

**On the pathological and physiological effects of ethereal inhalation : with an appendix containing an additional case and experiments.**

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ON THE

 PATHOLOGICAL AND PHYSIOLOGICAL EFFECTS

OF

ETHEREAL INHALATION.

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BY BUCKMINSTER BROWN, M. D.

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THE HISTORY OF THE

UNITED STATES OF AMERICA

BY JAMES M. SMITH

IN THREE VOLUMES

BY JAMES M. SMITH

*Dr. C. Hubbard.  
with the loan of his sister  
Martha.*

ON THE  
PATHOLOGICAL AND PHYSIOLOGICAL EFFECTS  
OF  
ETHEREAL INHALATION.

WITH AN  
APPENDIX,  
CONTAINING  
AN ADDITIONAL CASE AND EXPERIMENTS.

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BOSTON :  
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1847.

ON THE  
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APPENDIX.

IN ADDITIONAL CASES AND EXPERIMENTS.

BY BECKWITH BROWN, M.D.

BOSTON:  
PUBLISHED BY CLAP, KENTON, 151 WASHINGTON STREET.  
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ON THE  
PATHOLOGICAL AND PHYSIOLOGICAL EFFECTS  
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THE necessity that some regular course of observation should be followed by those who are employing the ethereal vapor in their practice, and that these observations should be carefully noted for the benefit of those who have less opportunity and are less experienced, will be readily acknowledged. In the present age of careful medical analysis and numerical study, it would be strange indeed if this new discovery were not subjected to the same rigid discipline, and if speedy application were not made in this instance of means for acquiring information which have elsewhere proved to be of such high value.

In Paris, where the numerical method originated, where accuracy of diagnosis and acute analysis of medical phenomena are carried, perhaps, to a greater extent and greater minuteness of detail than in any other place in the world, and where such vast opportunities are enjoyed for medical research, it is natural that this energy of scientific investigation should be directed in full force to a subject now exciting such universal interest. And here, accordingly, we find that the ether has been tried in a greater number of cases than has been possible elsewhere.

This occurs partly, also, as a direct consequence of the fact, that in France, more than in other countries, a medical man, after he has obtained a knowledge of his profession in all its branches, governed, as it were, by a natural impulse, seizes upon some one of these branches and devotes to it peculiar attention. He dives into its depths with a determined vigor, a hearty earnestness of inquiry, and, unsparing of his

labor, brings it, not to the greatest degree of perfection of which it is capable, it is true, for that would not comport with the slow and painful steps by which man is obliged to travel towards that high mark, but yet many degrees nearer the attainment of this end. He thus throws upon it so much light, that when he leaves it, those who follow have but to unravel the thread, often undoubtedly by laborious efforts, which he has placed in their hands. Thus when an important discovery in the arts and sciences is made, these men give it an attentive consideration, turning it over in their minds with an especial reference to their own subject of deepest interest.

Such has been the case in regard to the employment of ethereal inhalation. And it is very curious to observe how each has gone to work to apply this important agent to the furtherance of the object which he has in an especial manner nearest at heart. M. Dubois, the well-known accoucheur, immediately calls in its aid to the relief of those who must undergo the pangs of an artificial delivery. And not content with this, he makes use of it to diminish, if possible, those natural physiological pains attendant upon the puerperal state, when these extend beyond their ordinary limits. It is a singular, but sufficiently established fact, that a mother may now give birth to her offspring, not in the midst of severe suffering, but whilst she is enjoying the delights of some agreeable dream. MM. Roux, Velpeau, Malgaigne, Amussat and others, of course immediately employed it in those cases for which it was first presented to their notice, and with which their names are almost identified. M. Flourens and M. Longet, who are so distinguished as physiologists, have commenced a series of experiments with the ethereal vapor on animals, which, when taken in connection with the phenomena observed in man, will, it is to be hoped, in time, solve many a problem in physiology. These cannot but be watched with that deep attention which this subject, rich as it truly is in incitements of the highest character to prolonged study, is well calculated to command.

There is scarcely an operation in surgery in which the inhalation of ether has not been tested. But, more than this, it has been most successfully used for the alleviation of pain caused by disease. Agonizing suffering, in many of those cases which have hitherto defied all the efforts of the physician, or been lulled into but a temporary calm by the most powerful opiates, has been, in consequence of the benumbing power which ether is now found to possess, and to which we shall again refer, annihilated, while at the same time the mind has been left clear.

In the earlier part of the month of December last, soon after the dis-

covery was made known, I made use of it for this purpose, and through its agency had the satisfaction of being able to soothe the distress and to relieve the dyspnœa of a patient dying of phthisis, and to see death divested of half its pangs. Recently it has been employed much in this way, and the last days of a friend sinking under a disease accompanied by the most excruciating suffering, were by its means rendered comparatively easy and tranquil.

It is affirmed in one of the late Nos. of the "Gazette Medicale de Paris," that if certain other medicines are given in combination with the ethereal vapor, their specific effect is much increased. Thus the effect of quinine, administered in this manner, is many times greater than when exhibited in the ordinary way.

M. Ducros states further, that if sulphuric ether is associated with the extract of belladonna, and is inhaled, it will arrest as by enchantment the debilitating cough so often the commencement of phthisis, thus crushing, as he believes, in the germ, this fatal disease. And even if the disease has advanced to ulceration and formation of caverns, if the irritating cough can be eased and the organ be placed in repose, upon the same principle that we place any other diseased or wounded parts at rest, we may expect, all things considered, a like amelioration in their condition.

Such are some of the hints thrown out for verification by this writer. That this remedy may be used as a means of relief in certain cases, there is no doubt.

Another statement, advanced by the same writer, may prove at some period of inestimable importance to those who, in the course of their surgical practice, are called upon to deal with patients of all temperaments; the nervous, the irritable, and with, besides, various personal idiosyncracies. Upon some of these the process of etherization will undoubtedly have an unforeseen and alarming effect; producing, as has already been experienced in more than one instance, extreme narcotism, with coldness of the extremities, feeble pulse, sighing respiration—in others violent convulsions, delirium, a wild and frantic excitement. In such cases, in addition to the common anti-narcotic remedies, which, if they can be carried into effect, may be of no avail, it is of importance to know of some application which will have an immediate restorative influence on the system.

Two such remedies are offered us, which have been tried with success upon animals, and if they prove to be equally beneficial to the human species, then shall we be possessed of information of high value,

These are opium and electricity. In regard to the former, M. Ducros says that when the animal has respired the ether until he is in a state of torpor, if we administer to it a dose of hydrochlorate or acetate of morphia, he is instantly roused. In a more recent communication, he states that we can cause the insensibility and all the phenomena of etherization to cease instantly by passing through the body of an animal under its influence a current of electricity. I have known of but one instance where morphia was given in a case of human etherization. The various sources of error always attendant upon the administration of any medicament in one instance alone, to prevent its being cited as worthy of trust in the future, operate, of course, in full force in a case like the present. The result, however, was such as to encourage us to future trials of the remedy under similar circumstances.

Electricity has not, I believe, as yet been tested in this country. But should a case present itself of prolonged deleterious effects from the inhalation, in which this agent would seem to offer a reasonable chance of relief, there can be no hesitation in regard to the propriety of its employment. Should these remedies prove, after more extended experience, to have the beneficial effect which has been attributed to them, we may, I think, with reason, expect that the first named will be useful in those cases which are attended with delirium and other symptoms of cerebral excitement, while the latter will be of chief service in those characterized by coma, general coldness of the surface, &c.

The physiological effects of the ethereal inhalation cannot, of course, as yet be clearly comprehended; it is too early, and the recorded cases too few or not observed with reference to this point. Any attempt at classification under this head must necessarily be attended with errors, which time alone can correct. The phenomena observed, however, are sufficiently curious and interesting.

The ether acts in the first place undoubtedly as a stimulant. This is evinced especially by its effects on the heart, acting, it is possible, by the local stimulus afforded by the blood, loaded with the vapor, to its parietes. But this influence is also easily accounted for through the intervention of the nervous system—first, it would appear, as an excitant to the medulla oblongata and medulla spinalis, communicated by the par vagum and spinal cords, producing rapid pulse and quick respiration. The pulse has been known on one occasion, at least, as mentioned in the report of the carefully-noted experiments made by the Society of German Physicians in Paris, to number 174 per minute, while at the same time the respiratory movements were 57. In one or two other cases, reported

by an English physician, it has reached 180. A similar effect, although not to the same extent, has been noted in a majority of the cases reported.

Its secondary effects are narcotic, and it is possible that the effects of this medicament may be adduced in support of Dr. Billings's theory of the *modus operandi* of this class of medicines. If they produce their results by rendering the nerves non-conductors of nervous power, then we may satisfactorily account for the strange phenomenon of general numbness occurring while yet the brain is in a comparatively normal state. This loss of sensation, as has been proved by the experiments of M. Flourens, always precedes the loss of motion.

During the earlier period of etherism (as it has been recently termed by a French writer) the nerves of special sense are in a state to perform their functions even after this condition of general numbness has supervened. The respiration and circulation are, as has been shown, increased in activity, circumstances which indicate the existence of vigor in the medulla oblongata, and to a certain extent in the cerebrum, which latter is not, as it would appear, entirely put to rest during any part of the process.

These facts are proved by what has been observed in several of the narrated cases. One or two examples will be, perhaps, sufficient.

In one of the cases related by M. Velpeau, he states that the patient, totally insensible to pain, sat up and *watched* the progress of the operation with *curiosity* and *interest*.

Another case, related also by M. Velpeau, is that of a young physician, who appears to have taken great delight in experimenting upon himself, and whose singular experience while in this state is certainly worthy of note. He is rendered insensible to pain very quickly, without, however, losing his consciousness. While in this condition he directs what shall be done to him (probably in furtherance of the experiment), and plunges pins and lancets into his flesh without feeling them. In finishing his brief account, this accomplished surgeon adds, "It will be impossible to say how far this discovery will go. It constitutes one of the greatest facts that has been made known during the present century. And it is not in surgery alone, but also in physiology, that its effects will be felt."

In truth, it is manifest that total insensibility of the cerebrum does not occur, even during the later stage, for where, but in that portion of the brain which is the acknowledged seat of the intellectual faculties, can we suppose that the phenomena of dreams takes place? and it is well known that most of those who have been etherized have dreamed. This is a

decidedly mental operation, during which memory, imagination, hope and fear, have been called into action. Carpenter says, "whenever dreaming takes place, it is evident that the cerebrum is in a state of partial activity." In by far the larger proportion, happy emotions have been predominant.

Another of Velpeau's patients complains most bitterly of having been brought back among men ; she believed herself in heaven with God and his angels. These are, as we know, the general character of the expressions made use of by the patients. And still farther, we know that the hearing, and in some cases the sight, taste and smell, are retained. The patient is aware not only of what is passing around him while in this state of complete numbness, but hears and obeys when spoken to. One of M. Velpeau's subjects, upon whom he operated for a tumor in the region of the parotid gland, stated distinctly that although he did not suffer, yet he plainly heard the crackling of the bistoury near his ear. This fact appears a sufficient refutation of a suggestion that has been forwarded by more than one observer, viz., that the sense of suffering was not annihilated by the ether, but it was the memory of that suffering which was destroyed. Here it is apparent that ideas would be received and retained, and that the power of recalling them was not injured, although pain not having been experienced could not be remembered.

That this wonderful state of things exists in many cases, we gather from the remarks of this writer, and various other sources, although it has been impossible to learn the exact numerical proportion. In so striking a light have they at times presented themselves, that one physiologist has even ventured to suggest the possible existence of an organ in the brain appropriated peculiarly to the sensation of pain, and that in these cases it is this organ alone which is put to sleep.

Passing now to the next in order of the great nervous centres, we find that the cerebellum succumbs the most completely and rapidly. The power of producing combined and associated movement is injured, or else voluntary motion is entirely abolished. The patient loses anything like an equal control over his muscles, he reels like a drunken man, or he is affected with spasmodic movements, demonstrating that the organ in which is centred the power of harmonizing and regulating muscular action has ceased to perform its office. *Will* is not wanting in these cases ; far otherwise—and one instance is mentioned in which the patient, relating her experience, said that although she had suffered much, yet she could not in any way express her sensations ; that she was in a very

painful trance, or something similar to a trance, by which she was rendered incapable of making herself understood.

This unpleasant effect was owing, probably, either to some individual peculiarity, or to the imperfect administration of the vapor. It, however, in addition to other facts, makes evident that in the etherized the ability of producing muscular movements *may* be abolished, while yet the will and also memory remain perfect.

The peculiar reflex function of the spinal nerve is materially affected. When the patient is completely etherized, there is an entire relaxation of all the voluntary muscles, while those which act from their own inherent contractility, the uterus, &c., still preserve their natural energy. This indicates that the influence of the vapor has now extended itself to the medulla spinalis, and has destroyed, for the time being, one of its most important powers, viz., that of imparting tonic contractility, which has been found to be derived entirely from the spinal marrow.

This has been taken advantage of by the surgeon to aid in the reduction of dislocations, and two or three cases are related by M. Velpeau and others, where it has proved to be of the utmost utility in reducing fractures also—not only rendering this operation painless, but also entirely removing that spasmodic irritability and contraction of the tissues, which in certain cases offer so powerful an opposition to the best-directed efforts. The muscles, previous to the inhalation, were in a state approaching convulsion, so that it was extremely difficult, if not impossible, to reduce the member to its normal length and form; *afterwards*, they were relaxed and yielded to the slightest traction.

That this power of the spinal marrow is not entirely annihilated, is sufficiently proved by the fact that the sphincters are still intact, and no instance has as yet, to my knowledge, been reported where these have been relaxed. Should the inhalation be continued a sufficient length of time, undoubtedly this result would ensue, and we may then readily conceive that but one step more would be needed to involve the medulla oblongata, producing a check to respiration, and its immediate consequence, death.

The *medulla oblongata* possesses, however, the singular property of resisting for a long period its morbid influence; and this certainly is a most beautiful provision. A slight derangement of those parts over which it has control, is all that we notice.

To conclude, the specific effect of the ether appears then to be exerted, to a certain extent, upon the whole nervous system. But the susceptibility of the various nervous centres to its influence, is not at all uniform,

either in the degree or rapidity of its action. To form our conclusions from what we have thus far been enabled to gather, it is apparent that the cerebellum is the first to yield. Next in succession, the cerebral ganglia become partially inactive, the spinal cord, and nearly at the same moment the ganglia of special sense; lastly, the medulla oblongata. These deductions may differ in a slight degree from those with which M. Flourens concludes his experiments upon animals; they are drawn more particularly from observations upon the human subject.

The accounts which have reached us of the experiments made by M. Flourens, will with justice be considered but a prelude of what is to follow. They may, however, be perused with interest by your readers, and I will therefore give a brief translation of some of the most important, as presented to the French Academy of Sciences, and this I will follow by the narration of an experiment made by M. Gerdy upon himself.

"We have seen," says M. Flourens, "by my preceding experiments, what is the action of the ether upon the spinal marrow. When we submit an animal to the action of the ether, the spinal marrow loses in the first place its power (as a conductor) of sensation; and, secondly, its motor power. It is particularly worthy of notice, that it is its power of conducting sensation that is first destroyed. Soon the moment arrives when both sensation and motion are abolished. Yet the animal continues to live, he respires still. How is this effected? It was to obtain an answer to this inquiry that my experiments upon the medulla oblongata were instituted.

"*The first Experiment upon a Dog.*—We submitted the animal to the inhalation of the ether. At the end of thirty-five or six minutes, the phenomena of etherization having appeared, we laid bare first, a portion of the spinal marrow, and then the medulla oblongata. This done, we pricked the posterior columns of the spinal marrow, we pinched, and we cut the posterior roots, and the animal felt nothing. We pinched the anterior root, and there was slight movement. The inhalation was then continued some minutes more. These elapsed, we again pinched the anterior roots, and the animal did not move. We pricked and cut the anterior columns of the spinal cord; still he remained motionless. The spinal marrow had then lost its two properties of sensation and of movement. We then explored the medulla oblongata. Upon pricking it the animal uttered a cry, and at the same time there was muscular contraction in the cervical region.

"*Second Experiment upon a Dog.*—At the end of twenty-five minutes the animal appeared completely etherized. We laid bare the spi-

nal marrow, and pressure upon one of the posterior roots produced a slight degree of pain. The etherization was continued, and in two or three minutes more, upon again pinching the posterior roots, he felt nothing. We pricked and cut the posterior columns; still there was no pain. We passed to the anterior roots and columns, we pinched, pricked and cut them, and the animal remained motionless.

“This immobility, this insensibility of the spinal marrow being established, the medulla oblongata, already laid bare, was then examined. On touching it there was a marked trembling of the animal from head to foot; at the same time there were very manifest contractions of the cervical muscles. I then divided the medulla oblongata at a point which I call the vital knot of the nervous system, and that which happens under similar circumstances to an animal who is in his ordinary state, occurs also to the animal who is etherized, viz., the sudden abolition of all the respiratory movements—in other words, sudden death.

“*Third Experiment upon a Dog.*—As soon as the animal appeared etherized, I again laid bare the spinal marrow and the medulla oblongata. There was the same loss of feeling and of motion in the spinal marrow, the same persistence of both in the medulla oblongata, and in fine the same sudden death upon a section at the vital point in the latter. I will not add new experiments. Who does not see that the solution for which I sought is found? The spinal marrow loses its principles of sensation and of movement, yet the animal still lives, because the action of the medulla oblongata survives the action of the spinal marrow. In other terms, when we submit an animal to the influence of the ether, the nervous centres lose successively their force in a given order. First, the cerebral lobes, that is to say, intelligence, is lost. Then the cerebellum, that is to say, the equilibrium of the movements of locomotion; then the spinal marrow, or the principles of sensation and of movement; and lastly, the medulla oblongata survives alone in its action. It is on this account that life still continues.

“After having made with the sulphuric ether these experiments, and many others which I cannot report here, I wished to try other ethers. I commenced with the chlorohydric (hydrochloric) ether. The effect of this ether has been the same as that of the sulphuric ether. It has produced the same general insensibility; the insensibility of the posterior columns and posterior roots of the spinal cord, and the same immobility of the anterior columns and roots, with this difference, and it is a circumstance which may have its importance—the hydrochloric ether acts much more promptly than the sulphuric. At the end of twelve

minutes the etherization is complete, and as this effect takes place much sooner than with the sulphuric, so it disappears much more rapidly.

"In three successive experiments made with the nitric ether the animal has each time succumbed in between one and two minutes.

"The inhalation of alcohol has never given any result similar to the singular phenomena of etherization. With alcohol the animal becomes drunk, but he neither loses sensation nor motion.

"I shall continue these various experiments," continues M. Flourens, "waiting the new results which they are capable of affording. Those which precede are sufficient to establish—1st. That the action of the ether is successive and progressive; and 2d, that this successive action attacks first the cerebral lobes, then the cerebellum, then the spinal marrow, and lastly the medulla oblongata. Thus the animal loses first intelligence, then equilibrium of movement, then loses sensation and the power of movement. After this, the next step is the loss of life. It is this," says M. Flourens, in terminating, "that it will be necessary for the surgeon to have constantly in mind, that the ether which drives away pain can also drive away life; and that this new agent which surgery has now acquired, is at once marvellous and terrible."

M. Gerdy has watched and noted his own experience when etherized, with much accuracy. His description of this experiment is as follows.

"I submitted myself to the inspiration of air charged with ether. The sensations which I experienced in the throat caused me at first to cough, but being resolved to resist this, I readily triumphed over so petty an obstacle. The prickling and the cough gradually ceased. From this moment I experienced a sensation of numbness, with heat, as if alcoholic and inebriating vapor were mounting to the brain. This numbness spread itself quickly. Commencing in the feet and toes, it extended to the limbs and at the same time to the arms, after that to the loins, &c. It increased rapidly at each inspiration. It was accompanied in the sensible organs by a feeling of agreeable heat, by a sensation of crawling, of trembling or of vibration, similar to that which we experience on touching a vibrating body. These two impressions, when they have arrived at their acme, produce an obtuse impression, very agreeable and full of voluptuousness, an impression analogous to that of intoxication. The numbness caused by the ether is similar to that which arises from hydrochlorate of morphia or opium. It is this numbness which, blunting the general susceptibility, diminishes pain during operations.

"Sight is not sensibly affected by this numbness, for I read some philosophical signs by a feeble light, at a moment when I was powerfully be-

numbed. Hearing was more altered ; it became less and less distinct as the inebriety augmented, and became more and more clear and distinct as this disappeared. In truth it was easy to believe that the noises were growing more obscure because they were becoming more distant, and that they afterwards became clearer because they approached. Notwithstanding this, the more profound the numbness, the greater the resonance produced by sound ; but this intensity did not render it more clear. I am well assured that the senses of smell, of taste, of tact properly so called, were not paralyzed by the general numbness which I experienced, but I felt that the eyelids were heavy, a desire for sleep, and above all a wish to abandon myself to the delights with which I was infatuated. However, either because these phenomena had acquired the greatest degree of their development, or because I wished to observe myself until the last moment, I would not yield to the seductions which enticed me, and I *did not* fall asleep. I continued to study myself, and as I examined my sensations I directed my attention to my intellectual functions. I remarked, then, that with the exception of the vibratory sensation of numbness, which rendered my general tactile sensation and pain obtuse ; with the exception of the ringing in the ear, which prevented my distinguishing perfectly what I heard, my perceptions and thoughts were very clear, and my intelligence perfectly free. My attention was also very active, my will firm, so firm that I willed to walk, and I walked, that I might observe the state of my locomotive powers. I then discovered that my muscles were a little less sure and less precise in their movements, somewhat similar to those of a person slightly intoxicated, or who is at least rendered giddy by alcoholic drink. With the exception of the pronunciation, which was embarrassed and slow, the other functions of the animal economy did not seem to me to be sensibly altered. My pulse, examined at the moment when I was most benumbed, presented no marked change from a healthy standard."

"The same experiment, repeated upon six or eight persons, men and women, has given analogous results, although not absolutely similar. Some lost, as in sleep, their consciousness, while others were gay and had obscurity of vision, which last, however, was not present in the majority of cases."

In another communication to the Academy, M. Gerdy makes the following brief observations, which may prove well deserving of consideration. "From the fact," he says, "that an individual has submitted to a long and painful operation for the extraction of polypus of the nose, without experiencing the least fatigue, although he was not asleep, is it

not permitted us to hope that it will be the same in many similar cases? Does it not permit us to establish as a principle, that it is not indispensable to push the etherization until sleep has been brought on? Are we not forced to think that the etherization, when carried beyond sleep, even to general coldness or to feebleness of pulse, is dangerous? In fine, is it not permitted us to hope that it will frequently be sufficient simply to produce a general numbness, even without sleep, in order to greatly diminish the pain of operations and render them very supportable? It is on this account that I have not endeavored to produce profound sleep in the cases which I have related, but have hastened to operate."

In concluding this subject, I cannot refrain from repeating the opinion expressed in a former part of this article, confirmed, as we have now seen it, by various authors of acknowledged repute. It is apparent that the student of physiology has now opening before him a new path. New mysteries are now presented, to inspire in his mind renewed ardor of inquiry; an added impulse is given to his labors, and they are cheered by the hope that in the exploration of these, some of those which have hitherto escaped his keenest scrutiny will be unveiled, thus crowning his efforts with a most glorious reward.

*Boston, June 3, 1847.*

## APPENDIX.

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SINCE the publication of the foregoing paper, I have been pursuing a series of experiments with ether on animals, which, with their results, may serve still farther to illustrate previous observations ; some of these I will, on this account, briefly relate. Thus far they have confirmed, in a most satisfactory manner, the deductions which are there drawn from observation of the phenomena of etherism in the human subject, and also some of those which foreign physiologists have deduced from their experiments upon animals.

I will first, however, relate a case which lately occurred, furnishing, as it does, additional testimony, perhaps, somewhat remarkable in its character, in proof of that curious state of the brain, of the organs of sense and of the faculty of memory in an etherized subject, which has been particularly referred to in the previous pages.

It was as follows :—

Miss I. G., aged 23, was affected with powerful adduction of the os femoris, that greatly impeded walking, so much so, that anything beyond an exceedingly slow movement was rendered impossible. The adductor longus, and the gracilis, were divided a few inches from their origin by Dr. J. B. Brown, on the 31st of May, Dr. J. M. Warren and myself assisting at the operation.

In this instance, sponges alone were used for the administration of ether, an apparatus for that purpose having been found in most cases an useless encumbrance. She was soon evidently under its influence, exhibiting the usual appearance of a person in this state.

There was great dilatation of the pupils, and some degree of stertorous breathing, apparent total unconsciousness of all that was passing around her, and most certainly she was completely insensible to even the slightest degree of pain from the operation. When spoken to, she obeyed, or answered so far as to say that she could or could not do what was requested of her. There was some degree of stiffness of the joints, the etherism not having been carried so far as to produce muscular relaxation. Her eyes were widely opened, the pupils, as before stated, much dilated, and from their appearance, an observer would have supposed it utterly impos-

sible that an organ so fixed and glassy, and presenting so striking a contrast to its natural aspect, could have performed its office, or in any way have afforded a means of communication with the external world.

It appears, however, that the true state of this sense was very different. On her recovery, I learnt that she had indeed suffered no pain, was not aware that the operation had taken place, and had felt nothing that was done to herself, with the exception of a dim remembrance of having been moved; but, to all that was going on around her, she had been perfectly conscious. That she had seen and recognized each person near her, and those who entered and quitted the room, and that, still more, a connected train of thought had been passing in her mind. She had, she said, fixed her eyes upon the countenance of one of the gentlemen present, whom she had not before seen, with a wish to carry it in her memory, being fully possessed with the belief that all was now occurring in a dream, and thought to herself, "should I ever meet that man in real life and in the day time, whether in the street or any where else, I shall be sure to know him." Although he left before she had recovered from the effects of the ether, yet she described him accurately. In her remembrance of what had occurred, the order in which events took place seemed to have been somewhat deranged, and others she had, perhaps, forgotten.

One of the remarkable and valuable gifts which this discovery has presented to the world, is that of enabling the physiologist to pursue his researches and to perform experiments upon the living animal, without that infliction of suffering which is so revolting to his own best feelings, and from which all, not naturally callous, must shrink with emotions of painful sympathy.

Undoubtedly at times, a great and important point, or some mooted question in regard to the functions of some of the chief nerves or nervous centres was to be settled, the solution of which bore an important connection with the diseases and the sufferings of man. Then it must have been a duty in those who generously applied themselves to the task, to make a sacrifice of their own feelings, and endeavor to elucidate a subject which has been until recently so completely buried in mystery.

This has been the experience, undoubtedly, of many of those whose researches have placed our knowledge of the functions of the nervous system in its present advanced state.

When, however, those inquiries were once fairly answered, and the role which this or that nerve plays in the body of a living animal well ascertained, it has truly appeared a work of useless cruelty to repeat, as

has been done in Paris, day after day, the same experiments, merely that a new student or a new class of students should have an opportunity of visually demonstrating those facts which he may find clearly stated in his text books.

Now, however, many of those inquiries which have an aim of real utility in view, may be pursued without the infliction, during the operation at least, of the slightest degree of pain. And the subject is also removed from that great amount of uncertainty, which must always veil, in some degree of doubt, those results which have been obtained after the shock which the pain of a severe operation necessarily gives to the system. This shock has been, undoubtedly, in numerous instances, so great as to defeat the whole end of the experimenter, or else lead him into serious and fatal error.

The question, then, merges itself in this: shall animals, such as cats or valueless dogs, which are every day put out of existence in almost innumerable quantities, be of service, and even of important service, in their deaths? Shall all that beautiful and complicated machinery be allowed to decay at the bottom of some ditch, or shall it, without pain, or even the infliction of a greater degree of discomfort than occurs in drowning, serve for the advancement and the well being of humanity?

All will answer in the affirmative; and this will be, we hope, one of the means by which science will make strides even more rapid than those which have characterized its progress during the last half century.

My first experiment was upon a cat. She was fully etherized in about eight minutes. Previous to this state of complete torpor, on withdrawing the sponge there were the same irregular staggering movements which we have heretofore observed, denoting an affection of the cerebellum; and a commencing enlargement of the pupil, which was afterwards dilated to the full extent of which it was capable. She then lay with no sign of life, excepting an irregular motion of the diaphragm. The animal was in this state twenty minutes, during which time I did two operations, with a view to determining whether the degree of muscular relaxation was such as seriously to interfere with the performance of tenotomy, and thus prevent a full application of ether in cases in which this operation is to be performed. In those cases of contraction where we have previously made use of ether during the division of tendons, it has never been permitted to produce its full effect, but merely carried to such an extent as to blunt the sensibility and tranquillize the nerves. And this is all that need be done in a majority of cases, in which a short operation only is

requisite. But other cases may occur, in which a more complete insensibility may be necessary. At such times, it will be important to know whether the continued application of ether will, or will not, render the muscles so relaxed as to prevent their tendons being easily divisible by the knife. I divided sub-cutaneously the flexor tendons of the left fore foot, and the tendo-achillis in the hind leg. The former, from the nature of their situation, in addition to their state of flaccidity, were divided with some degree of difficulty. The tendo-achillis, favored by its natural prominence, was divided with great ease.

In four minutes after removing the sponge, the pupil commenced contracting; in two more, she had universal trembling from head to foot; evidently, action connected with the spinal system, independently of all sensation. This lasted eight or ten minutes: she then turned herself over, and shortly afterwards was sufficiently restored to crawl about the room, and in the course of the afternoon seemed to have recovered.

The end I had in view in performing the second experiment, was not attained, although I had the pleasure of observing various phenomena, well known theoretically, but never before so beautifully and satisfactorily placed before me.

It was my intention in this experiment to have completed one of those which M. Flourens had so happily commenced, and which has been previously narrated.

In this and the succeeding, I was assisted by Dr. W. W. Morland. But on account of the difficulty experienced in fulfilling our intention, and laying bare the brain in so young and delicate a subject (a kitten four weeks old) without causing hemorrhage so profuse as to render it probable that death would ensue before our design could be accomplished, it was found necessary to abandon it.

We had, however, an opportunity for the observance of the singular and long continued impulse of the heart after decapitation. Its separate, individualized auricular and ventricular action, was most beautifully exemplified. And the peristaltic motion of the intestines was prolonged for a considerable length of time by use of electro-magnetism applied at each extremity of the spinal cord. This power also produced a return of the respiratory movements, as well as the usual spasm of the limbs.

The last experiment to which I will here refer, was simply a verification of the statement made by M. Ducros, but which had, I believe, never been tested in this country, viz., the effect of electricity in producing

speedy recovery from the death-like state in which an animal is placed when fully etherized.

In six minutes the animal lay stretched upon the table in a state so nearly resembling death that it required close observation to catch its slow and irregular breathing, which alone indicated that the vital spark had not in reality fled.

We then put in action the electro-magnetic apparatus, placing one wire on the occiput and the other on the sacrum. The shocks passed with very great rapidity. But three or four had been received before the animal began to move, and rose with an uncertain, staggering motion to its feet. It required but a few more to give it complete steadiness, and in about six minutes it was running about upon the floor, apparently as well as ever, and ate a dinner of meat with a most excellent appetite.

This experiment, strongly corroborating the testimony heretofore adduced to the efficiency of electricity, is of value.

The resuscitation in this instance was perfect, and, as compared with former instances in which the only agent was atmospheric air, aided, perhaps, by a little cold water, its rapidity was truly astonishing.

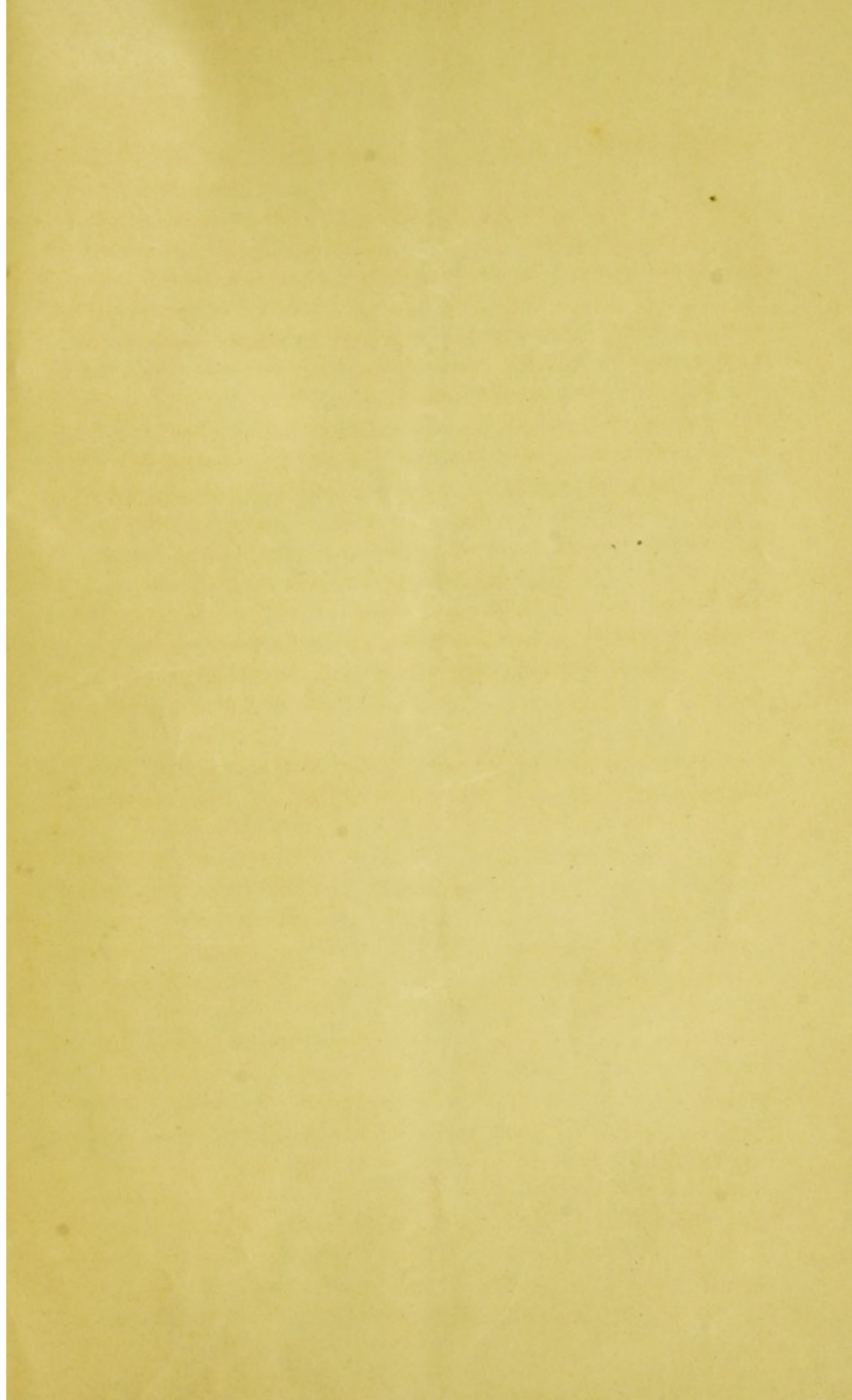
spedily removed from the deathlike state in which an animal is placed when fully anesthetized.

In six minutes the animal lay stretched upon the table in a state so nearly resembling death that it required close observation to catch its slow and irregular breathing, which alone indicated that the vital spark had not in reality fled.

We then put to action the electric apparatus, placing one wire on the occiput and the other on the scapula. The shocks passed with very great rapidity. But three or four had been received before the animal began to move, and soon with an uncertain staggering motion to its feet. It required but a few more to give it complete steadiness, and in about six minutes it was standing upon the floor, apparently as well as ever, and ate a dinner of meat with a most excellent appetite.

This experiment strongly corroborates the testimony previously adduced to the efficacy of electricity in its use.

The resuscitation in this instance was perfect, and as compared with former instances in which the only agent was atmospheric air, which perhaps for a little cold season is rapidly and truly a substitute.



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