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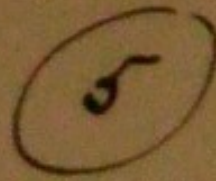
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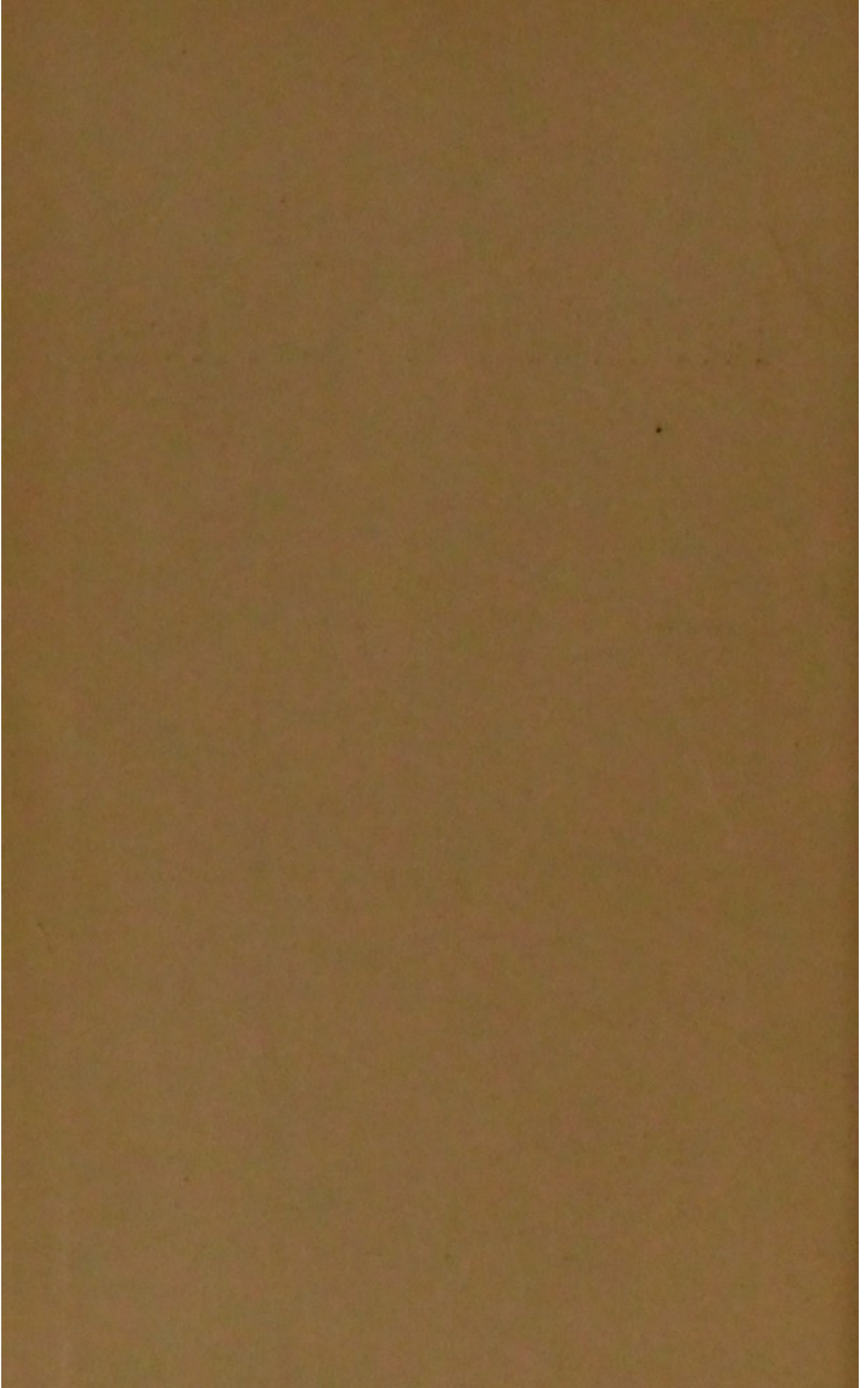
THE
Intestinal Suture.

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THE INTESTINAL SUTURE.¹

BY OTIS K. NEWELL, M.D.,

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THE subject of intestinal suture is one of such great interest and importance to-day, that I cannot do it full justice in this short paper. But I have endeavored by a brief review of its early history and a more close consideration of its development in the past few years to give a clear idea of the technique of the modern operation.

That this operation also is "no new thing under the sun" is shown by the fact that it was known to Celsus and practiced by many of the surgeons of early times. But notwithstanding that here and there isolated cases were operated upon, and intestinal wounds united by suture in some manner, it was still generally believed, that to meddle in any way with a tender and inflamed intestine, and above all to introduce sutures into it, was a grave and entirely unwarranted procedure. Total division of the intestine was, up to the beginning of the eighteenth century, looked upon as a necessarily fatal condition. Palfin taught, in 1710, that intestinal wounds could not unite, and advocated stitching the bowel to the abdominal wall so as to establish an artificial anus.

But the fact remains that many ingenious and often successful methods were adopted for the closure of intestinal wounds. In the Middle Ages Abulcasem and others made the most daring experiments with this operation. Roger united the intestine over a piece of

¹ Read before the Surgical Section of the Suffolk District Medical Society, May 5th, 1886.

elder tube, other operators used rolled pasteboard cards, pieces of candle, cork, swine's bladder, dried intestine, and the trachea of an animal.

The latter appears to have been the favorite among the materials thus used, and this method received the name of the Suture of the Four Masters, from its having been used by the four celebrated monks who practiced surgery together at Paris in the middle of the thirteenth century. I may here state that, according to Rydygier, all references to intestinal suture performed in early times, are made in regard to transverse or longitudinal wounds, as the first recorded resection with union of completely divided intestine was the operation done by Duverger in 1837. It is useless to discuss here how the great authorities of different times, and contemporaneous operators, differed in regard to the safety of intestinal suture. Scarpa was opposed to every suture, while Jobert, Reybard, Larrey, Lembert and others were in favor of their use.

In all the early methods, however, the main idea was to approximate the edges of the wound, in a general way, so as to give them an opportunity to heal together, but no definite rules were given for uniting them in any particular manner.

The great epoch in the history of this operation came in 1826, when Lembert, then an interne in one of the Paris hospitals, and a contemporary of Jobert's, who was also an interne, declared that in order to obtain union of sutured intestinal wounds the great essential was to procure careful apposition of the serous coats, and since then this has been the established fact upon which the foundation and success of all following methods have been based. Owing to a misprint in the first publication of the method Lambert was substituted for Lembert, and hence the frequent misquotations made even at the present time.

But a short time previous to Lembert's discovery, Jobert had published an account of his Invagination Method, and it is not at all unlikely that in the study of it Lembert's idea found its source.

This consisted in invaginating the lower end of the bowel, and then drawing the upper down into it and fastening it in place by means of sutures, two or more in number. These sutures passed through the whole thickness of the bowel and were intended to finally cut their way through and pass off with the stool. This method approximates the serous coats more or less closely and gives quite good chances for union. Its disadvantages, however, are that under ordinary circumstances it is impossible to determine which is the upper end and which the lower end of the bowel. The calibre of the intestine is also too much reduced and the edges of the intestine form a flap which, if the bowels have been inverted in position, will act as a valve giving rise to more or less, often complete and fatal obstruction. It is also necessary to separate the mesentery from the invaginated and inserted portions of the bowels, and this may cause local gangrene from loss of blood-supply.

Reybard's method was particularly adapted to the closure of intestinal wounds with loss of substance. A thin piece of wood was inserted into the intestine, large enough to overlap the edges of the wound. To the centre of this was attached a double thread, each end of which was passed through the abdominal wall at one side of the external opening, and the bowel then drawn firmly against the wall of the abdomen so as to enable it to become attached and thus close the wound.

This method, like that of Palfin and other operators who insisted upon the necessity of fastening the bowel in some manner close to the abdominal par-

ietes, had the advantage of giving the best chance, should union fail to take place, for the formation of an artificial anus, or a localized abscess by means of peritoneal adhesions.

Undoubtedly when union of the intestinal wound did occur after these operations it was because the serous surfaces had been well brought together, but that this was the great essential, none of the operators

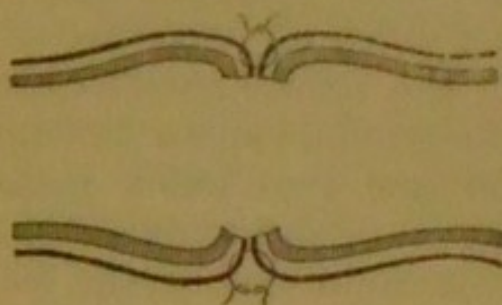


FIG. 1.

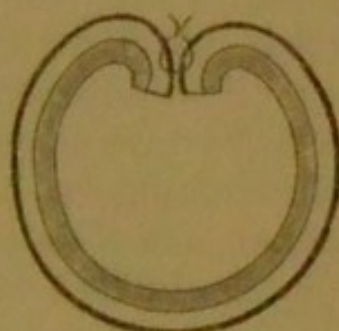


FIG. 2.

up to the time of Lembert had recognized. He, as already mentioned, was the first to discover the fact since abundantly proved by experiment, that inflamed serous surfaces when in contact tend to unite with great rapidity. A serous and mucous coat will not unite, and mucous surfaces heal together but slowly. Lembert, therefore, made his suture so as to give the best opportunity for this adhesion of serous surfaces. Figs. 1, 2 and 3, in which the suture includes only the serous and muscular coats, illustrate the manner of making this suture.

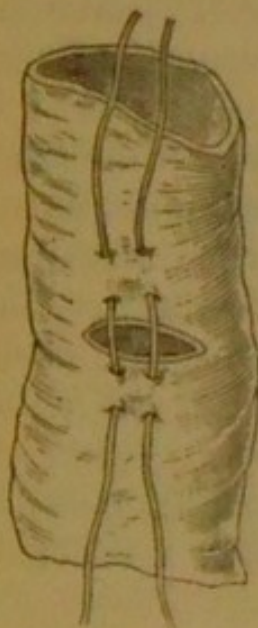


FIG. 3.

As readily seen, the edges of the wound are always nicely inverted when the stitches are drawn together. Lembert used the interrupted stitch. Numerous modifications of this suture have since been

made, and from among them the operator of to-day must make his choice.

Before considering the modifications of Lembert's suture it will be interesting and possibly of value in connection with emergency cases, to speak of a few methods in which Lembert's principle has been applied without the use of sutures, or with but slight aid from them.

Dedan's ingenious apparatus for uniting completely divided intestine consisted of three rings of silver or tin. Two of these were similar and of a diameter slightly less than that of the intestine. The third was equal in length to both the others but smaller in diameter. The two shorter rings were inserted into the bowel and the ends of the latter invaginated over their inner surface. The third ring was then passed inside of these so that the divided ends met midway upon it. The whole apparatus was held in place by passing a suture threaded at both ends first close to the edge of the rings above and through the inner ring then out again at the edge of the rings below. At each end the needles were now passed in at the point of the former needle puncture, and then up between the outer rings and the bowel to where these rings came together. The needles were finally passed out through the intestine and the suture tied together. The rings were thus held in place and the serous surfaces enabled to unite. After a time the edges of the outer rings cut their way through the portion of bowel included between them, and the apparatus passed off with the stool.

The method of Beranger-Ferand is also very ingenious and was for the union of transverse or longitudinal wounds. Two thin pieces of cork were cut into prismatic shape with a width of about six mm., a thickness of two mm., and a length slightly greater

than that of the wound. Small insect-pins were passed through these, their heads being covered in with sealing wax. One of these pieces was introduced into the bowel and the pins passed through the edges of the wound on one side about two or three mm. from its border. The other piece was placed in a similar manner on the opposite side. The edges of the wound were then inverted and the two pieces pressed together. An additional safeguard to their separation may be made at either end by inserting a piece of bent wire, and after the two pieces have been united, pressing this in from the outside. The wound was thus held together and the serous surfaces allowed to unite. The portion of bowel included between the pieces of cork soon ulcerated through and the apparatus passed off with the intestinal contents.

Amussat passed the ends of the divided bowel over a piece of cork deeply grooved in the centre. The ends were made to overlap slightly and the bowel then tied tightly down into the groove with a ligature. This also accomplished the desired result and after a time was discharged from the bowels.

Many other methods of suture, such as those of Gely, Emmert, and other operators are ingenious and interesting, but as they are no longer of much practical value, their description will be here omitted.

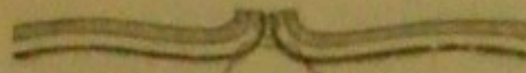
Probably the first change in Lembert's style of suture was that made by Czerny, who proposed to unite not only the serous coats but the edges of the wound as well. This he accomplished by using a double row of sutures (Fig. 4). This forms a sort of "Etage Naht" and is certainly, aside from the time it requires, a valuable adjunct, as it serves to protect the Lembert stitches by keeping the intestinal contents away from them. When this suture is made with the Kürschner stitch for the first row it does not require much time.



FIG. 4.



FIG. 5.



Gussenbauer then thought of doing this all with one suture and made his figure-of-eight stitch (Fig. 5). This is an ingenious but complicated suture and has the objection that should the lower portion ulcerate through, the whole stitch would become loosened and thus give rise to the escape of intestinal contents.

The Kürschner suture is a continuous one and (Fig. 6) is made by tying the first stitch and then proceeding as with any continuous suture, puncturing the in-



FIG. 6.

testine from within outwards, and fastening the whole when completed with a seamstress's knot. This is a very rapid and simple suture and closes the wound nicely. Nussbaum prefers it to all others and says, "The simple interrupted suture like Lembert's is very much harder to make, the needle must be laid aside ten or twenty times and the scissors taken in hand, while with the Kürschner suture this need be done but twice."

The remaining methods of intestinal suture which I am to describe are of very recent date, and have been used altogether for uniting the ends of resected intestines.

First, we have the method of Neuber used in operating for the cure of artificial anus and made as follows: A circumscribing incision was made through the skin about the anal orifices. The skin was then dissected away from the fascia beneath, and the edges of the flaps thus formed united with a continuous suture so as to prevent the escape of intestinal contents. The ends of the intestine were then loosened and brought down (Fig. 7). The abdominal wound was now closed by provisional sutures, as recommended by Madelung, so that just enough room remained for the ends of the intestine drawn through the wound (Fig. 8). The intestine thus constricted closed the abdominal wound, and prevented the entrance of faecal matter into the field of operation. The bowel was now held by digital compression and after removing a sufficiently large piece of mesentery and tying the bleeding vessels the ends were cut squarely off. (Fig. 8). Neuber now sutured the ends of the bowel together over a piece of decalcified bone tube.



FIG. 7.

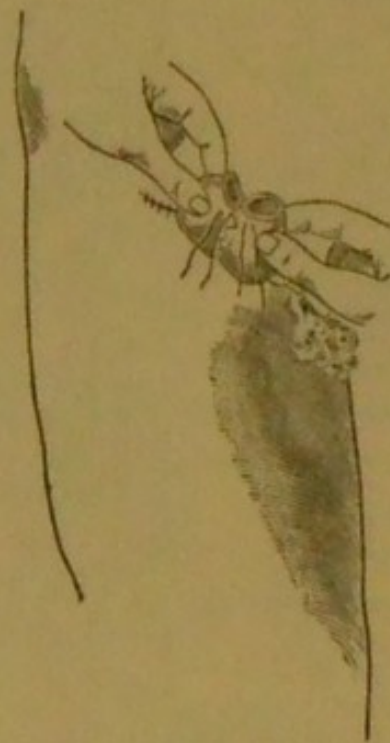


FIG. 8.

This tube was about two cm. in diameter, and turned so as to bulge in the central portion and have a deep groove in the middle line (Fig. 9). The sutures were made as follows: First before inserting the tube the ends of the bowel were united by two or three interrupted sutures, taken at the mesenteric insertion. The tube was then inserted and the ends of the bowel drawn closely together over it. The ends were now united by a number of Lembert stitches (Fig. 10 a). The intestine was then drawn down into the groove by means of a constricting "suture" or ligature (Figs. 10 b, and 9), and finally in order to get a most exact union of serous surfaces still another row of interrupted Lembert stitches was taken about one cm. apart (Fig. 10 c, and Fig. 9). Thus finally (Fig. 10 c, and Fig. 9) there was, in the depths of the groove the first row of interrupted sutures, then the constricting "suture" or ligature, and finally an outer row of interrupted sutures.

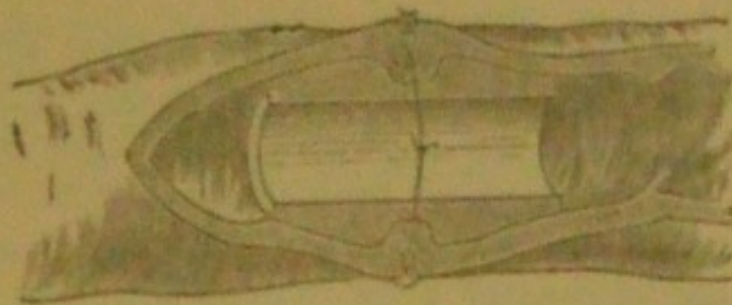


FIG. 9.

As advantages of this method Neuber claims, first, the ease with which it is performed, it being much easier to sew upon a firm foundation than otherwise. Secondly, the wound of the intestine is protected by the tube from contact with the intestinal contents. Neuber, to obtain the best possible asepsis, powdered a little iodoform into the groove. Thirdly, the tube maintains a free passage for the intestinal contents,

which is not always the case with some of the other methods, where at times the collection of faecal matter above the wound owing to more or less stenosis forms a serious and even fatal complication.

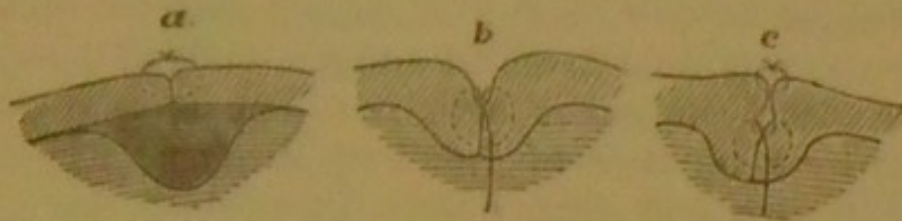


FIG. 10.

The intestine has been united in this manner after resection at the Kiel clinic three times, twice by Neuber and once by Schlange, and each time with success. Experiments upon animals have shown that after from four or five days the decalcified tube disappears. In the cases at the Kiel clinic, careful examinations of the dejections failed to give any trace of the tubes.

Professor Madelung, of Bonn, having in view the fact, well established in experimental pathology by Lister, Maas, Tillmans, Rosenberg, and others, that pieces of living tissue or other substances, when made aseptic, could be placed in the peritoneal cavity, and there become imbedded or encapsuled, and gradually absorbed without causing suppuration, devised what he calls the cartilage-plate suture. This suture is made as follows: The costal cartilage of a young calf is first cut in thin slices, which should have about the thickness, Madelung says, "of sections made by beginners in microscopic work," and the circumference of a small lentil, from four to six millimeters. These slices are prepared in the same manner as antiseptic silk. The ends of the bowel are first united with a Kürschner suture. A No. 12 needle is now threaded

so that its eye comes at the middle of the suture. The ends of the suture are then tied together in a double, or better, a treble-knot. The needle is now passed through the centre of one of the cartilage-plates, and the suture drawn through until the knot

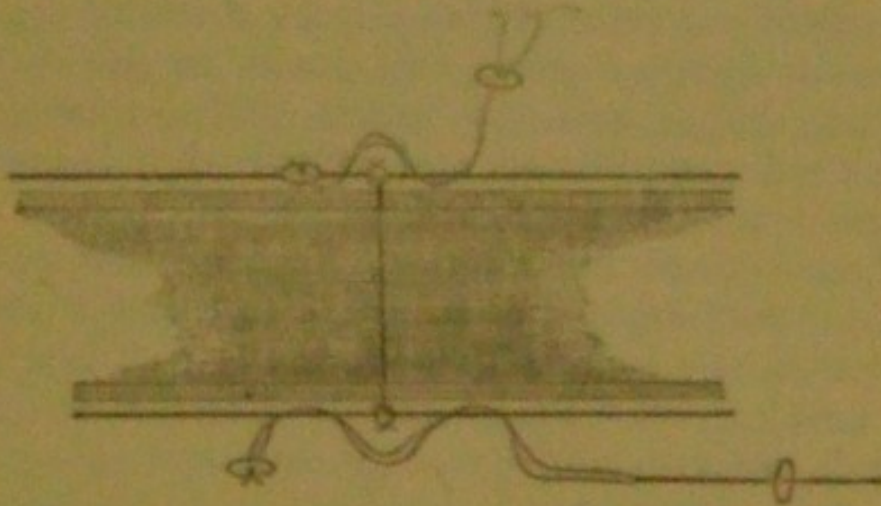


FIG. 11.

comes firmly against the plate. With the suture thus prepared, the needle is passed in the usual manner through the sero-muscular layer of both ends of the bowel, and then through a second cartilage-plate of the same size as the first (Fig. 11). The suture is now cut off close to the needle, and again tied in a treble-knot firmly down to the second plate (Figs. 11 and 12).

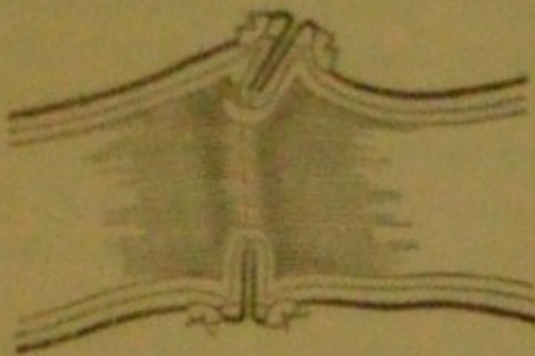


FIG. 12.



FIG. 13.

With the use of this suture, Madelung claims that it is possible, with a much smaller number of stitches, to obtain sufficient contact of the serous surfaces. Circular cutting through of the tissues by the suture is here avoided. If the wound of the serous coat made by the needle is enlarged a little by drawing upon the suture, the cartilage-plate will cover in this opening. Madelung hopes that his suture will not be looked upon as too complicated, and affirms that it is simple and practical in its application.

Mr. Bishop, of Manchester, England, has recently devised a very ingenious suture, a full and illustrated description of which will be found in last year's January number of "Braithwaite's Retrospect." This suture is unnecessarily complicated, and presents no particular advantages. Besides, being made in a single row, it should not involve the mucous coat, which it does. It has only been used in experimental operations.

So much for the different methods of suturing the intestine. From the first Lembert suture made with the single interrupted stitch, down to the most recent of the after-coming methods, which I believe to be those of Neuber and Madelung, all have been sufficient to secure, with varying frequency of success, union of the ends of a divided intestine, or the edges of transverse and longitudinal intestinal wounds. No method has yet been devised which stands preëminently above all others. That one is the best which secures and maintains the most perfect and undisturbed contact of the serous surfaces with the least reduction of the intestinal calibre, and it will be a matter of personal choice and experience in deciding which one best answers these requirements.

The various forms of intestinal suture may be applied to any part of the alimentary tract from the

œsophagus downwards, but their most frequent application comes after resection of the pylorus, or some part of the large or small intestine. This may be for the cure of (1) anus-preternaturalis or fæcal fistula; (2) gangrene following incarcerated hernia or intussusception; (3) malignant growths; (4) where adhesions to an abdominal tumor are so firm as to necessitate removal of a portion of the intestine or ligature of its blood-supply; and (5) stricture due to ulceration or other causes. Recently, a new application has been found in Wölfler's operation of gastroenterostomy, a procedure similar to the method illustrated in the "Surgical History of the War of the Rebellion," for uniting two simultaneously-wounded knuckles of intestine, with Gely's suture. Wölfler's operation, suggested to him by Nicoladoni, during a pylorus resection, where, on account of too extensive disease, the pylorus could not be removed, consisted in taking the loop of small intestine nearest the stomach, and after making a longitudinal opening in it, and a corresponding one in the stomach, a finger's breadth above the gastro-colic ligament, uniting the two by sutures, this being done instead of forming an intestinal fistula.

Let us now consider in detail the manner of making the intestinal suture. As there are now very few cases of intestinal lesion, which, if they lead to suture at all, would not be best treated by total resection of the affected portion, I will speak of the suture as applied in the latter operation. It is to be hoped that it is no longer necessary to urge the strictest adherence to the rules of antiseptic surgery, and also that any surgeon who will take upon himself the responsibility of such an operation, should it come as a case of emergency, has always in readiness all of the necessary materials, such as antiseptic sponge material, silk, catgut, needles, etc. It is also necessary to have

practised the operation a number of times on post-mortem material, or in experimental operations. The operation should never be hurried; within reasonable limits, the amount of time taken, one hour to one and one-half hours is of no great importance. As far as the success of the operation as such is concerned, the greatest danger lies in failure to apply the stitches perfectly. If the operation is done in emergency, there is, of course, no chance to get the bowels into the most favorable condition, namely, as empty and antiseptic as possible, but where the operation is a premeditated one, this should always be done. The stomach, when involved, must always be thoroughly washed out, and other parts, when possible, well irrigated.

After the intestine has been drawn out of the abdominal wound it may be held in position, either by applying provisional sutures to close the wound about it, as done by Madelung, or in the usual manner by the fingers and flat sponges or napkins placed beneath. To close the wound about the intestinal loop by Madelung's method, a number of sutures are taken through the abdominal parietes just as they usually are at the end of an operation, and after drawing the wound together tied in a bean-knot so as to be loosed at the end of the operation, when the bowel is to be replaced. They are then used with the additional necessary ones to close the abdominal wound. This method has also been used by Veit, of Bonn, in ovariectomies to prevent the protrusion of intestines while tying the vessels in the pedicle.

Now, when the intestinal loop is fixed, the bowel must be compressed above and below the portion to be resected, so as to prevent the escape of intestinal contents into the field of operation or the abdominal cavity. This may be done by (1) digital compression,

(2) long-bladed forceps with or without covering, (3) provisional ligature with stout catgut or silk, (4) various clamps devised for this purpose.

Rydygier's clamp consists of two flat pieces of iron notched at the ends and enclosed in rubber-tubing. They are fastened with rubber-bands. Makins' clamp is a large bull-dog forceps with a screw closure, the blades to be covered with rubber-tube. I have had made a clamp similar to the Dupuytren-Blasius, one for the cure of artificial anus (Fig. 14.) Its advantages

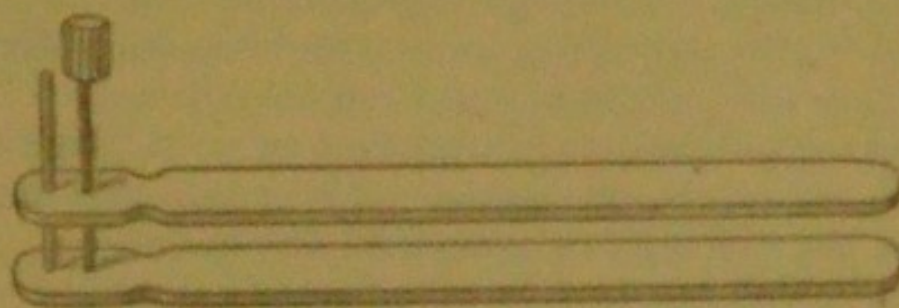


FIG. 14.

are supposed to be, that the blades, which are also to be covered with rubber-tubing, are kept parallel and the pressure thus made equable. The screw is so arranged, by being weak and not bringing the blades entirely together, that too great pressure cannot be employed. When polypus forceps or other clamps closing at an angle are used, the pressure at the inner part is apt to be too great and give rise to sloughing.

Digital compression is very good but in a long operation the fingers are apt to become very tired, and are, above all, much in the way.

A provisional ligature passed through the mesentery and around the bowel closes the canal very thoroughly but if tied too tightly will give rise to gangrene. It also wrinkles the bowels more or less, which may at times be an inconvenience.

After having closed the bowel in some manner the

next step is either to resect the desired amount of intestine with its triangular piece of mesentery and then tie the vessels, or tie the vessels first and then remove the intestine and mesentery. It seems to me it is much better to first tie the vessels and then remove the bowel with its mesentery. The vessels going to the bowel can be plainly seen or felt and the elimination of the blood-supply made with such exactness that very little if any bleeding will occur after the intestine is divided. The field of operation is thus kept much cleaner. The only objection to this method is that it is said to require more time, but the difference, if any, is very slight and not important.

One important point must now be remembered, and that is, to resect, no matter how much this may increase the difficulty or length of the operation, all intestine which has had its blood-supply removed. This, as already stated, is always easily determined. Operations which might otherwise have been brilliant in their results, have ended fatally through neglect of this point, the post-mortem examinations having shown that gangrene of intestine thus deprived of its blood-supply always occurred.

After the bowel has been resected any contents which may escape from the portions beyond the clamp, must be carefully wiped away and the ends thoroughly cleansed before commencing the suture. At this point, if no clamps have been used it can be seen how difficult it is to distinguish the upper from the lower end of the bowel, for if both contain ingesta they will escape in about equal amount from either opening. The character of the escaping contents is an indication as to what part of the intestinal tract has been opened.

The intestines are now to be united according to the suture employed. The edges of the protruding mu-

cous membrane may now be trimmed off, but this I think inadvisable and of no particular benefit. What seems to me to be the best of the simple sutures is, practically Czerny's, but differs from it in having the first row made with a continuous suture. The first row may be made with the Kürschner suture. For the outer row I used in an experimental operation a suture, which I do not find described, but which may be called a continuous Lembert suture. This was what I understood to be Kürschner's suture, but that suture as described and figured by Nussbaum perforates all the coats from within outwards. The continuous Lembert suture is simple and a great saver of time. It is merely the Lembert stitch made with a continued instead of interrupted suture.

If the material for Neuber's or Madelung's suture is in readiness they too might be used, and from the success which has thus far followed them, no failure of union having occurred, they are probably as certain, if not more so, than any of the others.

Bishop claims as advantages of his suture the fact that the knots are all made on the inside, and after ulcerating through, the stitches pass off with the stool. But the desired object to-day is to have the stitches become encapsuled or absorbed and not cut their way into the bowel. This should be the case with one row at least.

In making the suture it is always best to begin at the mesenteric insertion. This is the most difficult part to unite as the peritoneum over the mesentery is apt to tear away. If this occurs stitches may be later taken, outside of those that tear away. It is much better to hold the folded intestine gently between the fingers and sew with a straight needle and without forceps or needle-holder (Fig. 15). The intestine is thus injured as little as possible and the suture, by

avoiding the constant change from forceps to needle-holder, and *vice versa*, made more rapidly. In pylorus and other operations involving thicker parts, forceps and needle-holder should be used. The needle should be introduced so as to leave, in making a single row suture, two or three mm. of intestine beyond the needle puncture nearest the wound border (Figs. 1, 2, 3). Three or four mm. should be lifted upon the needle each time in sewing (Figs. 3, 4, and 5), and from the thickness of this portion which can be well judged it can be seen how much of the intestinal wall

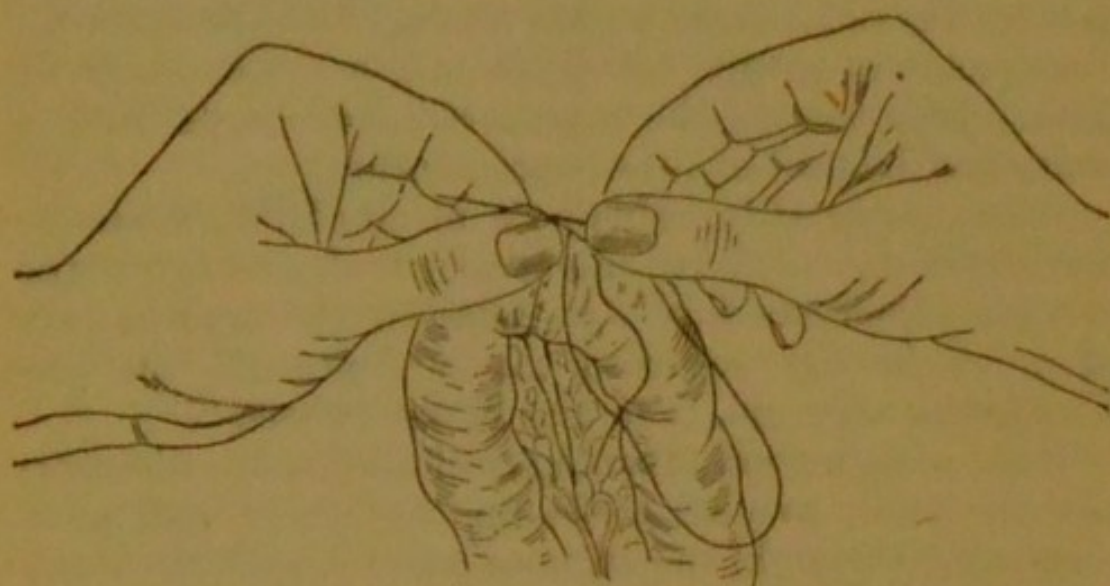


FIG. 15.

is being included in the stitch. The suture is now continued around the bowel. The stitches should be taken very close together, two or three mm. apart, as what may appear to be close stitches in the contracted bowel, will, when there is distention, as with flatus, be perhaps quite far apart. When this suture is ended it should be thoroughly inspected, and any point where good apposition is doubtful or where the suture has torn away at all, reinforced with one or more extra single stitches. The edges of the mesentery should then be united with a few interrupted sutures.

After removal of all clamps and other accessories to the operation which may have been placed about the bowel or elsewhere, the intestine is carefully cleansed and dropped back into place. The abdominal wound is then untied in the usual manner.

The needles used should always be plain, straight, round sewing needles and of the smallest size. A No. 12 English Pearl sewing needle is what is generally used, threaded with the finest conjunctival silk or Japanese silk twist. A No. 10 or 11 needle seems to me to be sufficiently small and is somewhat more convenient to use on account of its length. The finest catgut may also be used, but it is less pliable and above all requires a much larger needle and therefore necessitates a larger puncture wound. The suture may be threaded while dry, and then disinfected. This is done by tying the ends of the threads together and holding the needles in forceps or otherwise and then boiling them one hour in five per cent. carbolic acid solution. (Czerny's method). If it is desired to keep them in readiness they may be placed in alcohol where the needles will not rust. Rydygier in a large number of experimental operations always used catgut and never failed to get good results in cases of simple resection. But aside from the objections already made to catgut is the additional one that should suppuration occur about the wound, or pressure come from faecal masses moving down from above the wound, the silk would be there to resist their tendency to separate the freshly united surfaces, long after the catgut had disappeared. The antiseptic silk becomes readily encapsuled and may be sewed or tied in anywhere. In order to become encapsuled it must of course remain antiseptic, and since stitches which perforate the mucous membrane must absorb more or less of the intestinal contents they should, it seems to me, never be taken unless it is

desired to have them cut their way into the bowel. In addition to this, such stitches make a puncture wound through the wall of the bowel from which fluid contents may escape into the peritoneal cavity.

I have already stated that any disease or injury of the bowel, excepting slight wounds, where intestinal suture is needed, would probably be best treated by total resection of the affected portion and union of the divided ends. This I hold to be so from the fact that other operations necessarily lead to a large degree of stenosis at the point of suture, while in uniting the ends of a resected bowel, the largest possible calibre is obtained. This may be still increased by adopting a method advocated by Madelung and Weber of dividing the ends of the bowel obliquely so as to increase the room for passage at the point of union.

From the nature of the intestinal blood-supply, the edges of the bowel after resection are sure to have an abundant source of nourishment and therefore when properly sutured to unite with certainty.

Finally, let us consider briefly the value of this operation. Statistics are of but little weight in this connection as many of the early operations which were fatal in their results, owing to an undeveloped technique and imperfect or no antiseptic precautions, would have been followed in later years and to-day with success. This I think will be well seen in an analysis of seventy-three cases which had been collected up to April, 1881, by Professor Madelung.

All of these seventy-three cases were resections, that is, complete division, with removal of more or less of the intestine, from a few inches up to 2.5 meters as in Körberle's case.

Twenty-nine of these seventy-three cases resulted fatally, and as follows:

Fifteen died before the end of twenty-four hours,

and one other case was probably as rapidly fatal, but owing to incomplete report this is not certain.

One death occurred on the operating table from the entrance of vomitus into the trachea.

Death never followed after the thirteenth day.

Death was due in one case to embolism of the pulmonary artery from an old venous thrombus of the thigh, and occurred four days after the operation.

One patient died from delirium potatorum, and an insane patient from œdema of the brain.

Twice death was due to other simultaneously received wounds.

In six cases peritonitis had already begun at the time of the operation, and was the cause of death.

Three deaths are referred to "wound shock" and inanition marasmus.

One death was caused by stenosis of the intestine, due to a pseudo-ligament below the point of suture.

Five times fatal peritonitis and acute sepsis developed immediately after the operation. In three of these cases fecal matter escaped into the abdomen during the operation.

In seven cases death occurred during the period of convalescence, peritonitis following the escape of fecal matter through the resection wound. Twice this escape of fecal matter was due to incomplete resection of the gangrenous portion of the bowel, and in the other five to failure to completely close the wound with the suture.

Of these seventy-three recorded operations, fifty-two, with thirty good results, were performed in the years from 1877 to 1881, and the successful operations in this period are, without exception, those of German, Swiss, and Austrian surgeons; and Madelung says: "We have a right to be proud of the blossom to which this branch of operative surgery has come in our day,

but we must, nevertheless, understand that only the first step has been made on the new way."

There is no longer any doubt as to the safety of opening the peritoneal cavity, granting, of course, that it is done in the proper manner. The peritoneum, far from being a membrane of the most vulnerable sort, as it was formerly regarded, bears with the greatest tolerance an astonishing amount of cutting, burning, tearing, and manipulation. From the time when the surgery of the serous cavities was limited to a timid approach to the opening of some of the smaller joints, it went on to the free drainage of the chest for the cure of empyema; and so it will be, if it is not already, with the surgery of the abdominal cavity.

Numerous cases of peritonitis, where the parts have been found "glued together and bathed in pus," have been treated by abdominal incision and thorough washing out of the abdominal cavity with large quantities of water, and have made good recoveries. At our last meeting, Dr. John Homans reported a similar case.

To two influences, however, the peritoneum is greatly susceptible, and they are septic absorption and loss of heat. Unlike the skin, naturally adapted to protection from rapid loss of heat, the peritoneum is a moist, evaporating surface, from which, when exposed to the air, the loss of heat is constant and rapid. Wegner, in his valuable investigations and experiments, found, in a medium-sized woman, the area of the skin-surface to be 17,502 sq. cm., while that of the peritoneum was 17,182.

By exposing the peritoneum to rapid loss of heat, a reflex paralytic influence is exerted upon the heart, and unless warmth be rapidly applied, death occurs from collapse.

If an ice-compress is laid upon the exposed intestines of a dog, the heart instantly ceases to beat,

while, as Wegner found, a stream of warm vapor may be directed upon them for seven or eight hours without injurious effect.

Wegner further found that animals into whose peritoneal cavity he had injected large quantities of salt solution at the body temperature were never injured by the procedure, but moved about in as lively a manner as ever.

The capacity of the peritoneum for absorption, and, therefore, for infection, is indicated by the fact that in one hour, fluid equal in quantity to eight per cent. of the body weight may be taken up from its cavity, and in two days an amount equal to that of the entire weight of the body. A quantity of chloral solution injected into the peritoneal cavity exerts an almost instantaneous soporific effect. The large peritoneal area and the peristaltic movements are also elements aiding the rapidity of absorption.

These facts present their own argument, and are clear indications of what it is necessary to avoid in peritoneal operations.

Let us, then, hope that when occasion arises for the application of intestinal suture, no traditions in regard to the dangers which it involves will prevent its being used according to the means of to-day, and many lives thus saved or made comfortable. Without exception, when done with no technical failure, the operation has, in the last few years, been successful, and where death has occurred, it has been not because the intestinal suture failed to accomplish its object, but owing to other conditions involved in the nature of the case.

In conclusion, let me say that to the consultation of various works, mostly recent German ones, I am indebted for the majority of ideas and figures presented in this paper.

