integrity of the central nuclei. This, again, depends upon the occurrence of certain chemical changes in the nuclei themselves. "The function of organic matter and, *par excellence*, of nervous matter..... is to assimilate material having potential energy (anabolism), and to decompose that material (katabolism), with liberation of energy."¹ This material is assimilated from the fluid in which the cells are bathed, and according to the constituency and condition of the surrounding fluid, the cell functions are modified in the direction of excessive or defective action.

Stagnation of the surrounding medium—on Dr. Jackson's theory—causes excessive chemical activity in the cells of the motor cortex, nitrogenous or phosphorous bodies becoming more nitrogenous, and thus produces the variety of epileptiform convulsions which bears his name. Hyperphysiological activity in the cells may also be produced by poisons such as strychnia, or those of tetanus and hydrophobia, with certain distinctive characters about the symptoms, according to the selective action of the three poisons on special centres. In none of the above cases are the macroscopical or microscopical changes discovered adequate to account for the symptoms. Similarly the hypo-physiological condition may be produced in the cells by the circulation of poisons, such as that of diphtheritic paralysis. The effects of the poison upon the nutrition and function of the ganglia may be comparatively slight and transient, but yet sufficient to cause extensive degeneration of the nerve fibres. The ganglia may completely recover; but the effect on the nerve fibres may be more lasting, and may prevent them from obeying the stimuli to which they formerly responded. On the other hand, should the poisonous dose be large and continuous the ganglia themselves may be irreparably damaged. Finally, it is obvious that extremely slight interference with the function and nutrition of important centres, such as the medullary, may cause death, and yet leave no pathological changes which can be discovered even by aid of the microscope.

TREATMENT.

1. *General principles.*—Absolute rest in bed is indicated during the first six weeks from the onset of paralysis, even in the absence of the symptoms of failing vitality which I have described, for dangerous symptoms may occur on the slightest provocation. After this time, should the pulse and respiration remain normal, the open treatment usually recommended may assist in completing recovery. Abundant nutritious food, tonics, especially strychnia, should form part of the treatment from the first.

2. *The treatment of the crises.*—Their nature is to subside and to recur; therefore the utility of any special treatment is open to question. Death is due to the paralysing action of a poison upon the cardiac and respiratory centres, but this action is not persistent, and were it not for the hypersecretion of mucus into the air passages recovery might be the rule. So an antidote which both stimulates the failing centres and arrests the flow of mucus must be sought. Strychnia is a powerful stimulant to the respiratory and cardiac centres. Atropia arrests pulmonary and other secretions, but to produce this effect large doses are necessary, and these might still further increase the risk of cardiac failure.² This objection may be met by combining the two drugs. Three cases observed by myself, in which the characteristic crisis occurred, were treated on Hensch's plan by strychnia injections alone; two of these died. Three cases were treated by injections of strychnia and atropia, of each $\frac{1}{100}$ gr.; two of these recovered. The latter remedy is worth a further trial, and perhaps the best results might be obtained by giving larger doses of strychnia ($\frac{1}{50}$ to $\frac{1}{30}$ gr.), combined with smaller doses of atropia ($\frac{1}{120}$ to $\frac{1}{100}$ gr.). The physiological effects of atropia are rapidly produced in a child by a single dose of $\frac{1}{100}$ gr.; whilst belladonna in the form of the tincture is practically inert. The nasal tube has always been employed in these cases as soon as deglutition failed. Owing doubtless to the anaesthesia of the naso-pharynx, little or no discomfort is caused by its use. A stronger objection to its use is that digestion is probably much impaired at these times. Predigested food only should therefore be administered, and in the smallest quantities. It would be perhaps better still to rely entirely on rectal alimentation.

As regards the death-rate in diphtheritic paralysis, Landouzy gives the mortality as 16 in 117 cases, Lorain and Lépine give 12 per cent. of fatal cases. Drs. Bristowe, Eustace Smith, and Hilton Fagge are all agreed that deaths from diphtheritic paralysis are extremely rare, but the value of the last named author's statements is lessened by the fact that the nature of two fatal cases which he quotes remained unrecognised during life. The statistics of Paddington-green Children's Hospital (whence the materials for this paper have been obtained) give the following result:—Excluding a very large number of cases in which death occurred before the symptoms of the initial diphtheria had subsided, although the majority of these might well be included under the head of "deaths from diphtheritic paralysis"; twenty-nine cases have been treated from 1885 up to the present year. Eight deaths have occurred, giving a mortality of 27.4 per cent. Statistics based on such small numbers as these are, perhaps, not of great value. But in addition to this high rate of mortality there are other reasons for believing the death-rate of diphtheritic paralysis to be under-estimated. As mentioned above, one of the most prominent symptoms of a bulbar crisis strongly suggests an attack of capillary bronchitis. A medical man called in for the first time to see a case at the height of a crisis could hardly avoid the error of diagnosing "bronchitis or congestion of the lungs and cardiac syncope," especially in the absence of a history of diphtheria. A verdict to this effect is sometimes seen in the reports of coroners' inquests held on children who have died within a few hours of seeming perfectly well. But children suffering from bronchitis or congestion of the lungs do not seem well, within a few hours of death, neither do they die of syncope from these causes until many days after they have been obviously and seriously ill. It is possible that diphtheritic paralysis may account for some of these otherwise mysterious deaths. The treatment advocated by the authors of the leading textbooks must tend to withdraw the patient from observation, and may also hasten his death. Adults are too often allowed to follow their daily work with the disease upon them. Many of the children brought to the hospital had been running about by doctors' orders, although they were known to have recently suffered from diphtheria. The early and minor signs of diphtheritic paralysis are seldom regarded as indications of a disease which may rapidly prove fatal. Fresh air and exercise are prescribed when absolute rest in bed should be enjoined. A confident prognosis is given when the greatest reticence and caution should be observed.

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THREE CASES OF STRANGULATED HERNIA OF THE CÆCUM IN INFANTS.¹

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IT is an old saying that if a man gets one curious case he is sure to have another like it soon. By an odd chance of this kind, I have had in the last three months three cases of strangulated hernia in infants; and all three were cases of hernia of the cæcum. Mr. Howard Marsh, in the tenth volume of the St. Bartholomew's Hospital Reports, has collected forty-seven cases of strangulated inguinal hernia in children. In thirty-four the sac was opened at the operation. Out of these thirty-four, only one was a hernia of the cæcum. As regards the anatomy of the parts concerned in hernia of the cæcum, it has been described by Mr. Treves, in the tenth volume of the Transactions of this Society, and by Mr. Lockwood, in his Lectures on Hernia. They draw attention to two facts:—1. The existence of a proper sac in these cases. 2. The existence of a fold of peritoneum, containing muscular fibres—the plica vascularis,—which passes down from the cæcum along the back of the sac, and helps to cause the hernia by drawing or guiding the cæcum into the sac. Both these observations are illustrated by my cases, which are as follows:—

CASE 1.—On Jan. 27th, a male infant one year old, strong

¹ Hughlings Jackson, Lumleian Lecture, ii., 1890.

² Cf. Von Bezold: Von dem Einflusse des Atropias auf die Ursprünge des Herz Vagus.

¹ A paper read before the Medical Society of London, April 7th, 1891.

and well-nourished, was admitted to the West London Hospital with strangulated right scrotal hernia. The rupture had been noticed soon after birth; the child had worn a truss. The day before admission the rupture came down; the child vomited several times and had difficulty in micturition. On admission it looked well, and was not in pain. The hernia was large and tense; there was no impulse; the scrotum was red and inflamed. I operated at once. There was a proper sac; it contained a loop of small intestine and some omentum, and above these, at the neck of the sac, was the cæcum. There was no fluid in the sac. The intestine looked bruised, but was not discoloured. I divided the stricture and reduced the cæcum, and then the small intestine ran back of itself. The bowels acted twice that evening, and the child did well.

CASE 2.—On Feb. 11th, a male infant three months old was admitted to the same hospital with strangulated right scrotal hernia. The rupture had been noticed three weeks after birth; the child had worn a worsted truss. The day before admission the rupture came down; there was repeated vomiting, and retention of urine. It was a very small baby, a seven months' child, and the thirteenth in the family. It looked free from pain, and was not collapsed. The hernia was large and tense; there was no impulse. I operated at once. There was a proper sac, with about a drachm of clear colourless fluid; in it was the cæcum. The vermiform appendix, which was unusually long, came forward from the lower aspect of the cæcum. The cæcum was very slightly congested. I divided the stricture, letting out some more fluid. Then the infant's legs were held up high, and the cæcum was reduced. The bowels acted a few hours later. The wound healed, and the bowels acted regularly; but the infant had been brought to the hospital in the middle of a frosty night, and four days after the operation it showed signs of acute bronchitis, and of this it died on Feb. 23rd, twelve days after the operation.

CASE 3.—On Dec. 18th, a male infant three months old, neglected and starved, was admitted to the same hospital with strangulated right scrotal hernia. There was vomiting, and some retention of urine. The hernia was large and tense, and without impulse; there was acute inflammation of the scrotum. With chloroform I reduced the hernia, and could now feel that the testicle and the cord were greatly swollen. After this all went well for eleven days; the bowels acted freely and regularly; the infant took a quart of milk daily, and gained flesh. But on Dec. 29th the scrotum was again inflamed, and on the 30th it was acutely inflamed and distended, and resonant on percussion; the child vomited once; the bowels acted freely. On Dec. 31st the infant was restless; it vomited twice; the bowels acted freely. The scrotum was intensely inflamed, and at one spot, the size of a sixpence, it was thinned and soft. It was resonant on percussion. The prepuce was cedematous; the penis was twisted. In the inguinal canal was a hard cylindrical swelling; the spermatic cord could not be felt. Under chloroform the swelling was partly reduced, with a loud gurgling sound; the scrotum was now less tense, and the testicle and the cord could be felt again. But in a couple of hours things were as bad as ever: the œdema of the prepuce was increased, and there was distinct emphysematous crackling at the bottom of the scrotum. It was plain that the bowel had given way. I cut down carefully, and found no distinct sac. The bowel and the sac were all matted together; at the lower part of the bowel was a ragged opening; the tunica vaginalis was full of feces, and the testicle was acutely inflamed. I passed a director in at a pinhole opening which I had made in the bowel during dissection, and out at the ragged opening lower down, and laid the two openings into one, and stitched the bowel in the wound. For about a month the infant did well; the cavity of the tunica vaginalis granulated up, the bowels acted twice daily through the wound, and there was never any great prolapse. But at the end of a month the infant began to lose flesh, at the rate of a quarter of a pound a week, and it died between five and six weeks after the operation.

These cases seemed to me worthy of the notice of this Society, because strangulated hernia seldom occurs in infancy. Mr. Marsh says, "Many surgeons have passed through a long career of hospital practice without meeting with any instance of it, and I believe the only case in which an operation has been performed at the Hospital for Sick Children in the course of the last twenty-three years is that which I have just recorded."

In a very large majority of Mr. Marsh's cases the hernia was congenital; indeed, so far as the notes tell us, only four were not congenital. The hernia was more frequent on the right side than on the left, in the proportion of three to one. As regards the contents of the sac in Mr. Marsh's cases, the sac was opened in thirty-four out of the forty-seven cases. Of these thirty-four cases one was a hernia of the colon, one was a caecal hernia on the left side of the body, and one was a hernia of the sigmoid flexure; and two were cases of hernia of the ovary.

As regards the symptoms of strangulated hernia in infants, I may point out that in my cases there were two symptoms which we seldom find in adults. One of these was the retention of urine; the other was the acute inflammation of the skin of the scrotum.

Of my three cases the first made a good recovery. The second case recovered so far as the hernia was concerned. But it was a seven months' child, and the thirteenth in a poor family; it was brought to the hospital in the middle of a cold night; and I am sorry to say that after the operation it was put in a cot near a window, instead of in a basket near the fire. From these causes it caught the bronchitis of which it died. The specimen (Fig. 1) from this case

FIG. 1.

A, Plica vascularis. B, Mouth of sac, contracted.

shows the plica vascularis passing down into the sac. The sac is contracted. There is no communication between the sac and the tunica vaginalis. The great length and free mobility of the vermiform appendix suggest that it may have made its way first into the sac, and so may have drawn the cæcum after it; and we know that cases have occurred where the appendix alone was found in the sac at the time of operation.

In the third case I cannot doubt that I really reduced the hernia when the child was admitted. There was distinct slipping back of the bowel under my fingers, with a loud gurgle. The vomiting stopped for eleven days; the infant took a quart of milk daily; the bowels acted freely and regularly. They continued to act freely up to the time of operation, when the bowel had actually burst into the tunica vaginalis. It is therefore impossible to say exactly at what time the cæcum came down again and became strangulated.

As regards the treatment of this case, it appears from Mr. Marsh's paper that it would have been better to have done less. He gives two cases. In one of them the hernia had been strangulated for many days; the scrotum

had given way, and there was a free discharge of faeces. No operation was done, the openings in the scrotum gradually closed, and the child recovered. In the other case the bowel was found to be gangrenous, and firmly adherent to the sac. It was poulticed, and came away in a few hours. Twelve days later the bowels acted the right way, the wound closed, and the child recovered. Perhaps therefore it would have been better in my case to have done nothing, or to have simply incised the scrotum. There might thus have been no prolapse of the bowel. On the other hand, as it was a hernia of the caecum, the continuity of the bowel would perhaps not have been restored as it was in the cases quoted by Mr. Marsh. The specimen (Fig. 2) shows

FIG. 2.

A, Large intestine. B, Small intestine. C, Rod passed into large intestine. D, Rod passed into vermiform appendix. E, Rod passed into small intestine.

the prolapsed caecum, of a curious hammer-headed shape. A very fine rod is passed into the everted mouth of the vermiform appendix. A rod is passed into the ascending colon, which is contracted from disuse, and a rod is passed along the ileum.

In all three cases there was a complete hernial sac. In the third case this, of course, could not be made out at the operation, but it is clearly seen in the specimen. As regards the question whether in these cases there was any communication between the sac and the tunica vaginalis, there was no communication in the first two cases; the third case is of course uncertain.

I wish, in conclusion, to express my thanks to Mr. Eccles, the house surgeon, for his constant care of the children, and for his help in putting these notes together.

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QUININE AS A CARDIAC STIMULANT.

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At the last general meeting of the British Medical Association at Birmingham, Sir Walter Foster stated that he had found quinine of great service for reducing the pulse-rate in Graves' disease, when given in sufficiently large doses. This action of quinine is, I believe, but little known, and yet it is one that is in many cases so marked and of such great utility that it is difficult to see how it has so generally escaped recognition. In typhoid fever, at any rate, there is no drug that possesses anything approaching its power. At the Brisbane Hospital the cold bath treatment of typhoid fever has been carried out in its entirety for the last three years. Baths usually reduce the febrile temperature with ease, but in some cases, owing to its obstinacy, they fail. In these some antipyretic drug is evidently indicated. Quinine was therefore commonly given for this purpose, in doses of from thirty to forty grains, as recommended by Liebermeister. Now, of course, anything which depresses the temperature reduces the pulse-rate. Baths have this effect in common with all the

antipyretic drugs; but such reduction is almost always temporary, and in proportion, roughly speaking, to the fall in temperature, passing off as soon as the latter has regained its former elevation. In those cases, however, in which quinine had been the antipyretic given, it was gradually observed (1) that the pulse-rate, although it rose with the returning temperature, almost always failed to attain its previous frequency; (2) that sometimes it remained slower, in spite of the temperature having gained an even greater elevation; and (3) that not uncommonly, when the drug failed altogether as an antipyretic, the pulse-rate was markedly affected. These observations seemed to point to an action on the heart independent of the antipyresis. Experiments were accordingly made to discover if this effect could be gained from doses too small to have any appreciable influence on the temperature; for if so, the independence of its action on the circulation would be established. The anticipation was fully realised. The following is an illustrative case.

Mrs. S. B., aged forty, was admitted to the Brisbane Hospital on the fifth day of typhoid fever. During the next three days she had nineteen baths, of from fifteen to twenty minutes' duration. On the last of these her pulse had varied between 124—with a temperature of 103° F. before the bath—and 110, with a temperature of 101·4° half an hour after the bath. Three grains of quinine were ordered every three hours. The following day (the eighth of the attack) her pulse varied between 110—with a temperature of 103° before the bath—and 100, with a temperature of 100·8° half an hour after. Ninth day of fever: pulse 108, with temperature of 103·4° before bath; half an hour after, pulse 96, temperature 102·4°. Thenceforward no further anxiety was felt concerning the pulse, which continued to range between 110 and 92, although the case did not convalesce until the thirty-first day. The effect on the pulse is not limited to a reduction in frequency; the beats become stronger, more sustained, and more distinct, and the change is especially striking in a case where the pulse had been inclined to "run." The explanation appeared to be that the drug acted as a powerful tonic or stimulant to the heart. It was determined to treat systematically in this way every case that commenced to exhibit signs of cardiac failure, and the following rule was laid down—three, five, or seven grains of quinine to be given every three hours whenever the pulse-rate commenced to range above 120.

The first case was treated on April 15th, 1889. From that date to the end of the year 306 cases were admitted. Of these, sixty-nine came under the rule. Of the 306, eighteen died, a mortality of under 6 per cent.; but eleven of these were from perforation, two from profuse hæmorrhage, and three from dysentery. In the latter, extensive ulceration of the rectum was disclosed post mortem, so that in all of the sixteen death was the direct result of the intestinal lesion. Two only therefore remain to be considered. One of these succumbed to acute double lobar pneumonia, coming on suddenly before any sign of cardiac failure had appeared, and proving fatal in less than twenty-four hours. The other was altogether unusual. The patient, a young girl, had convalesced and been allowed to get up, when suddenly the temperature rose, a painful inflammatory swelling developed in the right submaxillary region, and she rapidly sank with hyperpyrexia in spite of treatment.

The above analysis of the eighteen fatal cases is enough to show that during the eight months and a half no patient died of the usual form of cardiac failure, which under ordinary circumstances is the most frequent cause of death. Most of this result is undoubtedly due to systematic bathing, which exerts a most powerful check upon the tendency to progressive enfeeblement of the circulation. The bath, however, occasionally fails, and it is always more potent as a prophylactic in this respect than as a remedy when once the condition is developed. Consequently quinine is especially useful in those cases admitted late in the course of the fever. Alcohol is, of course, given in the same cases as the quinine, but these are the cases in which alcohol always has been administered; and certainly the amount found necessary during the included period has been vastly less than formerly. Only quite exceptionally has more than four or six ounces of whisky been given even in severe cases, whereas previously eight, twelve, and even sixteen ounces were no infrequent quantity.

Some points in connexion with the action of quinine on the heart are worth noting. 1. The slowing of the pulse-rate is tardy in appearing, usually twenty-four hours