tions. The serum was prepared according to the formula given by Dr. Sidney Martin in his anthrax investigations.¹ The reaction of the broth must be alkaline, to ensure a successful growth.

As soon as the organism has grown the previously alkaline medium becomes distinctly acid, and this acidity is permanent. After two days' growth the cultures were filtered through a Chamberland filter, and the clear toxin evaporated at 38° C. to a sixth of its bulk, thrown into absolute alcohol, and the copious precipitate obtained treated exactly in the same way as already described in the case of the tissue extraction. In like manner the alcoholic filtrate was evaporated and the residue purified. Both products in appearance and chemical reactions were exactly similar to those obtained from the tissues, one being an albumose and the other an organic acid, a lactic acid reaction being obtained. Injected into animals also they produced precisely similar effects to the tissue products. A large dose of the albumose (3 g.) was also injected into the peritoneum. The temperature rose to 105.4°, and continued high (nearly 104°) for about three days, and the animal lost greatly in weight.

An interesting result was obtained from the filtered broth without peptone. After two days' growth a distinct biuret reaction was obtained, which was entirely absent from the control broth, and in which no other proteid could be detected. A copious precipitate was also given with alcohol and ammonium sulphate. It seems evident from this important reaction that a proteid is formed by the organism from nitrogenous material, the proteid thus being excreted after digestion as an albumose. It is perhaps hardly necessary after this to add that the albumose was also formed in the artificial serum.

The views of Dr. Sidney Martin may be alluded to in this connection. He has explained the production of toxic albumoses in diphtheria and certain other conditions by the digestive action of the chemical enzyme or toxin produced by the organism on the albumins of the tissues or of artificial serum. The enzyme he supposes to exert this action outside the organisms themselves. Thus in the case of diphtheria the enzyme is absorbed from the lesion, and exerts its digestive action on the albuminous constituents in the spleen and elsewhere.

It must be said that the result in the case of the peptoneless medium is opposed to Martin's view. Even granting that an undetected amount of albumin was originally present, it cannot account for the quantity of albumose precipitated. It seems clear that the albumose must have been formed by the living bodies of the organisms. That it is formed by a chemical ferment from and outside the organism has not been proved by Martin. In order to do so it would be necessary to isolate the enzyme and show the direct conversion of proteid. As the enzyme is carried down by all precipitants of the albumose, their separation has never yet been effected (except of course by the action of heat, which destroys the enzyme at 70° to 80° C.). In the case of a disease like diphtheria, where albumose is found in a distant organ, presumably without the presence of bacilli, there is no reason why it may not be absorbed from the primary lesion.

It remains to be observed, however, that though (in the case of the pneumococcus) an albumose is formed by the organism, there is no adequate proof that this proteid is in itself a true toxin. The true toxin may in all probability be united to, or mixed up with, the proteid in some undiscovered fashion, as has indeed been supposed by several investigators, and this proteid may be an albumose, a globulin, an albumin, or a peptone.

VACCINATION AGAINST THE DIPLOCOCCUS: IMMUNITY: PRODUCTION OF AN ANTITOXIN.

Cultures in veal broth were continued for six generations. These were made several times to test the variability of virulence. Doses of one and two cubic centimetres were injected into the flank from these various cultures, but taking care that each growth was only two days old at the time of inoculation. From the weakest cultures no appreciable reaction was observed from these doses. Notwithstanding this, it was evident from the subsequent inoculation of virulent cultures, that they conferred some resistance. This was proved from the effect on control animals. It was then found that if a cubic centimetre from the second and third generations of a culture of a standard virulence was first injected, and after two or three days the same dose given of the first generation that the animals afterwards survived doses of sufficient virulence to cause death in control animals in thirty-six hours. The result of this virulent inoculation in the vaccinated animals was a marked reaction, the temperature

rising to 105° F. or even 106° F. But no further signs of illness were shown, and the animals partook of their food as usual. After the fourth or fifth day, the temperature generally fell quickly, and no further reaction was obtained with subsequent injections. The filtered broth cultures were also tried. Compared with most other diseases, the broth toxin of pneumonia is feeble. The clear filtrate was therefore evaporated *in vacuo* at 37° C. to small bulk. Only the toxin of the first broth culture was employed. Small doses of this concentrated toxin were injected in the same way into the flank, and gave a temperature reaction of one to two degrees. In this manner resistance to virulent cultures was conferred. Evaporation of the toxin is, however, a tedious process, and quite as good, if not better, results were obtained by injecting the alcoholic precipitate from the broth in the manner already described.

To obtain an efficient antitoxin, the animal must be perfectly immune, and the temperature must be got up to 105° or 106° F. This may be done by the final administration of virulent cultures, but much the best way is to employ larger doses of the concentrated toxin from a first cultivation or else the albumose.

As this part of the subject is merely touched upon in this communication, it may be added that the serum from two immune animals was made the subject of experiment. Injected in small doses ($\frac{1}{2}$ c.cm. to 1 c.cm.), complete protection was conferred from measured doses of moderate virulence injected at the same time, and life was much prolonged in the case of the most virulent doses.

I must express my indebtedness to Dr. Woodhead, Director of the Laboratories, for some valuable suggestions.

REFERENCE.

¹ Local Government Board Reports, 1889-90. I am also indebted to Dr. Martin for kindly supplying me with a quantity of dried serum alkali albumin.

THREE CASES OF INTESTINAL ANASTOMOSIS.*

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CASE I. End-to-End Anastomosis of Ileum to Ileum.—The patient, a young woman, was under my care at St. Bartholomew's Hospital. Obstruction followed after an abdominal section for hysterectomy. A temporary enterotomy was performed by my colleague, Mr. Bruce Clarke. She recovered from this, but rapidly commenced to run downhill from malnutrition, for the obstruction was high up in the ileum, and all food only partly digested escaped from the enterotomy opening. All attempts to close this failed on account of the obstruction below. Ten weeks later I performed abdominal section. The strictured portion was found 7 inches below the enterotomy opening. The bowel was divided just below the obstructed portion, and again just above the site of the enterotomy opening, the intervening portion, about a foot in length, being removed and the ends united. I will not go further in the details of this case, for I mentioned them at the time in this Society. The patient recovered, and it may be of interest to know that from that time to this—nearly three years—she has been and remains in perfect health, without ache or discomfort, is thoroughly well nourished, and able to earn her own living.

CASE II. Double Anastomosis of Large and Small Intestine.—Mr. Y., aged 55, brought to me by Dr. Webber, had passed many years in India. He considered himself a healthy man up to eight months ago, when he commenced to suffer pain from time to time in the abdomen. The pain was of a paroxysmal character, and was referred to the pit of the stomach. It generally came on soon after taking food, but occasionally at other times. He has had two or three attacks of diarrhoea, but is more often constipated, and has never passed blood-stained mucus. He has not lost flesh, and has had no vomiting.

Examination.—Has a large, fat abdomen. On a line with the left nipple, about 4 inches below the ribs, a tumour can be felt the size of a large fist. It descends on inspiration, and admits of some mobility both from side to side, and from above downwards. It is possible to get the hand between the tumour, and what should be the position of the lower part of the stomach. The disease had been diagnosed as cancer of the stomach. Dr. Webber and I did not agree with this, and believed it to be the colon. The patient was extremely anxious that an operation should be done if there was the remotest possibility of giving him relief.

Operation.—In the presence of Dr. Webber, and assisted by my colleague Mr. Bruce Clarke, the abdomen was opened by an incision commencing 1 inch below the ensiform cartilage and extending to the umbilicus. On introducing the hand, and raising the omentum, the tumour was seen to be a mass of malignant disease in the transverse colon near the splenic flexure. Adherent to, and incorporated into it from an extension of the growth, was a coil of the ileum about 6 inches in length. The whole, together with adherent omentum, formed one mass the size of a cocoon. It was fairly movable, and could be drawn well up into the wound; the stomach was not implicated. The operation was continued by passing and clamping a piece of thin india-rubber tubing round the ileum on each side of the implicated loop, and about 3 inches free of it. The coi

* Read before the Medical Society of London, March 22nd, 1897.

as then clamped on either side an inch and a half nearer the portion incorporated with the tumour. After protecting surrounding parts, the bowel was cut across just beyond the pressure forceps on either side, a V-shaped piece of the mesentery being included. The cut ends were then accurately joined by Lembert sutures, about ten to the inch. The transverse colon, after being clamped in a similar manner, was cut across, its mesenteric attachment, which was very thick, being clamped and tied in portions. Incorporated with the tumour was about a pound and a half of thickened omentum. This, after being tied off in portions, was removed with the tumour. The length of the transverse colon removed was 7 inches. The cut ends of the transverse colon were united to each other in a similar manner to that in which the ileum was joined. A small quantity of faecal matter, on making a section of the colon, escaped on to the sponges but was at once washed up. The amount of blood lost in the operation was small. The intestines and viscera showing at the bottom of the wound were well swilled over, but the remainder of the abdominal cavity was not flushed; the wound was closed with silk gut sutures. The patient passed a fair night, but there was some abdominal distension and vomiting. Vomiting continued, and the abdomen became distended and tympanitic. The patient gradually sank without further symptoms, and died on the fifth day.

CASE III. Intussusception and Lateral Anastomosis of Ileum to Colon.—A lady, aged 23, had had the operation of ovariectomy performed nine months previously. She remained in good health till three weeks ago, when after a monthly period she had considerable pain about the abdomen. She did not remain in bed. Eight days ago she had severe colicky pains referred to the umbilicus and pelvis. Since that time the pains continued, being very severe at times. She has passed no motion for eight days. Four days ago she began to vomit, the vomit increasing in severity, and for the last twenty-four hours being of a distinctly faecal nature. The patient looked pinched and ill, and the pulse was quick and feeble, the temperature normal. On examination the abdomen was found moderately distended, with a good deal of gurgling. The distension was obviously more marked on the right than on the left side. *Per vaginam* an obscure swelling could be felt high up in the neighbourhood of the broad ligament. Nothing further could be made out by the rectum. A gravitation enema having failed to give relief, an operation was decided upon after consultation with Dr. Champneys and Mr. Meredith. The patient's condition was such as to forbid anything like a severe operation, especially as the cause and site of obstruction were quite unknown. It was therefore decided at once to give relief by performing a temporary typhlotomy, or by opening the ileum as low down as possible.

Assisted by Mr. Meredith I made an inch and a half incision over the neighbourhood of the caecum. The caecum appeared to be blocked, but not distended. A greatly distended coil of small intestine protruded into the wound, and with the finger I made out that this was the ileum close to the caecal valve. The distended part of the bowel was then fixed to the parietal peritoneum and skin, so that a portion of it—the size of a three-penny piece—was exposed, the rest of the wound was closed with silk gut sutures, everything being accurately shut off, the exposed bowel was opened with a tenotomy knife, and exit given to several pints of fluid faeces. The symptoms were almost immediately relieved, vomiting ceased, and the distension disappeared. On the eighth day the little opening was blocked up by some foreign body. On seizing this with a pair of forceps it proved to be a sloughed portion of small intestine 9 inches long, including the whole thickness of the bowel, together with a considerable piece of mesenteric attachment. The piece of bowel was obviously an intussusception that had sloughed off. Up to this time since the date of operation no faecal matter had been passed by the rectum, but from this date small quantities were passed from time to time. The great bulk of motions, however, came through the artificial opening, the material was fluid and ill-digested, the wound around was excoriated and very tender, and the patient commenced to emaciate rapidly, so that two months after the original operation she only weighed 4 st. 4 lbs. On two occasions the opening was closed by a specially devised plug. On each occasion, after about twelve hours, the abdomen became distended, and the patient commenced to vomit, manifesting all the symptoms of acute intestinal obstruction, and the plug had to be removed. It was now becoming very obvious that the patient would quickly die of malnutrition unless the passage into the large intestine could be restored. With this view, after consultation with Dr. Champneys and Mr. Meredith, the following plan of operation was decided on: To firmly plug the existing opening temporarily to enable the skin to be thoroughly cleaned, then to open the abdomen altogether free of the old scar, making the cut higher up and nearer the middle line, and then, without in any way disturbing the adhesions of the existing opening, to make a lateral anastomosis between the commencement of the ascending colon and the ileum, as near its termination as possible. It was considered undesirable to meddle with the old opening on the following grounds: First, the unsound and septic condition of the skin immediately round it; secondly, the extremely feeble condition of the patient made it undesirable to prolong the operation a moment longer than necessary; thirdly, the opening would act as a safety valve against distension and pressure whilst the lateral anastomosis union was becoming firm.

Assisted by Mr. Bruce Clarke, I performed the operation by uniting the ileum to the ascending colon for 3 inches opposite their mesenteric attachments, and making an opening a little over 2 inches long between them. The operation took a little over thirty minutes, and the abdominal opening was closed with silk gut sutures. The patient was extremely ill for two or three days, with a very feeble pulse of 150 to 160. She then rapidly recovered. After the fifth day copious actions began to be passed by the rectum, a very small quantity only coming through the old enterotomy wound. On the eighth day a little plug of special construction—an account of which I have already published in the *BRITISH MEDICAL JOURNAL*, vol. i, 1896, p. 133—was introduced. By its means the escape of any fluid was completely prevented; the skin around rapidly became perfectly dry and sound. All the motions passed the right way; the patient gained strength and weight. The edges of the fistulous opening were on two occasions pared and united. The effect of this was to diminish the opening to a little more than a pinhole size, but neither time was it completely closed. As the patient suffered comparatively little inconvenience, she preferred to wait awhile before any further

measures were adopted to bring about its complete closure. The patient is now in good health.

The first case recorded is of interest, from the lapse of time (three years) since the operation was performed, and from the knowledge that the patient is now in perfect health, suffers no sort of inconvenience, is thoroughly well nourished, and able with ease to earn her living in domestic service. After so long a period it is impossible to think that stenosis is the least likely to occur at the point of junction, so that the case may be fairly claimed as one of complete and permanent cure.

Case II is of interest from the nature of the operation performed, being one of double anastomosis, a portion of both the large and small intestine being excised. I have not been able to follow or look up the most recent literature on this subject, but I should be interested to know whether any of the members present have had a case of double anastomosis, or whether they can refer me to any such record. The particular point of interest would be not so much the surgical detail of the operation, which is quite practical, but whether a patient can survive such an operation. In my case I practically had no alternative to the method I adopted. The patient himself, who thoroughly realised his condition, begged that, if possible, whatever the state of affairs was that I found inside, I would not abandon the operation, and that he would run any hazard if the operation would afford him the least prospect of relief. On opening the abdomen it was obvious that I must either undertake the hazardous operation described, or close the abdomen and leave the patient to his fate unrelieved. I decided to give him the chance.

The third case is one of considerable interest as illustrating what I have long held to be the right method of treating acute intestinal obstruction in cases where the nature of the obstruction is doubtful, and the patient's general condition too grave to admit of an extensive and prolonged operation. The patient when I saw her was rapidly becoming exhausted from the shock and almost constant vomiting produced by complete obstruction. I hold that in such a case what is required is to give immediate relief to the distended bowel with the least possible disturbance to the abdomen. In these circumstances, if relief be given, the vomiting quickly ceases, and if the patient is not already too far gone she will get over the shock, and temporarily recover. Time is thus gained further to consider what may have been the cause of obstruction, and the best plan of dealing with it. To open an abdomen in a patient already suffering severely from shock, with an abdomen blown up and distended from delay in treatment, to search for the cause of obstruction, and at once to perform an anastomosis, is to my mind almost certain death.

On the other hand, a few weeks after temporary enterotomy, the surgeon can operate with far more hopeful prospects. There has been an opportunity for thoroughly preparing the patient for an aseptic operation. The intestines not distended no longer offer a formidable mechanical impediment to operative manipulation as they do when tightly distended, by crowding over everything; and, above all, the patient having rallied from the shock of prolonged obstruction, is in a far more favourable condition to withstand what may be a long and formidable operation. The surgeon, too, is no longer hurried, and he is able to attend to minute points of detail in the stitching—so important to success—in a manner which he could not do when every minute is of precious importance.

Lastly, the enterotomy opening, as in my case, will serve as a temporary safety valve after performing an anastomosis. The opening, of course, from the very fact that it was made in the distended intestine, means that it was above the point of obstruction, and will consequently, if an operation is subsequently performed, be above the new junction. Thus there will be no fear of undue distension at the line of junction by wind or faeces. The enterotomy opening being small, it may gradually close of itself after the obstruction beyond has been relieved. If it does not do so, it can be subsequently closed by operation. I do not in this short paper mention bobbins and buttons, for I have on several occasions stated my views on this matter, and with further experience I am more than ever inclined to regard them as incomparably inferior to accurate hand-stitching, and further I regard them as the direct cause of deaths otherwise avoidable.