been established that trypanosomata are the cause of sleeping sickness; that the human being is infected through the bite of a fly of the tsetse fly type, *Glossina palpalis*; that the fly carries the parasite for five days or more after biting a patient or animal infected with trypanosomata, but can transmit the disease for only two days; that practically all the *Glossina* flies captured around certain lakes in dangerous districts contain trypanosomata; that the trypanosoma of sleeping sickness is fatal for some lower animals, especially for monkeys, dogs and cats, and can be transferred to them experimentally, while other animals are more highly resistant to the human trypanosoma.

In addition to the facts just stated, researches have been made to determine what changes are produced in the tissues as the result of trypanosomatic infection, and studies into the mechanism of protection and immunity are already beginning to appear.

PROBLEMS TO BE SOLVED

Many experiments have been made to discover drugs with which to combat this type of disease, with an encouraging degree of success, and already two drugs, trypanred and atoxyl, have become recognized as having a definite value in the treatment of trypanosomatic infections. Other investigations have been made to make clear the complicated changes which trypanosomata pass through during their growth and reproduction; Schaudinn's work deserves special attention in this connection. Upward of a hundred trypanosomata have been described, which differ among themselves, either in structure or habits. It is important to determine how many species we have to deal with; to establish the specific differences; to gain information regarding the variations; so far as possible to determine the conditions under which variation occurs, and especially to obtain a clear knowledge of the manner in which these protozoa live when they are not parasitic in the blood of animals. Many experimental studies have been made which have in view some of the objects mentioned above, and among other important results already achieved a method has been devised by Novy and his colleagues for growing trypanosomata in cultures.

TRYPANOSOMATA WIDESPREAD

Enough has been said to show that diseases caused by trypanosomata are widespread and fatal for many lower animals, and that in Africa this protozoon is exceedingly dangerous to human beings. The problem of conquering these diseases is an immediately pressing problem. The interests involved are enormous, often national or even international. Success in preventing and eradicating these diseases can be hoped for only when preventive measures are based on accurate and detailed knowledge of the parasites and of the insect carriers. In attaining this knowledge it is necessary to study the sick animals, the climatic and geographical peculiarities, the distribution and habits of insects, and, above all, to study the parasites themselves. It is folly to assert that this knowledge can be gained equally well without animal experimentation. There is hardly a line of research on trypanosomata that does not require animal experimentation at one point or another. Without animal experimentation, progress in combating diseases of this group would practically cease.

CONCLUSION

It may be well, in conclusion, to try to stand to one side and view critically the experimental work that is briefly summarized in this article; to face frankly the

possible charge of inhumanity and cruelty and to face equally frankly the obvious motives of the experimenters, and the results aimed at and actually accomplished. Without doubt, to one not interested in zoology and out of touch with the ideals of investigation and research, it might seem wanton cruelty to capture field mice and wild birds and to study the blood of these creatures for parasites. There might well have been no obvious connection whatsoever between such examinations and human progress. But if studies like those of Danilewsky, MacCallum and Ross had been prohibited on the ground of cruelty, it is not improbable that the ravages of malaria would be yet unchecked. The wonderful revolution brought about by the discovery that yellow fever is carried only by the mosquito was almost directly a sequel to the malaria work, and it requires no great stretch of the imagination to suppose that if animal experimentation had been forbidden the world would to-day be as powerless as ever in the fight against these two scourges.

Again, there is no question that many animals have been sacrificed in experiments connected with Texas fever, surra, nagana and similar diseases. These diseases do not even attack human beings, and, therefore, in this group of cases, we do not have to balance the value of a human life against that of an animal. The motive animating the experimenters is perfectly clear and cannot be interpreted except in one way by any one who chooses to weigh the evidence. For example, no flight of imagination could go to the point of supposing that Bruce was sent out to South Africa in order to perform brutalizing experiments, or that he would have gone for any such purpose. It is so obvious that it sounds puerile to state that Bruce's mission was to learn to master nagana and to put a stop to its ravages among live stock. The question may be raised, "Was Bruce justified in sacrificing some animals in his experiments on the chance of thereby gaining information that might be used in saving the lives, or of improving the condition of great numbers of other animals?" There can be only an affirmative answer to this question, so far as economic interests are concerned, and even from the viewpoint of a strict opponent of animal experimentation it might seem proper to save the lives of many animals by the sacrifice of a few. The opposite attitude would, in fact, be both foolish and cruel, as it would disregard the welfare of the great majority of the animals. And yet if once it be admitted that animals may be sacrificed for the welfare of other animals the whole attack against animal experimentation collapses, for surely human progress and human welfare are objects as worthy as the welfare of the lower animals.

ARTIFICIAL VAGINA BY INTESTINAL TRANS- PLANTATION

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In the *Annals of Surgery* for September, 1904, I described an operation which I had devised, and the feasibility of which I had demonstrated on the cadaver, for the establishment of an artificial vagina in cases of acquired or congenital absence of that organ, by transplanting a loop of intestine. A very thorough examination of the literature of artificial vagina had been made for me by an expert connected with the Library of the Surgeon General's Office, and the operation suggested was found to be entirely unique.

Three years later, having had an opportunity to employ this method. I reported¹ the case in full at the twentieth annual meeting of the American Association of Obstetricians and Gynecologists. I have now had four of these cases and can recommend this method of operating to the profession with very great confidence.

Patient.—My fourth case was in a young woman, aged 18. She had always enjoyed excellent health, but had never menstruated, nor had she experienced any menstrual molimen. She was brought to me in the spring of 1909, but as she had just graduated from high school I made no examination but encouraged the mother to delay, thinking that the amenorrhea would disappear with improved nutrition; and I directed outdoor life and vigorous exercise. This failing to accomplish the desired result the patient was again brought to me, August 20, and I then made an examination. (I had previously operated on this patient, once for appendicitis, making the usual McBurney operation, and once for left inguinal hernia, the hernia containing the ovary. The ovary was replaced, and the parts closed in the usual way, but the patient was a mere child and no examination of the pelvic organs was thought of.)

Examination.—There was found complete absence of the vagina, its presence not being indicated even by so much as a dimple. Rectal examination was somewhat unsatisfactory, but was absolutely negative as to the existence of uterus or ovaries. I advised examination under an anesthetic, and this was done on the following morning. I could then by the rectum make out an irregular mass in the right side of the pelvis, but the character of this could not be determined. I supposed

Fig. 1.—Bowel seized by hemostat through opening for new vagina; a, b, sigmoid or ileum; c, d, points for section and anastomosis.

it to be either the right ovary or an imperfectly developed uterus. It was considerably larger than a normal uterus, so that if it represented that viscus it would probably be found that the increased size was due to retained blood. The deformity was carefully explained to the patient and her mother, and the possibilities of making an artificial vagina were discussed at some length. They were both very anxious that the operation should be made, and it was accordingly undertaken August 23.

Operation.—The perineum and lower abdomen having been prepared, the patient was placed in the lithotomy position and a transverse incision made in the perineum at a point corresponding to the normal opening of the vagina. With an index-finger in the rectum and a sound in the bladder, I carried this dissection forward until the peritoneum was reached. This opening was made amply large, and then lightly packed with gauze pressed in around a large hemostat, which was introduced so as to expedite the second step of the operation. The patient was then placed in the horizontal position, and the abdomen opened in the median line. It was then found that the mass in the pelvis, which had been previously made out, was behind the peritoneum. I at once passed my hand up and found, as suspected, an entire absence of the right kidney, and then a little more investigation showed that this tumor was the kidney congenitally misplaced. Not a trace of the uterus

could be found. (In two other cases which I have had of congenital absence of the vagina the uterus was represented by a small bit of tissue, about the size of the end of the little finger, on each side in close proximity to the ovaries.) The ovaries were normal, but were found on each side much higher up than usual. To each one was connected a small bit of Fallopian tube, like a plume on a lady's hat. On the right side was a very imperfect round ligament, but no trace of any on the left. The field of operation having been protected by gauze sponges, the lower end of the ileum was brought up, the intestinal contents displaced for about 12 inches, and this portion of bowel resected but with careful preservation of the mesentery. The ends of the resected section of bowel were inverted with purse-string suture, and the other ends connected to each other by a Murphy button so as to reestablish the continuity of the canal. I had left just enough of the lower end of the ileum attached to the colon to enable me to make this anastomosis. The peritoneum over the vagina was then opened, exposing the hemostat, which was then pushed on into the pelvis by an assistant. The detached bowel was caught at its middle by the hemostat and drawn down into the artificial vagina. The peritoneum was carefully brought together over and around the ends of this piece of bowel, so as to make a smooth floor. The abdomen was then closed in layers in the usual way. The patient being then placed in the lithotomy position, the bowel was opened

Fig. 2.—Section of bowel (a, b) with mesentery intact, drawn into new vagina; c, d, anastomosis; e, f, closed ends.

where it had been caught by the hemostat, each leg of the loop wiped out carefully, and then packed with iodoform gauze so as to press it snugly against the walls of the artificial opening. The edges of the opening into the bowel were caught to the edges of the new vulva, and a small drainage wick introduced at the very bottom so as to take care of any oozing which might take place. (The accompanying illustrations will serve to make clear the text.)

Postoperative History.—The patient went through the operation very nicely and made an absolutely uneventful recovery, the button coming away in two weeks. She returned to the hospital some weeks later, when the septum was removed in the usual manner, and at this time an ordinary examination would fail to reveal anything abnormal about the vagina, except the absence of a uterine cervix.

While studying the technic of this operation from a theoretical point of view, I took pains to examine the ileum and sigmoid in a large number of patients on whom I was making ordinary abdominal operations. Several hundred patients were thus examined, and in all I found that there would be no difficulty in drawing down such a loop of ileum into the vagina, or a loop of sigmoid if for any reason the ileum should not be found satisfactory. With either there would be plenty of slack of the mesentery so that the circulation would not be

1. Am. Jour. Obst., lvi, No. 5.

interfered with. I have always used, however, a loop of ileum because resection of the ileum is safer than resection of the sigmoid. In all of my cases operative recovery was absolutely smooth, and the new vagina seems to take the place very satisfactorily of the natural organ. I was induced to use the bowel for this purpose because a very extended study of the literature of artificial vaginas had shown that in cases of entire absence all other methods resulted in almost complete failure, although full of promise in many cases when the patient left the operating-table. The favorite method of operating had been by transplantation of pieces of skin, to line the artificial canal. In all of these cases, however, to the reports of which I had access, the ultimate results had been very unsatisfactory owing to cicatricial contraction. By the use of the bowel a normal mucous membrane is provided, surrounded by normal connective and muscular tissue, and with an ample blood-supply. Theoretically and practically, therefore, such a vagina would seem to fulfil to the highest degree all the requirements.

The dangers of operation are simply those inherent to any other deliberate resection and anastomosis of intestine; but the operation is one which should certainly not be undertaken by a tyro in surgery. My first operation took over two hours, the last one about half that time, and I think that in an uncomplicated case the operation should be made within the hour. There is, of course, no hemorrhage to amount to anything, and if the field of operation is carefully protected there should be no shock. The danger, therefore, would be merely the danger of a possible infection from the intestine, and that danger in the hands of an expert is very slight. Nevertheless, the danger should be fully explained to the patient, who would then decide whether the operation would be worth while.

In addition to the four cases of my own, a successful operation has been reported by Mueller² and one by Mori.³ Thus we have six successful cases with no mortality. (So far as I can learn neither Mori nor Mueller refer in any way to my own previous work, although my publications preceded theirs by several years. I understand, however, that such a failure to give credit is in certain foreign medical circles not looked on as either unethical or dishonorable).

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TORSION OF THE GREATER OR GASTROCOLIC OMENTUM

COMPLICATED BY ACUTE APPENDICITIS

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So very little is really known of the mechanical cause of the twisting of the omentum that the report of this case is interesting and may serve to throw some light on the subject.

Less is known of the symptom-complex leading to a correct diagnosis of such torsions. This is demonstrated by the fact that in some sixty odd cases recently collected, extending over a period of twenty-seven years since 1882, when the first report was made by Oberst, only one case was diagnosed as such before the operation.

Corner and Pinches lead one to be satisfied with a diagnosis at the operating table and not a differential one beforehand.

Fuller points out the difficulty of diagnosis and says that it is not at all remarkable or strange for a torsioned omental tumor to escape detection even during a laparotomy, unless the incision happened to be made directly over the tumor.

Richardson suggests an anatomico-pathologic classification according to the point of twisting, and asks for a report of all cases with an explicit statement as to the location of the tumor and the point of torsion. He thinks that if the possibility of torsion of the omentum be kept in mind in all cases of abdominal symptoms pointing to a strangulation a preoperative diagnosis of torsion of the omentum would become more frequent.

Weiner offers the very practical suggestion that if we cut down on a hernia that produced symptoms of strangulation and find only a strand of omentum in the canal we should investigate the intra-abdominal portion of the omentum to make sure that there is no torsion present.

Patient.—H. P. F., foreman by occupation, 32 years old, was admitted to my service at the Harlem Hospital, June 14, 1906.

Previous History.—The patient had an attack similar to the present one two years ago, from which he recovered. He was operated on ten years ago for right inguinal hernia.

Present Illness.—Two days previous to admission he was seized with very severe pains in the right iliac region, which continued unabated up to that time. He had been constipated since the beginning of the attack. There was no vomiting. He was in great pain on admission. His temperature on admission was 103 F., pulse 120, respiration 26.

Physical Examination.—General appearance—a well-developed, conscious male, very obese. Eyes—pupils contracted but reacted naturally; mucous membrane red and dry; lips scarlet; pulse regular in force and frequency; very rapid; respiration shallow and jerky; abdomen rigid and tense, general tenderness, tympanitis, pain more marked on right side. Urine—albumin with casts, hyalin, granular and epithelial. Arteriosclerosis was present. An indistinct mass could be made out to the right of the umbilicus, reaching down into the right iliac region. A cicatrix in the right inguinal region indicated that an operation for hernia had been performed. The wound had apparently healed by primary union, and there was no signs of recurrence. A diagnosis of appendicitis was made. A high leucocytosis and differential blood-count, with the mass and other symptoms suggested abscess.

Operation.—A long incision was made through the deep fascia on the outer edge of the right rectus muscle over the tumor. A quantity of bloody fluid escaped and a large mass of congested and partially strangulated omentum immediately presented itself in the wound, and was found to be adherent beneath the hernial cicatrix by the small thin band of adhesion at the lower end of the specimen seen in the illustration. This and several other small bands of newly formed inflammatory adhesions were easily broken up; as they were so small they were not ligated. The omentum was delivered through the wound and excised near the transverse colon. The appendix, which was found to be very markedly congested, was removed. There were, however, no adhesions between the omentum and the appendix. The abdomen was closed without drainage, and the patient left the operating room in good condition. June 18, four days after the operation, the wound was dressed and was found dry and clean. June 30 the patient was up and well.

Examination of Specimens.—The specimen of the appendix was small; there were no adhesions, though it was markedly congested, but probably not enough to account for the high temperature, pulse and leucocyte count, and surely not for the general congestion and the fluid in the abdomen.

The specimen of the omentum (see illustration) was 17 inches long, weight 9¾ ounces, and had 27 distinct complete twists or turns, the reverse to the thread of a right-hand screw. When partly untwisted it was found that the small band of adhesion to the peritoneal side of the hernia cicatrix

2. Mueller, A.: Formation of Vagina from Loop of Small Intestine, *München med. Wchnschr.*, Dec. 21, 1908; abstr. in *THE JOURNAL A. M. A.*, Jan. 29, 1910, liv, 419.

3. Mori M.: *Zentralbl. f. Gynäk.*, Jan. 1, 1910; abstr. in *THE JOURNAL A. M. A.*, Feb. 12, 1910, liv, 577.