have more satisfaction with this surgery than any other. It is always best to complete the work well, when once undertaken. Otherwise the old method of puncture through the vagina will be again heard from. In this connection I wish to say that I have seen at least four cases where puncture through vagina reached pus in the broad ligament, and was followed by an apparent cure. But if any practitioner will witness one of these sections, and see how perfectly thin and healthy the broad ligament remains after all adhesions and disease have been removed, he must indeed be hard to convince if he still believes in the old theory of "cellulitis" as explaining these pelvic masses.

Finally, and in conclusion, I must refer to the minor cases which have been operated upon, and which are abroad in the land by scores, without recognition. One case, No. 20. W. had been married sixteen years; one conception; pelvic disease ever since. Pain, retroflexion, sterility. Treated for months at a time by various physicians. Finally, after nearly two months more of treatment under my own supervision without result, section. Two large pus tubes like sausages. No trouble whatever in convalescence.

Another patient (Case 12), unmarried, had gonorrhœa some months before admission to hospital. Vaginitis treated. Pain in both ovarian regions, rapidly growing worse. Section. Plenty of pus in ovaries and tubes. Perfect recovery.

Another (Case 34) contracted gonorrhœa from husband. In four weeks pyosalpingitis of right side, involving intestine. At time of section free pus poured out of left tube. Fimbria of right tube implanted upon intestine like a placenta; ovarian and tubal abscess. Bowel gave much anxiety, as it was badly necrosed. Gauze packing and drainage after flushing. Perfect recovery. The length of this article forbids further mention of these very interesting cases.

THE PATHOLOGY OF INTESTINAL OBSTRUCTIONS FOLLOWING ABDOMINAL AND PELVIC OPERATIONS.

Read in the Section of Obstetrics and Diseases of Women, at the Forty-third Annual Meeting of the American Medical Association, held at Detroit, Mich., June 7, 1892.

BY WILLIAM EASTERLY ASHTON, M.D.,

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Notwithstanding the brilliant results which have been attained in modern abdominal and pelvic surgery there is still much to learn and to improve upon in our operative technique before some of the distressing after results of these operations are prevented or at least rendered less frequent. Among the most important of these post-operative complications I would include intestinal obstructions.

An enormous amount of literature has been written upon acute intestinal obstruction as a surgical disease and the subject is, very properly, receiving the attention it deserves in our medical societies, but, as yet, little has been done toward solving the problems suggested by bowel obstructions following abdominal and pelvic operations. It is, therefore, my purpose in this paper, which I have the honor of presenting before this Association, to enter into the pathology of these obstructions and to discuss such

views of the subject as my own experience and that of other surgeons may suggest.

In discussing the pathology of bowel obstructions following intra-peritoneal operations I shall limit myself strictly to those causes dependent upon operative interference and not refer to the causes of acute obstruction from the standpoint of a surgical disease.

I shall classify the causes of post-operative obstructions as follows:

1. Adhesions between the intestine and raw surfaces.

a. To an omental stump.

b. To denudations of the pelvic and parietal peritoneum.

c. To the edges of the vaginal wound following a supra-pubic or a vaginal hysterectomy.

d. To a pedicle.

e. To raw surfaces on the intestinal wall.

2. Paralysis of the intestines.

3. Local spasm of the intestines.

4. Impacted feces

5. Bands of inflammatory lymph.

6. Adhesions between coils of intestine or between the gut and neighboring parts due to a traumatic inflammation.

7. Kinking or twisting of the intestine due to a faulty technique.

8. Including the intestine within the loop of an abdominal wall suture, or between the edges of the belly incision.

9. Slipping of a coil of intestine through a slit or an aperture.

Adhesions Between the Intestine and Raw Surfaces.—By far the greater number of bowel obstructions are due to this cause. A knuckle of gut becomes attached by an adhesive inflammation to a denuded surface and a kink results and an obstruction of the bowel follows. Naturally the question will be asked, how do we explain the fact that so few cases of obstruction occur from this cause when there are so many bad pelvic cases requiring the separation of extensive adhesions? My answer is, that kinking does not necessarily follow the fixation of a knuckle of intestine unless the gut adheres in an abnormal position. In other words, if the normal position of a coil of intestine is near the position of the denuded surface to which it adheres obstruction will not as a rule follow. Furthermore, I believe that many of the cases which die after abdominal and pelvic operations, and the cause of death is ascribed to peritonitis, are in reality undiagnosed bowel obstructions.

The following cases present points of great interest in connection with this class of obstructions.

Case 1.—Reported by Meredith.¹ Section for double cystoma with extensive adhesions. *Secondary Section*, eighth day. The peritoneum was intensely red and congested, evidently in the first stage of acute inflammation. "Attention was attracted to a coil of greatly distended small intestine which was badly kinked and obstructed in consequence of the traction exerted upon it by a portion of the ligated omentum which was closely adherent to its surface." There was no other obstruction. The patient recovered.

Case 2.—Reported by Krug.² Section for double pyosalpinx and ovarian abscesses. Adhesions especially extensive behind uterus. Irrigation and drainage. *Secondary Section*, Fourth day. Signs of beginning peritonitis. A portion of the descending colon was found glued fast as an angular loop to the posterior surface of the uterus. The patient recovered.

¹ London Lancet, 1886, p. 64.

² Amer. Jour. of Obstet., 1890, xxiii, 1371.

Case 3.—Reported by Ahern.³ Section for large cyst of right ovary. Adhesions to brim of pelvis on left side and to sigmoid flexure. Raw surfaces two in number, and $\frac{1}{2}$ of an inch in diameter each. No drainage. *Secondary Section.* Ninth day. Upper part of small intestines congested and distended. Adherent to pedicle and to both denuded surfaces. Below the adhesion the bowel was contracted. The coil of intestine at point of adhesion formed an acute angle. The patient recovered.

Case 4.—Reported by Anderson.⁴ Section for ovarian cystoma. Adherent to parietal peritoneum just above the position of the cæcum. *Secondary Section.* Twentieth day. Coil of small intestine adherent to raw surface just above the position of the cæcum. Below the adhesion the gut was collapsed, above distended. The patient recovered.

Case 5.—Reported by Coe.⁵ Vaginal hysterectomy. Uterus retroflexed and adherent. Ovarian cyst right side punctured and removed. No ligatures. Two forceps to each broad ligament, and two pairs to bleeding points in utero-sacral folds. Peritoneal wound left open. Tampon iodoform gauze. *Section.* Fifth day. A loop of small intestine adherent to the right edge of vaginal wound. No peritonitis. The gut was distended above the adhesion and contracted below. The patient died next morning from shock.

The following cases of "ileus after vaginal extirpation of the uterus," quoted by Coe from a paper by Reichel⁶ are of great interest.

Case 1.—*Section.* Seventh day. The lower part of the ileum was attached to the edge of the vaginal wound. Gut above distended. No peritonitis. Patient died on the table.

Case 2.—(Olhausen.) *Section.* Ninth day. A coil of ileum adherent to edge of vaginal wound. The gut was bent at an angle. Died in 24 hours. *Post mortem.* Diffuse peritonitis. Two other coils found attached to edge of vaginal wound.

Case 3.—Collapsed and died on the eighth day. *Post mortem.* Coils of intestine adherent to edge of vaginal wound, the gut above greatly distended. The large intestine contained fecal matter, therefore, the obstruction was not complete. No general peritonitis.

The four following cases of obstruction consequent upon vaginal hysterectomy are also quoted by Coe.

Case 1.—Bakelmann's patient.⁷ Died on seventh day. *Post mortem.* Lowest part of ilium adherent to edge of vaginal wound. Gut distended and bent at an angle.

Case 2.—Leopold's patient.⁸ Death on fourth day. *Post mortem.* Two coils of intestine adherent to edge of vaginal wound. The gut bent at an angle.

Case 3.—Landau.⁹ *Section.* Seventh day. Adherent gut to edge of vaginal wound. Died next day.

Case 4.—Coe's patient.¹⁰ *Section.* Second day. Two or three coils of ilium adherent to edge of vaginal wound. Gas escaped per anum after they were detached. No peritonitis. Death in four hours.

These cases illustrate in a forcible manner the explanation and dangers of obstructions due to raw surfaces. In every one of the abdominal sections the obstruction occurred at a point where adhesions were separated at the time of operation. Again, in every instance, the intestines were fixed in an abnormal position and at the point of fixation formed a more or less acute angle. In the case reported by Krug where he found the descending colon "adherent as an angular loop to the posterior surface of the uterus" we have an instructive illustration of these points. The cases quoted of obstruction following vaginal hysterectomy, also demonstrate clearly the cause of bowel fixation and kinking dependent upon an adhesive attachment of the intestine to a raw surface.

The practical operative lesson all of these cases teach us is, that when we perform a secondary sec-

tion for their relief we know where to look for the seat of obstruction if we have kept in mind the position of denuded surfaces made at the time of the original operation.

Paralysis and Local Spasm of the Intestine; Impacted Fæces.—As the pathology of all of these causes of obstruction is the same, I shall discuss them under one heading. First, however, I shall cite some cases illustrating this class of intestinal blocking.

Case 1.—This case occurred in my own practice. Section for double pyosalpinx with slight adhesions. Irrigation, but no drainage. Death on fifth day. *Post mortem.* The small intestine, for a distance of 8 inches from the ileo-cæcal valve, was tightly contracted, causing an absolute obstruction. Above the contraction the gut was greatly distended. At the seat of constriction the bowel was red and congested, but no lymph was found. The abdominal cavity was dry. There were no adhesions.

Case 2.—Reported by Baldy.¹¹ Supra-pubic hysterectomy; extra-peritoneal treatment of the stump. *Secondary section.* Sixth day. Intestinal evacuation and drainage. Death in twenty-four hours. *Post mortem.* Intestines free, "but in one or two places had contracted so as to feel like hard cords."

Case 3.—Reported by Baldy.¹² Section for double pyosalpinx. Inflammation of some of the pelvic loops of intestine. *Secondary section.* Fourth day. Bowels enormously distended. Intestinal evacuation and drainage; death in twelve hours. *Post mortem.* "There was nothing abnormal found excepting the peritonitis affecting the coils of intestine in the pelvis. There was a slight adhesion of these coils to one another."

Case 4.—Occurring in my own practice. Section for chronic inflammation of the appendages. Dense pelvic adhesions. *Secondary section.* Twentieth day. Small intestines somewhat distended; no evidence of peritonitis or pus. The descending colon was tightly packed with hard feces from the splenic to the sigmoid flexures. Bands of lymph constricting slightly the bowel near the sigmoid. The patient recovered.

The true explanation of obstructions due to local spasm or paresis of the bowel will, most probably, be found in a study of the influence of various stimuli upon the nerves controlling intestinal peristalsis. The intestinal walls contain an automatic motor centre—the plexus of Auerbach—which influences the peristaltic action of the bowel. "If this centre is not affected by any stimulus, the movements of the intestines cease—comparable to the condition of the medulla oblongata in apnoea. The same is true—just as in the case of the respiration—during intra-uterine life, in consequence of the fetal blood being well supplied with O. This condition may be termed aperistalsis. It also occurs during sleep, perhaps on account of the greater amount of O in the blood during that state. All stimuli applied to the plexus myentericus increase the peristalsis, which may become so very violent as to cause evacuation of the contents of the large gut, and may even produce spasmodic contraction of the musculature of the intestine. This condition may be termed dysperistalsis, corresponding to dyspnoea. The condition of the blood flowing through the intestinal vessels has a most important effect on peristaltic movements. The continued application of strong stimuli causes dysperistalsis to give place to rest, owing to over-stimulation, which may be called intestinal paresis or exhaustion."¹³

With these facts before us concerning the effects of the absence or the presence of stimulation upon intestinal peristalsis we are able, most probably, to explain the pathology of these obstructions. For the first

³ Amer. Jour. of Obstet., 1891, xxiv, 326.

⁴ London Lancet, 1889, ii, 894.

⁵ Amer. Jour. of Obstet., 1890, xxiii, 144.

⁶ Zeitschrift für Geb. u. Gyn., Band xv, Heft 1.

⁷ Archiv. für Gyn., Band xxv, Heft 1.

⁸ Archiv. für Gyn., Band xxx, Heft 3.

⁹ Berliner Klin. Wochenschrift, 1888, No. 10.

¹⁰ Amer. Jour. of Obstet., 1890, xxiii, 469.

¹¹ Journal of Gynecology, August, 1891.

¹² Journal of Gynecology, August, 1891.

¹³ Landois, second Amer. edit., p. 263.

twenty-four or forty-eight hours after an abdominal section the intestines are in a condition of aperistalsis if the case be doing well. There are several factors concerned in bringing about this state. In the first place, the preparatory treatment of the bowels with salines, the liquid diet and the absence of food after section leave the intestines comparatively empty, thus removing the intestinal contents as a factor in stimulating peristalsis. Again, the rest in bed for two or three days before an operation, and the enforced quiet afterwards, add largely to the absence of intestinal activity. This condition is not only observed immediately after an abdominal section, but also after parturition or, in fact, in all cases in which the patient is required to lie quietly in bed for some time. The well known fact that changing the position of the patient in bed relieves tympany in some cases, and favors the downward movement of gas, shows the effect of exercise upon intestinal peristalsis.

The causes of operative stimulation of the intestines are: exposure to the air, lowering of the temperature, bruising, healing of denudations, peritonitis, operative procedures, irritating fluids, septic materials, and a neglect to thoroughly empty the bowels prior to operation.

We have found that dysperistalsis and paresis depend upon the same cause, namely: an irritation of the motor centres of the intestine, but that the intensity and duration of the abnormal stimulation alone determines the difference between the two conditions. For example, a simple congestion of the intestinal blood-vessels would most probably, even if long continued, result in a condition of dysperistalsis, while a severe inflammation, on the other hand, would cause a state of paresis.

In cases Nos. 1 and 2 there was a condition of intestinal dysperistalsis present, causing the obstruction. In both cases, at the beginning, this condition alone existed, but subsequently paresis of the gut above the constriction occurred, due to the continued effort made by the intestine to push its contents beyond the obstruction. The increased amount of gas and fluid in the bowel also aided in producing exhaustion, as they were necessarily a source of continued irritation. In case No. 1 the intestinal spasm was probably the result of the congestion, which was practically limited to the seat of constriction in the bowel. The cause of this congestion is difficult to determine. Possibly it may have been due to the irritation produced upon the intestine by the pus which escaped when the tubes were delivered, or the bowel may have been bruised during the operation, and a traumatic peritonitis was developing at the time of death. In case No. 2 the notes of the post-mortem examination were too superficial to be of any value in determining the cause of the nodulated condition of the intestines. Case No. 3 was clearly one of intestinal paresis due to peritonitis. The adhesions which were found between coils of the intestine after death were evidence that the peritonitis, which had existed at the time of the operation, had continued.

Case No. 4 is of especial interest. The patient had a bowel movement in forty-eight hours, and everything was doing well until she fell out of bed in her sleep on the third day. Now what had happened to bring about an obstruction due to faecal impaction after this accident? I believe that the fall caused a traumatic peritonitis which resulted in paresis of

the colon, and while the bowel was in this condition faecal accumulations occurred. After the intestine had regained its normal activity, it was then unable to empty itself on account of the great amount of faecal matter which had collected. In addition to this want of power in the gut, there was also more or less constriction, from bands of lymph, at the sigmoid flexure, which rendered the downward passage of the faeces difficult.

Bands of Inflammatory Lymph.—As the result of intraperitoneal inflammation following abdominal and pelvic operation, lymph is poured out upon the intestines, and coils of the gut become more or less adherent to each other. As a rule, no bad results ensue, but if the adhesions destroy the normal relations existing between the coils, or a knuckle of gut is constricted by a band of lymph, then kinking or strangulation follows. These obstructions do not manifest themselves early after operation, because no serious interference to the movements of intestinal fluids occurs, usually, until the bands of lymph begin to organize and to contract. Montgomery¹⁴ reports an interesting case of volvulus caused by bands of inflammatory lymph. Five weeks after the original operation, for peritonitis, symptoms of obstruction came on, associated with faecal vomiting. "The intestines were found matted together, so that over a yard of small intestine had to be forcibly liberated from extensive adhesions. The muscular coat was torn through at a number of points; a distinct twist was found in the small intestine, which was readily overcome by separating the bands of adhesions." The patient made a good recovery.

Adhesions between Coils of Intestine or between the Gut and Neighboring Parts, due to Traumatic Inflammation.—These adhesions have always been a subject of great interest to me. They result from an irritation of the serous membranes caused by the exposure of the intestines to the air, to lowering of their temperature, to handling or to necessary manipulations or operative procedures. This class of adhesions is, in my experience, a necessary sequence to all intraperitoneal operations. In fact they are, I might say, the opprobrium of abdominal surgery, for it must be indeed rare to have an abdominal operation not followed by more or less fixation of the viscera. In my experimental work upon the lower animals this fact has time and again forced itself upon me. For example, I have taken a perfectly healthy dog and performed upon the animal a lateral anastomosis without resection. At the time of operation not more than 10 inches of the bowel were exposed through an incision in the belly wall less than 2 inches in length, and every precaution was taken in the operative technique. Yet notwithstanding these facts, when the animal was killed in three weeks, after making an uninterrupted recovery, the intestines were so matted together that it was with the greatest difficulty I was able to separate the seat of anastomosis from the adherent coils of gut. This has been my experience, without an exception, in all my work upon the lower animals. I have seen numerous illustrations of these traumatic adhesions in the human subject revealed during a secondary section or a post-mortem examination. At an autopsy recently held at the Philadelphia Hospital upon a woman who had died three weeks after a supra-vaginal hysterectomy from disease of the kidneys, the intestines were found to be extensively

¹⁴ Philadelphia Hospital Reports, Vol. I, 1890.

matted together. The hysterectomy was a very simple operation, without adhesions; the abdominal incision was small and there was no exposure of the intestines, and yet, after death, extensive fixations of the gut were found. It is a very common experience, in performing a secondary section, to find the gut or the omentum adherent to the parietal peritoneum at the site of the original abdominal incision. This fact is so well recognized that great care is always taken in reopening the abdomen to cut to one or the other side of the cicatrix, in order to avoid the danger of wounding a knuckle of adherent gut. Fortunately traumatic adhesions, as a rule, are not followed by fatal results, as they do not cause kinking or twisting of the gut. They do, however, not infrequently cause remote troubles by giving rise to colicky pains and more or less tendency to constipation.

Kinking or twisting of the Intestine due to a Faulty Operative Technique.—These obstructions are not the result of adhesions, but occur after anastomotic operations upon the alimentary canal, or after the repair of bowel lesions. For example, a coil of intestine may be kinked or twisted by placing it in an abnormal position in making an anastomosis. Or, again, the bowel may be torn transversely while separating adhesions during an operation, and, if the opening be large, suturing the tear may result in a fatal obstruction from kinking. Tears in the wall of the bowel which are longitudinal to its long axis may be safely closed with sutures, even if it is extensive, but a large transverse opening into the gut will almost certainly cause a kink if sutured.

Including the intestine within the loop of an abdominal wall suture or between the edges of the belly incision.—At first sight these causes of bowel obstruction may appear to the surgeon as being extremely unlikely, or at least very rare. Yet, if we will recall to mind our own operations, as well as those of other surgeons, I think all of us will be struck by the fact that such an accident is liable to occur when the abdominal incision is closed. There is but little danger, I admit, of including a loop of intestine when the belly wall sutures are introduced, as the abdominal contents are protected by a gauze pad or a flat sponge, but it is when they are tied that the accident is likely to occur. After the pad or the sponge has been removed the intestines come in direct contact with the loops of the sutures and press up, more or less, between the edges of the abdominal wound. Naturally, therefore, it is next to impossible for the surgeon to know positively that a portion of the gut has not been caught when the sutures are tied. Of course, if the gut has been fastened to the abdominal incision no immediate result will necessarily follow unless the lumen of the intestine has been obliterated, leakage occurs or kinking takes place. Consequently, we are not aware, in the majority of instances, that such an accident has occurred. Or, again, if the accident be followed by a fatal result, its true nature cannot be determined except by an autopsy.

Shively¹⁵ reports an extremely interesting case in which death occurred five or six years after an ovariectomy from a bowel obstruction, which was the remote result of the fixation of the intestine to the abdominal incision. After the original operation the patient was always "greatly troubled with constipation and frequent attacks of colic." She was obliged to use strong cathartic pills to keep her

bowels open. On August 8, 1883, she was taken ill. "She said she was ill with an attack of colic," August 11. Fecal vomiting. Death.

Post mortem.—"At the lower end of the line of the belly cut, a discolored spot, half the size of the hand was seen. The bowel was here adherent. There were also extensive adhesions of the intestines to the sides and posterior wall of the abdomen, thus preventing the appearance of tympany. The intestines and cavity nearly everywhere gave evidence of former inflammation. Also a portion of the ilium (18 inches above cæcum) was adherent to and incorporated with the cicatrix corresponding to the lower angle of the original wound, and that around the short portion between this and the cæcum a loop of small intestine was twice twisted, forming a kind of knot and a complete and effectual barrier to the passage of the intestinal contents."

Slipping of a coil of intestine through a slit or aperture.—This accident may occur from the following causes: 1. The result of adhesions. For example, a band of inflammatory lymph may be so attached that an aperture is formed. Or, again, a coil of the intestine or the mesentery may adhere and form a loop through which a knuckle of gut may slip. I saw an autopsy upon a patient who had died after an abdominal section, where the omentum was found adherent to the parietal peritoneum by two distinct attachments, thus forming an opening through which the intestine might readily have passed. An instructive point in this case lies in the fact that the adhesions were caused by two omental stumps which were left after the omentum had been ligated for adhesions at the operation. Larkins¹⁶ reports a case in which death resulted from an obstruction following a jejunostomy. The original operation was performed for a cancer of the stomach, but in less than three months afterwards he did a jejunostomy on account of obstructive symptoms developing. The patient then did well for about two months when intestinal obstruction again occurred and death resulted.

Post mortem.—"There was a firm adhesion between the jejunum and the incision in the abdominal wall made in performing the gastro-enterostomy. The portion of jejunum taken in the jejunostomy was only two to three inches above this adhesion. The piece of jejunum between these two attachments to the abdominal wall formed a little loop, and between this loop and the parietes the upper segment of the jejunum had slipped. It was firmly nipped. The intestines above were greatly dilated and ruptured just above the seat of constriction; the intestines below were contracted."

2. A faulty method of dealing with tears or incisions through the mesentery. Thus, if the mesentery be torn during the separation of adhesions and the tear is not closed, and its flaps are not well sutured after the resection of the bowel, a coil of intestine is liable to slip into the opening and become nipped. 3. The slipping of a coil of intestine through the vaginal wound after complete removal of the uterus. 4. A knuckle of gut pushing its way through the intestinal loop formed in making a lateral anastomosis without resection. 5. From a fixation of the gall bladder to the abdominal incision. 6. From openings made through the transverse meso-colon and the great omentum to facilitate

¹⁵ N. Y. Med. Jour., 1884, vol. xl, p. 292.

¹⁶ London Lancet, 1891, 11, 1222.

the attachment of the bowel to the stomach in performing gastro-enterostomy. In a case¹⁷ of cancer of the pylorus in which this was done, the post-mortem examination showed that "almost all of the intestines were in front of the great omentum, having prolapsed through a hole in the transverse mesocolon and great omentum. There had passed all of the jejunum and the ilium to within four inches of the ileo-cæcal valve."

2011 Walnut Street.

SOCIETY PROCEEDINGS.

Gynecological Society of Boston.

Regular Meeting, held June 9, 1892.

THE PRESIDENT, AUGUSTUS P. CLARKE, M.D., IN THE CHAIR.

Dr. A. H. Tuttle, of Cambridge, read the following paper on
ANIMAL LIGATURES AND SUTURES, THEIR VARIETY, PREPARATION
AND USES.

Surgeons are divided in their opinions upon the relative merits of various sutures. Silk, one of the first materials to be employed, is still the most popular, and many operators employ it almost exclusively. In the large surgical clinics throughout the world it forms the chief material for closing all kinds of wounds. Catgut and animal ligatures are comparatively of recent use, and offer the special advantage of being absorbed by the tissues, which makes it unnecessary to remove them. In all wounds which are aseptic, these sutures may be used, buried deep in the tissues, without piercing the cuticle or appearing upon the surface of the skin, the line of incision closed with collodion dressing or, in certain localities involving mucous surfaces, with the compound tincture of benzoin, containing a little iodoform, and the wound will be entirely healed at the end of five or six days, without evidence of suppuration. Does not this seem to be an ideal method? There are certain cases, however, where this cannot be accomplished, and where the healing in part is attended with suppuration, *i. e.*, recovery by second intention. In such cases imperfect results are liable to follow the employment of animal sutures, since they will be softened, absorbed, and give way before healing is effected. Gaping of the wound will then result, which would have been prevented had a more permanent suture been used. In abdominal operations it is better to use animal sutures entirely, even if pus is present, since it will remain long enough to do all that is required of it, and it is less liable to become a foreign body, with subsequent sinus formations, and slow cure. In earlier times, before the ideas of sepsis, asepsis and antiseptis had taken material form, silk and other sutures were used without any special preparation, and as might be supposed, primary healing in certain localities never took place. No better example of this can be given than the work of ¹Marion Sims upon vesico-vaginal fistulæ. It will be remembered that Sims operated a great number of times, and in fact had perfected his operation, without realizing its success, and it was only after he changed the material of his suture from silk to silver wire, that he succeeded in completely closing the fistulous opening between the vagina and bladder. To Sims, it seemed as though the substance of the suture brought up the balance in favor of success, but viewing the facts through the spectacles of to-day, we can see still farther, and realize that it was not the mere material from which the suture was constructed, but upon its aseptic preparation, that his success was won. It is a simple matter to make a suture of fine silver wire,

free from irritating properties, and such measure of cleanliness as most surgeons used in those days, would render a suture of this kind practically aseptic. With silk, however, it is quite a different thing, and although it is easily sterilized by special measures, such as boiling, it would rarely be found free from irritating properties in the condition in which it was employed by the older surgeons. Experience has taught us the truth of these statements, for to-day, by simply sterilizing our suture, we can complete the operation for vesico-vaginal fistula without regard to the substance of which it is made. The aseptic condition of the suture is of the utmost importance, and if this condition is maintained, the suture, no matter what it be made of, may be placed almost anywhere without causing a great amount of irritation. If buried in tissue, most sutures, metallic ones excepted, will become absorbed, although it may take a long time, according to the material from which they are made. Firm union of parts should never take over ten days, when the union is by primary intention, therefore any substance which is used for a buried suture should be well under the process of absorption by that time, otherwise it will be in the way, and may retard the normal changes of repair. The animal ligature fulfils this requirement as nothing else will. It is owing to this fact that its growing importance depends. From a few, perhaps bold operators who used it at the beginning, there has been a steady increase in number, until now the larger part of the practicing surgeons of our country, and abroad, have come to recognize its value, and employ it. A great deal of opposition has checked its use, because it can only be made aseptic by a most careful preparation, and much of the material delivered from the instrument maker brought sepsis into the wound; furthermore, it may be absorbed too rapidly, and result in secondary hæmorrhage.

²Dr. Sims, of New York, objected to its use in operations upon the cervix uteri on the latter account. ³Dr. J. C. Warren has said, "I would not rest easy if I had tied an ovarian pedicle with catgut until the danger of secondary hæmorrhage was passed." A study of the various methods of preparing catgut, employed by many prominent surgeons throughout the world is sufficient to demonstrate that the great consideration is its aseptic condition, and but little stress is placed upon its being absorbed too rapidly. This then, is really a great gain in favor of the use of animal ligature, since, *a priori*, its too rapid absorption was the strongest argument against the use of this material. If it would not resist absorption long enough for the wound to be united firmly and long enough for a good strong clot to organize in the larger blood vessels, sufficient to protect against secondary hæmorrhage, it would not fulfil the requirements of a suture, or ligature, and must sooner or later for this purpose become obsolete. The fact that surgeons no longer bother themselves with methods to increase the resisting power of the gut, against the absorbing powers of the tissues indicates very strongly that they no longer fear that effect, and in fact practical experience shows that under the proper circumstances we can depend upon animal ligature to hold until the parts are firmly united. Most of the evil consequences come from the use of septic gut.

⁴Klemm claims that abscess formation takes place frequently in wounds closed with aseptic gut, where all aseptic precautions have been taken; the infection arising during the operation, and developing in the culture medium formed from the dead softened material of the ligature. He says: "It is almost impossible to keep a wound germ free," and thus explains the cause of the trouble. His gut was prepared by washing repeatedly in five per cent. alcoholic solutions of sublimate, until there was no turpidity, and then storing it in absolute alcohol. This gut was exposed to culture experiment, and by this means, determined germ free

¹⁷ Larkin. London Lancet, 1891, 11-1222.