has been arrested in its growth. An extended series of observations is required; and, as the cases are but rare, it will probably be a considerable time before all the facts connected with Superfoetation are known. A careful reflection on the cases which have been recorded, leaves in my mind no doubt of its having actually occurred, both where the uterus has been of the usual form, and where it has been double, or bilobed. It may take place during the first days of pregnancy, before the formation of the uterine plug; and also subsequently, within a limited period, if this plug have been removed by any cause, provided that the necessary ovarian nisis be present.

Essex House, Putney, November 1849.

EXPERIMENTAL AND PRACTICAL OBSERVATIONS ON THE USE OF CHLOROFORM IN MIDWIFERY;

AND ON THE INFLUENCE EXERTED BY THIS ANÆSTHETIC UPON THE
MOTOR POWERS CONCERNED IN PARTURITION.

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I AM not aware that any experiments have been performed, with a view to decide upon the influence of Chloroform on uterine muscular action. The following is a contribution to this interesting subject, and may, perhaps, tend to throw some light upon the physiological relations of Chloroform to Obstetric practice. Chloroform promises to be a great boon to the experimentalist, since it renders the most formidable vivisection as painless as dissection after death. It must, however, be borne in mind, that from the intense action of this agent upon the nervous system, it is extremely liable to complicate any nervi-motor experiments in which it may be employed. But this objection does not apply to experiments upon the action of Chloroform itself upon the nervous centres. In experiments of this latter kind, we can witness the action of Chloroform without the disturbing influence of pain; in all other experiments, we certainly lose the interference of pain and all its results, if we employ Chloroform, but we inevitably have a certain amount of derangement of the nervous functions from the anæsthetic. My present object is not so much to deal with the question of the propriety or impropriety of Chloroform in midwifery, as to inquire, how Chloroform acts towards the motor powers concerned in natural parturition, and in the accidents of the parturient and puerperal state dependent upon an abnormal condition of those powers? I would wish to consider it impartially, not as a poison, or as an agent with power to allay the agonies of surgery and obstetrics; but as a medicine capable of modifying the motor powers of the uterus, upon the integrity of which safe and natural parturition depends.

Observation 1. A guinea-pig being placed under the influence of Chloroform, the effects were carefully observed in the uninjured animal. At first, the breathing became hurried and increased in vigour, and the limbs, particularly the posterior extremities, were convulsed. When

the limbs were pinched, they were smartly retracted by reflex action. It was evident that, as a first effect, the function of the spinal marrow was *exalted*. This appears to agree very well with the opinions of numerous observers, to the effect that when parturient women are lapsing into, and recovering from, the anæsthesia of Chloroform, the pains of labour are somewhat increased in power.

Observation 2. After a few minutes, the respiratory movements diminished in force and frequency, becoming chiefly diaphragmatic. The limbs remained stiff, even when pinched or pricked, so that neither *sensation* nor *reflex* motor action remained. Everything now indicated that the energy of the spinal function was *diminished*. When the Chloroform was pushed to a further extent, the sphincters of the rectum and bladder were relaxed, so as to allow of the escape of their contents, and all the muscles of the body appeared loose and flaccid. This appears to agree with what is observed in the obstetric use of Chloroform,—namely, that the muscles of the outlet of the pelvis, and the vagina, are all relaxed (though the relaxation may not reach to the extent of allowing the urine and fæces to escape), the expulsion of the fœtus being thus considerably facilitated.

Observation 3. The spinal marrow being divided in the dorsal region, while the animal was in deep anæsthesia, and the abdomen laid open, a stilet was passed down the spinal canal, so as to destroy the lower portion of the spinal marrow. In ordinary circumstances, violent movements of the limbs attend the laceration of the spinal cord, but here, no movements whatever occurred. Thus the *direct* as well as the *reflex* motor actions were annihilated.

Observation 4. It was observed, that notwithstanding the destruction of the spinal marrow, the uterus, and the rectum and colon, were affected with vigorous peristaltic action, under the stimulus of the air, pricking with a needle, caustic, potash, etc. The guinea-pig is remarkably well adapted for observing the uterine peristaltic action; as even in the unimpregnated state, the cornu and body of the uterus are abundantly muscular, and endowed with peristaltic action.¹

Observation 5. When the Chloroform had been continued sufficiently long to annihilate all the other reflex actions, imperfect acts of respiration still continued. The thorax and the neck being laid open, the *nares*, the *larynx*, and the *diaphragm*, were seen to move simultaneously from time to time, as in inspiration. These organs, associated together by the *facial*, *laryngeal*, and *phrenic* nerves, continued in action some time after all the external muscles of respiration had ceased to move. These three organs were, in fact, the *ultima movens* of respiration; just as respiration is itself the last spinal function which remains active in poison by Chloroform. But for this persistence of respiration, accidents from the use of anæsthetics would doubtless be more frequent than they are at present.

¹ My friend, Mr. Barlow, of the Westminster Hospital, informs me that he has repeated the experiment on the unimpregnated guinea-pig, and found the destruction of the spinal function to be as I have described it, but he failed to observe the peristaltic action of the uterus. I can only account for this by supposing that it had contracted to its full extent before Mr. Barlow directed his attention to it. In my experiments, the uterine peristaltic action was witnessed by Dr. Marshall Hall, and Mr. Henry Smith, of Torrington Square.

Observation 6. After the total loss of the spinal function, whether as tested by the irritation of the excitor nerves, or by the laceration of the spinal centre, the power of the motor nerves still remained. A nerve supplying the abdominal muscles being isolated, and pinched with the forceps, these muscles readily contracted.

Observation 7. A fresh guinea-pig was nearly killed with Chloroform, and a stilet was at once passed through the whole of her spinal marrow, from the cauda to the cranium, but no spinal movement of any kind took place. In other respects, the same phenomena, as those which have been above detailed, took place. The spinal marrow was broken down entirely; still the peristaltic action of the heart, intestines, and uterus had not ceased. The contraction of the heart, intestines, and of the uterus, had each their own peculiarities of action. The heart and the intestines both contracted and dilated, as having to receive, and to transmit onwards, their contents. The uterus only shortens itself, as in an effort to expel its contents through the vagina. The uterus and intestines continued to act, moreover, after the beat of the heart had ceased. Thus there is apparently a certain definite order of dying, in the different organs under the control of the ganglionic system. In the human subject, the uterus evidently contracts so as to deliver its contents, after both heart and intestines have ceased to act; it is the *ultima movens* of the ganglionic system, just as the respiratory organs are of the spinal system.

Observation 8. But, lest it should be said that the spinal function was annihilated in these experiments, not by Chloroform, but by death, or by grave injury to the animal, it was determined to repeat them upon the frog, in which the reflex function remains active for at least a quarter of an hour after death: thus giving abundant scope for the observation of the effects of Chloroform upon the spinal portion of the nervous system. A healthy male frog was selected for experiment.

Observation 9. The frog was placed under a glass inclosing a little bibulous paper, wet with Chloroform. In a very brief space it became quiet, and lost all power of voluntary motion. When the animal became thoroughly under the influence of Chloroform, the most excitor parts of the surface of the body were successively irritated in order to test for reflex action. The conjunctiva, the eyelids, and the anus were pricked with a needle, without inducing closure of the eyelid or retraction of the lower limbs. The toes and the tubercles on the thumb, which, together with the testes, were considerably developed, notwithstanding the early season (October), were pinched without any motor result. Before the application of Chloroform, the tubercles in this frog, and the inner surface of the fore-arm, were found to be intensely excitor. These trials proved that, in the living frog, under Chloroform, the spinal reflex function remains in complete abeyance. Even the respiratory movements ceased entirely. On being removed from the Chloroform vapour, the animal recovered, notwithstanding the cessation of the respiratory movements for a considerable time—its recovery being probably owing to the influence of the skin as a respiratory organ.

Observation 10. A vigorous frog was placed as before, but turned upon its back so as to show the influence of Chloroform upon the heart's action: the impulse of the heart being visible upon the surface of

the body. The influence of the Chloroform was continued until the heart ceased to beat, and the animal was dead. The head was now removed, and a fine needle passed through the medulla oblongata. No movements whatever of the eyelids occurred. In ordinary circumstances in such an experiment, the eyes are drawn in powerfully, at the moment of destroying the upper portion of the spinal marrow.

Observation 11. The needle was now passed down the spinal canal; no movements whatever of the fore-arms took place, nor did any movements occur until the needle had reached the origins of the nerves at the bottom of the canal, when slight movements of the extremities were observed. The laceration of the spinal marrow itself produced no effect. This organ was evidently dead to all excitation, whether applied directly to the spinal marrow itself, or in the form of irritation to excitor nerves.

Observation 12. The nerves, also, were found to have lost their excitability, except at the time when they were irritated, as described, within the spinal canal. A large motor nerve being dissected out, was pinched without causing the slightest movement in the limb to which it was distributed. The galvanic stimulus was then applied to the nerve, with a like negative result. In this respect, the frog differed from the mammiferous animal. In the one, the *vis nervosa* remained active; in the other, it was entirely destroyed.

Observation 13. Another difference was also apparent. In the guinea-pig, the irritability of the muscles remained vigorously active for some time after death. In the frog, the influence of the Chloroform appeared much more intense. The muscles, being stimulated with galvanism, contracted very feebly. Even the muscular irritability, the last motor power which remains under ordinary circumstances, was impaired.

Observation 14. A remarkable phenomenon appeared as the last of the series. The *post-mortem* rigidity, which in the frog is very remarkable, and generally develops itself three or four hours after death, set in within ten minutes from the time when the beat of the heart ceased. The entire animal was extended and perfectly rigid. This fact renders the application of Chloroform, in the case of the frog, a very important agent for studying the nature of this peculiar form of contraction. The entire death of the frog under Chloroform is more rapid than death from the most virulent poisons; the animal dies more quickly than from either hydrocyanic acid or strychnine!

Observation 18. It remains to apply the preceding observations to the use of Chloroform in Obstetrics, and to its influence upon the physiology of parturition. The advocates of Chloroform in midwifery, admit that it exerts some influence upon the motor actions of labour. There are few who maintain, that under its use, anæsthesia is the simple and uncomplicated result,—that it annuls pain without in any degree affecting the motor powers concerned in labour. The advocates of anæsthesia maintain, however, that the perturbation of the natural actions of labour do not produce any ill results.

Observation 19. The opponents of anæsthesia in labour, contend not only that Chloroform affects the motor actions of labour, but that it affects them injuriously, weakening the parturient motor powers to such

an extent as to lead to retention of the placenta, uterine hæmorrhage after and during labour, and inertia of the uterus, to such an extent as to require the forceps or craniotomy, in cases when delivery would otherwise have occurred naturally. Both parties, the Chloroformists and the anti-Chloroformists, appeal to experience. But, in the present state of the matter, the experience on the subject is scarcely voluminous enough, or sufficiently well-authenticated, to justify an authoritative conclusion. Under these circumstances, physiology and physiological experiment can be appealed to, for at least some aid in the solution of the *questio vexata*, as well as to account for some of the contradictions which appear in the evidence furnished by experiments. In all such cases, physiology must necessarily be an important court of appeal.

Observation 20. The increased uterine action observed under the administration of Chloroform in natural parturition, would appear to be analogous to the increase of the spinal function on the first inhalation of this agent. A thousand facts in obstetrics testify most irrefragably to the influence of the spinal marrow, and of the reflex function, in parturition. That, under the influence of Chloroform, stimulation of the spinal marrow is observed in the first instance, appears to be proved experimentally. In human labour, the motor influence of Chloroform may be also increased by mental emotion, at the instants of passing into, and escaping from, anæsthesia. In some cases, when the anæsthetic is used in great moderation, its effects, however long continued, may, perhaps, be simply stimulant.

Observation 21. Where the motor pains of labour are rendered less vigorous by Chloroform, we may infer that it is because the function of the spinal marrow, particularly of its lower portions, is enfeebled by Chloroform, as in the experiments in which the reflex actions were so much reduced in power. The uterus and the parturient function are left chiefly to the peristaltic action of the organ.

Observation 22. But we know, that under these circumstances, delivery nevertheless takes place. The pains may appear weaker, but the child is expelled in many cases without any unusual delay, and, in others, after labours of very tardy progress. In many cases where the labour is completed within the common period, labour is said not to be interfered with by Chloroform, though in reality it may be, to a very considerable extent.

Observation 23. It has been mentioned, that in deep chloroformization, the sphincteric orifices of the pelvic viscera are relaxed. In the use of Chloroform in labour, it is universally maintained, that unusual relaxation of the vagina and perinæum is produced. This is naturally explained by the diminished energy of the spinal function. The vagina, the muscles of the perinæum, and of the floor of the pelvis, lose some of that reflex power which affects all muscles, and by virtue of which they resist the passage of the fœtus, until full dilatation has been performed by the gradual advance of ordinary labour. Thus, though in the use of Chloroform in labour, a power of expulsion is taken away, a power of resistance is at the same time withdrawn. In the balance of the two, labour proceeds, and, in some cases, even more rapidly than usual; in others, again, the process is very tardy or impossible. As already observed, Chloroform does not commonly dilate the sphincters when

given in labour, or in operations, to such an extent as to cause the escape of the contents of the bowels and bladder; but it does so when given in excess. In the relaxation of the parturient passages in labour, the dilatation, though partial, is still sufficient to render labour performable, by a less exercise of motor force than usual. The existence of dilatation is at once an indication of the presence, and a measure of the extent, of the failure of the spinal motor powers in parturition.

Observation 24. It has been seen experimentally, that the peristaltic action of the uterus continues vigorous after the total annihilation of the direct and reflex action of the spinal system. It is this power which effects delivery, in some cases, in the human subject in paraplegia, and even after death, when at least the actions of respiration, and of the heart, have entirely ceased. In cases of labour proceeding under the influence of Chloroform, when the anæsthetic is pushed to the extent of enfeebling the spinal function, it is, as I believe, the peristaltic action of the uterus which, in the great majority of cases, is then the principal agent in delivery.

Observation 25. Thus, in anæsthetic midwifery, the natural arrangement of the motor powers appear to be modified in the following manner. The reflex function, as concerned in parturition, is affected in two modes. 1. The reflex actions are weakened, so that the impression of the advancing fœtus upon the excitor nerves of the parturient canal does not excite their wonted reflex actions to the same extent as usual. The spinal *contractions* are below the average. 2. On the other hand, all the parts concerned in the dilatation of the parturient passage and outlet, are in a state of relaxation, depending upon the condition of the spinal function. The spinal *dilatations* are increased by the influence of Chloroform. While this state of things obtains, the peristaltic action depending upon the ganglionic system remains in the ordinary state of activity, and in the relaxed state of the passages, is sufficient in many cases to effect the delivery of the fœtus, without any unusual delay. This dilatation of the parturient canal also exists in certain cases of paraplegia, and even after death; so that the occurrence of delivery during profound anæsthesia—the occurrence of delivery, in some cases, in experiments in which the lower portion of the spinal marrow is injured or destroyed—the occurrence of delivery in the dead subject,—are no proofs whatever that the spinal marrow is not actively concerned in natural parturition, or that peristaltic action is the sole power by which the fœtus is expelled in natural labour in the human female, where the dilatation of the parturient canal is commonly a painful process. Delivery under Chloroform, appears, then, to be a pathological condition, in which, as regards the motor actions, a state of artificial dilatation compensates, in some degree, for the deficiency of expulsive power. From these data, as it appears to me, we must survey the motor derangements which are declared sometimes to occur in the practice of Chloroform.

Observation 26. The facts relating to the destruction of the spinal functions, including the respiratory function, tend to show, that in the treatment of persons dangerously affected by Chloroform, the attempt to excite artificial respiration alone is not likely to be attended with success; but that the peristaltic action of the heart should be kept up

by galvanism, and other direct stimuli, until, if possible, the poison shall have been eliminated from the spinal system. It appears evident, that after the reflex movements of respiration have ceased, the heart may still act; and to this organ attention should, I think, be chiefly directed in the attempts at resuscitation in accidental poisoning by Chloroform.

Observation 27. The experiments detailed, furnish some important obstetric hints of a practical nature. It has been recommended by the advocates of anæsthesia, that the ergot of rye should be given with Chloroform, in certain cases, in order to strengthen the actions of the uterus in tardy labours. A little consideration will show, however, that the ergot is not likely to be serviceable in uterine inertia, complicated with Chloroformization. There can be no doubt, that the ergot itself acts as a spinal excitant, sometimes even producing general tetanic movements in the limbs of the parturient woman. It is little better than a contradiction, to give a spinal *stimulant* and a spinal *sedative*, at one and the same time. The true indication in this form of inertia would be, to stimulate the peristaltic action of the uterus by galvanism, or by direct mechanical irritation. The appeal should be made, not to the spinal function—at least not while the influence of the anæsthetic continues—but to the peristaltic action of the uterus, which remains unimpaired by the Chloroform, after the spinal function has been enfeebled.

Observation 28. In uterine hæmorrhage after delivery, occurring under the use of Chloroform, the knowledge of the peculiar way in which this agent affects the nervous system, supplies important indications of treatment. Reliance should not be placed upon the administration of ergot, or the excitation of uterine reflex action by cold and other means; but on mechanical pressure, the galvanic stimulus applied to the uterus, and direct mechanical stimulation of the organ. In the arrest of uterine hæmorrhage under Chloroform, there can be little doubt, that we have the serious disadvantage of the loss of one of the most efficient motor powers for its arrest. Similar considerations also apply to those labours and obstetric operations, in which a diminution of the motor force of the uterus is of temporary advantage, and in which a safe and manageable sedative of the utero-spinal action would be an invaluable boon; but to enter fully upon these matters on the present occasion, would occupy more space and time than I can either claim or afford.

Observation 29. The principal conclusion deducible from the experiments detailed in the present paper, and warranted by the experience of Chloroform in midwifery, upon which I would insist, is this,—that Chloroform enfeebles the action of the spinal marrow and the reflex function, *pro tanto*, according to the profoundness of the anæsthesia induced, but that it leaves the peristaltic actions little, if at all, affected, so long as life continues. Besides the influence of volition and emotion, the action of the uterus in PARTURITION is both REFLEX and PERISTALTIC; the peristaltic action being, as I have insisted, in my work on *Parturition and Obstetrics*, “the basis of the other uterine actions”,—“the basis or radical element upon which the other causes of motor action operate”; and I quote these words to show that I have not underrated the importance of uterine peristaltic action. Setting aside natural labour, abnormal parturition may be divided into two great classes,—

1. Parturition with diminished motor action. 2. Parturition with excessive motor action. The study of the relation of Chloroform to these two classes of difficult labour, and to the different forms of motor power concerned in natural and difficult parturition, is scarcely less important than its study as an anæsthetic. I have attempted to supply the indications according to which this study should be pursued.

NOTE. In the discussion on the employment of Chloroform in midwifery, in the course of which the experiments detailed in the preceding paper were briefly alluded to,¹ Mr. Barlow is reported to have observed as follows: "He had heard it said that the production of anæsthesia in cases of midwifery, had shown that the uterus was independent of the spinal cord. They showed nothing of the kind. How could it be said that the influence of the cord was withdrawn from the uterus, as long as breathing continued? Was it possible to destroy the function of the cord below, and yet leave the medulla active, there being only one circulation for the whole cord?" Fully coinciding with the first remark of Mr. Barlow, I would refer to Observation 5, as giving the answer to his two most important interrogations. The function of the medulla oblongata *does* appear to continue, after the rest of the spinal marrow has died. I find that a confirmation of this observation may be drawn from a detail² of some excellent experiments performed by Dr. Sibson, but without any reference to uterine action. Dr. Sibson says, "As the action of Chloroform increases, costal respiration ceases, and the diaphragm only acts; the functions of the spinal marrow being gradually destroyed *from below upwards*." This is in strict accordance with what I have observed, and the mode of dying peculiar to the spinal marrow, is very important with reference to the influence of Chloroform upon the functions of this organ, and especially with reference to the uterine reflex actions.

Bolton Street, Piccadilly, November 1849.

¹ Vide Report of Proceedings of Westminster Medical Society, Oct. 27, and Nov. 3.

² Medical Gazette, February 18th, 1848.