saline antimonial mixture to keep the circulation quiet. Everything seemed to go on favourably till the evening of May 18th, when he complained of heat of the scalp; the pulse rose to 94. Ice was applied to the head, after twelve leeches had been used.

May 19th. Pulse 110. The scalp was hot; the pupils were rather dilated and sluggish. The patient did not appear conscious unless spoken to loudly, when he answered rationally. The treatment was continued, with the addition of a few doses of calomel.

May 20th. The coma had increased during the night, and once or twice he had attempted to get out of bed; the pulse varied at short intervals from 90 to 130. It was now evident that, although the depressed bone had not of itself produced any serious symptoms calling for its removal at an earlier period, yet the results of the depression, the inflammation set up in the encephalon by it, rendered an operation necessary to give exit to the inflammatory products. The wound was accordingly enlarged; and a portion of bone being removed by a Hey's saw, gave exit to a small quantity of pus, and allowed the extraction of two pieces of the inner table of the skull which had perforated the dura mater, and were sticking in the substance of the brain; the dura mater was dark and sloughy. Water dressing was applied to the parts. The man never recovered consciousness, though he lingered till the 23rd, when he died. His friends refused to allow a *post mortem* examination.

Original Communications.

THE FEVER OF LEICESTER.

By JOHN SLOANE, M.D., House Surgeon to the Leicester Infirmary.

[Read before the Midland Branch, June 18th.]

IN 1816 Broussais promulgated the doctrine that fever was caused by irritation or inflammation of the gastro-enteric mucous membrane. This doctrine was very generally received on the continent of Europe, but not in the United Kingdom, because in our own country, especially in Ireland and Scotland, those lesions of the intestinal canal were rarely seen after death which were so frequently found in France. The medical profession was divided into two parties on this question; those who held the opinions of Broussais were called non-essentialists, and those who dissented from them essentialists. Dr. Gerhard, of Philadelphia, was, I believe, the first to infer that the opinions held by the respective parties had been arrived at after observations made upon two distinct and separate diseases. M. Montault, M. Valleix, Dr. Henderson, and the late Dr. John Reid, Dr. Stewart, and M. Louis, in their respective articles on fever, successively became converts to this view, but it was not generally accepted till after the appearance of Dr. Jenner's paper in the *Medico-Chirurgical Transactions* for 1849, in which he ably proved that the fever in which ulceration of the intestine occurred was decidedly a different disease from that in which the bowel was not ulcerated. The latter he termed typhus, the former typhoid fever. He also described a febrile affection, which he named relapsing fever, which I believe to be rare; and as I have not seen an example of it in Leicester, I shall not again allude to it.

In the years 1847, 1848 and 1849, at the London Fever Hospital were observed 158 cases of typhus in relatives likely to visit each other, or in residents in the same house; and 25 cases of typhoid in persons under similar circumstances. If these had not been diseases caused by distinct and separate contagious poisons, we should have expected in these 183 cases some patient who had been exposed to the contagion of typhus to have exhibited the phenomena observable in typhoid fever, and the converse; but this occurred in only one instance.

"A man, aged 46, was admitted October 10th with well marked typhus fever, and his son, aged 16, had been received into the Hospital on September 19th with equally well marked typhoid fever. But in this apparent exception to the rule the mother of the boy had visited him in the Hospital, and therefore might have carried the contagion of typhus fever to her husband. The father, moreover, had been little exposed to the contagion emanating from the son, because the latter, a

vagabond at variance with the father, was from home when he was taken sick."

In the remaining 182 cases, those who had been exposed to the contagion of typhus were affected with typhus, and those exposed to the contagion of typhoid were affected with typhoid fever. This is what we observe in diseases of a similar type which are admitted to be different maladies, such as small-pox, measles, and scarlatina. If a person exposed to the contagion of one of these diseases became affected with one of the others indiscriminately, we should be justified in concluding that they were merely varieties of the same disease; but we find that an individual exposed to the contagious poison of small-pox, invariably, if he become affected, has small-pox; and the same remark applies equally to the other two. Yet these three diseases were for years confounded under one name; and it was not till after the appearance of Dr. Withering's essay, sixty-four years ago, that the profession was convinced that scarlatina was not a severe form of measles.

The following cases corroborate these observations by Dr. Jenner.

CASE. Catharine Gibbons, aged 22, an Irishwoman residing in Britannia Street, was admitted into the Fever House under the care of Dr. Shaw, on March 5th, 1856, suffering from typhus, with the characteristic rash. She attributed her illness to overcrowding at a soup-kitchen some days previously. She was in all probability exposed there to the contagion of typhus. She was discharged cured on March 18th. This woman's husband visited her once; and on the 29th of the same month he was admitted with well marked typhus of six days duration.

CASE. Wm. Henson, aged 25, from Sileby, was admitted into the Fever House on Feb. 28th, 1856, under the care of Dr. Crane, with well marked typhoid fever of seven days duration, with the distinctive spots. He had three days before admission attended the funeral of his mother, who died of fever, accompanied by purging. This woman had been under the care of Messrs. Downey and Atherley at her own home, and was daily visited by her son during her illness. Although I never had an opportunity of witnessing this case, I have much reason to believe that it was one of typhoid, not only on account of the purging which was stated to be present, but because there was at the time an epidemic of typhoid raging in the village, from which sixteen patients were admitted into the Fever House during a few months. Henson's mother was a nurse, and attended a woman in her confinement in a house in which there were three or four patients ill of fever, from which she returned to her home affected with fever, of which she died six weeks afterwards.

Typhoid and typhus may be readily distinguished by the rash and symptoms observable in each. Typhoid is by far the most common form of fever in Leicestershire. During the period I have held the office of house-surgeon, the last two years, three times a greater number of cases of typhoid than of typhus have been admitted into the Leicester Fever House. The prevalence of one of these forms of fever in particular districts is interesting. When attached to the Belfast Hospital, and to the Meath Hospital in Dublin, I can remember that all, or almost all, the cases of fever admitted were typhus. When I was a student at Edinburgh during the years 1846, 1847, 1848, and 1849, the same fever was as frequently seen in the wards of the Infirmary there.

I heard Professor Bennett inform his class that, at a time typhus was the only form of fever observed in Edinburgh, across the Frith of Forth, in Fifeshire, in a village where Professor Goodsir resided, typhoid was prevalent; and after death, as usual, he found ulceration of the intestinal follicles. During the years 1854, 1855, and 1856, there were 1087 cases of typhus, and 647 of typhoid fever admitted into the London Fever Hospital; and, judging from the statements of Andral, typhoid must be much the most common in Paris.

The rash of typhoid appears from the seventh to the twelfth day of the disease, sometimes later, and sometimes, but rarely, earlier. The eruption, according to Jenner, is scattered over the anterior and posterior surface of the trunk. In eleven cases in which I carefully noted the site of the eruption, it was present on the thighs in two; in two others it was observed on the face; and in another, in which there was a most copious eruption, there were some well marked spots on the right arm and forearm. In all these it was also observed on the trunk. Usually there is only a small number of spots visible at a time; but in the case last mentioned they were very thickly spread over the abdomen and shoulders. The spots are circular, about two lines in diameter; rose-coloured; elevated above the

surrounding cuticle; can be easily felt by the finger passed over them; they are not hard; they disappear on pressure, but soon reappear.

"The ordinary duration of each spot," Jenner states to be "about two days; but it varies from two to six days." In five separate cases of typhoid, of twelve spots, which I marked with a circle of ink, and most carefully watched, one disappeared on the second day, two on the third, two on the fourth, two on the fifth, two on the sixth, and one on the tenth day; so that, according to my observations, their duration varies from two to ten days.

"Fresh spots," writes Jenner, "appear every day or two from the outset of the eruption till from the twenty-first to the twenty-eighth day of the disease. This successive daily eruption of a few small, very slightly elevated, rose-coloured spots, disappearing on pressure, each spot continuing visible for three or four days only, is, so far as I know, peculiar to, and absolutely diagnostic of, typhoid fever."

All this I believe, except as regards the duration of each spot, and the day of the disease when the eruption disappears. I have already stated that a spot may continue present for ten days; and in one case I observed some typhoid spots on the thirtieth day of the fever.

Is typhoid fever contagious? I believe it is; but this question is still *sub judice*. If it be not, how can we explain such a case as that of Henson, to which I have already directed your attention? His mother, in a village in which there is an epidemic of typhoid, goes to nurse in a house in which there are four persons ill of fever. She returns to her home affected with typhoid, of which she dies. Her son visits her daily during her illness. On the day of her funeral he feels ill, and three days afterwards is admitted in the Leicester Fever House with well marked typhoid fever. If it be not contagious, how can we account for an epidemic such as that which last year occurred at Sibley? If it were caused by noxious effluvia, we should have expected it to be confined to the houses in the immediate neighbourhood in which the injurious miasm was engendered; and that it should not have spread over such a large village, unless the poisonous gases were being generated throughout its whole extent: and the cause of such an improbable occurrence could hardly have escaped the observation of the intelligent surgeon there, or of the inhabitants. I know that Sibley is badly drained, and that its sanitary reputation is low; but it was as well drained and cleansed last year as this or any previous year, and yet fever is not a common disease there. Within the last two years there has been a similar but less severe epidemic at Countesthorpe, and another at Markfield, both villages in this county. I believe that typhoid is contagious, but much less so than typhus; that they both are most likely to appear and to spread in densely inhabited, badly cleansed, and badly ventilated districts. Evidence of the truth of this statement is afforded in Leicester, of which the sanitary condition has, within the last few years, been much improved. In the last report of Mr. Moore, our zealous and efficient officer of health, it is stated that in Leicester in 1853 there were 104 deaths from fever (both forms are included); in 1854, 101; in 1855, 54; and in 1856, only 30. I cannot refrain from digressing a little to allude to the progress of preventive medicine in this town. I extract the following sentences from the last quarterly return of the registrar-general.

"The mortality of Leicester has been much reduced within the last three years. The deaths in the ten years 1841-50 inclusive, were 14,921, of which it was computed in the sixteenth annual report of the Registrar-General, that 5,575 were unnatural deaths, or the results of the insalubrities in which the people of Leicester lived. The borough, under the circumstances, appointed an intelligent health officer. The system of deep sewerage was completed in 1855, and the sewerage was deodorised. The river, which was the receptacle of nearly all the filth of the town, is now comparatively pure. The courts, which were covered with stagnant water, are now clean. The people who reside over the deepened sewers enjoy improved habitations. The annual mortality in the three years 1852-54 inclusive, was at the rate of 29, 27, and 25; while in 1855 and 1856 it fell to 23 and 21 nearly, in 1,000. Small-pox has been completely disarmed by vaccination. The mortality will fluctuate; but by persevering in her career Leicester will reap large rewards of health and fame."

In fourteen cases of typhoid, in which I noted the supposed cause, four were attributed to contagion; in eight the cause was unknown; one patient believed that a foul smelling privy in the vicinity of her residence was the cause of her illness; and one young woman, a servant in a public-house, thought that her

fever was occasioned by the gases from decomposing fish in an adjoining fishmonger's premises.

The premonitory symptoms of both fevers are much alike, and are those, so well known to you all, which are described in works on the practice of medicine. I noted the complications in fifteen cases of typhoid; in eight there was no complication; in three there was bronchitis; in two abscesses; in one bronchitis and abscesses; and in one bronchitis, gangrene, and bed-sores. The abscesses had the following sites: One woman had one in each axilla; a man had an abscess in his cheek; and another man one near the anus. The gangrene occurred in a young woman aged 16, of strumous appearance and feeble habit. On the twenty-first day of the fever I noted that there were several patches of ecchymosis, one on the inside of left arm, which extended over a space about as large as could be covered with two fingers; it was completely covered with a vesicle which contained serum. This one was the largest; but at many parts where there had been pressure these discoloured patches existed of variable size; they were hard as compared to the adjoining uninfiltreated tissue. On the following day, the left hand and forearm were slightly swollen; this extremity seemed to be paralysed, but she was able to move the left lower extremity. The paralysis gradually disappeared as the sore on the inside of the arm healed. The sloughs separated, and the wounds gradually cicatrised, with the exception of one over each trochanter, and these were steadily healing when she was sent into the country.

The *post mortem* appearances I have observed are of some interest.

Rokitansky states that "the small intestine is the seat of the ulcerative process in fever."

I have in three cases seen the glands of the large intestine more or less affected. At the autopsy of George Morson, aged 19, who died on the twenty-fourth day of the fever, I found Peyer's glands ulcerated on the lower foot-and-half of the small intestine; the ileo-cæcal valve blackish, and covered rather thickly with a number of small white spots. The mucous membrane covering the cæcum and ascending colon was dark red, and covered thickly with small white patches, generally about the size of a pin's head. They felt elevated when the finger was passed over them, and hard when pressed against the plate upon which the bowel was lying. In the immediate vicinity of some of these patches the mucous membrane assumed a bright red colour. Several ulcers, of about the size of a split pea, were scattered over the surface of the cæcum and ascending colon; one ulcer was situated at about the middle of the appendix vermiformis. The transverse and the descending colon and the rectum were slightly congested, and throughout their whole extent there were at intervals ulcers about the size of a pin's head, and small white patches similar to those previously described; these had not the hardness of those in the ascending colon, with the exception of a few, which possessed this character only to a slight extent.

The next case was that of Mary A. Hubbard, aged 8, who died on the thirty-seventh day of the fever. She had so far recovered as to be able to sit up and to run about the ward, when she was suddenly seized with severe abdominal pain and tenderness on pressure. This sudden and unexpected complication was believed to be caused by perforation, for which I prescribed opium in large doses, according to the plan introduced by my former teacher, Dr. Stokes, of Dublin. She gradually became worse, and died sixteen days after the supervention of these untoward symptoms. At the *post mortem* examination I found the mesenteric glands enlarged throughout whole extent of mesentery, but especially towards its lower part; the mesentery itself congested, and the whole large intestine thickly studded with black round spots, rather more than a line in diameter, which could not be felt by the finger passed over them. The ileo-cæcal valve was bluish black. In the lower part of the ileum were three or four cicatrices of ulcers, rather darker in colour than the surrounding bowel, not depressed. When the finger was passed over them a roughness was felt; on looking at them, it appeared as if there were little spots of lymph filling up the cavity which was covered by mucous membrane.

In Mary Sarson, aged 27, whom I lately examined *post mortem*, I found, besides the usual ulceration of the small intestine, ulceration of the whole of the large intestine.

In Jones and Sieveking's *Pathological Anatomy*, Dr. Handfield Jones alludes to this lesion as having been observed by him, but in such terms as to lead one to suppose that it is very rare. Andral mentions it as by no means an unusual *post mortem* appearance. Dr. Peacock also describes it; and Dr.

Wilks, in *Guy's Hospital Reports*, lately states that in five cases, besides the ulceration of the ileum, he found more or less ulceration of the cæcum, and of the ascending colon in one case.

Rokitansky states that, in fever, the ulcers, of an oval shape, always have their long axis parallel to that of the intestine. In the case of Elizabeth Ellis, aged 16, who died on the twelfth day of the fever, I observed the following appearances. The mesenteric glands were reddened and enlarged; one, in the mesentery, at the lower part of the small intestine, was about the size of a large bean. Ulcers were seen in the lower three feet of the ileum, of different sizes and shapes, generally oval or round; those of an irregular form appeared to be owing to the so called typhoid deposit not having wholly separated. The ulcers usually were about the size of a split pea; many, however, were smaller. In this case, I observed some of the oval ulcers to have their long axis in a direction across the bowel, and not in a direction parallel to it, as stated by Rokitansky. I shall not occupy your time further with the pathology of the disease, which is so well and fully described by Rokitansky and Andral.

The rash of typhus appears from the fourth to the seventh day of the disease. It is liable to occupy the trunk, the extremities, and sometimes the face. The spots are variable in size, but are usually larger than those of typhoid fever; they are not elevated, except slightly so, for a short period after their first appearance; they cannot be felt by the finger passed over them. Their shape is irregular; their number is variable; usually they are very numerous; their colour at first is a pink red, and at this stage they fade on pressure; afterwards they assume a purple colour, and are unaffected by pressure. Their duration is generally from their appearance till the disease terminates.

That typhus fever is contagious, is now almost universally admitted.

The complications most frequently observed in Leicester are bronchitis and delirium.

I have nothing to communicate regarding the *post mortem* appearances which is not well known. Is the characteristic eruption always present in these fevers? No; but I have never seen a case of typhus in Leicester without it; nor did Dr. Peacock, in 35 cases at St. Thomas's Hospital, which he closely watched, and which he published in the *Medical Times and Gazette* last year. Dr. Henderson and the late Dr. John Reid, in a report on the typhus of Edinburgh which they published in 1839, state that they found the eruption in 108 out of 130 cases; 6 of the cases, in which there was no eruption, were admitted into the infirmary at late periods of the disease; so that in only 16 cases was no rash observed. In typhoid, the eruption is not so frequent; I have found it absent in about one-fifth of the cases that have fallen under my own observation. This occasional absence of rash is another point of resemblance between these fevers and scarlatina, one of the eruptive contagious fevers to which I have already likened them. *Scarlatina sine exanthemate* is by no means uncommon.

A simple plan of treatment is, in my opinion, the best. Dr. Graves's principle of feeding fever should be acted upon; and I think it very important that the administration of wine and other stimulants should be commenced early. We know that both these fevers are attended with much depression; and those cases have appeared to me to progress most favourably in which wine was given as soon as symptoms of depression supervened. While the patient is awake, the wine or brandy should be given every hour or half-hour, in small quantities at a time, so that their stimulant action may be continuously kept up. The patient must be plied well with beef-tea, arrow-root, and such other nutritious easily digested articles of diet as he can be induced to take; and I have seen patients who were unable to swallow restored by the administration of enemata of strong beef-tea and wine. Uncomplicated cases are usually treated at the Fever House, in the early stages, by sesquicarbonate of ammonia in water, or camphor mixture; and, during convalescence, by decoction of cinchona bark with sesquicarbonate of ammonia. The purging of typhoid is best checked, according to my experience, by chalk mixture, combined with tincture of catechu and small doses of laudanum; and I have seen much benefit from small injections of starch, containing forty minims or a drachm of tincture of opium. The bronchitis of fever I usually treat by the administration of mild expectorants, by shifting the posture of the patient from lying on the back to one side and then to the other, by keeping up the strength, and by not applying large blisters, which I have observed frequently to cause much depression. Small blisters applied to the front of the chest may be useful.

An alarming and not unfrequent complication of typhus is violent delirium, which, if not relieved, terminates in coma and death. Dr. Graves has strongly advocated the exhibition of small doses of opium and tartar emetic. I have frequently used this combination, and have never seen it fail to give relief, and that speedily. I fear that its powers are not sufficiently known, as I have never seen nor read of it being prescribed in England except by myself.* To impress upon you the mode of administering and the value of this remedy, I shall briefly relate a few cases in which it was given. It should be prescribed only when the delirium is of a violent and active character, and not in the feeble delirium which occurs in the last stage of fever, where these remedies would only hasten death.

CASE. Martha Holland, aged 45, residing in Carley Street, was admitted into the Fever House on September 15th, 1856, under the care of Dr. Crane. A month previously she began to be ailing, with the usual premonitory symptoms of fever, with the addition of a soreness in her mouth and throat. Three weeks before admission, she was confined to bed, and since then had been gradually getting worse. She had been under the care of my friends Messrs. Derington, Gramshaw, and Thompson. She had been purged throughout the illness (probably from medicine, as will be seen afterwards), and since the day before had been very delirious and violent. There had been three cases of fever in the next house. These particulars I learned from the husband. She required to be held in bed, and was constantly shouting; and was under the impression that she had murdered her brother. She was sitting up in bed, with a wild expression of countenance. The pupils were dilated; the lips and teeth covered with sordes; she was thickly covered over the front of the abdomen and thorax with pale red circular spots, about half a line in diameter, which did not disappear on pressure. One large, bright red, round, slightly elevated spot, about a line and a half in diameter, was situated near the umbilicus. She was ordered to have low diet and beef-tea, and to take the following draught every hour until sleep supervened.

Rx Tincturæ opii miv; liquoris antimonii potassio-tartratis mxx; liquoris ammoniæ acetatis ʒss; aquæ ʒj. M.

September 16th. The medicine was administered with great difficulty; it required three persons to force her to swallow it. She slept about an hour and a half during the night, and had some sleep in the morning. She is now lying quiet, and answers questions rationally. The pupils are of natural size. She is very hoarse, from shouting yesterday. The tongue is moist, but thickly furred in the centre; she has much thirst; the appetite is bad; the motions are rather loose; pulse 96, feeble. She has some cough; no *râle* is audible over the chest. There is a copious eruption, with the characters described yesterday, over the trunk, and the upper and lower extremities. She was directed to take a dose of the medicine every four hours, and to have four ounces of wine daily.

September 18th. The tongue is moist, furred black in the centre; the appetite is pretty good. *The bowels have not been opened for two days.* Pulse 80. The skin is moist; there are some sudamina in front of the chest and abdomen. The rash is disappearing. She is rather deaf, and speaks hoarsely; but is perfectly rational and quiet.

Omittatur mistura.

Capiat ter die decocti cinchonæ ʒj; ammoniæ sesquicarbonatis gr. v; aquæ ʒss.

Her convalescence was uninterrupted, and she was discharged on October 14th, cured.

CASE. Ranald Sharman, aged 36, from Shearsby, was admitted on November 5th, under the care of Dr. Crane. On October 27th, he was taken with severe headache, but continued at his work during that day: since then he had been unable to follow his employment, but had been out of bed during a part of each day. On November 3rd he became delirious; and, as there was only one woman to nurse him, he had been much exposed to cold when he attempted to escape from imaginary dangers, such as the house being on fire, that he was to be murdered, etc., etc. He had been under the care of Mr. Gimson. These facts I learned from his relatives who accompanied him to the Fever House. He was ordered to take the opium and antimony, as prescribed in the previous case.

November 6th. He was very violent in the night, and the nurses were obliged to have recourse to the strait waistcoat to restrain him. The medicine was given regularly, but with

* My friend Dr. Robertson, of Nottingham, stated at the meeting, that he had frequently adopted this plan of treatment with very satisfactory results.

much difficulty. He went to sleep for an hour and a half this morning, and has been much quieter since. He is now lying quietly, with his eyes closed, and seems much inclined to sleep.

November 7th. He is quiet and rational. He was ordered to take a dose of his mixture every four hours.

November 9th. He was ordered to take his medicine three times a day.

November 14th. He complains of a difficulty in passing urine, and of feeling cold when out of bed. He sleeps badly. He was ordered to omit the mixture, and to take three times a day five minims of dilute sulphuric acid in decoction of cinchona bark; and to have full diet, with a pint of beer daily. A small abscess formed near the anus, which was opened. With this exception, he progressed rapidly towards recovery, and was discharged cured on December 2nd.

There are some remaining points in connexion with these fevers to which I might allude; but, as I can throw no additional light upon them, I shall not trespass further upon your attention.

ON THE ACTION OF CHLOROFORM.

By JOSEPH WHITE, Esq., M.R.C.S.Ed., Resident Surgeon to the General Hospital, near Nottingham.

[Read before the Midland Branch, June 18th.]

So much has been said and written during the last few years on the properties and mode of action of chloroform, and so many and various opinions have been entertained as to the manner in which its effects are produced, that I dare not occupy the time of this meeting with even a reference to those statements which have from time to time engaged the attention of the profession.

In the remarks which I am about to read, my object will simply be to bring forward a few facts which the observation of a considerable number of cases would seem to establish, and to introduce for our discussion some few points connected with the physiological action and mode of administration of this agent, which I believe may be of interest to us all.

That chloroform, when inhaled, produces its effect by becoming absorbed into the circulation, I believe admits of no doubt. The observations of numerous experimenters would all seem to prove it, and none perhaps more than those which have been so carefully made by Dr. Snow, and which have appeared in his excellent series of papers in the *Medical Gazette*.

A few years ago, at the time that Dr. Snow published his first observations, I made the following experiments. A small rabbit was poisoned by chloroform, being made to inhale its vapour in a nearly pure state; immediately upon respiration becoming weak, which was two and a half minutes after the first inhalation, about half an ounce of blood was taken from the femoral artery, and subjected to Biot's process for the detection of chloroform. It yielded the most distinct evidence of its presence.

In order to ascertain the quantity of chloroform which could be dissolved in the blood, I placed in a long narrow tube, which was graduated into five hundred equal parts, five measures of chloroform, and filled up the remaining four hundred and ninety-five with serum of blood. The end of the tube was carefully closed and shaken frequently; after twelve hours, there were only rather more than three measures of chloroform remaining at the bottom of the tube. Nearly two measures had been absorbed. At the end of five days, the same quantity remained.

I also placed in a wide mouthed glass jar about four ounces of serum of blood, and fixed over its mouth a portion of very thin bladder. The jar was inverted, and exposed to an atmosphere saturated with chloroform for twelve hours. At the end of that time, both this liquid and that contained in the tube were submitted to the process for the detection of chloroform, and each yielded the same evidence of complete saturation.

These experiments were several times repeated, and always with the same result. I believe that they show tolerably clearly the readiness with which the vapour of chloroform will permeate an animal membrane, especially such as that lining the air-cells of the lungs; and the rapidity with which it must necessarily act when applied to such an extensive and highly absorbent surface.

The recent experiments of Matteucci have proved that the process of endosmosis is most materially influenced by the number of minute vessels in an absorbing surface. These, upon the principle of capillary attraction, act with the greatest

force when least in size. I need not say that the pulmonary lining membrane presents in an eminent degree such a condition—a condition favourable to the most rapid action of endosmosis.

The vapour having thus entered the blood, and particularly having done so at so short a distance from the heart, its passage onwards is easy and rapid. Carried by the pulmonary veins immediately to the left side of the heart, it is at once thrown into the great circulating mass, and amongst other channels is conveyed by the coronary arteries to the substance of the heart, by the carotids and vertebrals to the brain, and by the vertebrals to the spinal cord. It is also, of course, impelled through the aorta to every part of the body; and, circulating in the minute capillaries, it permeates their coats, and coming into contact with the nervous filaments of a part, gradually destroys its sensibility by producing local narcotism.

Whilst the distance to which the blood has to circulate, and the minuteness of the vessels through which it has to pass, render the production of this general anæsthesia comparatively tardy, the larger size and the shorter length of the vessels which convey the blood to the brain favour the production of a much more rapid effect upon that organ.

Hence, no sooner does inhalation of the vapour of chloroform commence, than its effect upon the brain is indicated by the state of mental excitement and confusion of ideas which so generally present themselves during the first few moments of its administration.

As inhalation proceeds, more blood charged with the vapour circulates through the cerebral vessels, and permeating their coats produces a further effect upon the brain. Consciousness, which before was perfect, is now impaired; and in place of the perfect sensibility which existed, there is now a still greater degree of mental excitement, a dreamy state almost amounting to delirium. Common sensibility is now considerably impaired. The pain of many nervous affections is in this stage diminished in intensity, and it has generally been found unnecessary to go beyond this stage to relieve the pains of parturition. The chloroformed blood has now had time to be carried by the general circulation to the capillaries, and there coming in contact with the filaments of the nerves, produces by its local action that general insensibility to pain which, though in a slight degree, now begins to be rendered evident. There is now also some affection of the functions of the spinal cord. As in the brain, so in it, the first effect of chloroform is to produce excitement. We have, therefore, at this period of its action the strong involuntary muscular contractions which so often, especially in the young and robust, precede the occurrence of complete insensibility. This excitement is sometimes so great as to require considerable force to restrain the movements of the patient. There is often the most forcible contraction of all the voluntary muscles, including those of respiration, accompanied by violent and prolonged expiratory efforts and considerable congestion of the face and surface of the body. Though this condition appears alarming at the moment, it generally soon subsides under cautious perseverance in the administration of the vapour freely diluted with atmospheric air; and the next stage is generally quickly induced.

Inhalation still proceeding, more and more chloroform is carried by the circulation to the brain, to the spinal cord, and to the body generally. Its action upon the brain increasing, an almost total suspension of the cerebral functions is the result. All voluntary motion ceases; sounds of an articulate kind are no longer uttered; the eye becomes perfectly fixed, and the pupil moderately contracted, though still somewhat sensible to the stimulus of light.

Valentin considers upon anatomical grounds, and from experiments upon the lower animals, that the contraction of the pupil is due to the reflex* function of the brain, through the ciliary filaments of the motor oculi, and that the dilatation of the pupil is due to the reflex function of the spinal cord through the ciliary filaments of the cervico-spinal nerves. If this be correct, the sensorial functions of the brain are suspended, but the reflex functions are still entire.

The action upon the spinal cord increases also; and here, as in the brain, the sedative effect of the chloroform begins to supersede its stimulant action. The muscles continue to be slightly contracted, though far less rigidly than before. The action upon the sentient extremities of the nerves increases also, and the insensibility to pain, which before was partial, is now complete.

* By the reflex function of the brain is meant the excito-motor function of that portion of the true spinal system of Dr. M. Hall, which is seated above the medulla oblongata.