reapplication of chloroform; when sensibility was returning. Period not stated	Breathing became stertorous, and then very feeble; countenance livid; eyes turned upwards; the pulse had ceased. Artificial respiration appeared to revive him, and the pulse was again felt; he relapsed, however, and died.
8	June 28, 1848. Mr. Robinson, 'Med. Gazette.' London. Mr. Walter Badger, æt. 23	Extraction of teeth. Not commenced	An ether apparatus. Incomplete anæsthesia. Three or four minutes	Hands fell down, and head fell on chest. Artificial respiration, but no sign of recovery.
9	Dec., 1848. 'Med. Gazette.' Govan. Male youth	Operation on great toe. Not commenced	Not stated. Almost instantly	Not stated.
10	Jan. 19, 1849. Dr. Warren, 'Med. Gazette.' New York. John Griffith, æt. 31	For phimos. Had inhaled chloroform before. Completed	Napkin. Three drams used. Complete anæsthesia. Ten minutes	Face and neck became livid; the eyes turned upward; pulse imperceptible at the wrist; and whole body relaxed. After two or three gasps, he ceased to breathe.
11	Jan. 24, 1849. 'L'Union Méd.' Hôtel Dieu, Lyons. J. Kenier (male), æt. 17	Amputation of finger. Not commenced	Gauze. Two drams. During stage of excitement. Six minutes	Pulse ceased to beat; countenance altered. Action of heart had ceased, and the sounds could not be heard. Respiration still continued, but became irregular, weak, and slow; and at length ceased completely, in the space of half a minute. Attempts made to restore respiration, and in two minutes again commenced; but pulse did not return.
12	Feb. 20, 1849. 'Lancet.' Westminster. Samuel Bennett, mason, æt. 36	Amputation of a toe. Completed	Handkerchief. About half an ounce. Complete anæsthesia. Time not stated	At close of operation no blood escaped when the pressure was removed from the arteries; the patient was, in fact, dying, and in a short time expired. A few inspirations were noticed after the pulse had ceased at the wrist.



13	Aug. 23, 1849. 'Lancet.' Langres, France. Ma- dame Labrune, age not stated	Extraction of tooth. commenced	Not	Handkerchief. not stated. Incomplete insensibility. Time not stated	Quantity Incomplete Time not stated	As she did not become insensible, more chloroform was placed on handkerchief. She drew one deep inspiration; counte- nance immediately became pallid; dilatation of pupils, con- vulsive rolling of eyes; no pulse could be felt.
14	Oct. 10, 1849. 'Lond. Med. Gaz.' St. Thomas's Hospital. John Shorter, æt. 48	Removal of toe-nail. Com- pleted	Com-	An inhaler. About half a dram. Complete anæs- thesia. Five minutes	About half a dram. Complete anæ- thesia. Five minutes	Continued insensible after operation; face becoming dark; pulse small, quick; respiration laborious. After struggling for a minute, became still. Respiration continued a few seconds after cessation of the pulse. Artificial respiration produced no effect. She died suddenly.
15	— 1849. 'Journal of Prov. Med. and Surg. Assoc.' Shrewsbury. Female, age not stated	Excision of the eyeball. During operation		Sponge. "A small dose." Probably fully under. Time not stated	"A small dose." Probably fully under. Time not stated	
16	Jan., 1850. 'Lond. Med. Gazette.' Female, æt. 20	Extraction of tooth. Ope- ration seems to have been attempted several times at intervals unsuc- cessfully. Died when inhaling chloroform for sixth time	Ope-	Sponge and napkin. Com- mencing to inhale	Com-	Died suddenly, stretching herself out, and frothing at the mouth at the moment of death, the countenance at the same time becoming livid.
17	Jan. 29, 1850. 'Edin. Month. Journal.' King- ston, Jamaica. William Bryan, age not stated	Operation not stated. Pro- bably not commenced	Pro-	Sponge. About one dram. Stage of excitement	About one dram. Stage of excitement	Made a stertorous inspiration, and after some seconds made another inspiration; and this occurred several times, until at length respiration ceased entirely. (No report of pulse).
18	Feb., 1850. Board of Ordnance. Mauritius. An artilleryman, æt. 24	Amputation of finger. Pro- bably completed	Pro-	Handkerchief. One dram	One dram	After chloroform was discontinued face turned pale, pulse and breathing ceased.
19	— 1850. 'Hygiea.' Stockholm. Male, æt. 30	Operation on testicle. Not commenced.	Not	Cotton and folded towel. About two and a half drams. Five minutes	Cotton and folded towel. About two and a half drams. Five minutes	Some struggling on breathing fresh chloroform. Towel re- moved, but, patient not being insensible, again applied. After a few inspirations pulse ceased, face turned pale, breathing slow, and gradually ceased.
20	March, 1850. Dr. Snow, from Dr. Adams, Glas- gow. Male, æt. 7 or 8	Sounding for stone. During this operation	During	Lint. Insensible moaning	Insensible moaning	Countenance livid, eye vacant. Heart pulsation ceased. Made one deep gasp, and was to all appearance dead. Artificial respiration; no result.



No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which death occurred, and time.	Mode of death.
21	June, 1850. 'Med. Gaz.' Guy's Hospital. Police-constable, æt. 34	Amputation of portion of hand. During operation	Inhaler, then napkin	During operation hæmorrhage suddenly ceased, and he expired.
22	Sept. 20, 1850. Dr. Snow, from Dr. Adams. Cavan. Ireland. James Jones. æt. 24	Amputation below knee for scrofulous disease of ankle. Not commenced	Lint and towel, with sponge. About one and a half drams. About one minute	Slight convulsive movement of eyelid, froth at mouth, and he was dead.
23	April, 1851. Dr. Snow (newspaper report?). Stepney Workhouse. John Holden, age not stated	An operation on penis	Not stated. One dram	Died suddenly.
24	June 10, 1851. 'L'Union Médicale.' Strasburg. Madame Simon, æt. 36	Extraction of teeth. After extraction of some	Handkerchief. Less than one minute	Died suddenly.
25	July 8, 1851. 'Med. Times.' Seaman's Hospital, Greenwich. A mulatto, æt. 45	Removal of testicle. During operation	Linen cloth. About one and a half dram. Fully under influence. More than seven minutes	Hæmorrhage from artery suddenly ceased, and the pulse at the same moment. Respiration ceased almost instantaneously with heart's action, but one or two sigh-like inspirations followed. With artificial respiration there were several natural efforts at respiration.
26	Oct., 1851. 'Med. Times.' Chipping Norton. Elizabeth Hollis, æt. 37	Removal of impacted feces. (Cancer of uterus.) Completed (?).	Not stated, probably handkerchief. Ten and a half drams. Fully under influence. Eight or nine minutes	On completing operation the surgeon found that she had ceased to breathe.
27	March 17, 1852. 'Med. Times.' St. Bartholomew's Hosp. Thomas Haward, æt. 23	Ligature of arteries, aneurism in leg by anastomosis. Operation commenced	An apparatus. Five to ten minutes	Pulse suddenly ceased; chloroform removed, but in a few seconds the patient had ceased to breathe. With artificial respiration the act of respiration was performed several times, and the circulation was observed to be returning, but he quickly relapsed and died.



28	June 27, 1852. 'Gaz. Médicale.' Ulm. Madame W—, æt. 32	Extraction of tooth. commenced	Not	Sponge and handkerchief. Twenty-five drops. Only a few inspirations	On being asked a question, answered in a thick and trembling voice. At the same time stretched out her limbs; the face became bluish; the eyes haggard; the head and arms fell; she was dead.
29	Sept. 15, 1852. Dr. Snow, 'Anæsthetics.' London. Male, æt. 73	Lithotripsy. During operation	During operation	Snow's inhaler. Fully under. Fresh chloroform given, as signs of returning consciousness appeared. Time not stated	Appeared to hold his breath; the pulse had then ceased, the heart's sounds were still heard feebly. He made several further inspirations, and then ceased to breathe. Artificial respiration produced no result.
30	— 1852. 'Med. Times and Gaz.' Melbourne, Australia. Mr. J. Atkinson, age not stated	Fistula-in-ano. commenced	Not commenced	Handkerchief. About one dram. Not fully under. Not more than a minute	On applying fresh chloroform he spluttered at mouth. The chloroform was removed, but he suddenly expired.
31	Aug. 10, 1852. 'Monthly Journ. of Medicine.' Melbourne, Scotland. A cattle-dealer, age not stated	Application of potassa fusa to ulcers. During operation	During operation	Inhaler nor quantity stated. Fully under influence. A few minutes	When nearly completing operation a sort of catch in breathing on looking at him; the mouth and eyes open, and turned upwards; the breathing irregular; face pale, and the pupils dilated. Artificial respiration no effect. "In a few minutes the man died."
32	Dec. 24, 1852. 'Lancet.' Manchester Infirmary. Henry Hollingsworth, age not stated	Removal of malignant tumour of the thigh. During operation	During operation	An inhaler. Quantity not stated. Fully under. Chloroform acted slowly	Breathing became slow; he seemed to be sinking fast; he gave one strong gasp, and then died.
33	March 19, 1853. 'Lancet.' University College Hospital. Caroline Baker, æt. 28	Application of nitric acid to sloughing ulcers. Not commenced	Not commenced	On lint. Quantity not stated. Stage of excitement. Time not stated	A partial relaxation of the limbs took place; she became insensible and pulseless.
34	May, 1853. M. Triquet, 'La Patrie.' Paris. Madame Breton	Tumour of the face. During the operation	During operation	Compress. Stage of excitement	Had cough; made a deep inspiration, then a convulsive movement of the face and hand; the pulse and heart had ceased.
35	— 1853. M. Vallex, 'Gazette des Hôpitaux.' Paris. Male	For hæmorrhoids, in a patient suffering from aneurism of the aorta. Not commenced	Not commenced	Not stated. Fully under. Under five minutes	The respiration became embarrassed; there was trismus; then the movements of the heart ceased. With insufflation, and then with electricity, he breathed irregularly for twenty minutes. There was, however, no evidence of restored action of the heart.



No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which death occurred, and time.	Mode of death.
36	May, 1853. 'Med. Times and Gazette.' Hôtel Dieu, Orleans. A soldier, æt. 25	Removal of tumour near lip. Commenced	On sponge. Five grammes. Fully under. About four minutes	Patient became pale, respiration suspended, sank into a state of complete collapse. Artificial respiration used, but produced no effect.
37	Sept. 28, 1853. 'Monthly Journal.' Edinburgh Infirmary. John Mitchell, æt. 43	Perineal section. Not commenced	Handkerchief. About an ounce. Fully under. Time not stated	Had a slight convulsion; rallied, and continued chloroform; pulse became weak, and ceased. Breathing did not cease before pulse. Artificial respiration restored a few natural respirations, but this did not continue.
38	Oct. 5, 1853. 'Med. Times and Gazette.' University Hospital. Female, æt. 40	Strangulated hernia. Not commenced	Lint. Less than two drams. Stage of struggling. Five or six minutes	Struggled much; commenced to breathe with loud, rough stertor; the pulse was gone; gave several inspirations, then ceased. With artificial respiration and galvanism gasped about three times. After this no further signs of life were exhibited.
39	Oct. 20, 1853. 'Medical Times and Gazette.' St. Bartholomew's. Ann Smith, æt. 22	Application of actual cautery to canceroid sore. Not commenced	An inhaler. About 2½ drams. Fully under. About five minutes	Pulse became extremely weak and fluttering; countenance dusky; respiration at long intervals, with slight catching efforts. All efforts at respiration ceased about two minutes after first indication of failure; the pulse, however, as a very feeble flutter, was felt occasionally for at least two minutes later.
40	Nov. 16, 1853. 'Edin. Monthly Journ.' Vienna. Male, æt. 19	Extension of anchyloid knee. Not commenced	Inhaler. Quantity not stated. Probably not under influence. Less than a minute	Pulse became frequent and undulating; trismus occurred; the respiration became irregular, face livid; foamed at mouth. He only once made a feeble attempt at respiration.
41	— 1853. 'Med. Times and Gazette.' Neustedt. Female, æt. 13	Lipoma on back; removal. Commenced	Not stated. One dram. Fully under. Time not stated	Fell suddenly forwards on her chest. Attempts made to restore her; but, in the course of a few minutes, it became evident that she was dead.
42	Jan. 21, 1854. 'Assoc. Med. Journ.' Bristol Infirmary. Jane Morgan, æt. 59	An attempt to reduce dislocation at shoulder. Not commenced	Sponge. Two drams. Stertorous breathing. About six minutes	Breathing became stertorous, and immediately afterwards the pulse, which had hitherto continued pretty firm, became suddenly imperceptible, the respiration ceasing at same time. There was, with galvanism, "some convulsive efforts of respiratory muscles, but no further sign of life."



43	— 1854. 'L'Union Médicale.' Hôp. St. Antoine, Paris. Female, æt. 40	Removal of uterine polypus. Almost completed	Lint. Quantity not stated. Fully under. Time not stated	Pulse ceased to beat; face was extremely pale; a slow respiration still continued, but soon ceased.
44	— 1854. 'Assoc. Med Journ.' Sheffield. Mrs. Harrup, æt. 45	Removal of cancer of breast. Not commenced	Neither form of inhaler nor quantity stated. Fully under. More than forty minutes	After inhaling with little effect for forty minutes the chloroform took effect, but the countenance changed and the pulse ceased; after a few short laboured inspirations life became extinct.
45	May, 1854. 'Med. Times.' Lock Hospital. A tailor, æt. 18	Operation for phimosis. Not commenced	Inhaler (not covering nostrils). Two drams. Incomplete insensibility. About six minutes	Pulse suddenly failed, became imperceptible; countenance assumed a pale, leaden hue. With stimulus of cold water, after three or four minutes, pulse again felt, and spontaneous respiration renewed. This improvement continued for ten minutes; then pulse and respiration ceased together. Artificial respiration produced no effect.
46	May 11, 1854. Mr. Potter. 'Med. Times and Gaz.' St. George's Hospital. Female, æt. 37	Removal of tumour of breast. Not commenced	Snow's inhaler. Rather more than one dram. Commencing to inhale. One minute and a half	Breathing suddenly ceased; became deadly pale, no pulse could be felt; there were then two sighing efforts at respiration. Artificial respiration commenced within one minute, without effect.
47	June 1, 1854. M. Nistri, 'Gazette Hebd.' Pisa. Male, age not stated	Reduction of dislocation of the hip. Reduction effected	An apparatus (which mixed air with the chloroform). Complete anaesthesia. A few minutes	Pulse ceased; became pale; the respiration continued, but slow and irregular. Friction, ammonia, artificial respiration; the arms were raised, and some pulsations were again felt. He appeared to answer questions, but then fell back again into a state of syncope.
48	— 1854. MM. Vattelle. Perrin, and Lallemand. Hôtel Dieu, Lyons. Male, æt. 13	For cleft palate. During the operation	A compress, held two centimètres in front of mouth. Fully under	The pulse ceased; there was a strange expression of face. With artificial respiration and cautery there were two or three efforts at respiration.
49	July 13, 1854. 'Medical Times.' Middlesex Hospital. Labourer, æt. 65	Amputation in the thigh. Not commenced	Snow's inhaler. Three drams. Stage of excitement. Fourteen minutes	Pulse, which was full and steady, gave a few rapid, irregular beats, and then ceased; respiration ceased simultaneously; face became pallid and death-like. Artificial respiration was followed by a slight effort at inspiration.



No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which death occurred, and time.	Mode of death.
50	Oct. 11, 1854. 'Medical Times.' University Hospital. Shoemaker, æt. 39	Introduction of catheter. During operation	Lint. Quantity not stated. Fully under. Time not stated	Began to snore; then a long interval; the breathing became feeble, and was ceasing; artificial respiration then used, and after a few minutes it recovered, but again ceased. The pulse had continued to beat some little time after these symptoms and after cessation of respiration. Pulse suddenly ceased in femoral; then several respirations, which ceased, but were renewed slightly with artificial respiration.
51	Dec. 5, 1854. 'Med. Times and Gazette.' Guy's Hospital. Female, æt. 56	Amputation of leg. commenced	Lint, in oil silk. Two drams. Fully under. About three minutes	Pulse suddenly ceased in femoral; then several respirations, which ceased, but were renewed slightly with artificial respiration.
52	April 10, 1855. 'Med. Times and Gaz.' Ophthalmic Hospital. Male, æt. 40	Excision of eyeball. commenced	Dr. Snow's inhaler. Stage of excitement	Respiration became feeble and sighing. With artificial respiration there was occasional breathing, but this presently ceased. Pulse, when felt for after spasm subsided, was absent.
53	Sept. 8, 1855. Dr. Snow. London. Female, æt. 29	For relief of facial neuralgia	An inhaler. Half dram. Not fully under	Having inhaled twenty minims, she begged for more; began to inhale eagerly; gave a sudden start, as if taken in some kind of fit. No further sign of life.
54	— 1855. 'Edinb. Med. Journ.' Edinburgh. Female, æt. 36	Not stated. (Tooth extracted?) Not commenced	Handkerchief. About a dram and a half. Quite conscious. About a minute	Spoke, and said, "I am not over yet;" and immediately, while yet speaking, she gave a convulsive start, and, with a stertorous inspiration and with the eyes and mouth open, sank to the floor. Artificial respiration was employed, and after a short time there were a few spontaneous inspirations, and it is said the pulse could be perceived at the wrist.
55	Oct., 1856. 'Med. Times and Gaz.' St. Thomas's Hospital. A sailor, æt. 30	Removal of necrosed bone from finger. Not commenced	Sponge in lint. Not fully under. Time not stated	Raised hands, and trembled; kept spitting at the lint; appeared as if about to vomit. Suddenly he was violently convulsed, as if in an epileptic fit. The chloroform was at once discontinued, and he was laid in a semi-horizontal posture. The convulsion lasted only a few seconds; he began to breathe with effort, and to gasp irregularly. His pulse was almost imperceptible, and intermittent. With artificial respiration he rallied, and breathed without assistance. In a few seconds he relapsed, and could not be recovered.



56	Feb. 28, 1856. 'Med. Times and Gaz.' London. Male, æt. 9	Excision of scapula. commenced	Not	First an inhaler; then lint. Under influence. A few minutes	After making one long, deep inspiration (from lint), appeared to pass into a deep sleep. A few seconds later pulse began to beat very quickly, then ceased for two or three seconds, then beat rapidly several times and ceased. He continued to breathe for at least a minute longer. Respiration was ceasing, but continued, with cold water, &c., for two or three minutes. Brandy poured into mouth passed into œsophagus, but no effort to swallow. Artificial respiration produced some efforts at inspiration; but he did not rally.
57	April 5, 1857. 'Lancet.' Liverpool Infirmary. A labourer, æt. 35	Amputation of the thigh. Not commenced		Lint. Not a large quantity. Fully under. A few minutes (ten minutes from the time on table till death, but had inhaled in the ward three or four minutes before)	On raising eyelid it remained retracted; eyes slightly turned up. No pulsation in temporal or wrist. The respirations had almost ceased. With cold water, &c., respiration became better; in about two minutes a pulse was felt at the wrist. This continued, with good respiration, two or three minutes. The pulse then failed, and then the respirations. Artificial respiration produced no effect.
58	Aug. 7, 1857. 'Med. Times and Gaz.' Female, æt. 17	Application of nitric acid to sores. Completed		Snow's inhaler. One dram. Fully under. A few minutes	The operation being completed, moved as though recovering, and was left. A few minutes later, being noticed to be pale, was found pulseless and dead. Artificial respiration produced no effect.
59	March 13, 1858. 'Brit. Med. Journal,' p. 207. Reported by Mr. Prichard. Bristol Infirmary. Wm. Howell, æt. 49	Excision of elbow-joint. Operation not commenced		A hollow sponge. About one dram of chloroform used. Not under influence. About two minutes	Gasping respiration followed by "slow convulsive movement of limbs." The pupils became dilated and the pulse stopped.
60	April 17, 1858. 'Med. Times,' p. 415. Toronto. Male, age not stated	Extraction of teeth		No particulars	"Died suddenly."
61	May 1, 1858. 'Med. Times,' p. 457. Bonn. Male, æt. 23 (intemperate)	Plastic operation on forehead. Not commenced		Mode of inhalation not stated. Six drams of chloroform used. Not fully under its influence	Great excitement, with tossing about of limbs, followed by sudden collapse.



No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which death occurred, and time.	Mode of death.
62	June 26, 1858. 'Lancet,' vol. i, p. 630. Hôpital de Gros Caillou, Paris. Grenadier, æt. 45. Under the care of M. Ceccaldi	Castration for tuberculous disease of testis. Operation not commenced	Charpie in a fold of linen. Quantity not stated. Incomplete anæsthesia. Two to three minutes	Fresh chloroform was added, when patient suddenly sprang up, struggling to recover breath, and fell back, with strong expiration, motionless.
63	July 10, 1858. 'Med. Times,' p. 41. Reported in 'Macleod's Med. Surg. History of the Crimean War,' vol. ii, pp. 268-9. Case of Martin Hennessey, æt. 32. Crimea; 62nd Regt. (Occurred in August, 1855)	Removal of finger. Not commenced	A fold of lint. About two drams of chloroform used, given in 30-minute doses. Anæsthesia nearly complete	The chloroform caused a little cough at first, which soon ceased, and the stage of excitement set in. When nearly insensible he did not breathe freely, and there was spasmodic action of the larynx, as if from repeated swallowing of saliva. Chloroform was removed, and respiration had entirely ceased. No pulse could be felt. Artificial respiration and other means produced no effect. The heart's action continued for some time after the breathing and pulse had failed. P.M.—Frothy mucus throughout air-passages. Lungs healthy. Heart-substance healthy and firm; a little fat on external surface of left ventricle; valves natural. The chloroform was examined by Professor MacLagan, of Edinburgh. It was decomposed, evolved chlorine copiously, and had acid reaction from development of hydrochloric acid. "This chloroform was totally unfit for use, and it was acrid and nauseous when inhaled. "This chloroform was totally unfit for use. . . . No one could inhale the stuff you sent me without having cough and bronchial irritation, probably spasm of the glottis, caused by it."
64	Sept. 11, 1858. 'Brit. Med. Journ.,' p. 780. Towcester. Reported by Mr. Watkins. Case of William Rush, æt. 11	To examine an injury of the foot, of some weeks' standing	Cotton handkerchief. Amount not stated. Extreme insensibility. Ten minutes from the commencement of inhalation	The boy was much frightened, and breathed irregularly at first. Fresh chloroform was added, and after six or eight inspirations he became insensible. The handkerchief was given to the mother to hold, and the examination of the foot commenced. Stertor set in, and the chloroform was discontinued. Pulse became imperceptible, lips livid. Artificial respiration produced a few short inspiratory efforts. No return of pulse.



65	Sept. 18, 1858. 'Lancet,' vol. ii, pp. 261-314; and 'Brit. Med. Journal,' Sept. 4, p. 753. Epsom. Servant girl	Extraction of tooth. Completed	Administered by a druggist	"Seized with alarming symptoms." No further particulars.
66	Oct. 9, 1858. 'Med. Times,' vol. ii, p. 374. Ophthalmic Hospital, Moorfields. Male, æt. 8	Operation for strabismus. Commenced	Piece of lint. About 1½ dr. used at three applications. Incomplete anaesthesia	He flinched as the operation was commenced. More chloroform poured on lint. Face instantly became pale, and pulse ceased. Up till this had been quite regular, 80 per minute.
67	Oct. 16, 1858. 'Lancet,' vol. ii, pp. 410-457. Private case of Mr. Lawrence, at Barnes. Female, æt. about 45	Operation not mentioned	Handkerchief. Amount not stated. Ten minutes	No particulars.
68	Feb. 5, 1859. 'Med. Times,' vol. i, p. 142. Case of M. Richet, Hôpital St. Louis, Paris. Mechanic, æt. 43	For reduction of subcoracoid dislocation of shoulder. Reduction effected	Piece of linen rolled into cone. From 4-5 drams used. Anaesthesia. Chloroform had been removed, and remarks were being made by operator	Excitement followed the fresh application of chloroform, but soon passed off. Operation completed. Pulse and respiration regular; when pulse suddenly stopped; a few rapid, deep inspirations continued.
69	Feb. 26, 1859. 'Med. Times,' vol. i, p. 220; 'Lancet,' vol. i, p. 202, Feb. 19, 1859. Case of M. Marjolin, at Hôpital St. Eugénie, Paris. Female, æt. 7½	Forcible straightening of contracted hip-joint. Not commenced	Sponge. About a dram. Incomplete anaesthesia	Resisted when touched. On second attempt crying and struggling ceased; circulation had stopped; lungs continued to act for a few respirations.
70	June 4, 1859. 'Med. Times,' vol. i, p. 581. Mr. Critchett. Royal Oph. Hosp., Moorfields. Female, æt. 15	Operation for strabismus. Just commenced	Piece of folded linen. Quantity not stated. Complete insensibility	She gave a shriek, and became insensible. The operation was commenced. Face became livid; pulse could not be felt; slight inspiratory efforts at intervals for a long time, and movement of nostrils, for at least half an hour, after cessation of pulse.



No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which death occurred, and time.	Mode of death.
71	July 23, 1859. 'Med. Times,' vol. ii, p. 81. Mr. Holt's case. Westminster Hospital. Male, æt. 45	To make incisions for extravasation of urine. Completed	Inhaler. One dram and a half used. Anaesthesia	The addition of half a dram of chloroform produced insensibility, and inhaler removed. Face became pallid. Pulse fluttered, and ceased. Respiration continued for one to two minutes.
72	Aug. 20, 1859. 'Med. Times,' vol. ii, p. 194. Mr. Solly's case. St. Thomas's Hosp. Male, æt. 28 (R. W.), intemperate	Amputation of foot for an old injury. Not commenced	Inhaler. One dram used. Not under influence. (Had been fully so for an hour and a half for a previous operation)	When about half a dram had been taken pulse suddenly failed; face pallid. Inhaler removed. Gave a few gasps, passed urine, and died.
73	Oct. 22, 1859. 'Lancet,' vol. ii, p. 412. "Dreadnought" Hospital Ship. Reported by Mr. Bedford. Male, æt. 24	To apply nitric acid to syphilitic sores. Application commenced	Cone of lint covered with oiled silk. About two and a half drams given at intervals. Imperfect anaesthesia. Dead in twenty minutes	Resisted the application of the acid. Struggling suddenly ceased; face pallid; pulse and breathing stopped. Artificial respiration produced a few inspiratory efforts.
74	Nov. 19, 1859. 'Med. Times,' vol. ii, p. 503. London Hospital. J. P. (male), æt. 57 (very intemperate)	For delirium tremens, following a fracture of tibia and fibula involving the knee-joint	Piece of lint. About half a dram. Not under influence	After two or three inspirations the man "writhed," and fell back dead.
75	Dec. 3, 1859. 'Lancet,' vol. ii, p. 576. Hôpital de la Charité, Paris; under care of M. Manec. Female, æt. 50	To reduce a dislocation of the shoulder. Completed	"A simple compress." Chloroform given in small quantities, and at intervals. Complete insensibility	Reduction effected. Chloroform removed. Face became congested. Respiration failed, then stopped. Death-like pallor. No pulse. Artificial respiration and galvanism caused inspiratory efforts, but no return of pulse.
76	Jan. 7, 1860. 'Lancet,' vol. i, p. 20. Alloa, Scotland. Case of D. Renwick, æt. 27	Evulsion of ingrowing toenail. Operation completed	A towel, held by himself. Perfect anaesthesia. (Had frequently taken chloroform before)	Did not recover from chloroform. Pulse and respiration at first natural; gradually became less frequent, till they ceased, in spite of artificial respiration.



77	June 9, 1860. 'Brit. Med. Journ.,' p. 443. Doncaster. Female.	To relieve neuralgic pains	Administered by her daughter, aged 10, upon a cloth. In the habit of taking chloroform in this way, very frequently, and in enormous doses	The last dose given at nine o'clock; found dead at ten. Supposed to be asphyxiated. Had taken it twice to insensibility on the same day.
78	July 28, 1860. 'Med. Times,' vol. ii, p. 83. Liverpool Workhouse. Female, old. (Lunatic)	To allay excitement	Quantity not stated. Given on lint by the master of workhouse. Dead in eight to ten minutes. Had frequently taken chloroform before	Great excitement and struggling.
79	Sept. 15, 1860. 'Brit. Med. Journ.,' p. 731. Bellevue Hospital, New York. Case of Michael Lanahan, æt. 40	Circumcision for chancres beneath prepuce. Not commenced	A napkin. An ounce and a half, used in small quantities. About five minutes	After inhalation for about four minutes a sudden stertorous expiration caused discontinuance of chloroform, and after a few laboured respirations the breathing ceased.
80	Sept. 29, 1860. 'Lancet,' vol. ii, p. 309. Northampton Infirmary, under the care of Mr. Mash. Case of P. Carroll, male, æt. 42 (intemperate)	To remove a fatty tumour from the back. Operation not commenced	Piece of lint. Five and a half drams. Complete insensibility. Eight to ten minutes	Chloroform suspended, and was rolled on side to facilitate operation, when stertor set in, with great congestion of face. Respiration and pulse ceased. Artificial respiration produced some inspiratory efforts.
81	Dec. 22, 1860. 'Med. Times,' vol. ii, p. 618. Private case of M. Faus, in Paris. Male, æt. 26	Removal of toe-nail. Operation performed	Cone of paper containing charpie. Quantity not stated. Anæsthesia	At first much excitement, and fresh chloroform twice added. The operation ended, and chloroform removed. A moan was heard. Face pallid. Pulse ceased. Artificial respiration caused faint inspiratory attempts; no pulsation.
82	Summer, 1860. Notes from Mr. Ralfe. King's College Hospital, under the care of Mr. Henry Lee. Male, about 55 (very intemperate)	Perineal section for old stricture of urethra. Operation just commenced	Inhaler. About one dram. Complete anæsthesia	Took chloroform quietly; breathing natural. Face turned pale, and pulse ceased. A few faint inspiratory efforts afterwards. None followed artificial respiration.



No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which death occurred, and time.	Mode of death.
83	June 29, 1861. 'Med. Times,' vol. i, p. 683. Reported by Dr. Dobbie. J. C., male, æt. 31 (drunkard)	To induce sleep in an attack of delirium tremens	Handkerchief. Two to three drams. Not fully under influence	Much struggling and excitement at first. Half to one dram added. After several inspirations suddenly fell back; the breathing much embarrassed. The handkerchief at once removed, and artificial respiration practised. Three inspirations followed.
84	July 6, 1861. 'Med. Times,' vol. ii, p. 22, from 'L'Union Médicale,' No. 75. Mauritius. Male, æt. about 35	Extraction of tooth. Completed	On handkerchief, by himself. Quantity not stated. Not completely under influence. Death in five minutes after extraction	A sudden movement of the head at the moment of extraction, followed by great turgescence of face and convulsions. These increased in severity until death.
85	Sept. 28, 1861. 'Med. Times,' vol. ii, p. 321. Cumberland Infirmary. Reported by Mr. Devereux. T. C., male, æt. 35	Introduction of catheter for retention of urine. Commenced	Lint in shape of cone. Two drams. Anæsthesia complete	Insensibility being produced, chloroform removed. In two minutes face changed; lips livid; pupils dilated; one deep inspiration, and pulse ceased. Artificial respiration caused two or three spasmodic inspiratory efforts.
86	Sept. 28, 1861. 'Med. Times,' vol. ii, p. 321. Mr. Annandale's case. Newcastle Infirmary. Male, æt. 32	Amputation of thigh for scrofulous disease of knee-joint. Operation not commenced, the tourniquet being applied	"A simple fold of bandage." Two drams. Under influence of chloroform	At first greatly alarmed, but readily yielded to influence of chloroform, without excitement. A sudden relaxation of the sphincters took place. Pupils dilated. Pulse ceased. The respiration continued for a few seconds.
87	Nov. 9, 1861. 'Med. Times,' vol. ii, p. 490. Brighton. Reported by Mr. Nourse. Male, æt. 50 (apparently intemperate)	Removal of piles by écraseur. Not commenced	A hollow sponge. Two to three drams. Complete insensibility	Much excitement and struggling at first. Forty to fifty drops of chloroform added, and, soon after, stertor caused withdrawal of sponge. The stertorous breathing increased. Face livid, dusky. Pulse ceased. Respiration gradually failed. Artificial respiration caused a few faint inspiratory efforts.
88	Nov. 16, 1861. 'Med. Times,' vol. ii, p. 519. St. Mary's Hospital. Male, æt. 8	Plastic operation on face to relieve deformity from a burn. Operation half completed	Inhaler. Fully under influence of chloroform	The inhaler had been removed for fully two minutes, to allow the operation to proceed. Sudden pallor of face occurred, and the pulse stopped. Breathing continued for at least ten minutes—at first spontaneous; afterwards faint efforts from artificial respiration.



89	Dec., 1861. 'Brit. Med. Journ.,' vol. ii, p. 649. University College Hosp. Male (intoxicated). Mr. Erichsen's case	To reduce a fractured ankle"	No particulars	No particulars.
90	— 1861. 'Gazette des Hôpitaux,' p. 8; from Perrin and Lallemand's 'Traité d'Anesthésie chirurgicale,' p. 338, obs. lxxv. Near Bordeaux. Male, æt. 40	Amputation of leg for recent injury. Not commenced	No particulars	The patient was trembling, and extremely frightened. The chloroform was held a long distance from his face. After four inspirations the pulse and breathing suddenly ceased.
91	— 1862. London Hosp. Notes of case by Mr. Hutchinson. Male, under middle age	To reduce a dislocated humerus. Completed	No particulars. Under influence of chloroform	Took chloroform readily. Just as reduction was effected pulse stopped, and, after a few gasps, breathing also. Artificial respiration and galvanism produced no effect.
92	Jan. 12, 1862. 'Brit. Med. Journ.,' vol. i, p. 40. St. Mary's Hosp., under care of Mr. James Lane. Male, æt. 36	Forcible extension of contracted hip-joint. Not commenced	Inhaler. About a dram and a half. Not fully under influence	The man was highly nervous. One dram of chloroform being insufficient, half a dram more was added; and after a few inhalations the muscles became rigid, and he tried to raise himself in bed, when he suddenly fell back, the face became pale, and the pulse, which had been good up to this, stopped, the breathing became laboured, and shortly ceased. Artificial respiration of no avail.
93	Jan. 25, 1862. 'Lancet,' vol. i, p. 114. San José Hospital, Lisbon. Male, æt. 29. Occurred in 1859	Removal of cysts from eyelid. Not commenced	Piece of lint. About two drams. Not under influence	The inhalation caused great excitement, followed by collapse. The patient sneezed violently three times, and heart's action ceased. The breathing continued at intervals.
94	Feb. 22, 1862. 'Lancet,' vol. i, p. 204. General Hospital, Hobart Town. Reported by Mr. Turnley. Sailor, æt. 35	Castration for malignant disease. Operation not begun	"The usual way." Quantity not stated. Anæsthesia perfect. Four minutes	When insensibility set in the pulse became very feeble, and the chloroform was removed. In twenty seconds the heart stopped. Respired eight or ten times naturally. Artificial respiration ineffectual.



No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which death occurred, and time.	Mode of death.
95	May 17, 1862. 'Lancet,' vol. i, p. 534. London. Private case of Dr. Dieudonné. Male, æt. 33	Operation for fistula-in-ano. Not commenced	A piece of folded lint in a handkerchief. About one third of an ounce used. About ten minutes from commencement of inhalation	Was still quite sensible at the end of five minutes' inhalation. Soon after, he suddenly raised himself in bed, and the breathing ceased. No effect from artificial respiration.
96	June 28, 1862. 'Med. Times,' vol. i, p. 676. United Hospital, Bath. Female, æt. 40	Removal of tumour (cancerous) from lower jaw. Commenced	A napkin. About three drams in successive doses. Complete insensibility. Six or seven minutes	Anæsthesia complete in six minutes. The operation was commenced, and the third dram applied. Patient took one inspiration, and pulse stopped. The chloroform removed, and three or four gasps for breath followed.
97	Aug. 8, 1862. 'Med. Times,' vol. ii, p. 186. King's College Hospital, under care of Mr. Partidge. Female, æt. 17. Additional notes by Mr. W. F. Clarke	Plastic operation to close a large wound of labium, resulting from a sloughing ulcer. Completed	Inhaler. One dram and a half. Anæsthesia complete. About twenty minutes from commencing the inhalation	Was restless, and struggled much at first. After three or four minutes she suddenly became quiet and the breathing stertorous; lips and face pale; pulse stopped; heart's action imperceptible. She gasped at intervals for about fifteen minutes. Artificial respiration was employed.
98	Oct. 23, 1862. 'Med. Times,' vol. ii, p. 482. Painswick, Stroud, Gloucestershire. Mr. Curbitt's case. Male, æt. 23.	Amputation of thigh for old disease of knee-joint. Operation not begun	Inhaler. Quantity not stated. Insensibility	Some excitement produced at first, followed by a tranquil sleep. Was lifted from the bed to operating-table, when a sound as of vomiting was heard. Respiration and pulse ceased. Heart's action imperceptible. Laryngotomy and artificial respiration useless.
99	Oct., 1862. London Hospital, under the care of Mr. Adams. Male, æt. 23. Notes of case by Mr. Hutchinson. Patient very wasted and debili-	Amputation of the leg at the lower third, for disease of the bones of the foot. The limb was removed, and the arteries were being tied	Piece of lint. "A considerable quantity." Anæsthesia produced without anything unusual occurring	The man moved the limb slightly, and more chloroform was applied, when he suddenly became deathly pale, and his pulse ceased; "aspect like that of a corpse." The tongue drawn forward, and artificial respiration by compressing the chest kept up for half an hour. Efforts at inspiration occurred at intervals of from thirty seconds to a minute, for



<p>tated from disease, supposed to be phthisical</p>		<p>eight or ten minutes after the pulse had ceased—some of them of considerable force—so as to lead to a hope of a favorable issue; but no return of pulse or of colour to the face. Once or twice, with inspiration, a movement of the neck and right arm. Galvanism produced no effect beyond a quivering of the muscles. <i>P.M.</i> twenty hours after death. —Blood perfectly fluid, “like thin tar and water.” Heart flabby, moderately full, no coagulum, valves healthy, muscular substance natural both to the eye and under the microscope. Lungs contained more air than usual, everywhere crepitant; did not collapse much on opening chest. No tubercle anywhere. Liver and kidneys normal.</p>	<p>No particulars.</p>
<p>100</p>	<p>Nov., 1862. ‘Med. Times,’ vol. ii, p. 548. Bellevue Hospital, New York. Female, young</p>	<p>To examine an injury of the shoulder. Under examination</p>	<p>Mode of administration and quantity not stated. Incomplete anaesthesia</p>
<p>101</p>	<p>Dec., 1862. ‘Med. Times,’ vol. ii, p. 669. Guy’s Hospital, under the care of Mr. Bryant. Female, æt. 38</p>	<p>Plastic operation for vesico-vaginal fistula. Not commenced</p>	<p>Inhaler. Two and a half to three drams. Not fully under influence</p>
<p>102</p>	<p>April 8, 1863. London. Notes of case by Mr. J. H. P. Staples. Female, æt. 29, highly nervous and hysterical</p>	<p>Extraction of tooth. commenced</p>	<p>Handkerchief folded in a cone. About one dram used. Partially under influence. Less than four minutes</p>
			<p>Forty drops sprinkled on the handkerchief produced excitement after one and a half to two minutes’ inhalation. Twenty more were added, and the excitement passed away. Pulse good; breathing calm; eye sensitive to touch. Suddenly the head fell to one side, face became pallid, pupils dilated, pulse ceased; she gasped a few times convulsively. Artificial respiration and galvanism produced a few inspiratory efforts, but no return of pulse.</p>



No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which death occurred, and time.	Mode of death.
103	Sept. 23, 1863. London Hospital. Notes by Mr. Herbert Spencer. Male, æt. 42	Excision of the elbow-joint (following an injury a month previous). Operation not commenced	A piece of lint. Two drams of chloroform—the second dram applied four minutes after the first. Slightly under its influence	At first breathing regular and pulse somewhat quickened: about one minute after the second dram was applied the man struggled and tried to raise himself; the pulse suddenly failed, breathing continued for some minutes, and the lips remained florid. The tongue was immediately drawn forwards, artificial respiration and galvanism commenced, and continued for three quarters of an hour, but of no avail. P.M. examination.—Heart and right lung healthy; the left so infiltrated with tubercle as to render it almost useless for respiration.
104	Sept. 24, 1863. St. George's Hospital. Notes by Mr. Thomas Jones. Male, æt. 30; apparently a very healthy man	Operation for removal of necrosed portion of tibia. Commenced	Inhaler. About two drams. Complete anæsthesia. Death in six to seven minutes from commencing to inhale	Took the chloroform well; breathing regular and even, as also was the pulse. Operation commenced in five minutes; and a minute later the pulse, which was continuously watched, ceased instantaneously; the breathing continued unchanged for several seconds, when the face became pale, and the respirations lower, and soon stopped. Ammonia to nostrils, cold affusions, artificial respirations by compression of chest and by Silvester's method, galvanism to cardiac region and to needles passed into the heart, produced no result. P.M. twenty-three hours after death.—Brain dark, vessels congested, especially those of the cerebellum. Pericardium contained a quantity of turbid yellow serum. Heart; mark of one needle about an inch above the apex, the other an inch above this, both in left ventricle, which was partially contracted; right not so; valves healthy; slight fatty deposit amongst fibres of right ventricle, none on left side; to the eye the muscular tissue of the heart was perfectly healthy. Lungs healthy; slight congestion below and behind on both sides. Abdominal viscera normal, but rather congested. The blood was universally fluid.



105	Nov. 7, 1863. 'Lancet,' vol. ii, p. 547. Salis-bury, under the care of Dr. Blackmore. Female (young)	Operation for fistula-in-ano. Completed	A handkerchief. About four and a half drams used, administered by himself, no assistant present. Complete insensibility	The patient inhaled the chloroform readily, and was fully under its influence in six to seven minutes. Dr. Blackmore then removed the handkerchief, and commenced the operation, which lasted two or three minutes. She had not then revived; the breathing became gradually slower, and ceased in about three minutes. Cold affusion, ammonia, galvanism, and Marshall Hall's "ready method" for artificial respiration, proved useless. P.M. examination.—Chest contained much fat. Heart of a light yellow colour, fatty matter mixed with the healthy tissue, very flabby, walls of left ventricle abnormally thick, of right very thin. Lungs very small, engorged with blood, showing on section "the black patches which indicate death from chloroform." Liver very large, encroaching on the thoracic cavity, so as to interfere with the action of both heart and lungs. Was seated in a chair. In three or four minutes "the spasms which precede the loss of sensibility set in," when the pupils suddenly dilated, face became pallid and lips blue; no pulse could be felt. He breathed quietly for six or eight minutes, and then struggled violently. Had a sort of tetanic spasm; back curved, so as to rest on his head and heels. The chloroform was suspended during this excitement. Pulse regular, good. The inhaler was about to be reapplied, when the pulse in the temporal artery intermitted twice, and ceased. The body became ashy pale; patient gave three inspirations, each shorter than preceding, and breathing stopped; pupils natural. Cold affusion, ammonia to nostrils, artificial respiration by Silvester's method, and galvanism, were of no service. No heart-sounds could be heard. P.M. forty-eight hours after death.—Heart apparently healthy so far as muscular tissue was concerned; ruddy in colour; cavities dilated, and their walls thin. Lungs universally adherent; they contained some scattered tubercle and one small vomica. Liver large, pale, fatty. Kidneys natural.
106	Nov. 7, 1863. 'Lancet,' vol. ii, p. 547. Private case of Mr. Gay. Female, æt. 16	Operation for hare lip. Not commenced	An inhaler at first, afterwards a piece of lint	
107	May 16, 1863. King's College Hospital. Notes by Mr. W. Fairlie Clark. Male, æt. 28; not good health, intemperate. On Jan. 10, 1863, he had been operated on, under chloroform, for an exostosis of the femur, without any ill effects from its use	Operation for fistula-in-ano. Not commenced	Inhaler. One dram and a half. Partially under influence. Eight to ten minutes	



No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which death occurred, and time.	Mode of death.
108	Sept. 21. Male, æt. 22. Private case of Mr. H. C. Johnson, at the New Hummums, Covent Garden. He expressed no dread of chloroform to Mr. Johnson, but always had a great horror of it, and possessed an idea it would kill him	Operation for phimosis. Prepuce removed	Weiss's apparatus. Quantity not stated. Partially under influence	Was a little nervous; pulse good. In about four minutes face became slightly congested, and struggled to rise in bed. Chloroform suspended, and operation commenced. Face became dusky and lips blue. Cold affusion to face and compression of ribs caused a deep inspiration, but pulse could not be felt. Artificial respiration, and other measures, were tried; he breathed at intervals several times, but respirations became fainter, and at length ceased. No P.M. allowed.
109	Probably in 1855 or 1856. Letter from Dr. Recordon, of Lausanne, to Dr. Marcet; received Nov. 20, 1863. Male, æt. 14-15, the son of Dr. de la Harpe.	Extraction of a tooth	No particulars	The patient was seated; he had syncope, and died.



TABLE B.—*Imperfect Reports of Fatal Cases.*

No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which death occurred, and time.	Mode of death.
1	Sept. 18, 1858. 'Lancet,' vol. ii, p. 314. Dorking. Age and sex not given	Not stated	Apparently on a handkerchief	No particulars.
2	— 1858. 'Medical Times,' p. 534	Another death referred to by Dr. Robert Lee from chloroform administered during labour, said to have occurred at Edinburgh, in the practice of Dr. Matthew Duncan	...	No particulars.
3	April 9, 1859. 'Medical Times,' vol. i, p. 376. Paris, Hôpital de la Pitié. M. Maisonneuve's case. Male, æt. 60	Reduction of dislocated hip. Com- pleted	Mode of administration and quantity not given. "Never fairly under influence." Death in twenty minutes after the chloroform was removed	Very violent efforts necessary for re- duction, which was at length ac- complished, when symptoms of "cerebral congestion" set in.
4	Jan. 7, 1860. 'Lancet,' vol. i, p. 23. Liverpool. Male, age not stated	Suicidal	Purchased eight and a half ounces of chloroform. Appears to have poured it into a dish, and bent his head over it.	
5	April 21, 1860. 'Lancet,' vol. i, p. 412. Twickenham. Male, age not given	Supposed to be suicidal	A bottle containing a dram of chlo- roform was found on the table within reach of the body	The face and body were livid, cold, rigid. Bladder and rectum had voided their contents.



No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which death occurred, and time.	Mode of death.
6	May 4, 1861. 'Brit. Med. Journ.,' p. 477. Cincinnati, U.S. Male, age not given. Related in letter by Dr. Kidd	Operation for glaucoma. Appa- rently commenced	Not stated. Death in half an hour	Half an hour was occupied in administering chloroform, when vomiting set in, followed by a sudden fit and gasping for breath. The respiration ceased, but the pulse and heart "beat vigorously" for half an hour. Inhalation relieved the "spasm" (sic) of the glottis. The tube was readily inserted. Patient gave a gasps, and died. Artificial respi- ration ineffectual.
7	May 25, 1861. 'Brit. Med. Journ.,' vol. i, p. 549. Thornbury, Glou- cestershire. Reported by Dr. Davey. Male, æt. 7	Tracheotomy for laryngitis. Com- pleted	Not stated	
8	Dec. 14, 1861. 'Medical Times,' vol. ii, p. 625. Notting Hill Dis- pensary. Male, æt. 19	Probably suicidal	Was found with a cap containing a handkerchief placed over his face. The quantity used is not known, but about four drams had been taken from a bottle. Had fre- quently inhaled it before.	
9	— 1860. 'New Sydenham Society Year-Book of Medicine and Sur- gery' for 1860, p. 463; from 'Virchow,' vol. xvii, pp. 5, 6. Re- lated by Dr. Bückner. Male, æt. 40	To relieve the pain in passing gall- stones	Had suffered from the passage of gall-stones six to seven years, and to relieve the pain had taken morphia to the extent of twelve grains in the day, but had reduced it to about one grain and a half, and inhaled ether or chloroform during the paroxysms. Of ether he would use four to five pints, of chloroform from eight to thirty ounces, in a few days. He experienced relief, but subsequently resorted to laudanum. He had several attacks of mania, but was quite lucid in the intervals. "Dr. Bückner found him one morning in bed, breathing tranquilly, in the condition produced by long inhalation of chloroform." P.M. ex- amination showed the organs unaltered. Gall-stones in gall-bladder; one the size of a bullet in bile-duct.	



TABLE C.—Cases of Death which occurred some time after the use of Chloroform.

No.	Date. Authority. Place. Name. Sex. Age.	History. Symptoms. Treatment.	Post-mortem appearances.
1	April 27, 1852. Reported by Dr. Parker, of Sunderland. Male, æt. 16	Had suffered from symptoms of stone for twelve months; previously very healthy. There was great difficulty in inducing anæsthesia, owing to the boy being frightened at the "doctor's coming to take the stone away." Nearly three quarters of an hour elapsed before he was under the influence of chloroform. The lateral operation was performed, there was difficulty in removing the stone, which was small, of uric acid. He was never perfectly conscious after the operation; during the night constantly delirious; felt pain when abdomen was pressed fourteen hours after operation, and died at the end of twenty-eight hours.	No post-mortem examination.
2	Dec., 1862. Reported by Mr. Tatum. Female, æt. (about) 28. A slight, fair, nervous woman	This patient took chloroform for the removal of a small mammary tumour. The mode of administration is not stated. "A very moderate quantity" is said to have been given. The operation was performed on December 27th, at 3 p.m. She was very sick and faint afterwards, requiring the use of stimulants. During the night she was very restless, notwithstanding the exhibition of morphia. At 5 a.m. on the 28th violent vomiting of thin biliary matter again set in, and continued for several hours; it was at length checked by a dose (gr. iij) of calomel, which, however, was soon followed by purging. This went on until night, and produced depression to an extreme degree; stimulants failed to rally her. She continued in this exhausted condition, although highly restless, until the afternoon of the 29th, when she became unconscious, and died at 11 p.m., fifty-six hours after the operation. For several hours before death her pulse was quite imperceptible. The wound had healed by first intention.	No post-mortem record.



No.	Date. Authority. Place. Name. Sex. Age.	History. Symptoms. Treatment.	Post-mortem appearances.
3	April 15, 1863. Reported by Mr. Francis Lloyd. Female, æt. 52.	<p>Very stout and of plethoric habit, but extremely timid and nervous. Had been suffering from onychia of the left thumb for several weeks, but would not permit any incisions to be made. Under a fresh attack of inflammation she was persuaded to take chloroform for the purpose of operation. She was unusually long in yielding to the anæsthetic, and required a "more than ordinary proportion of chloroform vapour to atmospheric air;" she passed suddenly from a state of excitement to one of coma, which condition passed off in a minute or two, and nothing of an unusual character presented itself again, her pulse being better after conclusion of the operation than it was at the commencement. Rather less than one third of a grain of morphia was injected beneath the skin of the arm (she had taken about a grain in three doses during the night). The whole time from the first administration of chloroform until her return to consciousness was considerably under half an hour; she complained merely of feeling sick. She was left quite comfortable at half-past one. Until 3 p.m. she remained perfectly sensible, when she seemed to drop off to sleep, but soon after "began to breathe in a peculiar way." Her husband having examined her, and finding her pulse, as he thought, good, was satisfied, as he was accustomed to hear her breathe in this way when asleep. At 3.45 she was seen by her medical attendant, who was told that she was "sleeping nicely." He found her comatose, cheeks deep purple, lips livid, face cold, conjunctiva insensible, pupils contracted, not affected by light. Breathing stertorous, about three respirations in a minute; gurgling expiration; pulse 90, regular, small, and weak. Mustard poultices were applied to the epigastrium and calves of legs. Ammonia to nostrils and lips, followed by an enema of turpentine and coffee. Under this treatment the respirations increased to six or seven in a minute; the pulse, too, improved in volume and power, and the face grew less livid and dusky. Twelve leeches were also applied to the temples, but the slight improvement speedily gave way, the pulse became feeble, the respiration slower, till she sank gradually and died at 6 p.m., about five hours after the chloroform had been discontinued. Chloroform was administered to a healthy peasant for the removal of a tumour of the eyelid; an ounce and a half was given in half an hour, and produced only slight drowsiness. He remained well till six o'clock the next morning, and suddenly died about eighteen and a half hours after the chloroform inhalation.</p>	<p><i>Post-mortem examination</i>, twenty-four hours after death.—All the organs healthy. Coagulability of the blood slightly diminished.</p>
4	<p>— 1860. New Syd. Soc. 'Year-Book of Medicine and Surgery' for 1860, p. 462. From 'Oest. Zeit.' 1859, vol. v. Related by Dr. Linhart. Male, æt. 64</p>		



TABLE D.—*Accidents with Chloroform, not fatal.*

No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which ac- cident took place.	Symptoms. Treatment.
1	April 17, 1858. 'Med. Times,' p. 416. New York. Male, young	Amputation of thigh. Ligature of last ar- tery	No particulars. Chlo- roform very impure	Pulse and respiration suddenly stopped, countenance altered, and jaw dropped. Marshall Hall's "ready method" was persevered with for half an hour before there was any evidence of life; at end of forty-five minutes patient spoke.
2	June 28, 1858. 'Med. Times,' p. 662. New South Wales. Male	To examine the blad- der and prostate gland	...	In three or four minutes the breathing was much accelerated, and the chloro- form discontinued. The pulse ceased, and then the respiration. Heart sounds could not be heard. The "ready method" in two minutes caused signs of returning animation.
3	July 10, 1858. 'Med. Times,' p. 42. Paris, under care of Dr. Demarquay. Female, æt. 45	Removal of tumour from breast. Ope- ration nearly com- pleted	No particulars. Com- plete anæsthesia	More chloroform applied to prevent returning sensibility; pulse became weaker, and ceased; bleeding stopped, respiration suspended. Heart's action very imperfect. Face livid, then colourless; pupils dilated. Arti- ficial respiration, <i>bouche à bouche</i> ; in three minutes radial pulsation felt; in six or seven minutes complete recovery.
4	— 1858. 'Lancet,' vol. ii, p. 106. Paris	Reference to a case in which artificial respi- ration proved suc- cessful in Paris for an overdose of chlo- roform.		



No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which ac- cident took place.	Symptoms. Treatment.
5	Nov. 6, 1858. 'Med. Times,' p. 481. Re- ported by Mr. Chas. Hunter. Female, æt. 18. Had frequently taken chloroform for the same affection, even two or three times a day	To relieve neuralgia of eyeball	Snow's inhaler	In one to one and a half minutes the patient moaned, and respiration ceased; pulse continued steady; shaking and cold affusion instantly employed. Pulse commenced to fail. Artificial respiration by compression, then the "ready method," which brought on inspiratory efforts, but it had to be persevered with for three hours. Mr. Hunter considers it a case of "secondary apnoea," due to a prolonged administration of chloroform ten hours before.
6	Jan. 1, 1859. 'Med. Times,' p. 9. Female, æt. 6. Had taken chloroform to insen- sibility three times before	Excision of knee-joint	Anæsthesia	Insensibility passing away, more chloroform given. Pulse became feeble, and in a minute ceased to beat; the breathing also stopped. The tongue drawn forward, and artificial respiration by compression tried, but for fifteen minutes no pulse or positive sign of life. An enema with brandy given. The pulse then became perceptible, but very faint and flickering; in ten minutes it improved a little, and then gasping took place. Ammonia applied to the nostrils caused a scream and sudden inspiration. Artificial respiration kept up for more than half an hour.
7	Mar. 12, 1859. 'Med. Times,' p. 271. Ber- lin, under the care of Professor Langen- beck. Male, æt. 58	Removal of tumour from back	Less than two drams used. Imperfectly under influence	Patient became restless. Face congested, breathing laboured; cold affusion and compression of thorax. Pulse regular, good; respiration became feeble, and ceased. The pulse stopped two minutes after the breathing. Insufflation through a catheter passed down the larynx of no service. Tracheotomy performed, and air blown into lungs through an elastic catheter. After six or eight inspirations by this means the pulse returned. Very weak and irregular, and again disappeared. As artificial respiration was persevered with, the pulse again returned and increased in strength and regularity. Cold water, friction, and galvanism also tried, but for an hour and a half life hung in the balance; then a paroxysm of coughing took place, expelling a quantity of bloody mucus. Unconsciousness, with dilatation of the pupils, continued, and it was not till after a long sleep that sensibility returned.



8	— 1860. 'Medical Times,' vol. i, p. 196. France. Male, at. 4	Removal of tumour from eyelid. Not commenced	A sponge. One dram used	In less than two minutes the pulse became feeble; inspiration short, rattling; face livid, limbs relaxed. Cold affusion, and ammonia to nostrils, mucus wiped from epiglottis with a sponge; friction of thorax. These tried for two or three minutes, when pulse ceased; pupils dilated; jaw dropped. Compressions of abdomen used for three minutes, when one conductor of Du-bois-Raymond's induction apparatus was placed on the course of the phrenic nerve, the other on the seventh intercostal space, and alternated from side to side; this produced a sob, and on discontinuing the process there was a spontaneous inspiration; the pulse also returned. Compressions of abdomen was again resorted to, and continued for twenty minutes, when recovery was complete. Any cessation of the compressions caused enfeebled pulse and respiratory efforts.
9	— 1860. 'Brit. Medical Journal,' p. 731. From 'American Medical Times.' America. Male, in a state of intoxication	Dislocation of femur. Reduction accomplished	A handkerchief	Attempts to reduce the dislocation without chloroform having failed, he was left for an hour to become sober. In five minutes after commencing to inhale, the respiration became slow, laboured, stertorous; the pulse flagged, skin livid, "patient apparently asphyxiated." The chest and buttocks were flapped with a towel, and cold affusion was applied from a height on the centre of the chest. In two or three minutes a deep inspiration took place. Chest then compressed. Perfect recovery in half an hour.
10	— 1860. 'Lancet,' vol. ii, p. 429. Manchester Workhouse and Hospital. Female, at. 23	Amputation of the thigh for old disease of knee-joint. Not commenced	Piece of lint. Two drams of chloroform. Anaesthesia	Inhaled chloroform quietly. In two or three minutes was insensible, with slow, steady pulse, and natural respiration. Suddenly the pulse and breathing ceased. Cold affusion and compressions of thorax applied; in two minutes there were feeble inspiratory efforts, which ceased when the compressions were discontinued. Tracheotomy was performed, and inflation of lungs by a catheter through the opening. Soon natural respiration commenced, and in an hour and a half she was removed to bed. In twenty days from this, chloroform was administered with an inhaler, when she took six drams. She died forty-seven days after the operation, of hæmorrhage. <i>P.M.</i> examination.—Surface of ventricles fatty, walls thin, valves natural; kidneys disorganized. The microscope showed advanced fatty degeneration of the heart and kidneys. This patient was extremely debilitated, and sucking a child nine months old.



No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which ac- cident took place.	Symptoms. Treatment.
11	— 1860. Reported by Dr. Hillier. Fe- male, æt. 50. Pri- vate case of Mr. Quain	Removal of breast for cancerous disease. Not commenced	Inhaler. Insensibility not complete	In five minutes the conjunctiva was still sensitive, and pupil contracted; slight cough occasionally. A profuse perspiration broke out; the pulse failed, and, with the breathing, ceased. The pupils were "contracted to a pin's point;" face pale, lifeless. Cold affusion and compression of chest resorted to, when in about a minute the pulse could be felt fluttering, and soon began to improve. A gasp was given, and pulse rose at once, becoming regular, but weak. The operation was then performed, followed by faintness and vomiting.
12	— 1861. 'Medical Times,' vol. ii, p. 540. Reading Hospital. Male, æt. 14	Operation for necrosis of tibia. Commenced	Anæsthesia	Was very timid, and struggled much at first. During the operation com- menced again to struggle. Stertorous breathing set in, and the heart's action ceased; lips blanched; limbs flaccid. Artificial respiration, by Sylvester's method, was tried, with cold water to face and chest. In two or three minutes he gasped faintly. Galvanism was applied, and imme- diately excited the heart's action.
13	— 1861. 'Brit. Med. Journ.,' vol. ii, p. 594. Salford In- firmmary. Male, æt. 54	To pass a catheter in a case of stric- ture. Not com- menced	Nearly under in- fluence	The respiration became rapid, eyes assumed suddenly a corpse-like appearance. Pulse and breathing ceased. Tongue drawn forward. Artificial respiration by compression, cold water affusion induced several vigorous inspirations, and the pulse returned. The alarming symptoms lasted three minutes.
14	— 1862. 'Brit. Med. Journ.,' vol. ii, p. 237. Norwich. Reported by Dr. E. Copeman. Male, young	To sound for calculus	Not fully under in- fluence	Did not take chloroform readily. He breathed with stertor for a few seconds, and then respiration ceased. Tongue pulled forwards by means of a hook, and air was heard to rush into the now open glottis. Compressions of abdomen resorted to. Respiration and heart's action recovered.
15	— 1862. 'Lancet,' vol. ii, p. 533. Guy's Hospital, under the care of Mr. Cock. Male, æt. 32	Removal of bulbous end of nerve from painful stump of arm. Operation com- menced	Insensibility	Face suddenly became pale, pulse and breathing stopped. Cold affusion; tongue drawn forward; compressions of chest. In two or three minutes there was a sigh, and the pulse could be felt; in three or four minutes more, colour returned to cheeks, circulation and respiration were recovered.



16	Reported by Mr. Hine, of Nottingham. No date. Female, æt. 9	Removal of necrosed bone from femur. Commenced	Under influence	In thirty-five minutes face grew pale; pulse small, feeble, and fluttering; respiration slow and indistinct; surface of body cold, with relaxation of the sphincters. Exposure to cold current of air, warmth by heated flannels, administration of brandy and diluted liquor ammonia. She gradually, but slowly, recovered.
17	No date. Reported by Mr. Hine, of Nottingham. Male, æt. 64	Excision of a cancerous tumour from the axilla. Commenced	Complete anæsthesia	Had inhaled for ten minutes, when breathing grew stertorous, face congested. Pupils rather dilated, pulse labouring and slow. These symptoms became more marked, and respiration seemed on the point of ceasing, when he was exposed to a current of air, and cold affusion employed. Gradually the danger passed away, but he continued quite insensible until operation was completed.
18	Nov. 22, 1863. St. George's Hospital. Reported by Mr. T. Jones, under the care of Mr. Holmes. Female (child). Had taken chloroform previously two months before	To examine a diseased elbow-joint	Inhaler. Two drams used. Anæsthesia in six minutes	After being insensible for about five minutes pulse became quick, then slow, and afterwards imperceptible; the breathing also ceased. Tongue drawn forwards; compressions of thorax resorted to; face became intensely livid. In two or three minutes spontaneous inspiratory efforts. Recovered in about ten minutes
19	No date. Reported by Dr. Skinner, of Liverpool. Female, æt. 30	To relieve neuralgia of face	Napkin. Two or three drams. Had been under influence twenty minutes	Face changed to a pallid hue; eyes dull and glazed; jaw dropped. Respiration and pulse ceased. Heart sounds inaudible. Exposed to current of cold air. Tongue drawn forward, and in doing so a set of artificial teeth were found loose in the fauces, and removed. Artificial respiration by compressing thorax. In ten minutes there was a spontaneous effort at inspiration, and in ten minutes more had quite recovered.
20	No date. Reported by Dr. Parker, of Sunderland. Female, æt. 45	Removal of mamma for scirrhus disease. Completed	...	She was in the sitting posture. After having inhaled for one minute, the chloroform maintained a "strong influence" from 2 p.m. to 4 a.m. Fourteen hours after operation she suffered from syncope, the pulse being very irregular. She eventually recovered.



No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which ac- cident took place.	Symptoms. Treatment.
21	— 1852. Middle- sex Hospital, under the care of Mr. Arnott. Reported by Mr. Sibley. Male	Strangulated hernia. Not commenced	Piece of lint in a handkerchief. About two drams, in three doses, were used. Under the influence	<p>About forty minims were first given, with no effect beyond a slight spasm of the limbs, and a rise of pulse from 70 to 90. Thirty drops were added, but he still remained conscious at the end of three or four minutes, when forty minims were again added. In about half a minute the spasm relaxed. Pupils dilated; pulse 80, steady, full; slight stertor, and the chloroform was removed. The respiration became noiseless, slight, and in twenty seconds altogether ceased. The pulse intermitting. Cold water and a wet towel produced no effect, and the pulse ceased. Mouth to mouth insufflation, with pressure on the chest, produced a slight respiratory effort after about twenty inflations, and the pulse could be felt as a thread after seven or eight. Vomiting occurred, and respiration failed, but was restored by the same means, the pulse being weak, but steady. Soon vomiting again set in and the breathing gave way, but was reintroduced by artificial respiration as above. Consciousness returned after a short time. He remained very drowsy, but was not allowed to sleep, as when he dozed the respiration diminished and the pulse faltered. He gradually recovered.</p>
22	Oct., 1863. Middle- sex Hospital, under the care of Mr. De Morgan. Communi- cated by Mr. Sibley. Female, æt. 39	Removal of breast for scirrhus Completed	Snow's inhaler. About three drams used, in two-dram and one- dram doses. Perfect anæsthesia	<p>After five minutes' inhalation she vomited some mucus, and the chloroform was temporarily discontinued, but at the end of fifteen minutes from its commencement she was completely under its influence, with muscles relaxed; pulse 80 (it had risen to 144); breathing easy, with slight stertor. Chloroform discontinued, and operation commenced. After four minutes sensibility was returning, and inhaler reapplied with another dram of chloroform; this soon produced its effect, and was again removed. The respiration now became more and more feeble, so as to be scarcely perceptible in three or four minutes, and pulse irregular. Operation was now completed. Respiration improved slightly, but they shortly again failed, and there commencing to inhale) the face was livid, hardly any respiration, and the pulse scarcely to be felt; the tongue was not retracted. Cold douche applied, and ammonia to the nostrils. In about a minute galvanism was employed; a few applications caused a deep inspiration, and in a few minutes breathing was fully restored. Galvanism was continued for a short time, and consciousness returned. She had no relapse, and recovered without a bad symptom.</p>



23	<p>— 1860. New Syd. Society 'Year Book of Medicine and Surgery' for 1860, p. 463. From 'Virchow,' vol. xvi, pp. 5, 6. Related by Dr. Friedberg. Child, æt. 4</p>	Removal of encysted tumour from eyelid	No particulars	<p>Irritation of skin and compressions of abdomen produced no result. One conductor of Dubois-Reymond's induction apparatus applied over phrenic nerve at outer border of sterno-mastoid muscle, the other at seventh intercostal space on right and left sides alternately. This caused deep inspiration, with arching of the belly from contraction of the diaphragm; when interrupted, by way of experiment, there was a weak spontaneous inspiration. At the third application the countenance reddened, and the radial pulse became perceptible. When the induction stream was discontinued the pulse and respiration were much weaker, but were kept up by compression of abdomen, frictions, cold affusion, and ammonia at the nostrils. In twenty minutes the pulse and respiration were completely restored.</p>
24	<p>Jan. 16, 1864. 'Brit. Med. Journ.,' p. 63. Stamford. Related by Dr. Newman. Male</p>	Suicidal	<p>Did not know how much or how long he had inhaled chloroform. Did not swallow any</p>	<p>At 1.45 p.m. was found lying on a bed, partially undressed, with his face pressed in the pillow, congested, almost black; eyelids closed, pupils dilated, fixed; skin dark, moist with cold sweat; respirations six to eight per minute, irregular in force and rhythm; pulse 52, very feeble, regular. Breath smelt of chloroform. Cold affusion and friction of chest produced no effect. Artificial respiration by Sylvester's method did not increase the respirations. At 2 p.m. the stomach-pump removed a little glairy fluid. Water was injected and withdrawn; it smelt faintly, but distinctly, of chloroform (he declared afterwards that he had not swallowed any). At 2.5 p.m. galvanism—by Kemp's apparatus, of Edinburgh—was applied, one sponge over phrenic nerve at lower part of sterno-mastoid muscle, the other to the scrobiculus cordis, and occasionally rubbed over the chest. After several minutes the muscles were thrown into action. 2.15.—Respirations twelve per minute; pulse 65, stronger; heart's action not more evident; face less dark; no sensation. 2.40.—Face not so congested; respirations fifteen, deeper and more prolonged; pulse better, 65; pupils act from stimulus of light and remain more contracted, insensible to everything except he moved a little with the change of position of the sponge. 3.15.—Suddenly objected violently to the galvanism, and raised himself up in bed; recovered.</p>



No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler used. Amount of chloroform. Stage of exhibition at which ac- cident took place.	Symptoms. Treatment.
25	May, 1848. 'Med.- Chir. Trans.,' vol. xxxiv, p. 43. St. George's Hospital. Related by Mr. Pres- cott Hewitt. Male, æt. 35	Excision of upper jaw for tumour. Six years' duration. Completed	Dr. Snow gave chlo- roform with inhaler, and afterwards on a sponge	Patient was seated in a chair, and when the operation was nearly completed became faint, but rallied, and the operation was completed. His pulse again failed. He was laid on the bed and "different restorative means" used. He recovered from the faintness a little, but his breathing became difficult. Laryngotomy was performed, and frothy blood escaped from the opening, but the patient soon died. At the P.M. examination the trachea and bronchial tubes, even to their minute ramifications, were found to contain a quantity of frothy blood. To this report is appended a letter from Mr. Snow, which contains the following paragraph:—"He seemed a good deal embarrassed with blood flowing into the throat, and leaned forward to get rid of it. I thought once he vomited some. When he became faint he was but little under the influence of chloroform, and no more was given. When taken from the operating-theatre there was no difficulty of breathing, and the influence of the chloroform had left him."



TABLE E.—Cases where the Persons habitually inhaled immense doses of Chloroform.

No.	Date. Authority. Place. Name. Sex. Age.	History.
1	Nov. 21, 1857. 'Med. Times,' p. 533. Re- ported by Dr. De Mérie. Male, æt. 30. Copied from 'L'Union Médi- cale,' Nos. 106 and 112	<p>This patient became so accustomed to the use of morphia that it failed to produce sleep, and he commenced to inhale chloroform to relieve the excessive restlessness from which he constantly suffered. He became addicted to its use, and continued it for three years, passing his nights and, at last, a portion of the day also under its influence. His countenance became altered, manners strange, and his "moral disposition impaired." For a time he was induced to restrain this habit, but he gradually returned to it, and indulged in the use of the drug for, it is supposed, about five years. He remained in bed till twelve or one o'clock, repeating the inhalations whenever he awoke. His appearance was that of a man given to drink. He used a pound of chloroform in five or six days; it caused no headache or uneasiness. On August 8th, having purchased some of the anæsthetic, and being probably under its influence, he fell from a railway carriage and broke both his legs. Double amputation was performed under chloroform, which readily produced insensibility. Morphia was given after the operation to relieve pain, but without effect, and at his urgent entreaties he was allowed to inhale chloroform, under the superintendence of a dresser, constantly, at short intervals. He died forty-two hours after the operation, completely exhausted. No autopsy was allowed. Decomposition of the body proceeded with "frightful rapidity."</p>
2	— 1857. 'Med. Times,' Nov. 21, p. 533. Reported by M. Vigla, in the 'Moniteur des Hôpitaux,' for 1855, and copied from 'L'Union Médicale,' Nos. 106 and 112. Male, æt. 33	<p>This man commenced to suffer from spasmodic asthma, for which he could obtain no relief until April, 1855, when his medical man advised him to try chloroform inhalations. This was successful, and he continued the inhalations of his own accord until he took enormous doses. Between May 1st and 10th he used fifty-two and a half drams. Jaundice now set in, and he diminished the amount during four days, but the paroxysms became so insupportable that on the 18th he used 112½ drams. At the beginning of June jaundice recurred, and he discontinued the anæsthetic, but the attacks of asthma increased and he renewed it, taking <i>daily</i> about forty drams of chloroform from the 4th to the 25th of June, when he entered a Maison de Santé. These large doses only slightly relieved him; he obtained but little sleep, although in a constant state of dulness, from which the paroxysms scarcely roused him. On admission his countenance was peculiar, eyes brilliant and moistened, expanded features, and smiling, having the appearance of a person "ravished with delight," or slightly intoxicated. Small quantities of chloroform were given him for two or three days, but delirium tremens set in and it was discontinued. The delirium lasted from June 27th to July 4th; his delusion for a part of the time was that he was in danger of poisoning from chloroform. On July 4th his breath still smelt of the drug, although he had not taken any since June 27th. His attacks of asthma ceased, and he left on August 8th.</p>



TABLE F.—*Cases of Death from Swallowing Chloroform.*

No.	Date. Authority. Place. Name. Sex. Age.	History. Symptoms. Treatment.	Post-mortem appearance
1	Nov. 21, 1857. 'Med. Times,' p. 533. France. Related by M. Chereau. Male	<p>Had long taken ether by inhalation to relieve neuralgic pains. Heavy losses affected his mind, and he purchased (it was afterwards ascertained) thirty-seven and a half drams of chloroform, with which he went to a hotel. Not being seen for twenty-four hours, the door of his room was forced, as a moaning was heard. He was lying on his back; face cadaverous; slow, regular respirations at intervals, with short gasps between; subsultus of muscles; pupils widely dilated, insensible; widely opened mouth, tongue dry like parchment; jugular veins distended; hands clenched; livid stains on body and limbs, resembling those on corpses, or as in persons asphyxiated with carbonic acid gas; heart still beating, but scarcely perceptible; pulse felt with difficulty; bladder distended, urine dribbling away. Current of cold air introduced; friction with hot cloths; mouth to mouth insufflation; strong coffee. After an hour patient could be roused to answer by repeated calling, but incoherently. At end of second hour still quite stupid and drunken, but looked about him. Pulse 50. Became restless; thirst excessive, violent pain in hypochondrium. Smell of chloroform with each expiration. He became conscious, and conversed rationally just before death, which soon occurred.</p>	
2	April 30, 1859. 'Brit. Med. Journ.,' p. 354. London. Male, æt. 42	<p>Left the room frequently at intervals, joined in the general conversation on his return, and appeared to be quite sober; suddenly uttered some incoherent remarks, sank back on the sofa upon which he was sitting, became insensible, and snored loudly. Pulse was scarcely perceptible; eyes dim and fixed, pupils contracted; face pale and livid; sweat-drops on forehead; breathing much embarrassed, entirely abdominal. Odour of chloroform with each expiration; this was at 7 p.m. Cold water dashed on chest and face. Ammonia occasionally to nostrils and galvanism were applied up to 1 a.m., when he was sleeping as if</p>	<p>Forty-four hours after death.—Very slight rigor mortis. Blood quite fluid. Cavities of heart engorged. Muscular substance pale and flabby, especially on left side. Lungs crepitant, congested at bases. Stomach contained half a pint of brownish fluid similar to</p>



that vomited, which smelt strongly of chloroform. Mucous membrane studded with red patches of congestion, the rugæ of fundus quite black. Lower part of œsophagus intensely reddened. Small intestine everywhere showed dark red spots; valvulæ conniventes looked like black bars across the bowel. Large intestine natural. Four pints of fluid (like that described above) in the bowel. Brain natural. Liver and kidneys large, pale yellow, from interstitial deposit.

*P.M.* examination forty hours after death.—The skin of a yellowish-green colour, with much congestion of the depending parts. Abdomen tympanitic. Liver pale and finely mottled. Stomach with well-marked hour-glass contraction; surface much congested. On opening it the internal coat was highly inflamed, the rugæ larger than usual, and pulpy. For about two inches round the œsophageal opening the mucous and muscular coats were entirely eroded, the peritoneum alone remaining; around this erosion the tissues were extremely vascular. A similar change had occurred about the pylorus.

under influence of alcohol, breathing heavily. At 9 a.m. an emetic was given of sulphate of zinc, followed by mustard and water. In about an hour and a half he vomited upwards of half a gallon of brownish blood and mucus, having a strong smell of chloroform, followed by copious purging of the same fluid. At 11 a.m. he was put to bed. Ammonia administered internally, friction with hot flannels, hot-water bottles to surface, and galvanism occasionally during the day, but the pulse gradually became imperceptible; respirations more feeble (abdominal), at long intervals, with puffing of lips; pupils widely dilated; surface livid and cold, until 8 p.m., when he died. At first there were occasional gleams of consciousness. At least five ounces of chloroform had been swallowed. He had been in the habit of taking alcohol, opium, and camphor, immoderately

On October 27th, 1858, found the patient, a female, in bed, lying on her right side; head dropped on the chest, countenance pale and death-like, mouth open; eyelids half closed, with the eyeballs rolled upwards, pupils slightly contracted, and just responded to the stimulus of light. Pulse 84, moderately full. The breathing abdominal, without stertor. Surface of body and extremities warm, but quite insensible. Some thin fluid of a yellowish colour had run from the mouth. In the room was a three-ounce phial, marked "Chloroform," with about half a dram remaining in it. The stomach-pump was used directly to inject about a pint of warm water, which was returned immediately, tinged with bile. Sinapisms were applied to the neck, chest, and feet. She continued insensible and motionless for several hours, except at intervals of about a quarter of an hour, when the angles of the mouth were drawn, with convulsive movements of the throat, and vomiting occurred with difficulty; the respiration also ceased for about thirty seconds, the lips and face becoming turgid and blue. This was succeeded by a long stertorous inspiration, and the breathing went on regularly again. The intervals of these attacks became gradually longer until about 1 p.m., when irritation of the conjunctiva caused her to move her hands and lips slightly. The pulse had risen to 100. At 3 p.m. she was more sensible. Pulse 100. The forearms and hands livid, rather cold; feet warm; she had

— 1859. 'Lancet,'  
vol. i, p. 400. London.  
Reported by Dr. W. P.  
Bain, Surgeon to the  
Poplar Hospital



No.	Date. Authority. Place. Name. Sex. Age.	History. Symptoms. Treatment.	Post-mortem appearances.
3—	Case ( <i>continued</i> ).	<p>vomited much bile. 6 p.m.—Pulse 120. She answered questions, complained of tenderness at the epigastrium. Had passed feces and urine voluntarily, the latter in very large quantity. The odour of chloroform was very strong in the breath. Half-past 10 p.m.—Pulse 160. Skin warm, no headache, thirsty and sleepy. Stated that, in consequence of domestic troubles, she rose at 3 a.m., and poured a wineglassful of chloroform into a tumbler with an equal quantity of water, drank it, put out the candle, and went to bed. The narcotic effects of the drug had now entirely passed away. She suffered from symptoms of acute gastritis, and died on the eighth day. The odour of chloroform was present in the breath thirty-six hours after taking it.</p> <p>At a quarter past 7 a.m. on October 7th it was found that the patient, being unable to rest, had taken a dose of chloroform about half-past 12 a.m., and was still sleeping, but so profoundly as to cause uneasiness. He was in an apparently tranquil slumber, with a rather hurried and audible respiration; the pulse full, slower than usual; skin warm, eyelids closed, pupils highly dilated and quite insensible. A smell of chloroform pervaded the room and was perceptible in the patient's breath. Face pallid. A bladder of ice applied to the head, cold affusions along the spine, and an enema given. At half-past nine more pallid, getting cold, breathing not so loud, pulse weaker and slow. Electricity was now used, one pole placed on the pit of the stomach, the other along the course of the phrenic nerve on either side. After a few applications, with an interval of several minutes between each, the respiration became somewhat deeper and more distinct. The electric current was also applied to the spine, thoracic muscles, and calves of the legs. An enema with twelve or fifteen drops of ammonia was given and retained. The tongue was drawn forward, and then hung cold, pale and dry, beyond the teeth. Iced water to chest and pit of stomach alternately with warmth. Occasionally air was blown in along a tube with the natural inspirations. Half-past 11 a.m.—The narcotism continued, but the pupils began to contract; the breathing improved, pulse fuller, heat of body increased. Frequency of respiration very great, particularly when compared with the pulse. Smell of chloroform distinct in expiration.</p>	<p>Esophagus natural. Kidneys the seat of old disease. Heart and lungs healthy.</p>
4	<p>— 1862. 'Med. Times,' vol. i, p. 478. Translated by Dr. Wm. D. Moore, from the 'Hygiea' for February, 1862. Reported by Dr. Axel Lamm, Hon. Mem. Swed. Loc. Phys.</p> <p>Case of male, æt. 35. It was afterwards ascertained that this gentleman was accustomed to inhale and swallow chloroform to relieve his restlessness, but was very sensitive to it by inhalation, half a dram having caused insensibility a few months previous for the purpose of having</p>	<p><i>P.M.</i> examination thirty-eight hours after death.—Rigor mortis present. General congestion of the brain. Cerebral substance everywhere loose, soft, and dotted with blood. Dura mater adherent to skull. Small bony masses of falx major engorged with fluid blood, with a few coagula. Slight yellowish effusion between convolutions. Heart substance dark, otherwise natural. A small loose dark coagulum in right auricle. Lungs congested; the bronchi contained a quantity of frothy, bloody fluid, which extended into trachea and larynx. Stomach contained about three ounces of thick grayish fluid, in which floated a number of "gelatinous flakes." The cardiac</p>	<p><i>P.M.</i> examination thirty-eight hours after death.—Rigor mortis present. General congestion of the brain. Cerebral substance everywhere loose, soft, and dotted with blood. Dura mater adherent to skull. Small bony masses of falx major engorged with fluid blood, with a few coagula. Slight yellowish effusion between convolutions. Heart substance dark, otherwise natural. A small loose dark coagulum in right auricle. Lungs congested; the bronchi contained a quantity of frothy, bloody fluid, which extended into trachea and larynx. Stomach contained about three ounces of thick grayish fluid, in which floated a number of "gelatinous flakes." The cardiac</p>



a tooth extracted. The quantity of the fatal dose was not accurately known. The bottle from which it had been poured might hold about two and a half ounces, and the wife thought it was nearly half full

tion. 5 p.m.—Abdomen distended with gas. No urine having passed, the catheter was introduced, but no water drawn off. Half-past 6 p.m.—Skin warmer than usual, moist; pulse full, rather quick. An enema with colocynth drops given, in about an hour it brought away a mass of grayish excrement. At 9 p.m. the patient began to breathe in a moaning manner. The eyes commenced to move, the pupils appeared sensitive to light; moved the head away when ammonia was applied to the nostrils; the eyelids also showed some sensibility, but there was none in any other part. Profuse perspiration slowly set in; pulse 160, and rather hard. The patient sat up occasionally, and looked around with an air of surprise, but speedily fell back again. His expression at times was quite sensible. This continued for about half an hour, when he got more and more restless, throwing his head backwards and forwards; skin soaked in perspiration; pulse weaker and more rapid. Mucus accumulated in the throat, and he died at 11.45 p.m., about twenty-three hours after drinking the chloroform.

extremity was much congested, and studded with numerous minute livid spots. The mucous membrane near the pylorus was corrugated, but pale. There were no erosions or circumscribed patches of inflammation. Kidneys, spleen, liver, normal. Gall-bladder contained fluid green bile. No smell of chloroform when any of the cavities were opened.



TABLE G.—Cases of Swallowing Chloroform, not fatal.

No.	Date. Authority. Place. Name. Sex. Age.	Symptoms and Treatment.
1	Nov. 28, 1857. 'Med. Times,' p. 559. From 'Amer. Journ. of Med. Science' for Oct., 1857, p. 367. Dragoon	<p>Drank two ounces of chloroform, and when seen, fifteen minutes after, had vomited, but was then quite insensible. The breathing was stertorous; pulse 60. The stomach-pump was used, and some aromatic spirits of ammonia injected. The pulse and respiration became slower and more feeble. The pupils insensible. Cold douche to the head did some transitory good, but the surface of the body became gradually colder, so the patient was wrapped in blankets, a stimulating enema given, and mustard poultices applied. He continued to get worse, the face became purple, the pulse intermittent and scarcely perceptible. In about two and a half hours after taking the chloroform slight improvement commenced. Four hours from this, sensibility had returned. He had great irritability of the stomach for several days, and eventually an attack of jaundice.</p>
2	Dec. 12, 1857. 'Med. Times,' p. 615. Reported by Mr. H. D. Dean, of H.M.S. 'Indomitable.' Female, æt. 22	<p>When seen, five minutes afterwards, was generally convulsed, insensible, face flushed, pupils dilated, jaws clenched, foaming at mouth. Pulse full, oppressed. She was exposed directly to a current of fresh air, and the stomach-pump used, after which brandy and water was given every two or three minutes. She vomited, and became more sensible and less convulsed. The fluid ejected smelt strongly of chloroform. Ammonia was applied to the nostrils, and the cold douche to the head. In less than twenty minutes she was sensible, the convulsions had ceased, pulse regular and full. The brandy was continued at intervals. She had several relapses, becoming convulsed, with a clammy sweat and irregular flickering heart action, but ultimately recovered, with slight gastric and pharyngeal irritation.</p>
3	— 1861. 'Brit. Med. Journ.,' vol. i, p. 377. New York. Reported in 'Amer. Med. Times,' by Dr. Fennell. Female, æt. 18	<p>She swallowed an ounce of chloroform, walked the length of the room, placed the phial on the mantelpiece and fell heavily to the floor. She was seen about twenty minutes afterwards, lying on a sofa, with a hot burning sensation at the stomach, countenance pallid, extremities cold, pulse feeble and quick. She refused to take any remedies, but an ounce of powdered ipecacuanha in warm water was forced down her throat. In a few minutes she commenced to vomit, the odour of chloroform being very distinct in the ejecta. About forty minutes after drinking the chloroform she became comatose, with stertorous breathing, feeble rapid pulse; contracted pupils, insensible to light and touch. Mustard poultices were applied to extremities, cold water to the face, and gentle flagellation with a towel. She remained insensible for about half an hour, when consciousness slowly returned. As this took place she passed through the various stages observed in persons who inhale chloroform. At 11 p.m., three hours after taking the drug, she had perfectly recovered from its effects.</p>



On April 6th, at 8 a.m., he swallowed two ounces of chloroform. As he had been unwell for some days, he was not disturbed till 3 p.m., when he was found in a state of deep coma, the breath smelling strongly of chloroform. The pupils were widely dilated, quite insensible. Pulse slow and feeble. Surface of body colder than natural, movements of thorax scarcely perceptible. No sensation whatever. Sinapisms were applied, hot-water bottles, and cold affusions, but without any effect. The stomach-pump was now used, and removed a quantity of chloroform, mucus, and watery fluid. The viscus was thoroughly cleansed with warm water. Signs of consciousness soon returned, and in less than an hour he answered rationally. For three or four days a burning sensation was felt in the throat and epigastrium, which gradually passed off, leaving no ill symptoms of any kind.

TABLE H.—Cases of Death from Chloric Ether.

No.	Date. Authority. Place. Name. Sex. Age.	Nature and stage of operation.	Inhaler and amount of chloroform. Stage of exhibition at which death occurred, and time.	Mode of death.
1	Aug. 22, 1857. 'Med. Times,' p. 199. America. Male, æt. 5. Reported in 'Amer. Journ. of Med. Science' for July, p. 284	Removal of fatty tumour from the back. Tying the arteries after excision	A hollow sponge. One dram of mixture of four parts of washed ether and one part of chloroform. Complete anæsthesia	Vomiting set in. The pulse, which was previously good, suddenly ceased. He had lost four or five ounces of blood.
2	Aug. 14, 1858. 'Med. Times,' p. 174. United States. Dragoon, æt. 23 (very in-temperate)	Examination of injured elbow. Not commenced	A sponge in a bell-glass, and afterwards a towel. Quantity not stated. The chloric ether, as used in the U.S. army, consists of one part of chloroform and two parts of absolute alcohol. The same bottle produced "unpleasant symptoms" in six other cases. Never completely under influence.	Excitement followed the application of the towel. Face became turgid, and the muscles relaxed. Vomiting set in. The pulse, which had been 100 per minute, suddenly stopped; but there were two or three inspirations after this. A piece of cabbage was removed after death from the larynx.



## APPENDIX C.

## SELECTED EXPERIMENTS FOR RESUSCITATION.

*Artificial Respiration.*—From *Chloroform*—

## After cessation of respiration.

Successful	(39) 10 per cent.	Recovery after 60 sec.
	(82) Chlor. strong.	Recovery after 75 sec.
	(88) Chlor. strong.	Recovery after 60 sec.
Unsuccessful	(67) Strong.	Death after 45 sec.
	(19) 5 per cent.	Death after 60 sec.
	(13) 10 per cent.	Death after 1 min. 30 sec.

## After cessation of heart's action.

Successful	(66) Strong.	Recovery after 30 sec.
	(70) Strong.	Recovery immediate.
	(71) 4 per cent.	Recovery after 10 sec.
Unsuccessful	(68) Strong.	Death immediate.
	(69) Strong.	Death immediate.
	(72) 5 per cent.	Death after 15 sec.

From *Mixtures*—

## After cessation of heart's action.

Unsuccessful	(65) C, strong.	Death after 10 sec.
	(73) C, strong.	Death after 15 sec.
	(74) A, strong.	Death after 10 sec.
	(75) A, strong.	Death immediate.

*Galvanism.*—

## After cessation of heart's action.

Successful	(76) Mixture A, strong.	Recovery after 25 sec.
Unsuccessful	(77) Chloroform, strong.	Death after 10 sec.
	(78) Mixture A, strong.	Death after 10 sec.
	(79) Mixture A, strong.	Death after 15 sec.
	(80) Chloroform, strong.	Death after 10 sec.
		(Secondary asphyxia.)



*Galvanism (continued).*

(81) Chloroform, strong.	Death immediate.
(84) Chloroform, strong.	Death after 20 sec. (Secondary asphyxia.)
(85) Chloroform, $7\frac{1}{2}$ per cent.	Death after 5 sec.
(87) Chloroform, $7\frac{1}{2}$ per cent.	Death immediate.

*After cessation of respiration.*

Successful. (83) Chloroform, strong.	Death after 60 sec.
Unsuccessful. (86) Chloroform, $7\frac{1}{2}$ per cent.	Death after 60 sec. (Secondary asphyxia.)

*Artificial Respiration with Oxygen Gas.—*

(89) Chloroform, strong.	Recovery 60 sec. after cessation of respiration.
(90) Chloroform.	Recovery 90 sec. after cessation of respiration.

*Artificial respiration, after cessation of respiration.  
Recovery.*

(Exp. 39.) Chloroform, 10 per cent., was given to a very large dog. He became insensible at 3 min. 20 sec. At 6 min. 20 sec. the pulse suddenly stopped, and the respiration ceased. After 60 sec. artificial respiration was commenced by pressing the chest. At 8 min. 45 sec. there was an effort at respiration. At 11 min. 30 sec. the animal commenced to respire; the pulse in the femoral was perceptible. At 12 min. 30 sec. the cornea became again sensitive, and shortly after this he had completely recovered.

*Artificial respiration. Recovery.*

(82.) Chloroform vapour, of the strength of 8 per cent., from Mr. Clover's bag, was given to a rather large dog. He became insensible at 1 min. 5 sec. At 2 min. 20 sec. the respiration had nearly ceased; at 2 min. 45 sec. the last



effort at respiration took place. At 4 min. artificial respiration was commenced, the needle in the heart indicating a feeble but still regular movement of that organ. At 6 min. 45 sec. an effort at voluntary respiration took place, and after this natural respiration continued. At 7 min. 50 sec. the cornea became sensible, and the animal recovered.

*Artificial respiration. Recovery.*

(88.) Chloroform,  $7\frac{1}{2}$  per cent., from Mr. Clover's bag, was administered to a small dog. At 1 min. he was insensible. At 6 min. 40 sec. the respiratory movement ceased. At 7 min. 40 sec. artificial respiration was commenced. At this moment the heart was still beating regularly, and the pulse could be detected in the femoral artery. At 9 min. 30 sec. there were some natural efforts at respiration, and soon afterwards the animal commenced to breathe freely.

*Artificial respiration, after cessation of respiration. Unsuccessful.*

(67.) Strong chloroform was given to a dog by means of a handkerchief. He became insensible at 1 min. 30 sec. The respiration ceased at 3 min. 45 sec. At 4 min. 30 sec. artificial respiration was commenced by means of the hands; the heart was at this time acting feebly. At 8 min. 30 sec. slight tremor was observed in the tongue and at the angles of the mouth. At 10 min. 35 sec. there were some efforts at respiration, and the artificial movements were interrupted. At 11 min. 30 sec., the natural respiratory movements having failed, artificial respiration was again commenced. These movements were not very effectual, owing to an accumulation of mucus in the fauces. There were no further efforts at respiration, or other signs of life. At 25 min. 30 sec. the artificial respiration was finally discontinued.

(19.) Chloroform, 5 per cent., was given by the trachea



to a small terrier dog. The heart's action became very uncertain and irregular. The respiration ceased at 1 min. 45 sec. Artificial respiration by pressing the chest was commenced at 2 min. 45 sec. There were slight efforts at natural respiration at 3 min. 30 sec.; but these ceasing, the artificial respiration was again commenced at 5 min. 5 sec. There was no further sign of life, and the artificial respiration was discontinued at 7 min.

(13.) Chloroform, 10 per cent., was given by the trachea to a moderate-sized bitch. The pulse ceased at 1 min. 15 sec. The respiration soon after ceased for a few seconds, but again commenced; it finally ceased at 4 min. 30 sec. At 4 min. 45 sec. the heart fluttered, but continued to beat. At 6 min. artificial respiration was commenced. At 7 min. there were some gasping efforts at respiration, and the artificial respiration was discontinued till 9 min., when, the natural efforts ceasing, it was again commenced. The movements of the heart ceased at 11 min. 45 sec., and after this there was no further sign of life. The artificial respiration was discontinued at 13 min. 30 sec.

*Artificial respiration, after cessation of heart's action.  
Recoveries.*

(66.) Strong chloroform vapour was given to a moderate-sized dog by a towel. He became insensible at 1 min. 15 sec. At 1 min. 30 sec. the pulse ceased to be felt in the femoral artery. At 1 min. 45 sec. the respiratory movements ceased; and at this time no movement of the heart could be detected by auscultation. At 2 min. 15 sec. artificial respiration was commenced. At 2 min. 50 sec. slight muscular movement was observed. At 5 min. 15 sec. some movement was noticed in the epiglottis. A few seconds later there were voluntary efforts at respiration, and the animal soon recovered.

(70.) Strong chloroform was given to a small dog by means of a towel. The animal became insensible at 1 min.



20 sec. At 2 min. 5 sec. voluntary respiration had nearly ceased. A pin was inserted through the walls of the chest, so that the movements of the heart could be observed. The last respiratory movement was at 2 min. 35 sec. The needle ceased to indicate any movement of the heart at 4 min. 50 sec. Artificial respiration was at once commenced. At 5 min. 35 sec. some movements of the tongue and of the tail were observed. At 6 min. 5 sec. there was movement of the epiglottis, and at 7 min. 20 sec. there were efforts at respiration. Shortly after this, breathing was freely established, and the animal recovered.

(71.) Air charged with 4 per cent. of chloroform vapour was given to a full-grown terrier dog. This was inhaled for 38 minutes without any symptoms of impending death. The animal was allowed partly to recover, and was then made to inhale air containing 5 per cent. of chloroform vapour. He became insensible in 1 min. The respiration ceased at 17 min. 15 sec.; and the needle ceased to indicate any positive movement of the heart at 18 min. At 18 min. 10 sec. artificial respiration by the hand was commenced. At 18 min. 40 sec. some gasps took place, but, being inefficient, the artificial respiration was continued till 24 min. 10 sec., when the animal breathed freely; it was then discontinued, and the animal recovered.

*Artificial respiration, after cessation of heart's action.  
Unsuccessful.*

(68.) Strong chloroform was given to a small dog by means of a towel. He became insensible at 2 min. 15 sec.; the respiration ceased at 3 min. 35 sec. The heart ceased to beat (as shown by the needle) at 4 min. 30 sec., but for some little time previously the movements had been very irregular. Artificial respiration was commenced immediately upon the heart ceasing to move (4 min. 30 sec.), and it was continued for 11 minutes (till 15 min. 30 sec.); the animal, however, exhibited no sign of restored anima-



tion. In this case there was some doubt whether the air passed into the chest during the artificial respiration.

(69.) Strong chloroform was given to a rather large dog by means of a towel. The respiration finally ceased at 4 min. 15 sec.; the movement of the heart, as indicated by the needle, at 5 min. 5 sec. Artificial respiration (manual), but without success.

(72.) Chloroform, 5 per cent., was given to a middle-sized dog. He became insensible at 4 min. 15 sec. The respiration ceased at 27 min. 20 sec.; the heart at 30 min. 15 sec. Artificial respiration commenced at 30 min. 30 sec., and continued for ten minutes, but the animal exhibited no further sign of life. In this case the respiration had been shallow and interrupted some little time before its cessation, and had been again renewed. The heart's action, also, for some time before its final cessation, had been very feeble and irregular.

*Galvanism, after cessation of heart's action. Recovery.*

(76.) A large dog was made to inhale the Mixture A by means of a towel. He became insensible at 2 min. 15 sec. The heart stopped at 10 min. 30 sec. (as ascertained by the needle); there was one respiration at 10 min. 35 sec. At 10 min. 55 sec. galvanism was applied—the one pole to the needle in the heart, the other to the mucous membrane of the prepuce, the current being slight in force and interrupted. At 11 min. voluntary efforts at respiration commenced. These movements of respiration continued regularly till 11 min. 50 sec., when they ceased; during this period no galvanism was applied. The needle did not indicate any movement of the heart. Galvanism was then again employed, and at 13 min. 50 sec. the animal again commenced to breathe, and some movement of the heart was observed. At 15 min. 30 sec. the respiration was regular, the heart beating 140 per minute. The galvanism was



gradually discontinued. At 18 min. the animal was breathing regularly. At 20 min. the cornea became sensible, and the animal recovered.

*Galvanism, after cessation of heart's action. Unsuccessful.*

(77.) Strong chloroform (by means of a towel) was given to a dog. He became insensible at 1 min. 30 sec. At 2 min. 30 sec. the respiration became very shallow, and the heart's action very irregular. The respiration ceased at 6 min., the heart's action at this time being slow and irregular (about 10 in 30 sec.). After this the heart's action became more regular for a short time. At 7 min. 15 sec. the needle indicated that the action of the heart had ceased for a few seconds; but it again went on beating. The heart seemed likely to stop again two or three times, and at 7 min. 10 sec. it ceased to move. At 7 min. 20 sec. galvanism was applied in the manner before described—one pole being connected with the needle in the heart, the other with the prepuce. The galvanism was continued for ten minutes, but the animal exhibited no further sign of life.

(78.) The Mixture A was administered to a dog by means of a towel. At 2 min. 15 sec. he became insensible. At 13 min. 50 sec. the respiration and heart's action ceased simultaneously. At 14 min. galvanism was applied in the manner before described, the current being sent from the needle in the heart to the prepuce. At 15 min. the heart again commenced to beat with some regularity. At 16 min. 45 sec. the heart was acting feebly, and only when the galvanism was applied. Soon afterwards all movement ceased; there was no effort at respiration, or any other sign of life. The galvanism was continued till 22 min. 30 sec.

(79.) The Mixture A was given to a rather large dog by means of a towel. At 4 min. 30 sec. he was insensible. At 16 min. 30 sec. the respiration became slow, feeble, and irregular (about 8 in 15 sec.); the heart's action at this



period being regular (25 in 15 sec.). At 19 min. 30 sec. the respiration ceased till 20 min. 45 sec., when a few respiratory movements again took place. In this interval the pulse in femoral artery ceased, and the heart's action became very feeble. At 21 min. 45 sec. the heart's action almost ceased, but slight movements were observed till 22 min. 30 sec. At 22 min. 45 sec. galvanism was applied as in the other cases—one pole being connected with the needle in the heart, the other with the prepuce, and subsequently with the mouth. There was, however, no further sign of life, and the galvanism was discontinued at 36 min.

(80.) Chloroform in a strong form was given, by means of a towel, to a moderate-sized dog. He was insensible at 2 min. At 3 min. the heart's action was irregular and feeble. At 5 min. 30 sec. the respiration ceased till 6 min. 30 sec.; when it was resumed it was extremely shallow at first, but subsequently improved. At 14 min. 30 sec. the respiratory movement finally ceased, and at 14 min. 55 sec. the heart stopped beating. At 15 min. 5 sec. galvanism was applied as in the other cases, from the needle in the heart to the prepuce. At 16 min. 15 sec. voluntary respiration commenced, and continued for rather more than a minute; gradually, however, it became more and more feeble. During this time there were no pulsations of the heart. At 17 min. 45 sec. there were a few pulsations of the heart, and at 18 min. 15 sec. these had quite ceased. At 25 min. 15 sec. the galvanism was discontinued, the animal exhibiting no further sign of life.

(81.) Chloroform was given in a strong form, by means of a towel, to a rather large bitch. At 1 min. 50 sec. she was insensible. At 3 min. 30 sec. the heart had nearly ceased beating. At 3 min. 50 sec. the respiration temporarily ceased, and the pulsations in the femoral artery were arrested. At 6 min. 45 sec. there were a few efforts at respiration, which ceased after a few seconds; the heart's



movement became extremely feeble, being scarcely perceptible; and all movement finally ceased at 8 min. Galvanism was at once applied as in the other experiments (from the needle to the prepuce), but the animal exhibited no further sign of life. At 19 min. 30 sec. the galvanism was discontinued.

(84.) Chloroform, of the strength of 8 per cent., was given, by means of Mr. Clover's bag, to a small terrier dog. He became insensible at 1 min. 15 min. At 4 min. 15 sec. the respiration was very shallow, the pulse very weak in the femoral. At 10 min. 35 sec. the respiration, the movement of the needle in the heart, and the pulse in the femoral artery, ceased simultaneously. At 10 min. 55 sec. galvanism was applied, the current was first directed from the needle in the heart to the prepuce, and afterwards from a needle in the diaphragm, the other pole being connected with the tongue. At 12 min. respiration commenced, and the pulse returned in the femoral; the galvanism was discontinued. Only a few efforts at respiration were, however, made, and these having failed, at 13 min. a few artificial respirations were made, and the galvanism was recommenced. The galvanism was continued till 17 min., but the animal did not exhibit any further sign of life.

(85.) Chloroform, of the strength  $7\frac{1}{2}$  per cent., was given, from Mr. Clover's bag, to a middle-sized terrier bitch. The animal became insensible at 2 min.; at 9 min. 15 sec. the respiration ceased; at 9 min. 45 sec. the needle in the heart stopped moving. Galvanism was applied 5 min. after—one pole being placed on the neck, the other connected with a needle inserted in the diaphragm. A few seconds later slight movements were observed in the needle in the heart, but these soon ceased. There was no effort at respiration, or any further sign of life. The galvanism was discontinued at 13 min.

(87.) Chloroform ( $7\frac{1}{2}$  per cent.) was given to a small dog, from Mr. Clover's bag. At 1 min. 30 sec. he was insen-



sible. At 9 min. 40 min. the heart ceased moving, its pulsations having been very feeble for some time. The respiration had nearly, if not quite, ceased, having been slight and irregular for some little time. Galvanism was at once applied—one pole being placed on the neck, the other attached to a needle in the diaphragm. At 10 min. 10 sec. the heart was again beating, and at 10 min. 30 sec. the respiration recommenced. At 11 min. 30 sec. the respiratory movement and the heart's action both stopped, and did not recommence. During the time that the heart's action was partially restored no pulsation could be detected in the femoral artery. The galvanism was discontinued at 16 min.

*Galvanism, after cessation of respiration. Recovery.*

(83.) Chloroform, of the strength 8 per cent., was given, by means of Mr. Clover's bag, to a rather small terrier dog. He became insensible at 1 min. 30 sec. At 3 min. 50 sec. the heart's action (indicated by the needle) had become irregular and intermitting. At 4 min. 40 sec. respiration ceased. At 5 min. 40 sec. galvanism was applied—the one pole being connected with the needle in the heart, the other with the prepuce. At this time the needle indicated regular, but feeble, pulsations. At 8 min. there was a slight effort at respiration, as pulse was felt in the femoral artery, and the heart evidently acted more strongly. The galvanism, however, was continued till 10 min., when the respiration was regular, but feeble, and the heart's action was strong. The animal recovered. In this case there was some little doubt whether effective galvanism was applied quite as soon as noted, as the apparatus had got out of order at the time.

*Galvanism, after cessation of respiration. Unsuccessful.*

(86.) Chloroform ( $7\frac{1}{2}$  per cent.) was administered to a rather large dog, by means of Mr. Clover's bag. He was



insensible at 1 min. 15 sec. A few minutes later the respiration became feeble and irregular, and nearly ceased. At 7 min. 30 sec., however, he commenced to breathe freely. After this the respiration again failed, and finally ceased at 10 min. 35 sec. At 11 min. 35 sec. galvanism was applied; at this time the heart was still beating, but feebly, and there was a pulse in the femoral artery. The galvanism was applied over the two phrenic nerves in the neck. In the course of a few seconds the respiration again commenced. At 12 min. 25 sec., however, the needle in the heart ceased moving. At 13 min. 30 sec. slight movement of the needle in the heart was again observed; the respiration, however, was extremely feeble, and ceased a few seconds later. The galvanism was discontinued at 17 min. 30 sec., there being no evidence of life.

*Artificial Respiration with Oxygen Gas. Recoveries.*

(89.) Chloroform was given, by means of a towel, to a moderate-sized dog, and when insensibility was produced a tube was inserted into and tied in the trachea. He was allowed partly to recover, and at 13 min. the tube was connected with chloroform vapour. At 14 min. 40 sec. the respiration stopped; the heart at this time was beating slowly and imperfectly. At the time the artificial respiration was commenced (15 min. 40 sec.) the movement of the heart had almost, but not quite, ceased. At 15 min. 40 sec. artificial respiration was effected by means of a bladder of oxygen gas connected with the tube in the trachea. At 16 min. 40 sec. the pulsations of the heart had become much stronger. At 17 min. 45 sec. voluntary efforts at swallowing were made. At 18 min. 30 sec. the animal breathed freely, and sensibility returned.

(90.) Chloroform having been given to a rather small dog, a tube was inserted into and tied in the trachea. The animal was then allowed nearly to recover. At 6 min. 30 sec. chloroform was given, the trachea-tube being con-



nected with the vapour in a chloroform-bottle. At 7 min. 45 sec. the respiration, having ceased for 30 sec., again commenced, but at 12 min. 30 sec. it finally ceased, the heart still beating. At 14 min., the heart still beating steadily, artificial respiration with oxygen gas was commenced. This was accomplished by connecting the trachea-tube with a bladder containing the oxygen gas. At 17 min. natural breathing was established, and the animal soon after recovered. At 18 min. 40 sec. chloroform was again given, as before. At 20 min. 30 sec. the heart's action was very feeble, and the respiration slight. At 21 min. 20 sec. the respiration ceased for some time. The heart's action continued steadily. There were, however, no efforts at respiration till 27 min.; and at this time some feeble respiratory movements were observed. (It is possible that, in this experiment, some oxygen may have diffused itself into the lungs, as, after the cessation of the respiration, the trachea-tube was disconnected from the chloroform, and connected with the bladder of oxygen gas, so as to facilitate the commencement of artificial respiration.) The movements, however, were extremely slight, and only lasted a few seconds. At 28 min. 30 sec. all movement of the heart ceased. At 28 min. 40 sec. artificial respiration with oxygen gas was commenced. At 32 min. slight quivering movements of the tongue were observed, and at 34 min. there were efforts at respiration, the heart again beating. The animal recovered.







*performed without Chloroform.*

	Disease.			Accident.			Totals.		
	Cases	Died.	Per cent.	Cases	Died.	Per cent.	Cases	Died.	Per cent.
Liverpool Northern Hosp., 1834 to 1843 ...	40	5	...	55	13	...	95	18	...
" " 1845 to 1846 ...	14	6	...	11	4	...	25	10	...
Glasgow Infirmary, 1794 to 1839 .....	155	35	...	121	65	...	276	100	...
" " 1839 to 1848 .....	59	23	...	225	99	...	284	122	...
Newcastle Infirmary, 1823 to 1843 .....	144	28	...	81	26	...	225	54	...
Chester Infirmary, 1838 to 1841 .....	11	2	...	10	7	...	21	9	...
Exeter Hospital, 1816 to 1849 .....	206	18	...	94	25	...	300	43	...
Radcliffe Infirmary, 1838 to 1847.....	69	12	...	22	2	...	91	14	...
Edinburgh Infirmary, 1840 to 1845 .....	49	16	...	17	15	...	66	31	...
" " 1846 to 1847 .....	...	...	...	...	...	...	14	2	...
Aberdeen Infirmary, 1841 to 1846 .....	27	6	...	15	5	...	42	11	...
Bristol, St. Peter's, 1844 to 1846 .....	5	1	...	...	...	...	5	1	...
" " Infirmary, 1845 to 1846 .....	30	3	...	6	...	...	36	3	...
Derbyshire Infirmary, 1845 to 1846.....	11	2	...	...	...	...	11	2	...
Dundee Infirmary, 1844 to 1846 .....	6	...	...	5	1	...	11	1	...
Elgin Infirmary, 1844 to 1846 .....	9	2	...	1	1	...	10	3	...
Leicester Infirmary, 1845 to 1846.....	9	1	...	6	...	...	15	1	...
Perth Hospital, 1840 to 1847 .....	22	8	...	...	...	...	22	8	...
Sussex County, 1844 to 1846 .....	6	2	...	7	4	...	13	6	...
Salisbury, Stockport, Worcester, York, } 1845 to 1846 .....	25	2	...	21	8	...	46	10	...
Liverpool Infirmary, 1834 to 1836 .....	...	...	...	...	...	...	43	3	...
Edinburgh Infirmary, 1839 to 1841 .....	...	...	...	...	...	...	61	31	...
Six Scotch Hospitals, 1842 .....	...	...	...	...	...	...	24	3	...
Reading Infirmary, 1838 to 1845 .....	...	...	...	...	...	...	27	5	...
<b>Provincial Totals.....</b>	<b>897</b>	<b>172</b>	<b>19·11</b>	<b>697</b>	<b>275</b>	<b>39·4</b>	<b>1763</b>	<b>491</b>	<b>27·8</b>
<b>London " .....</b>	<b>316</b>	<b>73</b>	<b>23·1</b>	<b>192</b>	<b>77</b>	<b>40·1</b>	<b>823</b>	<b>219</b>	<b>26·6</b>
<b>Grand Totals .....</b>	<b>1213</b>	<b>245</b>	<b>20·1</b>	<b>889</b>	<b>352</b>	<b>39·5</b>	<b>2586</b>	<b>710</b>	<b>27·4</b>



## TABLE of Amputations

IN LONDON.

	Disease.			Accident.			Totals.		
	Cases	Died.	Per cent.	Cases	Died.	Per cent.	Cases	Died.	Per cent.
St. George's, 1852 to 1859 .....	115	29	...	34	12	...	149	41	...
St. Thomas's, 1857 to 1860 .....	32	7	...	33	15	...	65	22	...
Guy's Hospital, 1853 .....	...	...	...	...	...	...	25	2	...
Ditto, 1854 to 1861 .....	148	21	...	96	46	...	244	67	...
Eight London Hospitals—Simpson .....	65	10	...	15	6	...	80	16	...
St. Bartholomew's, Jan., 1853, to Oct., 1863	228	46	...	130	28	...	358	74	...
Totals.....	588	113	19·2	308	107	34·7	921	222	24·

## TABLE of Amputations performed with Chloroform.

MILITARY.	Primary.			Secondary.			Totals.		
	Cases	Died.	Per cent.	Cases	Died.	Per cent.	Cases	Died.	Per cent.
Crimean War, to Nov., 1854 .....	152	17	...	64	41	...	216	58	...
Ditto, from April, 1855 .....	440	163	...	60	36	...	500	199	...
British Naval Brigade .....	45	14	...	18	9	...	63	23	...
	637	194	30·4	142	86	60·5	779	280	35·9
AMERICA.	Disease.			Accident.			Totals.		
	Cases	Died.	Per cent.	Cases	Died.	Per cent.	Cases	Died.	Per cent.
Massachusetts Hospital .....	26	3	...	26	10	...	52	13	25·



*performed with Chloroform—*

## IN THE PROVINCES.

	Disease.			Accident.			Totals.		
	Cases	Died.	Per cent.	Cases	Died.	Per cent.	Cases	Died.	Per cent.
Radcliffe Infirmary, from 1847 .....	45	12	...	28	7	...	73	19	...
Leeds Infirmary, 1853 to 1861 .....	110	17	...	79	28	...	189	45	...
Edinburgh Infirmary, 1850 ....	19	5	...	8	3	...	27	8	...
Birmingham Hospital, 1859 to 1860.....	30	4	...	14	6	...	44	10	...
Glasgow Infirmary, 1849 to 1857 .....	152	64	...	93	33	...	245	97	...
Newcastle Infirmary, 1846 to 1857 .....	61	8	...	88	28	...	149	36	...
Twenty-four Provincial Hospitals .....	90	21	...	27	7	...	117	28	...
Fifteen ditto .....	59	10	...	23	8	...	82	18	...
Totals in Provinces .....	566	141	24·9	360	120	33·3	926	261	28·1
Totals in London .....	588	113	19·2	308	107	34·7	921	222	24·1
Grand Totals .....	1154	254	22·	668	227	33·9	1847	483	26·1

TABLE of Amputations performed without Chloroform.

MILITARY.	Primary.			Secondary.			Totals.		
	Cases	Died.	Per cent.	Cases	Died.	Per cent.	Cases	Died.	Per cent.
Fenwick—Guthrie .....	...	...	...	...	...	...	...	...	...
Alcock .....	...	...	...	...	...	...	1452	448	30·8
CONTINENT AND AMERICA.	Disease.			Accident.			Totals.		
	Cases	Died.	Per cent.	Cases	Died.	Per cent.	Cases	Died.	Per cent.
Massachusetts Hospital .....	59	7	...	30	12	...	89	19	...
Pennsylvania Hospital .....	45	6	...	184	46	...	229	52	...
Phillips, 1834 to 1838 .....	...	...	...	...	...	...	95	24	...
							413	95	23·
Hôtel Dieu, 1836 to 1842 .....	...	...	...	...	...	...	178	104	...
Malgaigne .....	355	154	...	164	107	...	519	281	...
Phillips—France .....	...	...	...	...	...	...	203	47	...
„ Germany .....	...	...	...	...	...	...	109	26	...
							1009	458	45·3



## APPENDIX E.

## OBSTETRICAL REPORT.

*The Effects of Chloroform in Obstetrical Practice, and in the Diseases of Women and Children.*

The committee, in investigating the effects of chloroform in obstetric medicine, including the diseases of women and children, having determined that a series of direct experiments on the human subject would be surrounded by difficulties, considered that they would best promote the practical objects of their inquiry by collecting the accumulated experience of the profession on the various obstetrical uses of anæsthetics since their introduction.

A series of questions was therefore prepared and forwarded to all the teachers of midwifery and to the obstetrical officers of public institutions in the United Kingdom, requesting a record of their experience and opinions on the various matters indicated.

The following is an analysis of the replies :

## A.—IN NATURAL LABOUR.

*Question 1.—Have you observed any instance of the occurrence of sudden death during the administration of chloroform in labour, or of the occurrence of symptoms indicating immediate danger to life?*

To this question 29 answers were received, all being in the negative, both in regard to the occurrence of sudden death or of symptoms indicating immediate danger to life. But in certain instances this negative was qualified by the observation that in certain cases some unfavorable symptoms had occurred, which, although not strictly dan-



gerous to life, may be briefly indicated as accidental to the employment of chloroform. Thus, one writer remarks that he had seen no death, but great exhaustion; another had observed in two cases rigidity of the lower limbs, with a sort of convulsive movement of the upper and of the face, which made him fear convulsions, but all ceased on suspending the inhalation. A third had met with a few cases of induced intermission of the pulse even under small doses of the vapour, and this had led him to prescribe a stimulant when the pulse is feeble. A fourth states that he had seen alarming faintness and swooning after delivery, without any hæmorrhage. A fifth remarks that in a few cases he had seen great prostration; and a sixth, that in a highly nervous woman the anæsthetic caused slight convulsions of an hysterical nature, and in another, who was very plethoric, a degree of coma which required active depletion.

*Question 2.—When chloroform is given so as to produce deep anæsthesia, does it, according to your experience, interfere either with the uterine contractions or with the auxiliary powers of parturition?*

An analysis of 28 answers to this question gives the following results:

In 8 it is stated to interfere with or lessen the uterine contractions.  
 In 3        "               "               "       the auxiliary powers.  
 In 14       "               "               "       both; whilst  
 In 3 it is stated not to interfere with either.

*Question 3.—When administered in a moderate degree and under proper regulation, has it, in your practice, protracted labour by weakening the expulsive powers, either in the early or later stages of parturition?*

Twenty-seven answers were received to this inquiry, to the following effect:

In 4 it is said to weaken them in the early stage.  
 In 2        "               "               "       later stage.  
 In 12       "               "               "       in both; and  
 In 9        "       not to weaken them in either.



*Question 4.—Has it any beneficial effect in promoting the dilatation of the maternal passages?*

Of 26 answers to this inquiry, 22 were in the affirmative, and 4 only in the negative.

*Question 5.—Has its employment during natural labour predisposed to puerperal convulsions, apoplexy, or other complications on the part of the mother?*

Twenty-seven answers were received in reply to this question, and, with 3 exceptions, in the negative. Of the 3 exceptional replies, one writer refers to 2 cases in which slight convulsive movements occurred during its employment, and ceased on its withdrawal. Another had observed hæmorrhage to occur when long given, and apparently from its relaxing effect upon the uterus; and a third had observed dangerous fainting to occur after delivery without hæmorrhage. On the other hand, two writers speak of it as having the power of lessening the tendency to convulsions; and one of them states that, in his experience, it has warded them off in several cases.

*Question 6.—Do you believe that the number of cases in which instruments must ultimately be used to terminate labour is likely to be increased from the employment of chloroform?*

Fifteen answers were returned to this question in the negative, and 9 in the affirmative. But, as regards the latter, it should be stated that this result was only apprehended by some of the respondents when the drug was given largely, just as, in regard to the former, it was assumed that the drug had been given cautiously and judiciously.

*Question 7.—Has it, in your experience, predisposed to imperfect contraction of the uterus after delivery, and thus led to post-partum and secondary hæmorrhage?*



To this question 29 answers were returned. One gentleman expresses himself doubtfully in the negative; 13 aver that it predisposes to both, and 15 that it predisposes to neither.

*Question 8.—Has it had any such after-effects on the nervous or vascular system of the mother as to retard her convalescence, or render her more liable to any of the forms of puerperal disease—e. g. puerperal fever, phlegmasia dolens, puerperal mania?*

Of 29 answers received to this question, 26 were distinctly in the negative, and in several it was stated to have a directly contrary effect to that of retarding convalescence. Thus, one writer remarks that it appears to him to have a "precisely contrary effect;" another has found convalescence to have been more favorable; a third remarks that the convalescence has been manifestly better; a fourth, that it promotes convalescence; a fifth says that, so far from retarding convalescence, in his experience it has been the reverse; and a sixth, that it aids and expedites recovery.

On the other hand, three answers were returned in the affirmative; in one, it is stated that a lady was amaurotic for several hours after labour; in another that two or more attacks of puerperal mania had followed its use; and in a third that convalescence had been retarded, apparently from its effect on the nervous system.<sup>1</sup>

*Question 9.—Has it had any tendency, from its after-effects, to interfere injuriously with the function of lactation?*

In reply to this query, 27 answers were received in the negative, and one in the affirmative.

<sup>1</sup> No reference is made in any of the replies to the subsequent occurrence of sickness as a drawback to the employment of chloroform in obstetrical as distinguished from surgical practice.



*Question 10.—Has it any injurious influence on the child?*

Of 29 answers received, 27 were in the negative. In one it was stated that the writer was not in possession of sufficient facts to answer the question, and in one that the respondent had observed great drowsiness and a disinclination on the part of the child to take the breast for two or three days.

B.—IN ABNORMAL LABOUR.

*Question 1.—Have you employed chloroform in any obstetrical operations? If so, what advantages do you think you have gained by its employment, and what evils have seemed to you to detract from its value?*

*(e. g.) In cases where the patient is much enfeebled by hæmorrhage, and turning or instruments must be employed, is the use of chloroform, in your opinion, to be regarded as the introduction of a further element of danger, and likely to diminish the chances of ultimate recovery?*

An analysis of 29 replies to this question gives the following result:—25 of the respondents had employed it with advantage, 2 had not used it, and 2 had employed it and found its action unfavorable. Amongst the cases instanced in which it had proved beneficial are—turning; the application of the forceps, especially in a narrow pelvis; the extraction of retained placenta, and craniotomy: and the advantages claimed for it are—that the patient is passive instead of resisting under treatment; that the operator is not disturbed by her outcry; that the shock is reduced to a minimum; that it lessens resistance by relaxing rigid tissues, and that it favours convalescence by preventing pain, and consequently exhaustion. On the other hand, in the two instances in which it was reported upon unfavorably, it was stated in one that the writer had found it disadvantageous



in forceps cases, from the turning over of the patient; and, on the other, that in forceps and craniotomy cases the woman had been always more unmanageable because unconscious. As regards the propriety of using it in these cases, when the patient is much enfeebled by hæmorrhage or other causes, 17 answers were received unfavorable to its employment, whilst in 4 a contrary opinion was expressed, 2 of the latter being qualified by the remark "provided opium and stimulants were given."

*Question 2.—Have you employed chloroform in the treatment of puerperal convulsions? If so, do you believe that it may enable the practitioner sometimes to dispense with other aids (such as bleeding, &c.) occasionally used in such cases?*

Twenty-eight replies were received to this question, which may be thus tabulated:—14 of the respondents had used it and found it beneficial, 11 had not tried it, 1 had tried it and found it not beneficial, and 2 returned qualified answers in its favour. Of the 13 affirmative replies, the following may be regarded as an embodiment of the principal information furnished. One writer observes that, except in slight cases, he had never ventured to dispense with other treatment, but that he had repeatedly seen it arrest the convulsion both in forceps and craniotomy cases. Another had used it beneficially, but in most cases after bleeding; when bleeding, however, is improper, it quiets the patient, although the writer would not trust to it exclusively. A third had used it with the best effects without having used the lancet. A fourth had used it beneficially in one case, in which, from the weakness of the patient, he was opposed to bleeding. A fifth had used it with advantage in forceps cases, but thinks that care should be taken in giving it when much insensibility is present. A sixth had found it useful, but not to the exclusion of other aids, and more especially with the view of arresting post-partum convulsions until sleep had taken place. A seventh states that he had used it with



signal advantage in several cases, and had found it to supersede bleeding entirely; and he further adds, that it acts as a preventive in patients who had previously had them. An eighth had repeatedly given it with striking success, but doubts if it supersedes the use of bleeding where the pulsation of the temporal arteries is firm and strong, and especially if the patient sees sparks or flashes of light before her eyes. A ninth had used it with great success; but thinks that bleeding, and other means with it, might be both prudent and proper. Of the two qualified answers received, in one the writer observes that he thinks he has sometimes seen it useful, but is sure that it acts injuriously when respiration is imperfect, the face blue, and the breathing short and interrupted; and in the other it is stated that everything must depend upon the type of the convulsions, and that usually he would not give it before resorting to bleeding and other depletory means. On the other hand, one writer states that he had only used it once, that it did no good, and that he would not trust to it without other means.

C.—MODE OF ADMINISTRATION; QUESTION AS TO THE  
USE OF ETHER.

*Question 1.—Have you any reason for giving a preference to ether over chloroform in obstetrical practice?*

Sixteen answers were received to this question, and all in favour of chloroform; but in two instances a qualified preference was given to ether where chloroform disagreed. Thus, one writer remarks that he gives a preference to ether when chloroform disagrees by producing sickness, &c., or when it is especially disliked by the patient, and another expresses himself to the same effect. On the other hand, three of the answers were decidedly in favour of chloroform, one writer preferring it on account of its more certain effect; another stating that he had twice given ether, but with disappointment, and remarking that it was much less efficacious;



whilst a third affirms, that he would not under any circumstances use ether, inasmuch as he had tried it in a few cases, and had found it to be a most disagreeable and dangerous agent.

*Question 2.—What rules have you observed, or would you be disposed to recommend, for the use of anæsthetics in natural and morbid labour?*

The general bearing of the answers to this question is to the effect that, as regards natural labour, chloroform should be given sparingly, and so as to alleviate rather than to extinguish the pains. With this view a great many of the respondents recommend that it should only be given at the commencement of each pain; others, that it should only be given if the pains are very severe; and others, that it should only be given in the latter stages of labour. On the other hand, it is generally recommended that in morbid, and especially in instrumental or operative, labour, it should be given freely. The rules for its safe administration may be stated as deduced from different answers:—1. Avoid giving it directly after a meal. 2. In primiparæ especially give it very moderately. 3. Dilute well with air and watch the pulse and the breathing. 4. Keep your finger constantly on the pulse, and the moment it fails, discontinue the chloroform. 5. Give it slowly. 6. If depressed, give an occasional stimulant. 7. When the head bears upon the perinæum, give it more freely, to promote relaxation. 8. In excitable persons, unless it acts well, it is better not to use it. 9. Always suspend its administration towards the end of labour. 10. Do not continue its use for a prolonged period if not absolutely necessary. 11. When deep anæsthesia is required it is best to have a skilled administrator. 12. With this object give it slowly, and if it causes delirious excitement withhold it. 13. In ordinary cases administer only as much as will render the patient indifferent to pain rather than unconscious of it, and give a little brandy at intervals.



*Question 3.—Have you any reasons for believing that a special apparatus is desirable in obstetric practice? What, in your experience, has appeared to be the best method of exhibition?*

To the first part of this inquiry 22 answers were received in the negative, and 4 in the affirmative. Of the latter one respondent states that he prefers an apparatus which gives some degree of certainty as to the per-centage inhaled with air. A second remarks that, although he does not consider a special apparatus necessary, yet he thinks that a Snow-form of apparatus is desirable. A third uses and recommends an apparatus designed by himself, and a fourth thinks it is best to have a special apparatus when the patient is to be placed fully under its influence.

Of the 22 negative replies, the majority of the writers use and recommend merely a pocket-handkerchief or towel, some place pieces of lint or sponge moistened with chloroform into a tumbler or shallow cup, and one or two recommend an adjustment of the handkerchief or towel in a peculiar way. It should be added that some of these writers deprecate very strongly the use of a special apparatus.

#### D.—DISEASES OF WOMEN AND CHILDREN.

*Question 1.—The use of chloroform in the diagnosis of diseases of women (spurious pregnancy, hysteric tympanitis, and other allied affections).*

Fifteen answers only were received to this question, in one of which the writer states that he had not used it in these cases, whilst in the other 14 it is stated to be highly useful. The cases in which its utility is represented to be greatest are chiefly—the diagnosis of spurious pregnancy and phantom tumours; the facilitating of examination of the uterine organs where there is much sensibility or intolerance of pain;



cases of feigned disease ; the diagnosis of abdominal or pelvic tumours ; certain forms of dysmenorrhœa ; and in some hysterical affections.

*Question 2.—The use of chloroform in the treatment of spasmodic diseases of women and children.*

Fourteen replies of a favorable character were received to this question, and on the other papers either no answer is given or it is stated that the anæsthetic had not been tried. Of the 14 answers which were in favour of its efficacy, the following are some of the cases in which its utility had been favorably tested :—Hooping-cough, especially when complicated with convulsions ; some laryngeal affections, when there is much spasm of the glottis ; spasmodic croup ; epileptic seizures ; hysterical convulsions in women ; some forms of convulsion in children arising from no other cause than cerebral irritation ; hysterical local muscular contractions, and wry-neck.

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The thanks of the committee are due to the Council of University College for their liberality and courtesy in allowing the experiments to be made in the physiological laboratory of that institution. They also wish to express their cordial thanks to Mr. Clover, who, although not a member of the committee, attended, at their request, nearly all the meetings for experiments, administered the chloroform, and contrived, from time to time, with remarkable ingenuity, special apparatus for carrying them on.

The committee desire to record their thanks to those members of the profession who have contributed important communications respecting accidents with chloroform, and observations concerning its administration in surgical and obstetric practice ; also to those surgeons of the hospitals



and to the chloroformists by whom the various mixtures of chloroform and ether have been tested; to Drs. Parker, Richardson and Kidd, and to MM. Potter, Clover, and Bader, for the valuable information they have given respecting the practical administration of anæsthetics; and to Dr. Althaus, for kindly assisting at some of the experiments on resuscitation.

(Signed)—

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