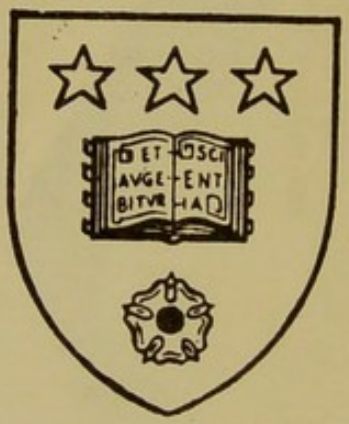
Abdominal operations / by Berkeley Moynihan.



ABDOMINAL OPERATIONS

VOLUME II

BY

SIR BERKELEY MOYNIHAN, M.S. (LONDON), F.R.C.S.

LEEDS, ENGLAND

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CONTENTS OF VOLUME II

SECTION III (CONTINUED)—OPERATIONS UPON THE INTESTINES

SECTION IV—OPERATIONS UPON THE LIVER

SECTION V—OPERATIONS UPON THE PANCREAS AND SPLEEN

ABDOMINAL OPERATIONS.

CHAPTER XXVI.

SURGERY OF THE LARGE INTESTINE.

THE OPERATIVE TREATMENT OF MALIGNANT GROWTHS OF THE COLON.

If a malignant tumour of the large intestine be removable, the scope of the operation to be practised will depend upon a consideration of several factors. The chief of these are:

1. The pathological anatomy of growths in this portion of the gut.

2. The vascular distribution in the bowel.

3. The lymphatic distribution.

1. The **pathological anatomy of growths** in the colon has been elaborately studied by Okinczyc, under the auspices, and with the encouragement, of his master, Hartmann. The work of these two authors gives the most excellent account yet published of the surgery of the intestine ("Travaux de Chirurgie," Troisième serie, Chirurgie de l'intestin, Paris, 1907, G. Steinheil). It is now known that cancer of the large intestine is to be considered amongst the least virulent of malignant growths, for the development of the tumour is usually very slow, the invasion of the lymphatic area appears to be some time delayed, metastatic generalisation is rarely to be found, and then only, as a rule, in very advanced cases. The growth itself, when examined after removal during life or on post-mortem examination frequently shews not a fierce activity of cellular proliferation, but, rather, a remarkably constant tendency to mucoid degeneration. Though these are the rules, exceptions to all of them may occur, for a growth may be rapid, or a secondary invasion of the liver may be

discovered while yet the primary growth is small and easily amenable to removal. Within the last twelve months I have operated upon three cases in which the secondary deposits in the liver were large, while the ring-like primary stricture of the sigmoid flexure was small, and to all appearances had caused no involvement of the immediate glands. In these cases, no doubt, the extension of the disease had occurred along the radicles of the portal vein, either a direct invasion and thrombosis of a sigmoid vein occurring (of which condition I possess two specimens), or a lymphatic vessel had communicated directly with a vein in the manner which Leaf has demonstrated ("Surgical Anatomy of the Lymphatic Glands," 1898). H. S. Clogg ("Lancet," 1908, ii, 1007) points out, in a paper to which subsequent references will frequently be made, that "cancer of the colon is in many cases a local disease, and that secondary visceral deposits are not the great barrier to any radical operation." In 41 cases of cancer of the colon causing death, there were only 6 in which visceral deposits could be found, Haussman ("Thèse de Paris," 1882) gave the following table, shewing the results of 112 autopsies on cases of carcinoma of the colon:

In 21 cases the disease had become generalised.
36 cases the neighbouring lymphatic glands were involved.
35 cases the disease was limited to the gut (there was no special note as to the state of the retroperitoneal glands).
20 cases the disease was absolutely limited to the gut without any doubt.

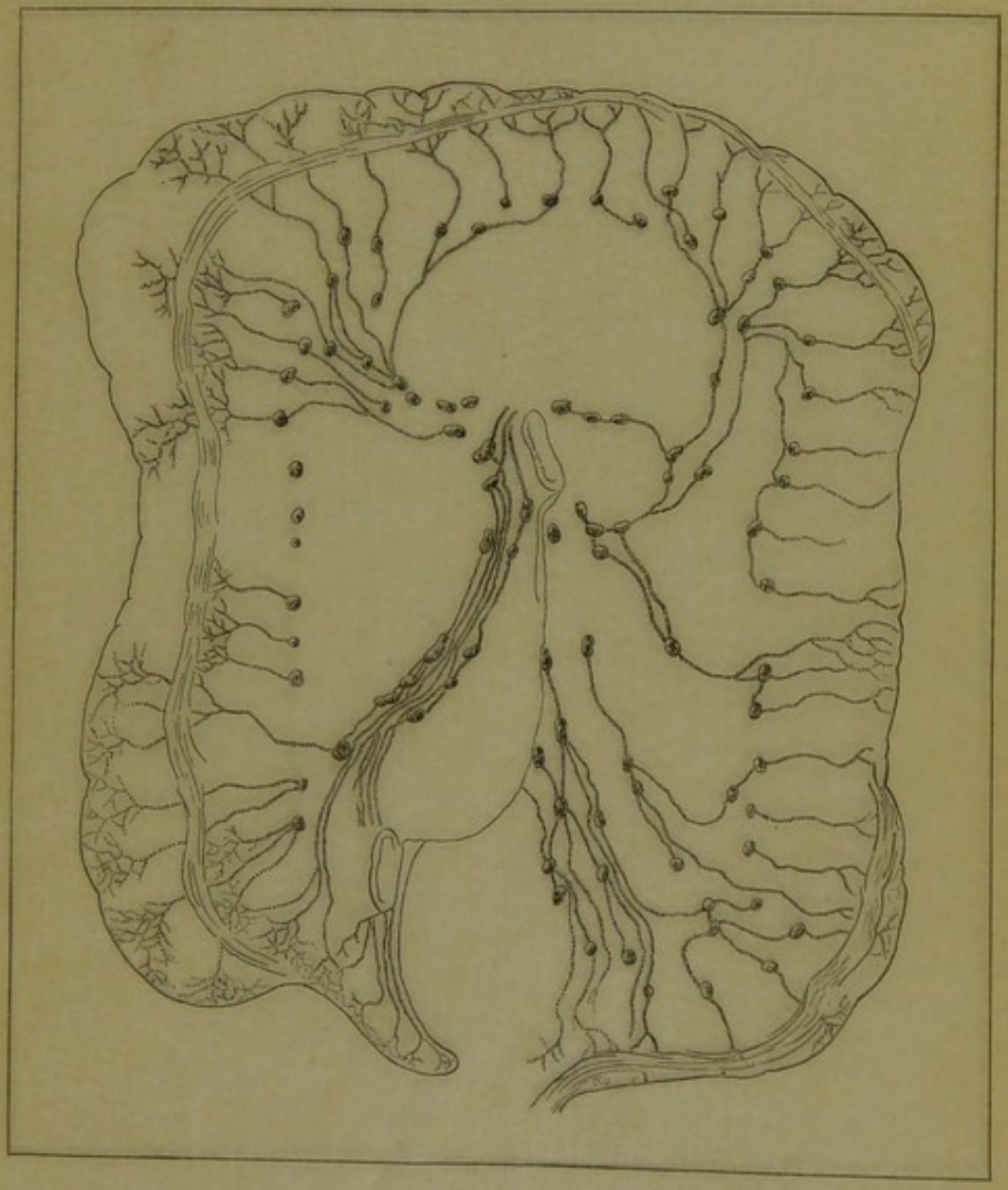
112 total.

It is rare to find in cases of carcinoma of the colon that any large extent of the bowel is involved. The growth appears to be small and strictly, even abruptly, limited. But Sampson Handley ("Brit. Med. Jour.," 1910, i, p. 927, and pp. 1378 and 1379) has offered some evidence to shew that permeation of the lymphatics occurs wide of the disease; in one case of early cancer of the rectum, cells, apparently carcinomatous, were found at the extremity of the specimen removed about 6 inches above the growth. Adhesions of the growth to the posterior abdominal wall or to

other parts of the intestinal canal are sometimes encountered, and may, though rarely, prohibit any attempt at removal. I have twice been prevented from removing a growth in the ascending colon, by reason of deep and extensive invasion of the abdominal wall. It is, however, chiefly at the hepatic and splenic flexures that the parietal attachments of the growth are closest. In the case of the sigmoid flexure it is not very uncommon to find the small intestine so adherent as to make it necessary to remove a segment of this also. In one case I found the transverse colon adherent, and I was accordingly compelled to remove the bowel from the hepatic flexure to the lowest part of the sigmoid. I turned the hepatic flexure downwards, and performed a side-to-side anastomosis with the sigmoid flexure, with a perfectly satisfactory result. We are, I think, entitled to believe that a carcinomatous growth of the colon, by reason of its small size, its (apparently) abrupt delimitations, its long restriction to the intestinal wall, the tardy appearance of metastatic deposits, and the paucity of the lymph-glandular supply should prove amenable to successful attack by the surgeon. It would appear to be true to say that if cancer is to develop in the body, there are few places it could select with so happy a chance to the patient of ultimate and complete relief as the large intestine.

2. It is important to know **the vascular distribution in the colon,** for it is alongside the arteries that the lymph-currents flow and the lymph-glands chiefly lie. The large intestine is supplied by branches of the superior mesenteric artery, and by the inferior mesenteric artery. The ileocolic artery, which appears to continue in the direct line of the main trunk of the superior mesenteric artery, supplies the last few inches (about 6) of the ileum, the cæcum, and a part of the ascending colon. It takes origin at or near the level of the third part of the duodenum, and descends, inclining to the right, to reach the ileocolic angle. From its right side, as it descends, the right colic artery is, as a rule, given off, though this vessel may arise directly from the superior mesenteric trunk. As the artery approaches

the ileocolic angle it divides. The mode of its division varies, but, as a rule, the artery to the appendix is first detached and the remaining trunk divides into anterior and posterior ileocolic arteries; the anterior ileocolic gives off a branch to the ileum, the posterior a branch to the cæcum. The middle colic arises near the lower border of the pancreas and directs its course towards the right in the layers of the transverse mesocolon, where it divides into branches, each of which again divides, to form a series of arches, joining on the inner side of the ascending colon with the right colic, and towards the splenic end of the transverse colon in an anastomosis (anastomosis magna of Riolan) with the ascending branch of the left colic artery. Not infrequently an accessory middle colic artery (Waldeyer) is given off as the first branch of the superior mesenteric artery, to run direct towards the middle of the transverse colon. The inferior mesenteric artery springs from the front of the aorta about the level of second and third lumbar vertebræ, slightly beneath the lower border of the duodenum; it is directed to the left and then downwards, and gives off the left colic artery at the point of division of the aorta. The left colic is a short, thick vessel which soon divides into two branches, an ascending, which mounts towards the left end of the transverse mesocolon, where it anastomoses on the one side with the middle colic, as already described, and on the other with its own descending branch, which, for its part, joins with the first sigmoid artery in the usual arching anastomosis. The sigmoid arteries, one to four in number, arise directly from the inferior mesenteric artery, and radiating outwards and downwards in the mesosigmoid, divide each into an ascending and descending branch; these, anastomosing with their neighbours, form a series of arches, from the curved side of which branches are given off, sometimes to form secondary arches, sometimes to run direct to the intestinal wall. The anastomoses of the branches of the left colic and sigmoid arteries result usually in the formation of a single uninterrupted "marginal artery," which extends from the splenic flexure to the lowest part of the sigmoid flexure. Here, however,



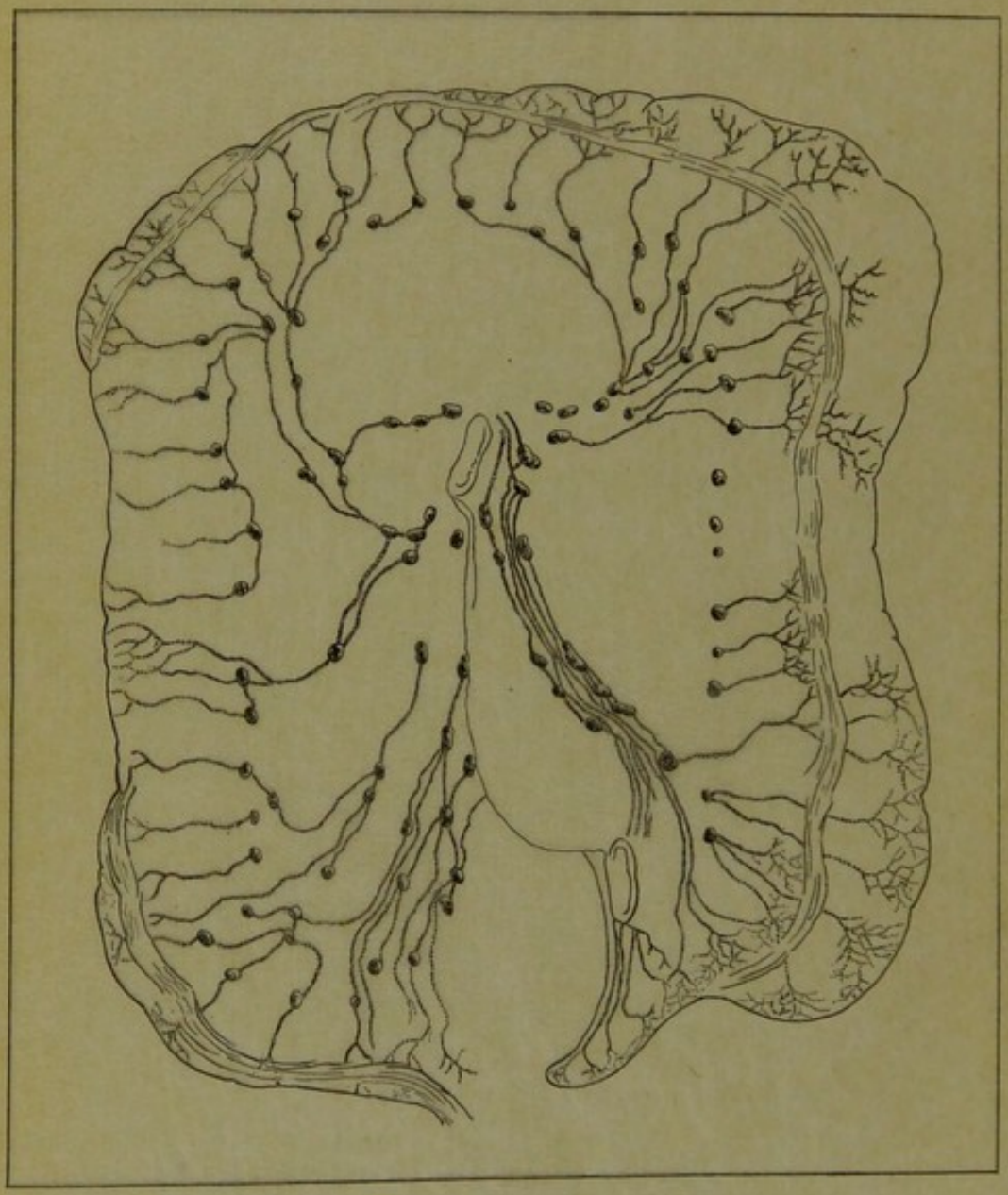
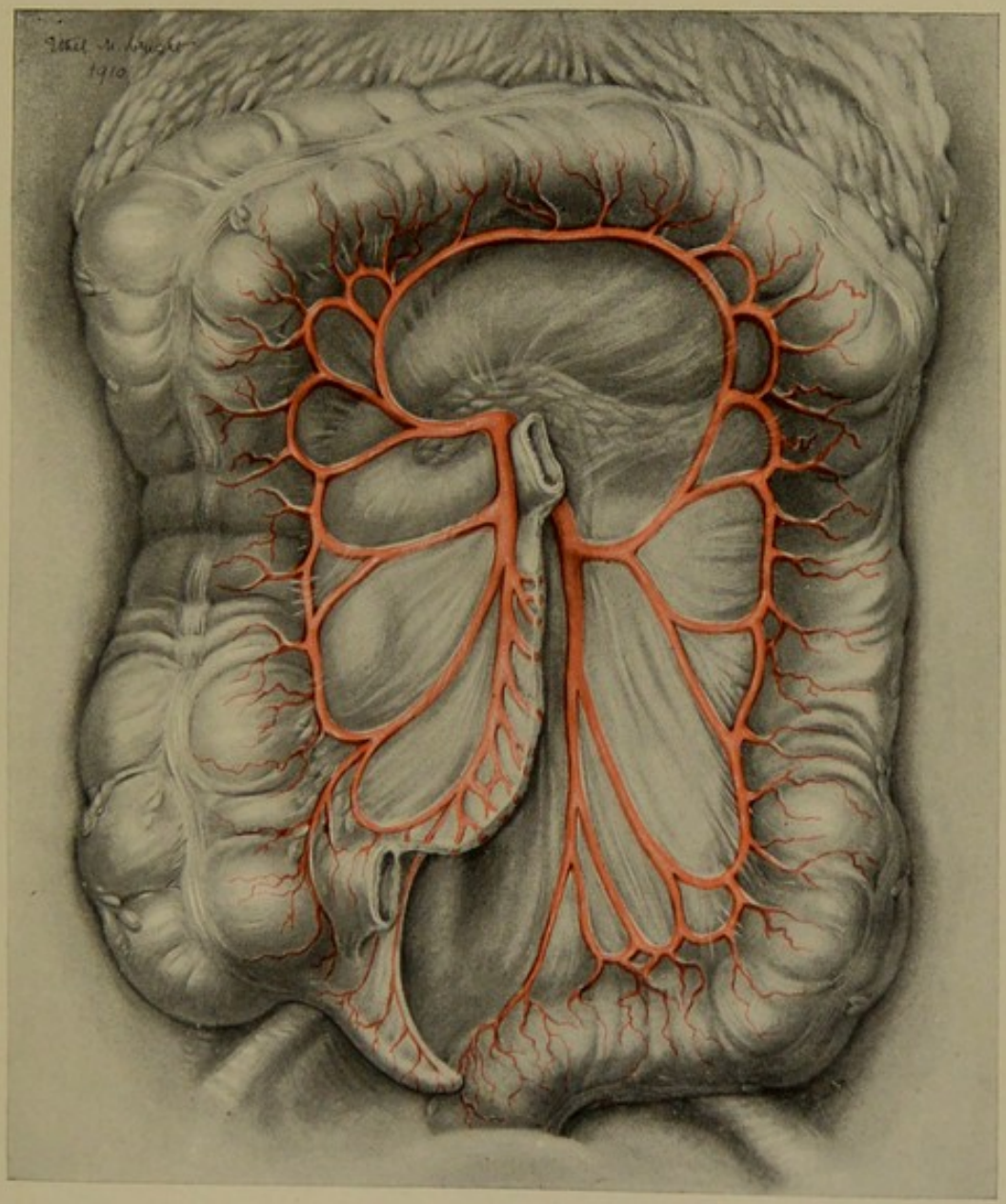
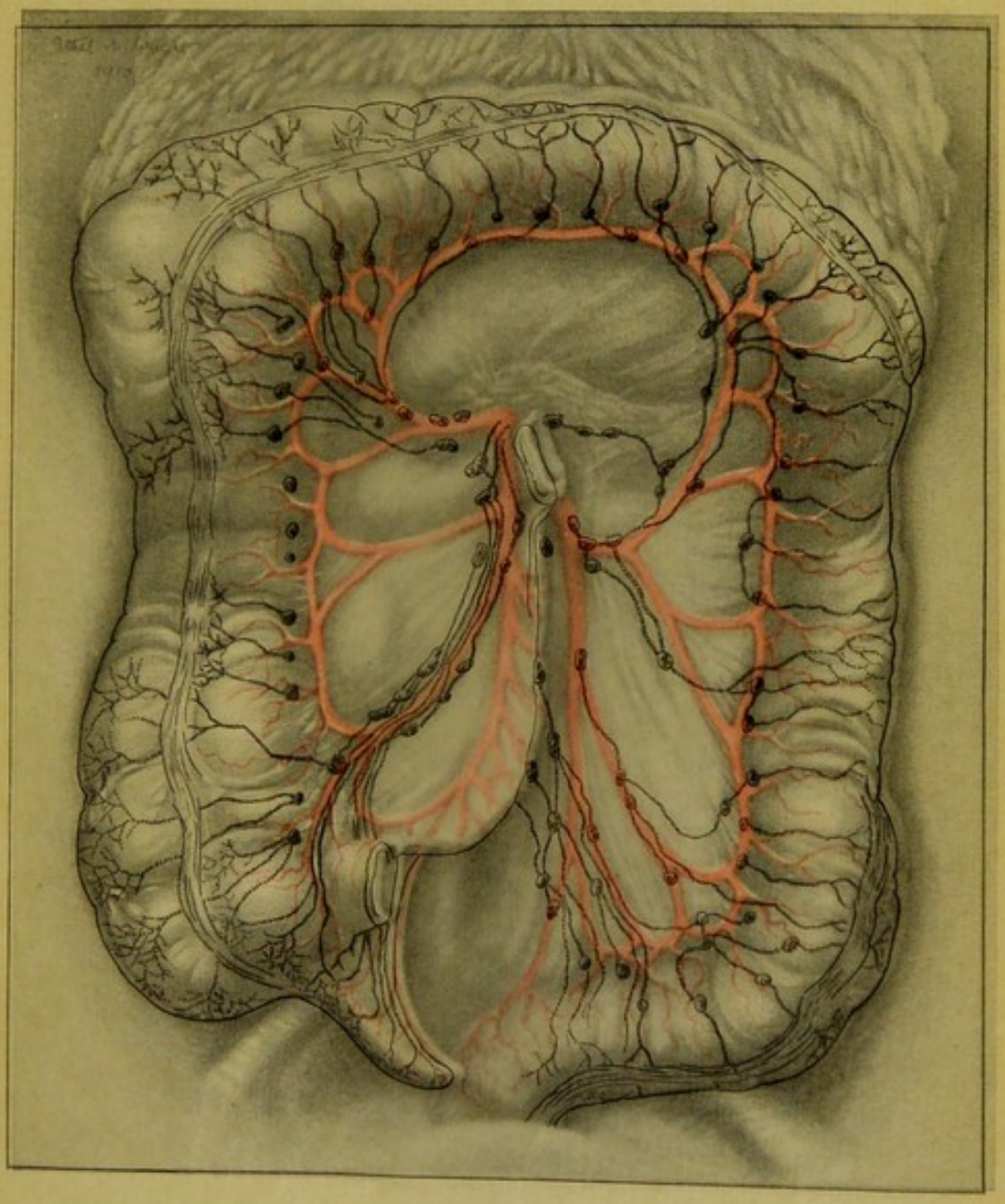


PLATE III



Colectomy. Arteries and lymphatics of the colon. (After Jamieson and Dobson.)

the ileocolic angle it divides. The mode of its division varies, but, as a rule, the artery to the appendix is first detached and the remaining trunk divides into anterior and posterior ileocolic arteries; the anterior ileocolic gives off a branch to the ileum, the posterior a branch to the cæcum. The middle colic arises near the lower border of the pancreas and directs its course towards the right in the layers of the transverse mesocolon, where it divides into branches, each of which again divides, to form a series of arches, joining on the inner side of the ascending colon with the right colic, and towards the splenic end of the transverse colon in an anastomosis (anastomosis magna of Riolan) with the ascending branch of the left colic artery. Not infrequently an accessory middle colic artery (Waldeyer) is given off as the first branch of the superior mesenteric artery, to run direct towards the middle of the transverse colon. The inferior mesenteric artery springs from the front of the aorta about the level of second and third lumbar vertebræ, slightly beneath the lower border of the duodenum; it is directed to the left and then downwards, and gives off the left colic artery at the point of division of the aorta. The left colic is a short, thick vessel which soon divides into two branches, an ascending, which mounts towards the left end of the transverse mesocolon, where it anastomoses on the one side with the middle colic, as already described, and on the other with its own descending branch, which, for its part, joins with the first sigmoid artery in the usual arching anastomosis. The sigmoid arteries, one to four in number, arise directly from the inferior mesenteric artery, and radiating outwards and downwards in the meso-sigmoid, divide each into an ascending and descending branch; these, anastomosing with their neighbours, form a series of arches, from the curved side of which branches are given off, sometimes to form secondary arches, sometimes to run direct to the intestinal wall. The anastomoses of the branches of the left colic and sigmoid arteries result usually in the formation of a single uninterrupted "marginal artery," which extends from the splenic flexure to the lowest part of the sigmoid flexure. Here, however,



Colectomy. Arteries and lymphatics of the colon. (After Jamieson and Dobson.)

it stops for the superior hæmorrhoidal artery, which is the continuation of the inferior mesenteric trunk after the sigmoid arteries have left, does not divide into two arch-forming branches, but runs directly to the intestinal wall. The great importance of this fact has been demonstrated by Sudeck ("Münch. med. Woch.," 1907, liv, 1314) and by Manasse ("Arch. f. klin. Chir., 1907, lxxxiii, 1003), from whose articles many of the foregoing details have been taken. (See also Waldeyer: "Die arteriæ colicæ," Berlin, 1900.) A reference to the figure will shew that, if the lowest sigmoid artery and the superior hæmorrhoidal artery be separately ligatured, the circulation through the marginal artery will be destroyed and gangrene must follow in the part of the bowel supplied by these two vessels. If, however, a ligature be applied to the trunk of the inferior mesenteric artery anywhere above the origin of the last sigmoid artery, this vessel will be able to convey blood arriving in the marginal artery, into the superior hæmorrhoidal trunk. The point of junction between the superior hæmorrhoidal artery and the lowest sigmoid artery is therefore called by Sudeck the "critical point." Ligature of the superior hæmorrhoidal artery and the lowest sigmoid artery below the critical point must almost inevitably result in gangrene of the portion of the rectum supplied by them. The importance of the marginal artery in so far as the procedure of intestinal resection is concerned cannot be overestimated. It has received especial emphasis in an excellent paper by Archibald, of Montreal ("Jour. Amer. Med. Assoc.," 1908, i, 573), who demonstrates from post-mortem investigation and from experiments upon animals that the supply of blood passing along this trunk from the anastomosis with the middle colic artery is ample to maintain the vitality of the whole of the descending colon and the sigmoid flexure after the inferior mesenteric artery has been ligatured at its origin (See also Morestin, "Bull. Soc. Anat.," Paris, 1903) and Hartmann ("Annals of Surgery," 1910, 1, 1091).

3. **The lymphatic distribution.**—A knowledge of the number, course, and termination of the lymphatic vessels and of the

distribution of the lymphatic glands is essential to all sound surgery of malignant disease. The surgery of carcinoma is the surgical anatomy of the lymphatic system. If a growth affects any organ, it is necessary to know the boundaries of the lymphatic area of that part, to know, that is, the origin, the course, and the destiny of all the lymph-vessels which drain the part that is affected.

During the last few years, as a result of the discovery of a method of injecting the lymph-vessels by Gerota, a great deal of investigation has been carried out by many workers, chief among whom, in this connexion, are Clado ("Comptes Rendu de la Soc. de Biol.," 1892, iv, 142), Polya, and von Navratil ("Deut. Zeit. f. Chir.," 1903, lxix, 421), Cunéo ("Traite d'anat. Hum. par Poirier et Charpy," 1902), and Jamieson and Dobson ("Lancet," 1907, i, 1137; "Annals of Surgery," 1909, l, 1077).

All, or almost all of the investigations by these several observers were carried out upon the fœtus (see also my remarks in the chapter dealing with cancer of the stomach). In the fœtus and young child the lymph-supply is free, and the number of glands appears to be relatively smaller than in the adult. As age advances, changes take place everywhere in the lymphatic system, as C. H. Mayo and Polya and von Navratil have shewn, and probably these changes are, to say the least, as considerable in the large intestine as in any part of the body. They consist in the obliteration of vessels by quiescent inflammatory processes, or by a simple process of involution and by the interruption of the long vessels of the fœtus through the development of a gland or glands in their path. Moreover, we know nothing from all these observations of the one supremely important fact in connexion with the spread of carcinoma—that is, the changes in the direction of the flow of the lymph when one channel becomes blocked.

So long as all channels remain open the lymph-flow seems destined always to take a definite direction, but in malignant disease cancer cells are carried away in the lymph-stream, and may soon

form an embolus in any vessel within which they lie. That path is then closed, but the flow from the growth continues. As to the direction it may then take, we are given no evidence. All these various points make it certain that great though our interest in the lymphatic system of the fœtus may be, we must not let our surgical procedures be too strictly dependent upon a knowledge of it. The plan of the lymphatic areas of the fœtus does not shew us the direction taken, the vessels traversed, and the glands involved when cancer attacks any part and cancer cells are set free, but it indicates, rather, the very worst that could conceivably happen if the entire lymph system had remained unaltered from birth, and if every channel remained patent.

The method of inquiry which should give the most helpful results would seem to be the investigation of the bodies of patients who have died from malignant disease and the examination of specimens removed by operation. The latter method cannot, of course, be so satisfactory as the former, for even should the patient be completely and permanently relieved of the disease, there is no proof that every cancer cell, or every gland involved, had been taken away.

In the case of the colon, a most excellent beginning has been made in this enquiry. H. S. Clogg reports, in a most valuable paper ("Lancet," 1908, ii, 1007), the result of an examination of 72 cases of cancer of the large intestine; he indicates the glands affected, and gives an outline of the various operative procedures necessary in the different parts of the colon. He divides the colon for purposes of description into its several arterial segments, a justifiable division for the researches of those I have already named agree in placing the lymphatic glands along the lines of the larger arteries.

1. **The Glands Along the Ileocolic Artery.**—Along the whole length of the ileocolic artery some lymphatic glands lie. Though they form an almost continuous chain, they are roughly divided by Jamieson and Dobson into a lower and an upper group, the former lying around the point of division of the

artery, the latter on and below the duodenum. The vessels from the appendix consist of three sets. One drawing lymph from all except the root ascends between the layers of the meso-appendix with the branches of the appendicular artery to the glands of the lower ileocolic group; a few vessels, however, ascend to the upper group. Those from the root of the appendix are anterior and posterior; the anterior, passing upwards, escape past the anterior ileocolic glands to reach the lower main ileocolic group; a vessel or vessels may pass these also to reach the upper group; the posterior vessels end in the posterior ileocolic group.

The vessels from the point of the cæcum run with and terminate in the same glands as those of the appendix root.

The point of chiefest importance in the lymphatic arrangement of the cæcum and appendix is that, as Polya and von Navratil first shewed, vessels may pass from their origin direct to the upper group of the main ileocolic chain. The importance of this observation is, of course, this, that it seems to indicate that in any "radical" operation for the removal of carcinoma of the cæcum or appendix the highest glands along the ileocolic artery must be included as well as the lower group, and those subsidiary groups which lie along the branches given off to right and left at the termination of the artery. Clogg, in his paper, reports on the examination of 16 cases, 14 post-mortem specimens, and 2 specimens obtained by operation. In only three-fourths of the cases were the enlarged glands infected. These were found in four groups: (1) In the ileocolic angle, generally close to the intestine, but occasionally extending a little distance upwards; in 3 only as high as the origin of the right colic artery. (2) Continuous with these were glands along the inner side of the ascending colon. (3) Continuous with (1) were a few glands on the upper border of the ileum; (4) a few glands in two cases "behind the growth." In one only were there glands around the head of the pancreas.

The operation intended to remove the lymphatic area attached to a growth of the cæcum and ascending colon must, therefore,

include the last 6 inches of the ileum, the cæcum, the ascending colon, and about one-third of the transverse colon. This is the operation described by Friedrich, and the one which in recent years I have always adopted.

2. The lymphatic system in connexion with the middle colic artery extends from the hepatic almost to the splenic flexure, and embraces, therefore, a small portion of the ascending colon, the hepatic flexure, and about two-thirds of the transverse colon. Glands lie along the margin of the intestine, between it and the series of vascular arches from which the straight vessels to the bowel are derived. Groups lie also along the main trunk of the vessel, especially at its bifurcation and its point of origin. This last group which lies on the vessel as it enters the transverse mesocolon received in the specimens, examined by Jamieson and Dobson vessels "from the intestine itself" five times in fourteen specimens. In the transverse colon, however, all the lymphatic vessels are interrupted by glands lying close to the gut; none escape to enter the main group on the origin of the artery.

The number of specimens examined by Clogg was too small to be more than suggestive of the route followed in the lymphatic invasion by cancer cells. It would appear that in the case of a growth in the hepatic flexure, the glands not only in the immediate vicinity of the tumour are involved, but also those which lie along the undivided trunk of the middle colic artery. This vessel, therefore, must be tied close to its origin, which will involve a removal of about one-half of the transverse colon, the hepatic flexure, and a part of the ascending colon; but for ease of subsequent anastomosis it is better to tie also the ileocolic and right colic arteries, as in cancer of the cæcum, so that the ileum may be readily brought over to the transverse colon. The operation of Friedrich, that is to say, is performed with the addition of the ligature of the main trunk, instead of a branch, of the middle colic, and a rather longer piece of the transverse colon is excised. If the growth be in the transverse colon, it is only necessary—in accordance with the fact that the lymph-channels are almost

at once arrested and never pass direct to the main group—to excise widely three inches approximately on each side of the growth, and to take away the attached portion of the mesocolon with its contained glands. The vascular supply on each side of the line of section is well secured, and an easy end-to-end or side-to-side anastomosis can be performed.

3. The lymphatic system in connexion with the inferior mesenteric artery extends from the left end of the transverse colon to the rectum. (*a*) The splenic flexure, supplied by the left colic artery, is drained by vessels which speedily encounter lymphatic glands. Jamieson and Dobson have "never seen a vessel passing directly to the main group of glands lying on the left colic artery," but they draw attention to a vessel which may "sometimes be seen running directly to the splenic glands."

Clogg examined the glands post-mortem in six cases of cancer of the splenic flexure. "In five cases glands were enlarged in the vicinity of the primary growth, in the angle of the flexure, or a little posterior to it, in relation to the spleen or to the inner side of the descending colon. In three, glands were also present in the mesocolon near to the lower border of the proximal transverse colon."

An operation destined to remove the whole lymphatic area attached to the splenic flexure would, therefore, appear to be impracticable in view of the possible engagement in it of glands in the hilum of the spleen, unless the spleen itself were excised. But probably the indications are sufficiently met by a removal of a part—about one-third of the transverse colon, the flexure itself, and one-half or rather more of the descending colon. Owing to the mobility of the transverse colon an end-to-end or side-to-side anastomosis is, I have found, always quite easy.

(*b*) The descending colon is drained by vessels which end in the group of glands lying to the inner side of the gut, and along the trunk of the left colic artery and its two branches. In the fœtus vessels also go, according to Jamieson and Dobson, towards the hilum of the spleen.

(*c*) The sigmoid flexure and the rectum are drained by vessels which are tributaries to glands of the inferior mesenteric chain. Along the whole length of this vessel glands are found in some cases, but not above the origin of the left colic artery in all.

Clogg records 18 cases in which post-mortem investigation was made of the glands in cases of growths in the sigmoid. In 17 of the 18 cases enlarged glands were present. "In every instance they were found in close proximity to the primary growth. In 6 glands were found at some distance from the primary growth, near to or at the base of the mesentery." The extent of the glandular enlargement varied in these 6 cases; in 3 the highest gland was well below the origin of the first sigmoid artery; in 3 glands were higher up on the main trunk of the inferior mesenteric artery. In only two-thirds of the cases were cancer cells found in the glands. Clogg points out that cancer in this region remains for long a local disease; that all glands that seem to be enlarged are not necessarily cancerous, and that in no single instance was glandular involvement only a barrier to radical operation. An operation to remove the whole lymphatic area involved in a growth in or near the middle of the sigmoid flexure would involve the ligature of the inferior mesenteric artery below the level of the left colic artery (or if glands are felt above this, the artery may be ligatured at its origin from the aorta without fear of gangrene; that, at least, has been my frequent experience) and the division of the bowel above at the junction of the descending and iliac colons, and below at the lower end of the sigmoid flexure. If the growth should be in the lower part of the sigmoid flexure or in the upper part of the rectum, the upper part of the sigmoid bowel may be felt; the remainder of the sigmoid, with the upper part of the rectum, being removed with the mesentery attached to it after the ligation of the inferior mesenteric artery below the origin of its left colic branch.

It may be urged against the operations thus briefly outlined, presently to be described more fully, that they are needlessly extensive, that less heroic measures have in the past given no little

assurance of freedom from recurrence, and that the gain to be expected from a so much wider removal with high ligature of the arteries is not commensurate with the extra risks that are run. I have had a fairly considerable experience both of the older, restricted methods, and of the newer, more ample procedures, and I have not the smallest hesitation in saying that the latter are easier to perform, more quickly done, and that subsequent anastomoses, if they are to be attempted, are more easily secured. For in order to make feasible this wide removal of the possibly infected bowel and the lymphatic area attached to it, it is necessary to strip the gut freely from its attachments. In a former paper I have emphasized the need for free mobilisation of the colon in all cases needing resection ("Surgery, Gynæcology, and Obstetrics, 1908, i, 463), and have spoken of the ease with which displacement of the bowel may then be made. It is astonishing how much may be done by these manœuvres; in one recent case I was able, without real difficulty, to attach the bowel, about 2 inches below the splenic flexure, to the rectum. The simplicity conferred upon the operation by this preliminary liberation of the attachment is the keynote of the whole procedure in resection of any portion of the colon. It will be found that both the ascending and the descending colon are but loosely attached to the posterior abdominal wall. Their connexions with it are due to the process of "physiological fusion" described by Toldt; to dissociate the adherent intestine from its attachment and thus *to reproduce the fœtal conditions* is simple. The ascending colon and the descending colon, after incising the serosa on their outer sides, may be stripped quite up to the middle line; they remain attached then simply by a mesenteric leaf, which contains the vessels running to supply them. After being so freely lifted up they may easily be displaced and brought to lie loosely in new positions. And so an anastomosis which, in ordinary conditions, would be difficult and subject at its completion to serious tension, may now be made with great ease, either by the end-to-end or by the side-to-side applications. The principle

of mobilisation, followed by transplantation or displacement, to which I called attention in the paper referred to above, was soon afterwards rediscovered elaborated in so far as it applies to the sigmoid flexure and the descending colon by Cavaillor and Chalier (Lyon Chirurgical, 1908, i, 379). The principle applies equally to the operation upon the right side. When carried out thoroughly it results in the colon having as great freedom of movement as the small intestine.

The choice between the two methods of anastomosis, side-to-side and end-to-end, has exercised the minds of surgeons for some years. There are advantages in both. If the peritoneal investments are complete in both ends to be united, then end-to-end anastomosis seems to me the best method. It is, however, far more difficult to do with accuracy, neatness, and precision; if done in a slipshod manner, disaster is bound to follow, leakage will occur from the suture line, and a general peritoneal infection or a localised abscess will be the result. If the serous covering is incomplete in one or other segment of the bowel, then I think it more prudent to close the two cut-ends, and to approximate their serous surfaces in a side-to-side anastomosis, which should always be of ample size. Healing in such an attachment occurs readily, and the union is sound and firm within a few hours. It has been supposed, and the supposition receives undoubted support from experimental observation, that an end-to-end anastomosis allows a more easy onward progression of the intestinal contents. It may be so, but I have never seen any difficulty arise in my own cases when the anastomosis has been made laterally; and as W. J. Mayo points out, the side-to-side anastomosis if seen a few months after its formation differs from the end-to-end very slightly in appearance—a small elbow alone marks the point at which the junction has been made ("Annals of Surgery," 1910, 1, 200).

Operation.—The following are the details of the several operations. When an end-to-end anastomosis has been completed and the surgeon has any doubt as to the security of the suture line,

the following method may be put in practice. The point of anastomosis is brought as near as possible to the abdominal incision; the parietal peritoneum on each side of the incision is then stripped away from the posterior surface of the abdominal to a degree sufficient to allow it to be pushed backwards into the abdomen till it comes to surround the two ends of the bowel which have been joined together. A few points of suture then hold the parts in this position, in such manner as to secure that, though within the abdomen, the line of junction is extraperitoneal. Should leakage then occur it results merely in a local disorder, and not in a general peritoneal infection. Bloodgood ("Annals of Surgery," 1909, xlix, 160) has suggested a very ingenious device for overcoming the serious consequences of leakage from the lines of closure of the bowel, when a lateral anastomosis has been performed. The two segments of bowel to be united are laid parallel to each other, the ends which are pointing in the same direction being inverted and closed. A lateral anastomosis is then performed. When the parietal peritoneum is stitched, the two ends of the bowel are brought up into the wound. Bloodgood states that "there is always danger of sloughing when intestines are inverted in this way, especially when the bowel has been distended and its walls thickened, which when sutured in this manner any leak would take place extraperitoneally." In my own experience, when lateral anastomosis has been performed, after closure of the divided ends of the bowel, I have never seen any leakage occur in almost 100 consecutive cases.

Removal of a Growth in the Cæcum or Ascending Colon. Ileocolic Resection. Friedrich's Operation.—The abdomen is opened by an ample incision six to eight inches long, slightly internal to the outer border of the right rectus muscle. The rectus sheath is opened, and the muscle itself pulled inwards towards the middle line and the posterior sheath incised. In doing this the nerves (especially the tenth) which pass transversely are carefully kept. This is quite easy if the displacement of the rectus muscle is carried out by gauze stripping.

As a rule, the ninth, tenth, and eleventh nerves are exposed in the incision; at least two of them are carefully preserved.

The peritoneum being opened, the parts are examined to determine the position, connexions, and extent of the growth. In some cases the omentum will be found adherent to the tumour. If so, it is ligatured off piecemeal a few inches from the growth. Resection of the tumour having been decided upon, the parts to

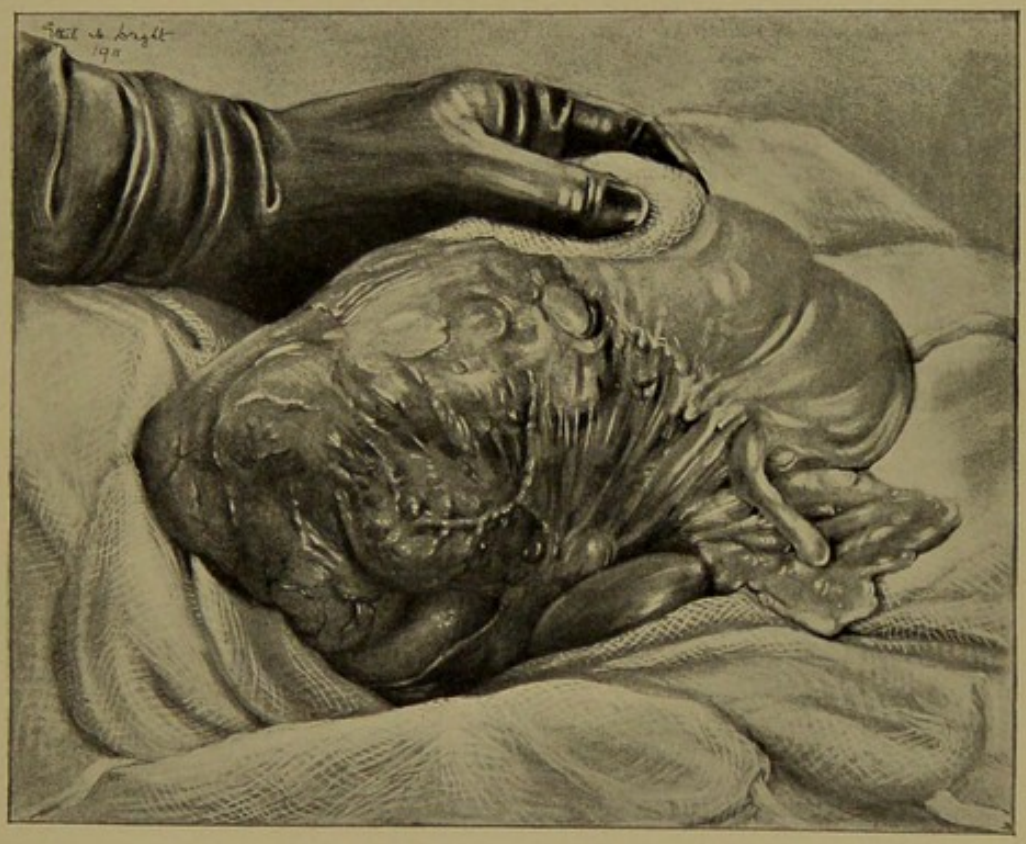


Fig. 217.—Colectomy. Shewing cæcum and ascending colon stripped up.

be engaged in the operation are packed off from the remainder of the abdominal cavity. The small intestine, with the exception of the last 8 inches of the ileum, is pushed well over to the left and into the pelvis, and protected by hot moist gauze swabs; another large swab is placed above the hepatic flexure, hiding the stomach and the liver; another is placed in the iliac fossa below the cæcum. The parts to be removed, the last five or six inches of the ileum, the cæcum and appendix, the ascending colon, and

about three or four inches of the transverse colon, are exposed. Over the swabs and the edges of the wound the rubber and gauze sheets are now carefully laid, so as to isolate the operation field completely.

The first step in the procedure of the removal of this length of the gut consists in the loosening of the ascending colon—its "mobilization" after the manner practised upon the duodenum

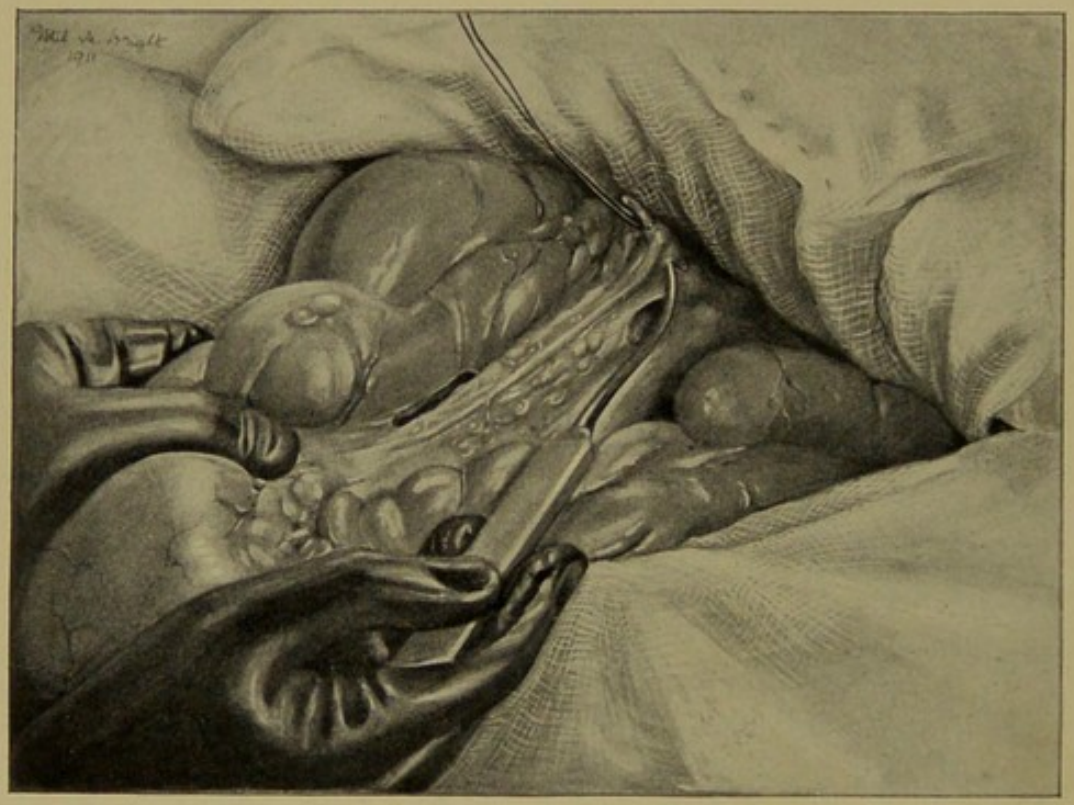


Fig. 218.—Colectomy. Removal of cæcum and ascending colon, together with a part of the ileum (Friedrich's operation). The parts having been freed the ileocolic artery is secured.

by Kocher. An incision is made along the posterior wall of the abdomen, about one inch to the outer side of the ascending colon, through the peritoneum. The inner edge of the peritoneum is stripped upwards towards the middle line, the fingers, covered with gauze, separating the parts easily. The process of stripping is carried behind the ascending colon in all its length, until the hand can pass beneath the colon quite to the middle line. The ureter is to be displayed and stripped carefully so as to en-

sure that no injury is inflicted upon it. The ovarian or spermatic vessels may also be seen and are to be carefully preserved. Any roughness at the time of their separation is apt to be followed by a wounding of the vein, so that the lightest handling here is necessary. At the upper end of the incision a part of the second and all the third portions of the duodenum are exposed, the peritoneum being lifted well away from the duodenum up to the point where the superior mesenteric artery crosses it. The

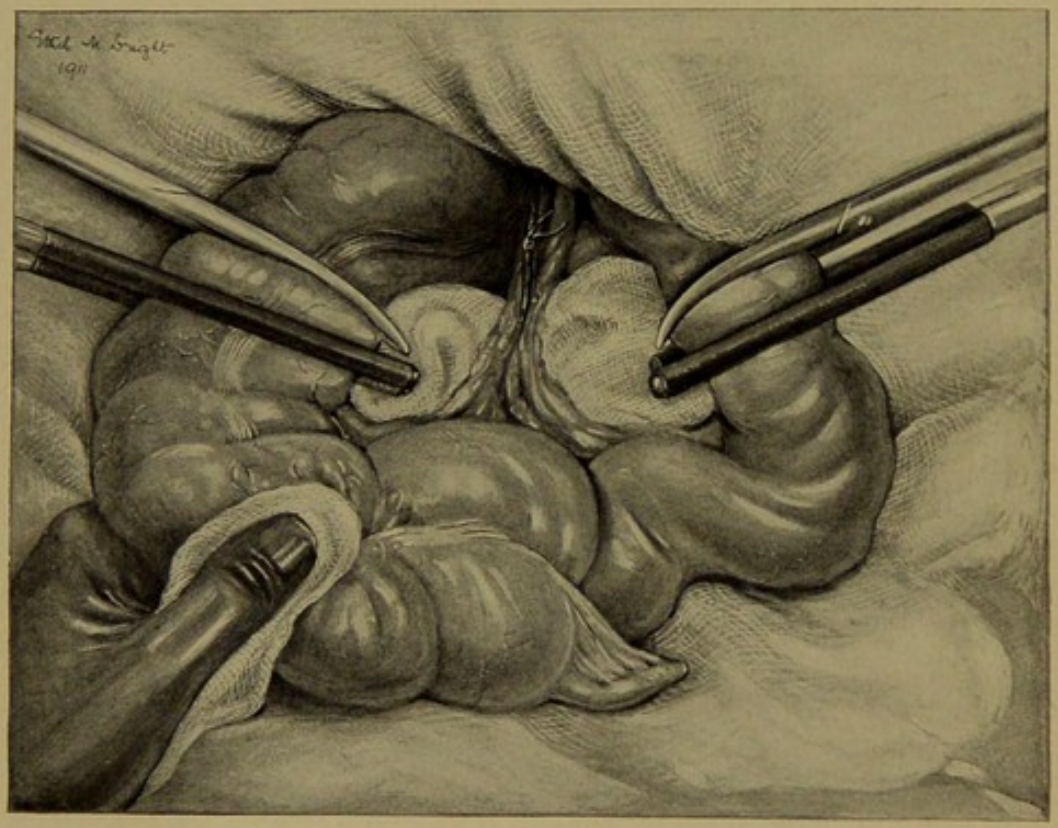


Fig. 219.—Colectomy. The artery is tied, the enteric mesentery divided up to the desired point of section on the ileum and colon. Clamps are applied to both large and small bowel.

process of stripping is continued at the upper end until the hepatic flexure can be easily lifted up, and at the lower until the cæcum is quite free. The terminal part of the enteric mesentery on its lower (left) surface will be divided for a short distance. The gut to be removed from ileum to transverse colon is now reduced to its primitive condition, in respect of its mesentery. Into the space behind the ascending colon a large hot moist swab is packed.

The left hand of the operator is now passed behind the ascending colon until the fingers lie below the third part of the duodenum. The peritoneum is stretched by the fingers, and a small incision made into it from the front; this cut is rapidly enlarged by gauze stripping until the superior mesenteric artery, with the ileocolic artery arising from it, is displayed. An enlarged gland

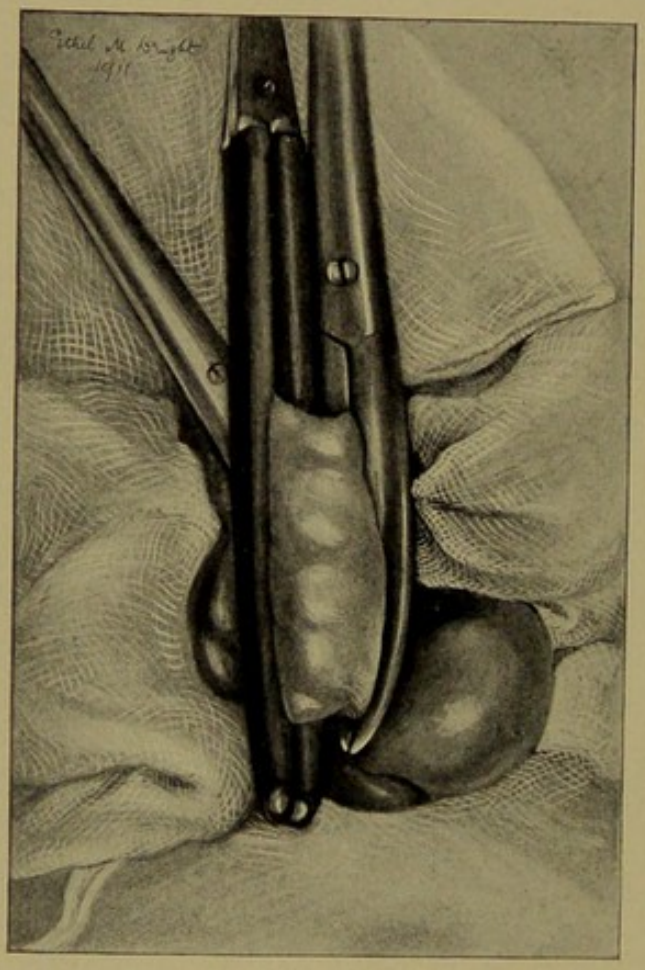


Fig. 220.—Colectomy method of division of the ileum, with closure of the proximal end.

is almost always seen here, and is to be stripped downwards with the peritoneum towards the cæcum. The exact position of the ileocolic artery and of the right colic artery can usually now be both seen and felt. By holding the ascending colon well out of the wound the translucent peritoneum, which is all that attaches the ascending colon, can be carefully inspected, and the precise

origin and direction of the vessels can be seen. An aneurysm needle carrying a double thread is passed under the ileocolic artery and the vessel ligatured in two places, and divided between them. As a rule, the right colic arises from the ileocolic, but if it should not do so it is separately ligatured. The part of the mesentery in which these vessels lie is often thick with a deposit of fat, and some care may be needed in properly displaying the vessels before ligature. When they are secured, two incisions are

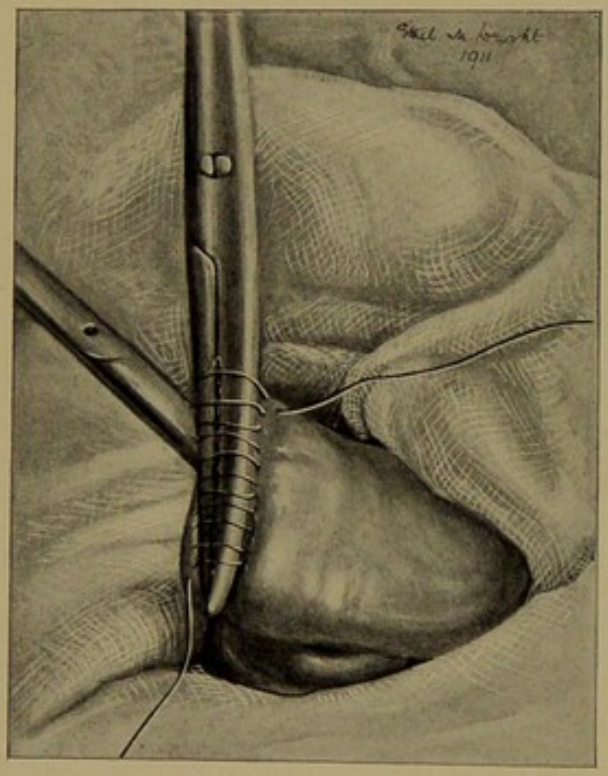


Fig. 221.—Colectomy. The ileum is divided close to the clamp. The suture passed from side to side of the intestine over the clamp.

carried through the peritoneum from the small incision already made to reach the vessel, the one extending downwards to the ileum and the other upwards and outwards to the beginning of the transverse colon. The peritoneum only is divided at first; then by holding the mesenteric leaf up to the light the vessels can be seen in them. In the incision leading to the ileum there is the terminal branch of the superior mesenteric artery going to its anastomosis with the ileal branch of the ileocolic. It is liga-

tured and divided, and the incision carried down and through the mesentery to the ileum. Close to the gut one or two vessels require ligatures. A similar incision is carried from the ligature on the ileocolic artery upwards to the transverse colon. The large branch of the middle colic which anastomoses with the right colic must be secured by ligature and divided, about two to three inches from the gut. As a rule, the incision through the peritoneum can then be carried up to the transverse colon, without injury to any but the smallest vessels.

At this stage of the operation the part to be removed, with a large triangular piece of the mesentery, and mesocolon continuing the terminal part of the superior mesentery artery, the right colic artery and a part of the middle colic, with all the lymph-vessels and glands lying along them have been raised up in one piece, now attached only by bowel above and below. The gut at each end is divided between clamps, and the mass is free. The division of the bowel and the subsequent anastomosis of the upper and lower ends may be carried out in a variety of ways. I prefer to divide the gut, close the ends, and perform lateral anastomosis. I have performed end-to-end and end-to-side anastomosis in different cases, but I have a strong preference for the lateral anastomosis. The ileum is divided first between clamps. On the proximal side a curved clamp with longitudinal grooves upon its blades is applied; about three-fourths of an inch distal to it a rubber sheathed clamp is placed, and is closed as tightly as possible. The bowel is then divided as close to the proximal clamp as possible, is indeed "shaved" off from it so that no part of the gut is seen beyond the clamp. The distal cut end is then sterilised at once with the cautery, in case it should by chance be brought in contact with the hand or an instrument, wrapped in a gauze swab, and laid aside. The cautery is run lightly over the blades of the proximal clamp, so as to destroy any small piece of the mucosa that may possibly be still attached. The end of the ileum is then closed by a suture of Pagenstecher thread applied in the following way: The clamp is held vertically in the

right hand of the assistant, with the tip of the blades pointing to the surgeon's right. The suture begins at the mesenteric border, on the left of the clamp. Here a stitch is taken about one-third inch from the clamp parallel to the mesenteric edge, and as close to it as possible. The needle when withdrawn is taken across the front of the clamp blades, while the clamp itself is twisted by the assistant over to the left so as to make the surface of the

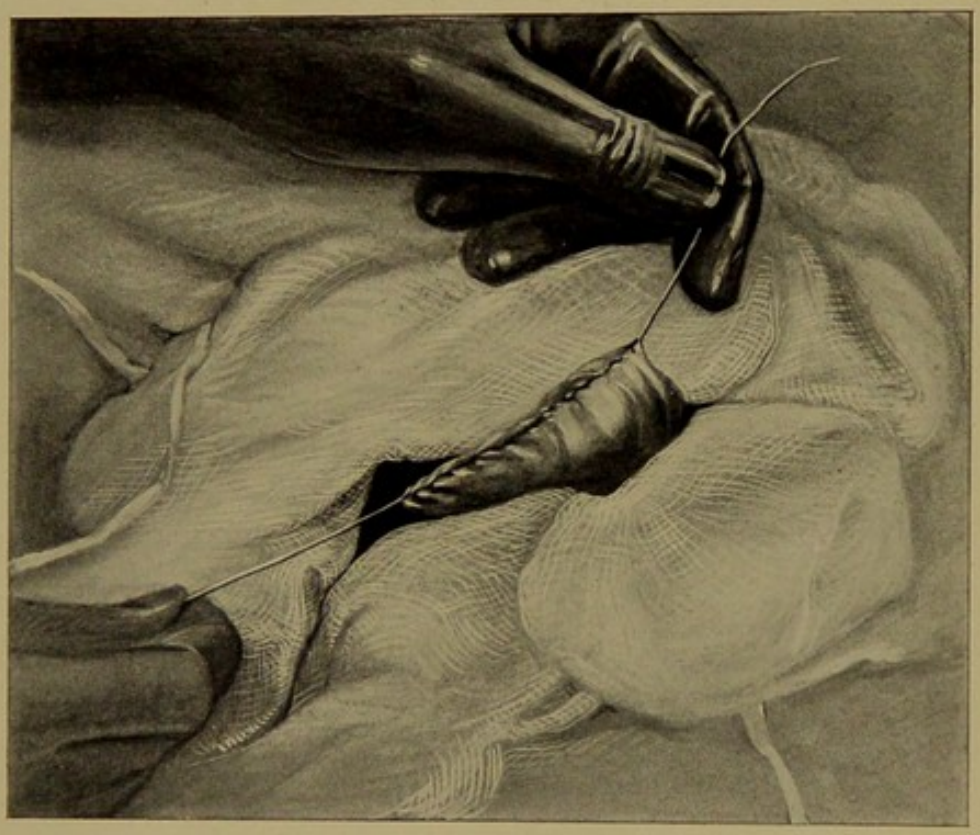


Fig. 222.—Colectomy. The clamp released and the suture tightened, with instant closure of the end of the ileum.

bowel to the right of the clamp present. In this a turn of the needle is taken, about one-fourth inch from the clamp, parallel to it, and starting as close to the mesenteric edge as possible. This stitch is drawn tight so that a thread is now seen to pass over the front of the needle from the first to the second turn of the needle. Again the clamp is twisted by the assistant until the left side of the bowel presents and in this a turn of the needle is taken about

one-fourth inch from the clamp, and parallel to it. So the stitch proceeds first on one side of the bowel, and then on the other, as the clamp is twisted in the assistant's hands, and each aspect of the bowel is made prominent. The last turn of the needle is taken on the side opposite to that on which the stitch began, and it is longitudinal (as was the first turn); the needle being entered near the clamp, at its tip, and taken along the bowel in a direc-

Fig. 223.—Colectomy. Anastomosis of ileum and transverse colon; side to side.

tion away from the clamp. The stitch is then grasped at each end by the surgeon, while the assistant opens and disengages the clamp. Then at once the stitch is drawn tight, by pulling with both hands, and instantly the cut ends infold, and the closure of the bowel is secure. The suture is then made to return along the bowel to the starting point, where it is knotted and drawn tight, so that the cut end of the gut puckers up very tightly. I

generally introduce one or two interrupted sutures over the dimpled end of the bowel, though probably this is not necessary.

A very ingenious and most satisfactory method of closing the ends of the large intestine was told to me by the late Jordan Lloyd, of Birmingham. At the place where the bowel is to be divided a circular incision is made through the seromuscular coats, which are detached from the mucosa and stripped up until a wide "cuff" is made. The mucous coat is then ligatured by fine silk or cat-

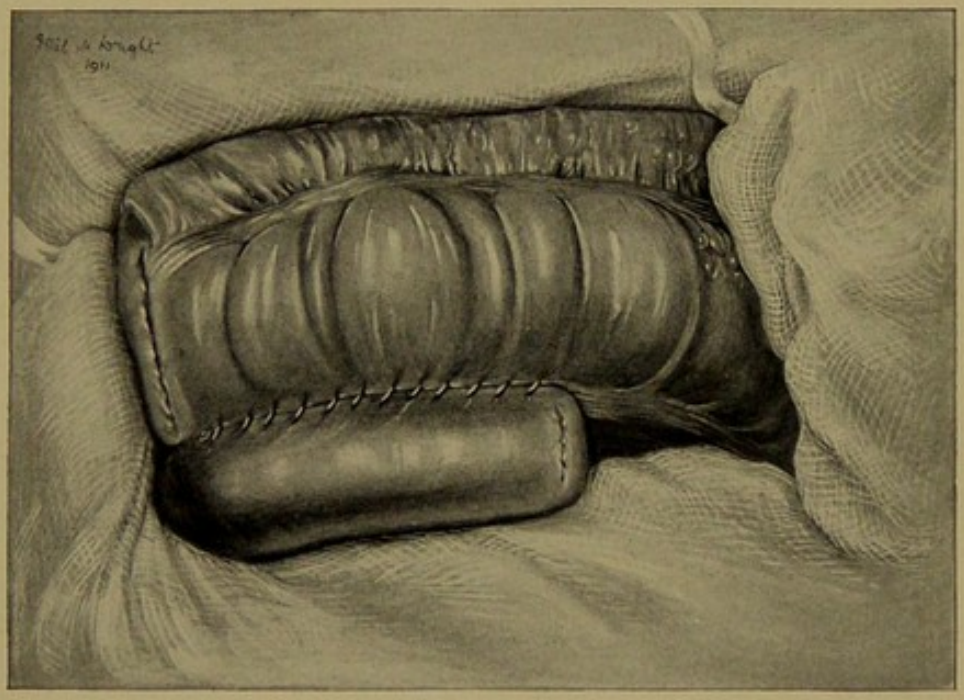


Fig. 224.—Colectomy. The anastomosis completed. The omentum is now brought down to cover the parts. The lateral anastomosis continues up to the cut end of the intestines. It is essential not to leave any part to form a "blind end."

gut in two places about one-third inch apart. The ligature when tightly drawn compresses the mucosa to a fine cord hardly as thick as a crochet needle. Between the two ligatures the cautery is placed to sear through the constricted and puckered mucosa. The sterilised and charred stump is then buried by suturing over it the cuff of the seromuscular tissues raised up at the first. The same method of closure is applied to the transverse colon which is divided about three or four inches from the hepatic flexure. An-

other simple and speedy method of dividing and closing the cut ends of the ileum and colon is as follows: The line of division is determined upon, and a powerful clamp—the compression forceps of Doyen—is applied, and as great a pressure as possible is made with it. On taking the clamp off it will be found that all the coats of the gut, with the exception of the serosa, and perhaps a few fibres of the muscular wall, have been crushed away. To the crushed part a single catgut ligature is applied and the bowel is divided beyond it. Around this cut end a purse-string suture is applied; it picks up the serous and muscular coats, and when tied, the catgut ligature on the crushed stump is buried. The purse-string suture is then itself protected by a single line of continuous suture, so that perfect security of closure is ensured. The colon may be dealt with in a similar manner, but is better closed by a double layer of suture in the manner already described.

At this stage the swabs, if soiled, may be changed. Fresh clamps are then applied to the ileum and to the transverse colon, those parts being grasped which are to be engaged in the anastomosis. It is important to see that the very terminal part of the two portions of the intestine are used; three or four inches of either small or large bowel must not be left between the anastomosis and the closed extremities. The closed end of the ileum is made to point to the left. The part of the colon which is embraced by a clamp includes a longitudinal muscular band; on the under side of the omental attachments. The anastomosis is now made. An outer suture of Pagenstecher thread, and inner of fine chromic iodised catgut are used. The inner suture is of the "loop on the mucosa" type depicted on p. 403, Vol. I. The opening at the anastomosis is made of good length, two inches and a half at the very least.

The anastomosis being complete, it remains only to wipe the parts with a hot moist swab, to remove the swabs, and to cover over the denuded surface on the posterior abdominal wall, with peritoneum.

The original peritoneal incision, made to the outer side of the ascending colon, is sutured to the anterior edges of the enteric mesentery and the transverse mesocolon; the edges come readily into apposition and are held by a continuous catgut suture. Before doing this I change my gloves, for they are possibly infected by the inner stitch used in the anastomosis. The abdominal wound is then closed. I rarely use a drainage-tube. If one should be needed it is better to pass it through a stab wound in the loin, below and to the outer side of the kidney; a metal tube is better than a rubber one. The advantages of this extensive resection are that it enables all the possibly infected glands to be removed; that by preliminary or early ligature of the vessels, an almost bloodless operation results, and that, as was shewn to be desirable by Friedrich, the two cut ends of the bowel utilised for the anastomosis are mobile.

An operation upon the lines here laid down was first described by Friedrich ("Arch. Intern. de Chir.," 1905, ii, 231), and has been generally advocated by subsequent writers. When resection and anastomosis have been safely completed, the raw surface which has been exposed by the stripping up and removal of the ascending colon is covered by stripping the neighbouring peritoneum and drawing its edges together—"peritonisation," as the French have termed it.

Resection of a Growth in the Hepatic Flexure.—An exactly similar operation is carried out if the growth lie in the hepatic flexure, or in the transverse colon close to it. But in this case another two or three inches of the transverse colon will be sacrificed, since it is necessary to ligature the middle colic artery near to its origin in order to secure the glands which there lie upon it. Owing to the anastomosis magna of Riolan, the vascular supply of the left half of the transverse colon is assured, the blood being derived from the ascending branch of the left colic artery. In detail the operation proceeds in the manner already described.

Excision of a Growth in the Transverse Colon.—If the growth is situated in or near the middle of the transverse

colon, the operation is simple in character and the results are good. The transverse colon is almost completely surrounded by peritoneum, it is always curved in direction, dipping downwards in the middle towards, and often reaching, the false or the true pelvis; the growth is, as a rule, small, and the glandular involvement limited to those lymphatic glands which lie upon or alongside of the bowel. For these reasons the resection need only be limited; a fair length can be removed, and an anastomosis made without tension (the colon merely taking a shorter, straighter line from the hepatic to the splenic flexure), and the anastomosis, whether end-to-end or side-to-side, is made between surfaces well attired with peritoneum. If the growth should lie in the transverse colon, close to one or other flexure, it is best dealt with in the same manner as are growths which begin in the flexures. The following description applies to a growth in or near the centre.

The abdomen is opened to right or to left of the middle line, according to the situation of the growth. It is better to displace the rectus to one or other side (if on the outer side, preserving the nerve supply) so as to secure more perfect closure of the wounds at the last. The peritoneal cavity is packed off with hot moist swabs and the wound edges covered with gauze and rubber sheeting as in all cases of colectomy. The first step consists in the division between ligatures of the gastrocolic omentum. In some cases the growth will have puckered this, or have infiltrated it to such an extent as to necessitate the ligature of the gastro-epiploic vessels on the greater curvature of the stomach or even in some cases, the removal of a part of the stomach itself. Poirier asserts that through the mediation of the lymphatics of the gastro-epiploic omentum the vessels of the transverse colon enter into relation with the lymphatics of the lower border of the stomach. If possible, and it is always possible in the earlier cases, the gastro-epiploic vascular arch is left intact, the ligatures being placed a little below it. Then on the transverse colon the limits of the resection are determined, and the great omentum is ligatured off as it hangs downwards from the gut. The line of

ligatures runs at each side along the boundary between the part that is to be removed, and the lateral parts that will remain dependent from the ends of the bowel which are to be united.

The growth with the omentum attached to it is then lifted well away from the posterior abdominal wall, and an additional flat swab is packed into the lesser sac of the peritoneum. The arch of the middle colic artery is then defined, and is ligatured at the lateral limits of the piece to be removed; two ligatures being applied at each side and the vessel divided between them. The accessory artery of Waldeyer, if present, must be secured also. The transverse mesocolon is then divided and the mass to be removed remains attached only at its extremities. At each end two pairs of clamps are applied and the bowel divided between them. It now only remains to perform an end-to-end or side-to-side suture and to place round the suture line the adjacent pieces of omentum, to make assurance doubly sure. The ligatures which have secured the middle colic artery at each end have been left long, and are now tied together so as to draw the cut edges of the mesocolon into apposition. A few sutures may also be applied so that access to the lesser sac is barred. If it is desired to make a side-to-side anastomosis this may early be done by liberating either the hepatic or the splenic flexure from the posterior attachments in the usual manner.

Excision of a Growth in the Splenic Flexure.—In removing a growth in this region it is necessary to take away one-third or one-half of the transverse colon, and a part or the whole of the descending colon. Owing to the freedom with which the transverse colon and sigmoid flexure can be mobilised and transplanted, an anastomosis between the divided proximal and distal ends is always possible. The glandular involvement has been shewn by Clogg to extend sometimes to the right in the direction of the transverse mesocolon and sometimes into the great omentum. The glands on the left colic artery are not primary; the lymphatic vessels which reach them are always derived from other glands nearer the bowel. Glands in the hilum of the spleen

are also in the lymphatic area attached to this segment of the intestine, so that, theoretically, a complete removal of all possibly infected glands is impracticable.

The abdomen is opened through the upper part of the left linea semilunaris, the outer edge of the rectus being displaced inwards, and the nerves to the muscle being left intact as far as possible. The peritoneal cavity is thoroughly protected. The visceral part of the operation then commences with a division of the peritoneum to the outer side of the descending colon; the incision is carried round the splenic flexure, the costocolic ligament being cut across, and the outer portion of the gastrocolic omentum divided. The splenic flexure is then raised from its bed and freely mobilised. The descending colon also is raised, and if need be, a part of the sigmoid flexure also, until the whole angle of the bowel can be lifted out of the abdomen and turned over to the right attached only by the mesentery which contains the left colic artery and its anastomosis with the middle colic. The main trunk of the left colic is then recognised as it springs from the inferior mesenteric stem. The ascending branch of this artery is surrounded by two ligatures and divided between them. The main trunk of the left colic is not to be divided unless it is thought necessary to remove the lower end of the descending colon. From the point of division of the artery two incisions are then carried, the one upwards to the transverse colon (which encounters the middle colic artery on its way to the anastomosis of Riolan) the outer towards the descending colon (which encounters the marginal artery here constituted by the two branches of the left colic artery) to those points on the bowel which have been selected as appropriate for division. The outer half or third of the transverse colon is to be removed, and as a rule the upper two-thirds of the decending colon. The bowel at each point is divided between two clamps, and end-to-end anastomosis performed or the two cut ends are closed by suture, and a lateral approximation made. I think the latter procedure the safer in this situation. The line on the transverse colon chosen for the anastomosis

is immediately below the attachment of the omentum, which then forms a convenient protection for the suture line when the operation is complete.

The most serious features in cases of carcinoma of the splenic flexure I have found to be very strong adhesions which bind the growth to the posterior and lateral abdominal walls, and in some cases to the spleen rendering removal almost or quite impossible. Adhesions to the kidney are occasionally quite inseparable. In one case Bilton Pollard was compelled to perform nephrectomy.

Removal of a Growth from the Descending Colon.—In this case the steps of the operation are similar to those just described. The outer third or a little less of the transverse colon must be removed, mobilisation is effected in the same manner as before, and the left colic artery at its origin from the inferior mesenteric artery is defined. It is ligatured here, so that the stream through both its branches is checked. From this point two incisions are carried through the peritoneum to the bowel at the points selected for division. That which is directed to the transverse colon meets the middle colic artery at its junction with the left colic, and divides it. The lower peritoneal incision divides the marginal artery between the lower branch of the left colic and the first sigmoid artery. The intestine is divided, and the anastomosis made, as before, either by the end-to-end or side-to-side method, frequently by the latter. If there is any difficulty in obtaining easy apposition, the sigmoid flexure may readily be mobilised and displaced upwards.

Removal of a Growth of the Sigmoid Flexure.—The same principles which guide one in the removal of a growth in the cæcum or ascending colon are followed here also. The incision is made in the left semilunar line, or a little to its inner side. The anterior sheath of the rectus muscle is opened, the muscle itself displaced inwards, care being taken to avoid the nerves supplying it as far as possible, and the abdomen opened through a vertical peritoneal incision which lies about 1 inch to the inner side of the external margin of the rectus. The deep epigastric artery and

vein may require ligature. On several occasions I have used a median incision, but the lateral seems to me the better as giving easier access, and a very secure closure. The abdomen being opened the position and connexions of the growth are examined, and if resection is determined upon, the patient is placed in the Trendelenburg position, large hot swabs are packed in the abdomen so as to surround and isolate the operation area, and the wound edges are then covered with rubber and gauze squares.

The first step in the operation consists in the free mobilisation of the whole of the sigmoid flexure and of the lower part, or in some cases of the whole of the descending colon. It is impossible to do this too thoroughly, for the more widely the bowel is made free the more easily can apposition of the divided ends be obtained after the resection has been completed. If, as sometimes occurs, the mesosigmoid is short, and the flexure itself of no great length, the mobilisation can be carried upwards to the splenic flexure which when thoroughly detached from its normal moorings may be displaced downwards for several inches. To effect this loosening, an incision is made in the parietal peritoneum about an inch outside the origin of the mesosigmoid, and is carried upwards along the outer side of the descending colon and downwards over the brim of the pelvis to the left side of the rectum. The inner cut edge of the peritoneum is then raised towards the middle line and a finger covered with gauze begins deftly to strip up the serous membrane from the iliac fossa. By stripping up, in this way, little by little the sigmoid flexure is gradually lifted away from the pelvic wall, held only by the mesosigmoid, and the continuation inwards of its inner leaf. In this the vessels lie, so that the integrity of the vascular supply is unimpaired. As the stripping proceeds inwards to the middle line the ureter is to be sought and displayed. It is apt to be lifted up with the serosa to which it is attached with some degree of firmness; but it must be gently detached and left lying in the iliac fossa. The spermatic or ovarian vessels are also seen, and care is taken to avoid any injury to them.

Careless or hasty handling may result in these being wounded, and removal of the testis or ovary may then be necessary.

The descending colon is now separated towards the middle line in the same manner, and the origin of the ureter and the lower pole of the kidney are seen as the stripping proceeds mesially. The splenic flexure itself is quite easily detached and displaced inwards and downwards after division of the costocolic ligament. When the mobilisation is complete it will be seen that the early fœtal condition of the descending colon and the sigmoid flexure is reproduced. This length of bowel is now attached to the middle line by a broad fold of peritoneum, a mesentery in which lie all the vessels of supply, the inferior mesenteric artery and its branches. As the bowel is held up, its mesentery, even when containing an abundant deposit of fat, is translucent and the details of the vascular supply can be seen quite readily. The trunk of the inferior mesenteric artery is now sought at its origin just below the duodenum, and the first branch the left colic artery recognised. If enlarged glands, one or more, are found upon the main trunk of the artery it is better to strip them down with gauze until the artery is cleared to a point below the origin of the left colic branch. The course of the artery is then followed downwards little by little the peritoneum being incised over it, until the origins of the sigmoid arteries are seen and the continuation of the vessel into the superior hæmorrhoidal artery is recognised. The first sigmoid artery is then tied with two ligatures and divided between them. From the point of section the peritoneum is divided outwards to the upper part of the sigmoid flexure, the incision being at first parallel to the lower of the two branches of the left colic artery. As the mesentery is divided the anastomosis between the left colic and the first sigmoid artery, the "marginal artery," will be met with and must be secured by ligature and divided, and a few smaller points between here and the bowel, owing to severance of the straight vessels directed from the marginal artery, will need to be tied. From the point of section of the first sigmoid artery, a second incision is now carried down-

wards along the outer side of the trunk of the inferior mesenteric artery and the second, and often a third sigmoid artery will be met with, secured by two ligatures and divided. The lowest sigmoid artery if it can be recognised should be saved, it arises about 1 to 1½ cm. below the sacral promontory, a situation which, according to Hartmann ("Annals of Surgery," 1909, ii, 1091), is constant. The preservation of the main trunk of the inferior mesenteric, of the sigmoidea ima, and of the superior hæmorrhoidal artery renders absolutely secure the vascular supply of the lowest part of the sigmoid and of the rectosigmoid junction. A continuation of this lower peritoneal incision is now made quite up to the sigmoid flexure, and again the marginal artery is cut and ligatured. The wedge-shaped portion of the mesentery containing the lymphatic area of the growth is now free, and all that remains is to divide the bowel above and below and to anastomose the divided ends. It will be seen that the intestinal division here, as elsewhere, is left until the last, so that every step up to this point has been done without the risk of infection. The bowel is divided at each end with the most sedulous care. If an end-to-end anastomosis is to be made, rubber clamps are applied above and below and the bowel divided between them, the ends then are approximated and the stitching carried out in the usual manner. If a side-to-side anastomosis is to be made, the ends of the bowel to be joined are closed by the suture already described in the paragraphs dealing with resection of the cæcum and ascending colon. After the junction is completed, the bowel is replaced in the abdomen, and the raw peritoneal surface covered in, if possible completely, by a few sutures.

The length of the bowel removed by this operation varies according to the length of the sigmoid flexure. My specimens vary in length from 8 to 15 inches. In all an easy apposition was secured by reason of the freedom conferred by extensive mobilisation. When the growth is situated at the junction of the sigmoid flexure and of the rectum, or in the lower part of the sigmoid, or the upper part of the rectum the steps of the operation

are in many respects similar. The gut is mobilised in the same manner from the middle or upper part of the descending colon downwards; as the brim of the pelvis is reached the incision in the outer leaf of the mesosigmoid is carried downwards on the wall of the true pelvis until the reflection of the peritoneum from the bladder or uterus, to the rectum is reached; it then passes across the front of the rectum, dividing the peritoneum transversely at the bottom of the pouch of Douglas, and is then continued upwards on the right of the rectum and sigmoid presently to join the incision which will be made downwards from the point of division of the main arterial trunk. The middle sacral artery will be met with, and must be divided and ligatured. When the whole segment of the bowel is freely loosened, the inferior mesenteric artery is displayed, and is divided between two ligatures, immediately below the point of origin of the left colic artery. In this resection the area supplied by the lowest sigmoid artery and the superior hæmorrhoidal (at least some part if not all this latter) is taken away so that the ligature and removal of the inferior mesenteric artery is essential. The sigmoid flexure is divided above the middle, the rectum is cut across at a point well below the growth, and the tumour, with the intestine and the lymphatic area removed. It now remains to anastomose the two ends of the bowel, and this may be a matter of some difficulty. In this position an end-to-end anastomosis made inside the abdomen is technically impossible, at least with a sufficient degree of accuracy. One of the following procedures must then be adopted.

1. Closure of the lower end of the bowel, and the invagination of the stump; and the performance of inguinal colotomy. This is the most rapid procedure, and may be enforced upon the surgeon in some cases. It is, however, the least satisfactory ending to such an operation, for I am loath to believe that an artificial anus should be regarded as anything but a rebuke to the operator's powers, if the case has been of average severity. Colotomy should be restricted to the cases in which there is

obstruction, or in which the growth is too far advanced to permit of resection.

2. The lower end of the rectum, after the sphincter has been well stretched and the bowel cleaned, is everted. The upper cut end is then passed through the lumen of the everted end until both cut ends lie together outside the anus, when a circular suture is supplied after Maunsell's method. The invaginated bowel is then replaced. In performing this operation I have always made a posterior incision from near the anus, to the coccyx which is removed. After the suture line is replaced a few extra stitches, ten or twelve, are applied on the outer side of the suture line, access being given by the posterior opening. In one case I have in this way anastomosed a point two inches below the splenic flexure to the stump of the rectum with a good result. Unless the reinforcing sutures are applied from the outer side a fæcal fistula is apt to form. A few rubber strands are left in as a drain through the posterior incision. I have several times used this method, and am well pleased with it; but I find it a good method to hand over the perineal part of the operation to an assistant, while I proceed with the abdominal toilet and closure.

3. **Rutherford Morison's Method** ("Brit. Gyn. Jour.," February, 1901).—This in many cases is the most desirable and the most easily accomplished procedure. It is thus described by its author:

"I proposed and carried out four years ago the following operation, the steps of which are:

(1) The diseased bowel is excised.

(2) A glass bobbin with India-rubber tube affixed is tied tightly into the upper end of the sigmoid flexure.

(3) The India-rubber tube is passed down from above through the lower cut end into the rectum, where it is aided to pass through the anus by the finger of an assistant. If there be any difficulty in effecting this, the assistant passes a stomach tube up from the anus into the belly. A piece of string is tied to the stomach tube and to the India-rubber and all are drawn back through the anus.

(4) The tube is drawn upon till the ligature on the upper cut end of bowel is inside of the lower cut end of bowel.

(5) A ligature is then passed round, immediately below the lower cut end, and tightly tied. This makes the junction water-tight.

(6) The tube is again pulled upon, whilst the lower portion of bowel immediately below the button is steadied till, by trac-

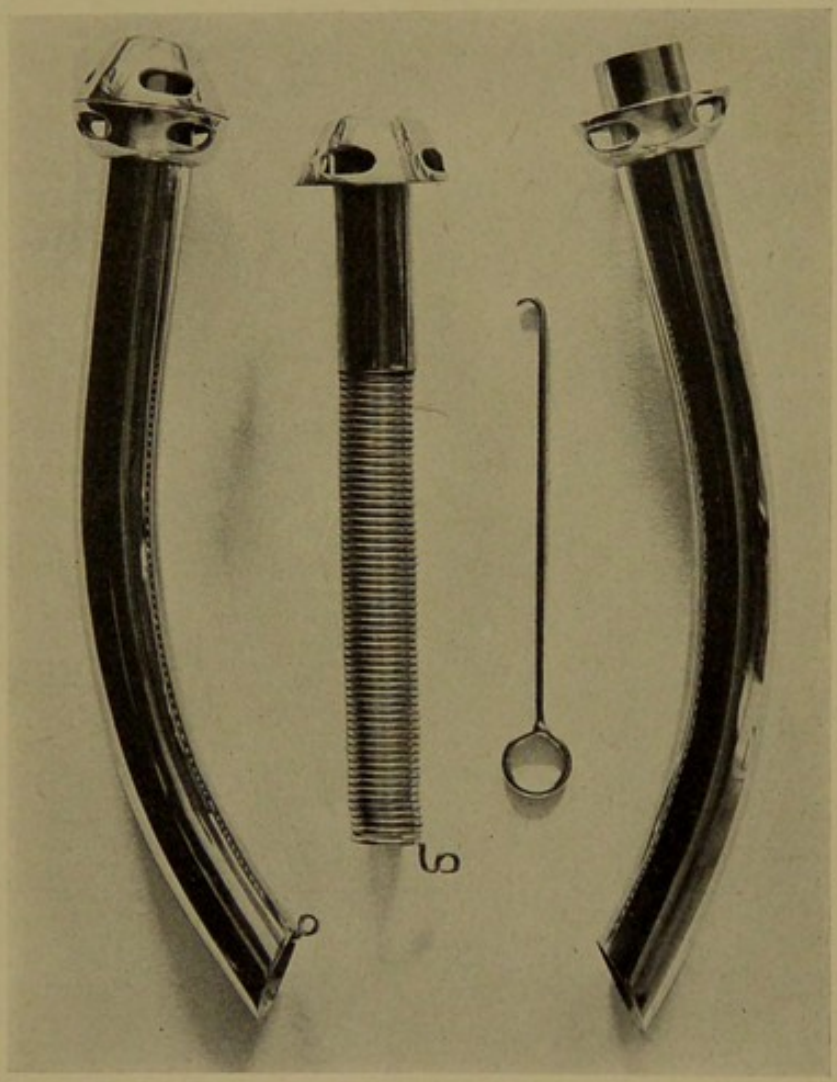


Fig. 225.—Metal tube for use in anastomosing sigmoid and rectum.

tion from above, a short intussusception is produced. This is maintained by a few Lembert's sutures.

In from four to eight days the ligatured sloughing bowel separates, and the tube is then released. I have performed this operation fourteen times; twice for complicated pyosalpinx, in the remaining twelve cases for malignant disease."

The same principle has also been recently advocated by Lockhart Mummery ("Lancet," 1908, i, 1403) and by Donald Balfour, of Rochester, on behalf of W. J. Mayo, who has used this method on several occasions during the last few years ("Annals of Surgery," 1910, li, 229). A very useful form of rubber tube for this purpose with one end made hard and stiff, has been intro-

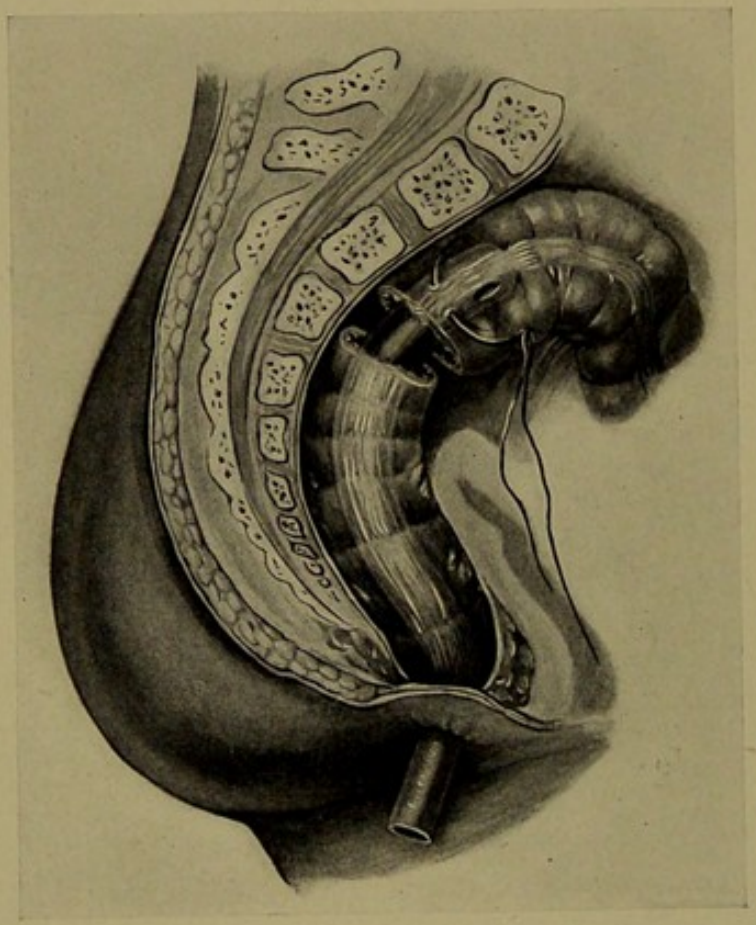


Fig. 226.—Anastomosis between sigmoid and rectum. Rutherford Morison's method (after Balfour).

duced by Lockhart Mummery. A metal one consisting of inner and outer parts, the upper ends of which are made on the principle of a Murphy button, may also be used.

After-treatment.—The chief point which requires attention in the care of patients, after colectomy has been performed, is concerned with the supply of fluid to them. We drink with our large intestine, and if a great part of this, especially of the prox-

imal part, has been removed the absorption of liquids is much reduced. Arbuthnot Lane lays great stress upon the necessity for a free supply of fluids after excision of the colon, and he has devised a most useful apparatus for administering saline solution subcutaneously. It consists of a rubber bag, tube, and a needle, all of which (the bag being nearly filled with salt solution) can be

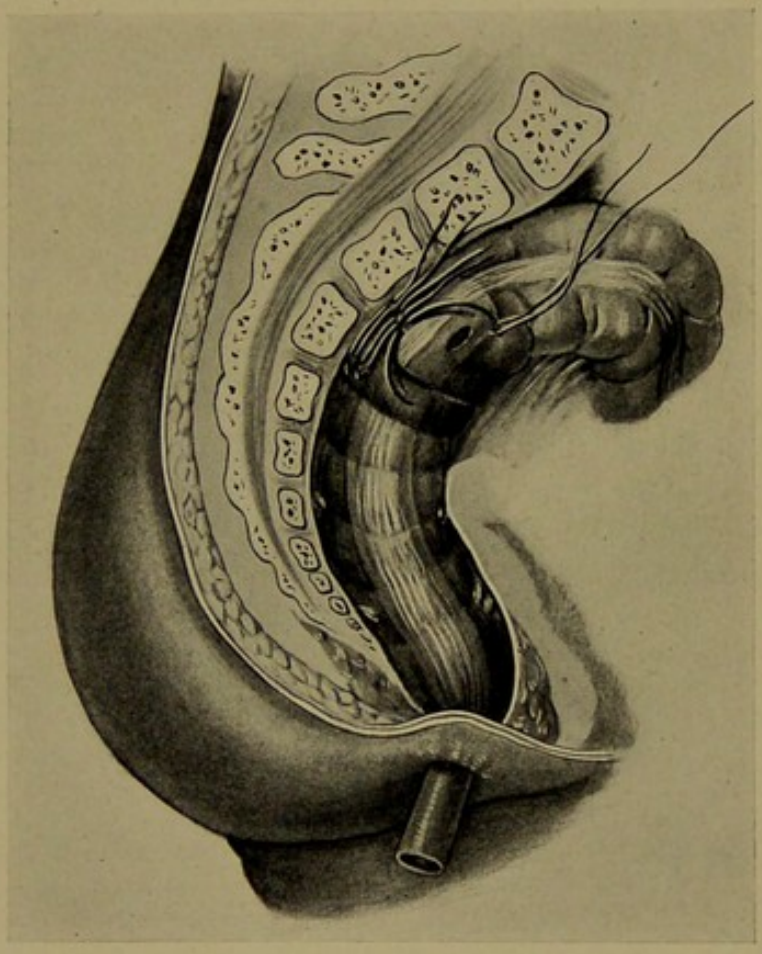


Fig. 227.—Anastomosis between sigmoid and rectum. The intussusception is made and secured by a second line of sutures (after Balfour).

boiled together. The bag is then hung up, a needle or needles plunged into the thigh, or the chestwall, and the fluid, when at the proper temperature, allowed to flow. Lane begins the infusion before the operation is started, and allows it to continue throughout the operation, and for some hours afterwards. If need be a little glucose may be added to a part of the liquid

given; but it is fluid rather than nourishment that these patients chiefly need.

In many of my earlier cases I was troubled by infection of the suture line, or of the parietal wound, resulting in the formation of a small abscess which had to be opened, and which delayed for some time the healing of the wound. Nowadays, how-

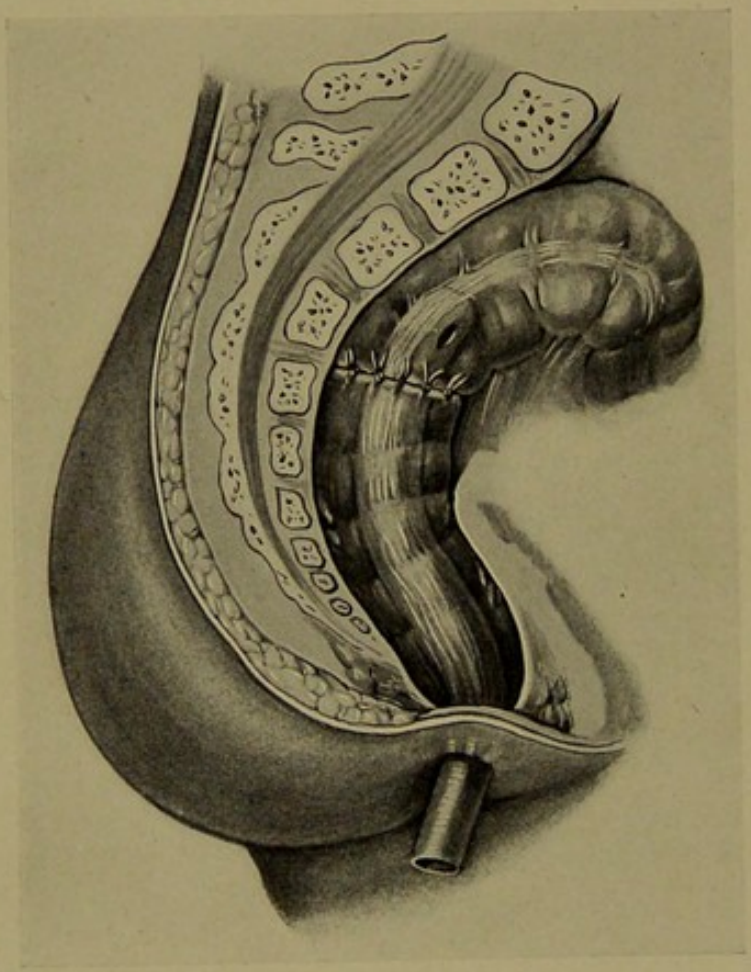


Fig. 228.—Anastomosis of sigmoid and rectum. The first layer of sutures (after Balfour).

ever, the wounds heal without any trace of infection, as they ought to do. This I attribute to —(*a*) the impenetrable barrier placed around the operation field, consisting of thick gauze swabs, and (most important of all) rubber and gauze sheeting; (*b*) the performance of the greater part of the operation, mobilisation, division of vessels, etc. before the intestine is opened; (*c*)

the performance of the intestinal suture within an area cut off from the general operation area; (*d*) the change of gloves once or twice when they are possibly or certainly soiled. I believe it is easier to infect the wound in a case of colectomy than in any other abdominal operation; but I know that infection can surely be avoided.

As soon as the patient has recovered from the anæsthetic water, tea or other fluids are given in unrestricted quantities. The bowels are not disturbed for two, three, or four days according to their condition. If discomfort appears then a glycerine enema (two ounces of glycerine with two ounces of hot water) may be left in the rectum for half an hour or an hour, when a sufficient action then generally takes place. A simple enema or a turpentine enema may be necessary; and in many cases an occasional hypodermic injection of eserine sulphate, $\frac{1}{100}$ grain, will aid in expelling flatus. One ounce of liquid paraffin is given night and morning, on the second and subsequent days, as in almost all abdominal cases, to ensure soft, easy, and sufficient alvine evacuations.

(*b*) **Resection of the Large Intestine for Growth Causing Intestinal Obstruction.**—In the great majority of cases of acute intestinal obstruction caused by growth in the large intestine an operation having for its sole purpose the relief of the overdistended bowel will be performed. The nature of this operation will depend partly upon the degree of the obstruction, but chiefly upon the position of the growth. Typhlotomy, colostomy, and ileosigmoidostomy are those most commonly practised. The resection of the growth is left until later. There are few rules so binding upon the surgeon as that which prohibits the resection of growths, and subsequent end-to-end anastomosis of the large intestine in cases of acute obstruction. The disparity in the size of the bowel above and that below the obstruction, the infection and ulceration of the mucosa on the proximal side, and the certainty of mischance when such un-

healthy material is sutured—these are some of the reasons which deter the surgeon from attempting any such operation.

In many cases of growth in the large intestine that come to operation a tumour is already perceptible; in some the growth forms a "ring-stricture" and is with difficulty perceptible, in cases of obstruction, even when the abdomen has been opened. If a block in the large intestine has been diagnosed, but the exact site of it cannot be determined, an exploration in the middle line will be necessary. The position of the growth being discovered, the central opening is sutured and an incision made over the site of the growth. When the growth is exposed, it will be found that, as a rule, the tumour itself is small—of the size, very often, of a dinner napkin-ring—and feels solid. The finger invaginating the bowel either from above or from below discovers no passage through it. The gut above the obstruction is enormously distended; its walls are thick, reddened, and sodden in appearance, and the peritoneum may slither away under one's fingers in the gentlest handling, leaving a raw, oozing surface. During the manipulations this thickened gut may be seen to harden and contract in its exaggerated effort to overcome the block to its outlet. The intestine below the growth is thin, pale, and collapsed from long disuse.

The most satisfactory solution of the question as to the best method of dealing with the growth in these conditions has been furnished by Mr. F. T. Paul. In an article in the "British Medical Journal," May 25, 1895, p. 1139, he describes an operation which seems to me, both in theory and in practice, to be the best possible operation. The following is the description there given:

"1. Explore first in the middle line unless the stricture has been located.

"2. Make a sufficiently free incision over the site of the tumour.

"3. Having cleared away any adhesions, ligate the mesentery

with the help of an aneurysm needle, and divide it sufficiently to free the bowel well beyond the growth on each side.

"4. Let the loop of bowel containing the growth or stricture hang out of the abdomen, and sew together the mesentery and the adjacent sides of the two ends, as shewn in Fig. 182. See that the stump of mesentery lies beneath the bowel, where, if deemed advisable, it can be drained by packing cyanide gauze down to it.

"5. Ligate tightly a glass intestinal drainage-tube into the bowel above and below the tumour and then cut away the af-

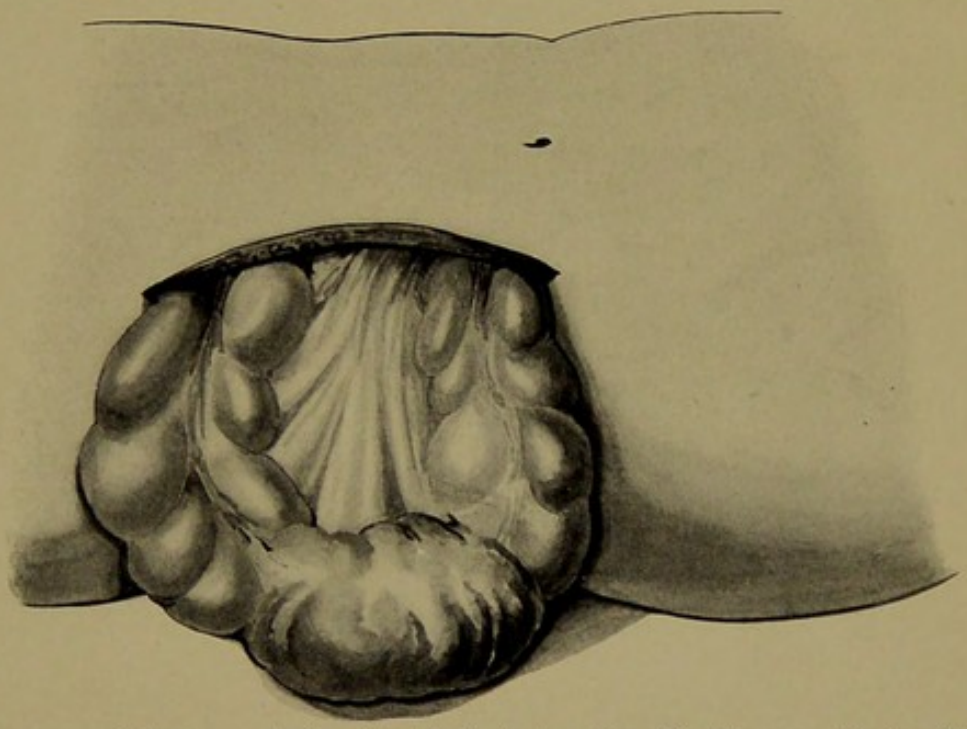


Fig 229.—Colectomy during intestinal obstruction (Paul's operation). The growth is delivered through the abdominal wall.

fected part. Do not cut off first, or blood will be unnecessarily lost. Only the proximal tube is really necessary. The distal end may be closed or included in the proximal ligature.

"6. Close the ends of the wound with a few silkworm-gut sutures, passing through all the layers of the abdominal wall: no others are necessary.

"When the operation is performed in this way, all the vessels except those in the primary incision are tied before they are cut, and the intraperitoneal work is rendered quite bloodless.

"The second stage of the operation, that of breaking down

the spur with an enterotome, should generally be undertaken about three weeks later. As soon as this has been satisfactorily accomplished the artificial anus is closed by separating the rosette of mucous membrane from the skin, turning it in, and bringing the freshened edges of the latter together over it."

A very similar method to this has been adopted for some years by Professor von Mikulicz. In a paper read before the American Surgical Association ("Boston Med. and Surg. Jour.," vol. i, 1903, p. 611) he gives a very brief description of the operation as practised by him, and makes the following remarks as to the selection of the operation:

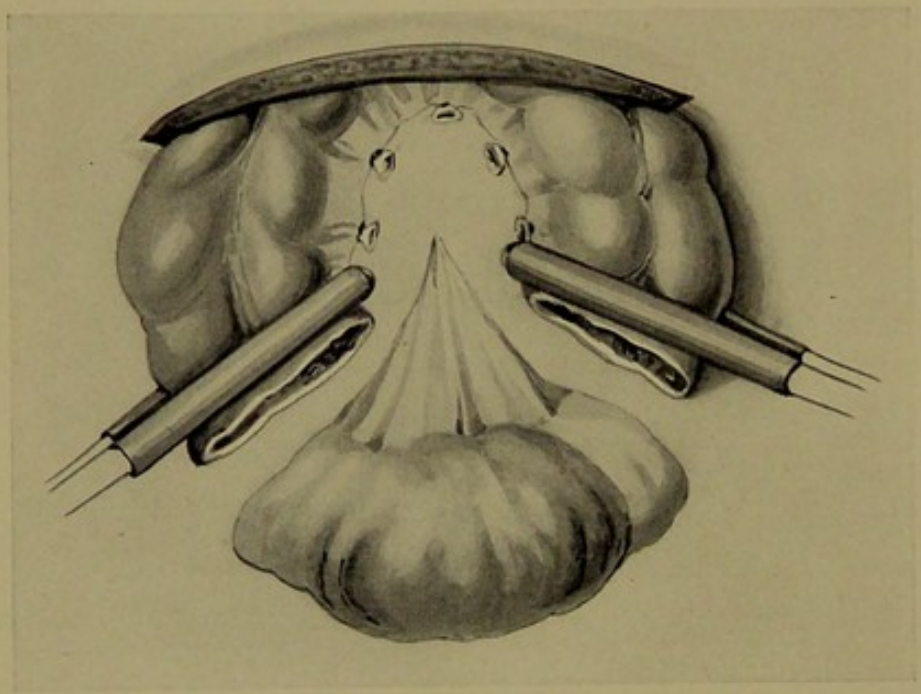


Fig. 230.—The bowel on each side of the growth is clamped, the mesentery ligated, and the growth removed.

"Statistics collected until now shew that the prevalent method of excision of the tumour and immediate suture of the intestine gives very bad results, the mortality varying between 30 and 50 per cent., and most patients succumbing to peritonitis. The cause of this phenomenon is found, I believe, mainly in the secondary changes which take place in the intestinal walls under the influence of carcinomatous stenosis.

The gut is dilated, its nutrition impaired, and its muscular wall is insufficient: consequently after the operation we are apt to have complete atony of the intestine—the contents are arrested at the site of the suture, the suture yields, and peritonitis results. For this reason Bloch, as early as 1892, advocated operating in selected cases in two sittings. Allingham and E. Edmunds also have divided the operation in special cases. For a number of years I have invariably performed the operation in two sittings, and have found that the results were infinitely better than formerly. Of 24 cases operated on, only 4 died after the operation: but in none of these cases can the method of procedure be held responsible for the fatal termination. One patient died, eleven days after the operation, of embolism of the lung: another, after a week, of pneumonia; a third six weeks after the operation, of general carcinomatosis; and the fourth within two days, of peritonitis, caused by rupture of the carcinomatous gut during the enucleation of the tumour, so that a large amount of infective intestinal contents reached the peritoneal cavity during the operation.

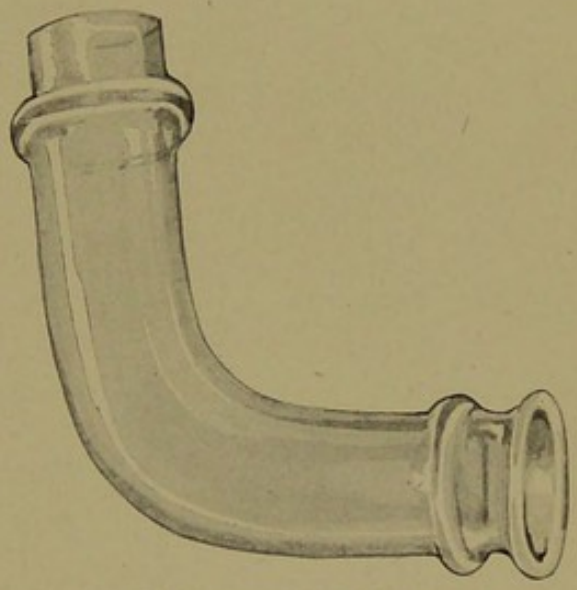


Fig. 231.—Paul's tube.

"As regards the technique of the two operations performed by myself, I should like to say the following: The primary incision, the enucleation of the tumour, the removal of the lymphatic glands,—in short, the entire operation,—is performed exactly as when one operation only is done. If, now, the tumour has been free and completely enucleated, it is drawn out of the wound, the loop of gut is stitched to the parietal peritoneum with sutures including only the serous coat, and the abdominal wound is closed, leaving only room enough for the loop of the gut. Now only after the abdominal cavity is completely closed, the tumour is excised, and an artificial anus is es-

tablished, which is closed in two or four weeks, according to the usual methods. The disadvantage of this process is that the patient is afflicted for a few weeks with an artificial anus, but I believe that this is fully balanced by the advantage of greater safety."

A somewhat similar plan is followed by Hartmann ("Bull. et Mém. Soc. de Chir.," November 8, 1904, p. 866), who writes:

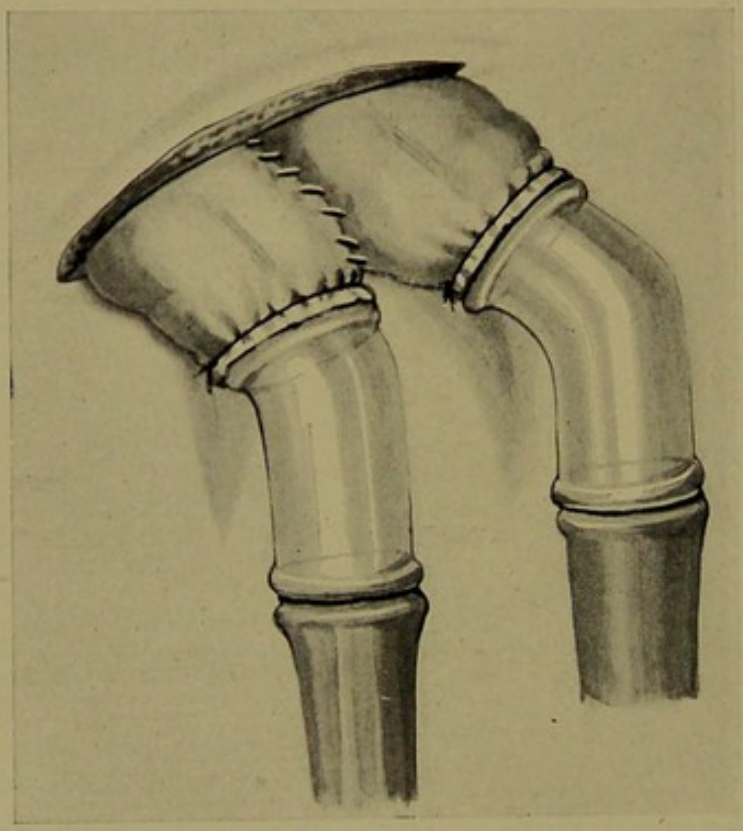


Fig. 232.—The limbs of the colon loop are stitched together, and into each divided end a Paul's tube is introduced.

"The tumour being freed from its connexions I draw it well outside the abdomen and fix the two ends of the loop of bowel to the parietal peritoneum by a continuous stitch. This is done without fear of infection if the gut has not been opened. I pack round the loop with iodoform gauze and then apply a compression forceps to the lower distal limb of the loop, and apply in the groove left after their removal a single catgut ligature. This limb is crushed on a level with the skin. The same procedure is applied to the upper proximal limb, with

this exception, that, instead of the line of crushing being on a level with the skin, it is at least two to three inches outside this. At this stage, therefore, the abdomen is completely closed: from it project two limbs of bowel, each securely closed. The lower limb is level with the skin, the upper is 2½ to 3 inches in length. In this latter a small button-hole incision is made, through which a tube is passed which drains the bowel. The tube is tied securely in and is left four to six days. It is then removed. The upper end retracts little by little, and finally makes only the smallest projection upon the skin. A fortnight later the abdomen is opened, the two ends of the bowel are crushed, ligated, and buried by suture; lateral enteroanastomosis is then performed, the artificial anus excised, and the abdomen closed."

It may fairly be urged against these operations that they are too niggardly, that too little both of the intestine and of the possibly infected glands is removed, that it would be wiser to relieve the colonic obstruction first by means of a typhlotomy, and at a later stage to perform the ideal resection. The objections are more likely to come from the ardent or enthusiastic novice than from him who has been brought frequently face-to-face with patients in urgent need of relief. These patients are sometimes old, far from robust, with no great recuperative power. The certainty of removing the growth at once is something not to be lightly forfeited; and when we remember the several circumstances of carcinomatous growths of the colon to which reference has already been made we can feel confident that, in some cases, we are doing that which is safest, best, and therefore right in adopting Paul's method.

The Choice of Operation in Cases of Malignant Disease of the Large Intestine.—From what has been said it will be readily understood that the choice of an operation in cases of carcinoma of the colon is by no means free from difficulties. There is no established practice: surgeons of equal eminence differ in their methods. Of one thing there can be no question, in cases of acute obstruction no attempt to resect the growth

and to perform an immediate restitution of the canal is justifiable. The immediate indication in such circumstances is to afford relief; the surgeon must be content with that, and must never be persuaded into doing more than that. Relief to an acute obstruction may be afforded by opening the colon above the growth, by colotomy, typhlotomy, or by appendicostomy. The use of the appendix for such a purpose has only of late years been adequately appreciated. Some eleven years ago, in a case of acute obstruction due to a growth in the hepatic flexure, I began an operation, intending to open the cæcum (typhlotomy). I found the appendix directly beneath my incision, and as it was of good size I drew it to the wound, stitched it, about half an inch from its base, to the parietal peritoneum, and closed the rest of the incision. The greater part of the appendix then hung out of the wound. It was opened by cutting off the tip and passing upwards in the lumen a No. 10 catheter, which was tied in by an encircling ligature; the catheter was connected to a larger tube which led into a basin at the side of the bed. Perfect drainage of the overloaded intestine was thus established, and resection was performed about eight days later.

When the growth is situated in the cæcum, an acute obstruction is rarely caused. In almost every instance, therefore, a resection, with immediate suture of the divided ends, can be performed. As a rule, end-to-end suture is readily performed, but latterly I have met with good success by closing both ends of the bowel and performing a lateral anastomosis between the ileum and the transverse colon. Especial care must be taken to effect a perfectly secure closure of the divided end of the ascending colon. In some circumstances a terminolateral (end-to-side) anastomosis may be performed, though I have no personal liking for this method.

When the growth lies in other parts of the colon than those mentioned, if obstruction is present, Paul's operation, or some of the modifications I have described above, should be

performed; if obstruction is not present, resection and immediate end-to-end suture will prove a perfectly satisfactory operation.

Where an artificial anus has been made,—in the cæcum, for example,—a resection is undertaken at a later date; the anus may be allowed to remain in action until a sufficient time has elapsed to permit of secure healing of the line of anastomosis. In ten to fourteen days the artificial anus may be closed and the intestinal current restored.

STATISTICS OF CASES OF COLECTOMY FOR MALIGNANT DISEASE.—Dr. W. J. Mayo "Annals of Surgery," 1909, 1, 200) gives the following report upon 100 cases of resection of the large intestine:

ONE HUNDRED CONSECUTIVE RESECTIONS OF THE LARGE INTESTINE IN THE ADULT OPERATIONS PERFORMED AT ST. MARY'S HOSPITAL, ROCHESTER, MINNESOTA, BETWEEN FEBRUARY, 1898, AND FEBRUARY, 1909. OF THESE RESECTIONS, 61 WERE FOR MALIGNANT DISEASE, WITH 8 DEATHS (OR 13 PER CENT.).

CANCER OF THE CÆCUM AND ASCENDING COLON.

Number of cases	24
Sex (male)	17
Sex (female)	7
Age of oldest	72
Age of youngest	31
Average age	48
Patients of ages between thirty and forty	7
Patients of ages between forty and fifty	11
Patients of ages between fifty and sixty	2
Patients of ages between sixty and seventy	3
Patients of ages between seventy and eighty	1
Average duration of symptoms, thirteen months	
Operative mortality (12.5 per cent.)	3
Patients dying within one year after operation	1
Patients dying between one and two years after operation	3
Patients alive less than one year after operation	2
Patients alive one and two years after operation	2
Patients alive two and three years after operation	3
Patients alive three and four years after operation	2
Patients alive four and five years after operation	1
Patients alive five and six years after operation	1
Patients alive six and seven years after operation	1
Patients alive seven and eight years after operation	1
Number not located	3

Of 11 patients operated upon more than three years ago, 10 have been traced; 6 (or 60 per cent.) are alive and well to date.

CANCER OF THE TRANSVERSE COLON INCLUDING THE HEPATIC AND SPLENIC FLEXURES.

Number of cases	7
Sex (male)	2
Sex (female)	5
Age of oldest	66
Age of youngest	35
Average age	52
Patients of ages between thirty and forty	1
Patients of ages between forty and fifty	2
Patients of ages between fifty and sixty	2
Patients of ages between sixty and seventy	2
Average duration of symptoms, sixteen months.	
Operative mortality (14 per cent.)	1
Patients dying one and one half years after operation	1
Patients dying two years after operation	1
Patients alive and well one year after operation	2
Patients alive and well three years after operation	1
Number not located	1

CANCER OF THE SIGMOID.

Number of cases	30
Sex (male)	21
Sex (female)	9
Age of oldest	71
Age of youngest	31
Average age	52
Patients of ages between thirty and forty	5
Patients of ages between forty and fifty	7
Patients of ages between fifty and sixty	8
Patients of ages between sixty and seventy	8
Patients of ages between seventy and eighty	2
Average duration of symptoms, two years	
Operative mortality (13 per cent.)	4
Patients dying one year or less after operation	3
Patients dying one to two years after operation	5
Patients dying two to three years after operation	1
Patients alive and well one year after operation	7
Patients alive and well one to two years after operation	5
Patients alive and well two to three years after operation	2
Patients alive and well three to four years after operation	3

Out of 6 cases operated upon more than three years ago (3 or 50 per cent.) are alive and well.

RESECTIONS FOR BENIGN DISEASE OF THE LARGE INTESTINE.

Number of cases (4 deaths, 10 per cent.)	39
Colectomy for ulcerative colitis (nearly all the colon removed)	2
Cæcum and ascending colon	24
Localised tuberculosis	12
Inflammatory disease	11
Intussusception	1
Transverse colon, including hepatic and splenic flexure	2
Diverticulitis	1
Fibrolipoma (one death)	1
Descending colon and sigmoid	11
Tuberculosis	2
Diverticulitis (2 deaths)	5
Fibrolipoma	1
Hirschsprung's disease	1
Inflammatory disease	2

CHAPTER XXVII.

RUPTURE OF THE INTESTINE.

Any surgeon whose experience of hospital work is extensive will have realised the great difficulty that almost always exists in discriminating in the early stages between those cases of abdominal injury which are trivial and those in which a laceration of the intestine has occurred. If there is a wound of the abdominal parietes, the surgeon's course is clear; it is his duty in all cases to open up the wound, and, if need be, to investigate the conditions within the peritoneal cavity. If, however, there is no sign of external injury, the necessity for operation must be determined by the signs and symptoms which are present. In such cases "it becomes necessary," as Dr. Le Conte says, "to make a most careful examination of both the subjective and the objective symptoms presented by the patient, to separate the trivial from the important points, and with our best judgment to sum up the evidence for or against operative procedure." The accurate observation and instant recording of symptoms, and of their variation from hour to hour, are needed to enable the surgeon to form his opinion correctly. I propose to discuss the relative values and significance of the chief signs and symptoms and to indicate the steps by which an accurate decision may be formed.

The character of the injury sustained should be determined as closely as is possible. As a rule, the damaging force is one of two kinds: it is either a blow from some small or sharp object, the force being considerable and applied only to a small area of the abdominal wall; or it is a force diffusely applied over the greater part or the whole of the abdomen. Of the former, the most exemplary instances occur when the abdomen is struck by a small, rapidly moving object—the fist, a horse's hoof, or

a boot; or when the patient, while moving rapidly, strikes the abdomen against the sharp corner of a table. Of the latter, the most common instance occurs when a patient is run over by the wheel of a cart or train, or is squeezed between the buffers in a railway accident. The injury when the force is of the former kind is found to be a rupture, by crushing, of the intestine, beneath the point struck. When the force is diffused, a rupture occurs, as a rule, at one of the fixed points of the bowel—at the duodenojejunal flexure or at the ileocæcal junction—or the mesentery is torn.

The injury to the intestine is of different kinds. The bowel may be crushed between the offending object and the spinal column or pelvic wall; it may be burst when full of its normal contents; it may be torn away from one of its fixed points; it may be damaged, though not completely ruptured, by the blow, and sloughing and gangrene at the injured area may lead to secondary perforation, or the mesentery with its vessels may be so injured that gangrene of the gut supplied from these vessels will in time result. The injury may be limited to the mucous coat or to the peritoneal coat, or it may, and most frequently does, involve the whole thickness of the wall.

Homer Gage, in collecting the records of 85 cases operated upon between 1887 and 1902, found that in 75 the injury was due to direct violence, and in 32 of these was due to a kick by a horse or by man. In 19 it was caused by a fall, and in 6 by a piece of wood thrown from a circular saw. In 9 it was the result of a crushing force, and in 1 the cause is not stated. From this it is clear that there is a greater likelihood of damage when there is a high velocity of the striking object and when the area struck is small.

In Makins' series of 21 cases occurring at St. Thomas's Hospital between 1889 and 1898, 6 were the result of kicks by horses, 5 patients were run over, 4 fell against resisting objects, 2 patients were caught between buffers, 1 was struck by the end of a plank on a sawing-machine, 1 was pinned by

the pole of a van against the wall, 1 was struck by a falling box, 1 was caught and rolled between two passing railway trucks.

LOCATION OF THE LESION.

In 79 of the 85 cases collected by Homer Gage the injury was located as follows:

Duodenum	10
Jejunum	20
Ileum	43
Large intestine	6

These figures agree with those given by other writers. It is an undoubted fact that rupture is more common the greater the distance from the duodenojejunal flexure.

An examination of the abdomen in these cases will frequently shew, especially after the lapse of a few days, that the point of impact is indicated by a bruise. In a great majority of cases this will be found to be below the umbilicus. In the 9 cases of injury to the small intestine in Makins' series in which the position of the bruise was ascertained, it was found to be below the umbilicus in 8. In the cases of injury to the large intestine this fact was even more marked. There were 5 cases of injury to the large intestine: in 1 the junction between the cæcum and ascending colon was torn; in 1 the lower end of the ascending colon; in 2 the transverse colon (in both of these the colon was U shaped and hung down below the umbilicus), and in 1 the sigmoid. The part of the abdomen below the umbilicus may, therefore, be quite appropriately named the "*dangerous area.*"

THE CHARACTER OF THE LESION.

As a general rule, there is only one rent in the intestine. In 9 cases in Homer Gage's series of 85 cases there was more than one tear. In one case recorded by Kopfstein, six rents were found and were closed successfully. In some instances, especially in those cases where the injury is due to the kick

of a horse, two ruptures may be found at a distance of three or four inches from each other. It is suggested that the injuries are then due to the impact of the two ends of the hoof. In one case which I saw a piece about 5 inches in length was cut completely out of the intestine. The rent may be small, or it may be large, longitudinal or transverse, ragged or straight—it may, in fact, be of any shape or size or run in any direction. Injury to the mesentery is found in about 10 per cent. of the cases.

A very excellent paper on Traumatic Rupture of the Intestine was read by Mr. James Berry and Mr. Paul Guiseppi, before the Royal Society of Medicine ("Proc. Roy. Soc. Med.," 1908, ii, 41).

The authors relate the case of a man, aged twenty-six, under their care in the Royal Free Hospital. He had been kicked by a horse and was admitted to the hospital shortly afterwards. The symptoms after admission were local tenderness, rigidity of the abdominal muscles, severe abdominal pain, occasional vomiting, and a rising pulse-rate. A diagnosis of rupture of the intestine having been made, the abdomen was opened four and a half hours after the accident. A rupture of the ileum, 1½ inches long, was found and sewn up. The abdomen was drained for a short time, and the patient was kept in a sitting position from the time of the operation. Saline infusions were given per rectum, the patient absorbing 26 pints in the first three days. The patient made a good recovery.

These authors collected details of all the cases of rupture of the intestine without external wound that had occurred in ten of the principal London hospitals in fifteen years (1893 to 1907 inclusive). Many of these cases have been already published in hospital reports or elsewhere, but the notes of the majority were obtained from manuscript hospital records. The cases are 132 in number. Details are given of the nature of the accident in each case, of the situation and nature of the rupture, of the principal symptoms, and of the mortality and treatment.

Of the 132 patients, 122 were males and 10 females; 14 were

children under ten, 32 were between the ages of ten and twenty, and 79 were over twenty years of age.

The cases are classified as follows:

NATURE OF ACCIDENT.

Run over	51
Squeeze or crush	24
Blow	23
Kick	16
Fall	11
Reduction of hernia	1
Uncertain	6
	132

SITUATION OF RUPTURE.

Large intestine only	10
Small intestine only	
Duodenum	23
Duodenaljejunal flexure	3
Jejunum	32
Ileum	32
"Small intestine"	25
Large and small intestine	4
Partial rupture (not involving lumen)	3
	132

In 22 cases the rupture was multiple, in four it was retroperitoneal. In 24 cases the rupture was complicated by the coexistence of other severe injuries such as fracture of the pelvis or spine, rupture of liver, etc.

Of the total number of 132 cases, 17 recovered and 115 died. Upon 84 of the cases an operation was performed; of these, 17 recovered and 67 died. In 47 cases no operation was performed; all these died. Certain cases are mentioned by the authors in which it is at least highly probable that rupture of the intestine did occur, and was followed by recovery without operation. In 15 of the cases operated upon the rupture was not discovered until after death. In 7 of these the laceration was in the duodenum.

THE DIAGNOSIS OF INTESTINAL RUPTURE.

The importance of an early diagnosis of rupture of the intestine cannot be exaggerated, and delay of an hour in any

case may mean—does, in fact, mean—that the chances of recovery by operation are thereby lessened. A laceration of the intestine is more likely to involve the ileum than the jejunum. The upper part of the intestine, as is well known, contains fewer and less virulent organisms than the lower part, and therefore the lower down in the intestine the wound lies, the greater will be the damage done to the peritoneum by the escape of the contents.

The patient when first seen will probably be suffering from shock and its attendant symptoms. In this there is nothing characteristic, for an equal degree of shock may be produced simply by a severe bruising of the abdominal wall. The pulse will, at the first, be small and thready. In doubtful cases the pulse must be counted by a reliable observer *and recorded* every hour. A pulse which increases steadily in frequency should arouse suspicion, more especially if the rate of respiration is also increasing and the temperature, after a rapid rise, following the subsidence of the early collapse, begins to fall. As the shock is passing away the patient will vomit. If the vomiting should continue, the outlook is most serious. Persistent vomiting is the most characteristic symptom, and is present, almost without exception, in cases of intestinal rupture. This has been our experience at the Leeds Infirmary, and the same observation has been made by Trendelenburg and others. The abdomen may be tender from the first. Owing to the injury done to the anterior abdominal wall, the skin may be sensitive to pressure and the muscles may be rigid. In cases of rupture of the intestine there is very often the most absolute rigidity of the abdominal wall. The muscles are tense, and will not yield to the gentlest or to the firmest pressure. Even when morphine has been given, the muscular rigidity does not disappear; indeed, it hardly lessens to any perceptible degree. Gentle kneading of the abdominal wall with the open hand does not permit a deeper examination of the abdomen. The rigidity increases steadily

from the time of injury, and it is always unyielding. A definitely localised tenderness is often found when there is a rupture of the kidney or of the bladder, one or other side or the hypogastrium being tender and resistant when the rest of the abdomen is supple. It is the universal and unalterable rigidity that is significant.

The abdomen is not distended at the first, but within a few hours a little fullness is often noticed. If the distension increases rapidly, it is a sign of great gravity. Free fluid may be found in the peritoneum; it is due—(*a*) to blood which has escaped from a rent in the mesentery or in the bowel-wall; (*b*) to escape of thin fluid contents from the intestine; (*c*) to the rapid outpouring of serous fluid from the peritoneum. If fluid be present, it is an evidence decidedly in favour of operation.

The general appearance of the patient almost always gives one the impression that his condition is serious. He looks anxious, his features are drawn, his face is pale, and the skin is sweating. Dr. Le Conte, who considers the facial expression the most positive of all the symptoms of severe abdominal injury, writes: "The abdominal facies consists of a peculiar drawing of the lines and deepening of the furrows of the face, which give an anxious, careworn, and painful expression to the countenance, while the eyes are questioning and anxious and search the faces of the people about." He adds: "I cannot recall ever having noted it as present in a case which failed to shew a serious lesion."

To sum up, one may say that when a patient has sustained such an injury to the abdomen as is likely to produce a serious lesion—if the abdomen soon becomes rigid and tender; if the rigidity steadily increases and affects the whole abdominal wall; if the vomiting is repeated at short intervals; if the patient, by his facial appearance, conveys the impression of serious illness—then an exploratory operation is not only justified, but is imperative. A reckless opening of the abdomen in all cases where any severe injury has been sustained

is not to be condoned. A discrimination of the serious cases —of the cases that can be cured only by operation—from those which will recover unaided can be made with very few exceptions by attention to the points which have been mentioned.

All the signs mentioned above may not be present simultaneously. Reliance must then be chiefly placed upon the onset and continuance of vomiting after the period of shock is over, and upon a continuous increase in the pulse-rate. These two signs together fully justify an exploration. The greatest difficulty in diagnosis occurs in cases in which the injury is inflicted upon the highest part of the jejunum in patients who have not partaken of food for many hours. Dr. Le Conte relates the case of a man who was struck a glancing blow on the abdomen by a rolling steel ingot weighing two tons. This happened at 8.30 A. M., and the man had not partaken of food since the previous evening. Fifteen hours later he presented no sign of intestinal injury. During the next six hours symptoms of perforation rapidly appeared: pulse and respiration rapidly increased; the temperature fell below normal; vomiting began; tympany appeared, with marked tenderness in the region of the umbilicus, and the expression of the face was anxious and drawn. Operation shewed that the first part of the jejunum was completely torn across, the laceration extending for 2½ inches into the mesentery; in another place there was a 2½-inch tear in the mesentery which had extended to the small gut, and about one foot of the intestine shewed commencing gangrene.

Dr. F. B. Lund ("Boston Med. and Surg. Journal," vol. cliii, 1905, p. 603), in recording 19 cases of rupture of the intestine, makes the following remarks upon the question of diagnosis:

"The symptoms which at first ensue upon a rupture may be, and often are, so slight that the surgeon feels a false sense of security. He judges that probably no harm has been done, and the patient is left until a general peritonitis is developed before he is

operated upon. It is for this reason, it seems to me, that a knowledge of the common etiology of these cases is important.

"In cases which have been subject to injuries of this sort an exploratory laparotomy should be done without waiting for an absolutely certain diagnosis, which also means the almost certain death of the patient. After these blows upon the abdomen by a board from a circular saw, or by a horse's hoof, the patient is very often faint, sometimes vomits, and then the rapidity with which the symptoms come on depends upon the rapidity with which the intestinal contents are poured into the abdomen. If the rupture is a small one, as not infrequently happens, it may be nearly closed by protruding mucous membrane. Here the pain, tenderness, muscular spasm, and temperature indicative of peritonitis, may develop gradually as in the case of general peritonitis, in which the patient went to work the day after the fatal accident happened to him. Or, if the rupture is a large one, the rapid extravasation of intestinal contents brings into immediate evidence the symptoms of general peritonitis and leads to immediate operation.

"The peritonitis must be quite general before the patient looks badly. The pain, tenderness, muscular spasm, slight rise in temperature, and the fact that the patient is getting worse, should be sufficient for immediate operation without waiting for the facies which practically always indicates that peritoneal sepsis has progressed to such an extent that no operation will control it."

V. Z. Cope ("Lancet," 1914, i, 164), writing of the early diagnosis and treatment of suspected or doubtful cases of ruptured intestine, sums up as follows:

"Providing there be no lesion in the chest and that renal trauma is excluded I would submit that it would be desirable to open the abdomen on the suspicion of ruptured intestine if the following conditions be present:

(1) When severe abdominal pain persists for more than about six hours after an injury, if the pain be accompanied by either—(*a*) vomiting, especially bilious vomiting, or (*b*) a pulse gradually rising from the normal; or (*c*) local rigidity tending to increase; or (*d*) deep local tenderness with shallow respiration, and—

(2) When abdominal pain is absent or only slight, but the pulse rises steadily hour by hour and the patient is very restless or listless."

A possible criticism of this statement would be that many cases may need operation, although they show only one symptom, *i. e.*, abdominal pain.

A sign which I know to be of value in cases of injury to the abdominal viscera has been described by E. B. Claybrook ("Surgery, Gynæcology, and Obstetrics," 1914, i, 105). It consists in the transmission of the heart and respiratory sound, so that they can be heard all over the abdomen almost as well as, or even better than, they can be heard all over the chest. The transmission of the sound is due to the presence of fluid, peritoneal exudate or blood.

Delay in the onset of symptoms may be due to a *secondary perforation* of the bowel. The damage at the time of the accident concerns the mesentery, or bruises, but does not lacerate, the intestine. Sloughing of the bowel occurs twelve to forty-eight hours later, and is announced by the sudden onset of the symptoms of perforation already described.

In Angerer's series of 160 cases the 10 cases which recovered after the formation of fæcal fistulæ were undoubtedly exemplary instances of secondary rupture.

Dr. Arthur L. Fisk records ("Annals of Surgery," vol. ii, 1900, p. 626) the case of a man who, on October 29, 1900, while crossing the street, was run over by a hose-carriage, one of the wheels passing diagonally across his right loin. He was immediately taken to the Trinity Hospital in a condition of shock, with a subnormal temperature. Examination shewed a large swelling in the left side of the abdomen, especially in the lumbar region, which was regarded as a hæmatoma. There was no blood in the urine, and when his bowels moved, the stool was also free from blood. The abdominal muscles on the left side were distinctly rigid.

On November 4 there was fluctuation in the mass referred

to, and the man began to have some fever. The mass was thereupon incised in the loin, and a large quantity of pus evacuated; the pus had a faint fæcal odour. Two days later there was a discharge of fæces through the wound, and for two weeks all the fæcal contents of the bowel were evacuated in this way. On November 21 there was a severe hæmorrhage from the sinus; a second on the twenty-fifth, and a third on the thirtieth. From that time on the sinus passed directly into the ascending colon.

A. L. Bonanome ("Brit. Med. Jour.," Epitome of Current Literature, August 27, 1904, p. 30) reports a case of rupture of the small intestine by indirect violence. The patient, a man thirty-seven years of age, jumped to the ground from a height of about two feet, and came down heavily on his heels. He immediately felt acute pain in the hypogastrium, accompanied, for a very short time, by slight mental confusion and followed by vomiting. Feeling unable to continue his work, he walked home, about two miles, and then walked to the hospital, where he was seen an hour and a half after the accident. Inspection of the abdomen revealed nothing. Palpation caused pain in the hypogastrium, and especially in the abdominal muscles. The recti muscles were contracted a little. No pain was caused by palpation of the epigastrium, the hypochondrium, and the flanks. In the iliac fossæ it was possible to press back the abdominal wall so as to feel the bones. Voluntary contraction of the abdominal muscles caused increased hypogastric pain. The liver and spleen did not pass the costal arch, and their areas of dulness on percussion were normal. No free fluid could be made out in the abdominal cavity; 150 c.c. of normal urine were removed from the bladder by catheter. The pulse was full and regular—80; respirations, 22; temperature, 36.9° C. The face was a little pale. He remained in the hospital, and ice was applied to the abdomen. In the evening the temperature was 37.5° C., pulse 85, respirations 24. The abdomen was soft except at the hypogastrium. There was no meteorism. Flatus and urine had been passed, but no fæces. The patient had ano-

rexia, but not thirst. The next morning he was in rather better condition after several hours' sleep. On the afternoon of that day, beginning twenty-seven hours after the accident, the appearance of the case completely changed. The pain, the muscular contraction in the hypogastric region, and the meteorism were increased. The area of hepatic dulness disappeared. The face indicated distress. The patient, who had all along stated that, but for the pain, he felt well, now complained of illness. Temperature, 38° C.; pulse, 90; respirations, 26. A diagnosis of peritonitis was now made, and an abdominal section decided upon. Gas and liquid were found in the peritoneal cavity. An oval opening into the small intestine was found on the convex side of the intestine at a point diametrically opposite to the insertion of the mesentery. The long diameter of this aperture, about 4 mm. in length, lay in the direction of the course of the intestine. The edges were cleanly cut and not ecchymosed. The mucous membrane protruded a little through the wound. No appearance was found of other recent or old-standing disease or injury of the intestine. The wound was closed with two planes of Lembert sutures and the abdomen cleansed and drained. The patient died ninety-nine hours after the accident. At the autopsy the opening in the intestine was found to be about nine feet from the ileocæcal valve. The sutured portion was healthy, and the whole intestinal mucosa presented a normal appearance. No foreign body was found in the intestine or in the peritoneal cavity. The cause of death was general peritoneal infection.

OPERATION.

When it has been decided to operate, all preparations must be made before the patient is anæsthetised, for speed is one of the essentials of success. An abundance of hot saline solution will be needed for the purpose of irrigation. Operation should be deferred until the first shock has passed off. The incision should be made in the middle line, and should be of ample length.

Many authorities advise that the incision should be made at the point where the blow was inflicted, but there are no advantages in so doing. All parts of the intestinal canal can readily be examined through a median incision; an incision through the area of impact will often open up an extensively bruised area, large collections of blood in the abdominal wall will be found, and septic changes therein are prone to follow. The incision is at least four inches in length, and may, with advantage, be six inches or even more in stout or muscular patients. As soon as the peritoneum is incised there will be an escape of blood-stained, thin, fæcal fluid, or of fluid which is turbid and has a fæcal odour. If the bleeding is at all abundant, it is better to turn the intestine out at once and to make a careful search for a rent or rents in the mesentery. If there be little or no bleeding, then the intestine is examined methodically. It is better to begin at the cæcum and to work upwards along the small intestine, the bowel, as well as the mesentery, being very minutely examined. If a rent be discovered, the part of the bowel which it involves is wrapped in a large moist swab and held by the assistant, while the search is continued. In approximately 10 per cent. of cases there are more ruptures than one. If no other points of injury are discovered, the greater part of the intestine is returned within the abdomen, and the injured loop is packed around with moist sterile compresses. The evisceration undoubtedly simplifies the search for the damaged spots. If carried out speedily, it is not provocative of harm. The intestine, while outside the abdomen, should be carefully surrounded by hot mackintoshes, and must be returned within the abdomen at the earliest possible moment.

Trixier has shewn that the shock of evisceration is directly in proportion to the condition of the peritoneum and the length of exposure. If the peritoneum be healthy and the exposure brief, no harm is done. In all cases there is a "period of indifference" during which no shock is experienced. This period is shortened when the peritoneum is inflamed. The

search for a damaged spot is very much simplified by observing whether there is any deposit of plastic lymph upon the gut. Lymph is very rapidly poured out, and may be found in abundance within six hours of the receipt of the injury. It is always found in greater quantity at and near the perforation.

The rent in the bowel is repaired in a manner best suited to the condition of the injury. If a small transverse or longitudinal tear be found, it may be closed at once by a double layer of continuous sutures, the one including all the coats, the other picking up only the serous and muscular coats. If the portion of the bowel most distant from the mesentery is torn by an irregular rent, a part of the wall of the gut may be excised. The mesenteric portion of the intestine is left intact, and an angular union is effected, the two portions of the bowel being, as it were, bent upon the bridge of bowel which remains at the mesentery. This is the "elbow" anastomosis of Jeannel.

If there are two or more injuries close together, or if there be only one rent with a considerable amount of bruising of the parts around, either mesentery or intestine or both, an excision of the damaged area should be performed. On rare occasions a double or even triple resection may be necessary.

If there should be a rent in the mesentery completely dividing the vessels therein, the bowel supplied by these vessels must be resected, for gangrene is certain to follow. A small tear in the mesentery may necessitate a large resection of the bowel, for, as has been already pointed out, one inch of the mesentery near its posterior attachment may contain the blood-supply of two feet or more of the intestine.

In certain cases none of these measures may be possible. The patient may be desperately ill, and able to bear only the least of all surgical manipulations. In such circumstances the rent in the intestine may be sutured to the abdominal wall, the repair of the wound being left for a subsequent operation. This method—the establishing of an artificial anus—was, at one time, the method advocated by all authorities, but in recent

years it has been recognised that instant repair of the damaged bowel should be performed whenever possible.

After the intestinal wounds have been securely closed, it is necessary to deal with the mesentery. Any small bleeding points near the intestine may be ligated, and a tear which does not involve any vessels may be closed by suture. In some cases the two layers of the mesentery may enclose a diffuse blood-clot; this may, as a rule, be ignored, provided that the vascular supply of the attached bowel be unimpeded. A very small vessel may give rise to a very large hæmatoma. Search for a bleeding vessel in such a bruised area will be fruitless, and only provocative of further harm.

When all the measures of repair are accomplished, the peritoneal cavity is cleansed. Free washing-out with hot and sterile salt solution is always necessary in late cases, and perhaps advisable in many early cases. The lavage should be free, and all parts of the cavity should receive attention. The irrigation is best carried out by means of a funnel to which is attached about a yard of large, soft, India-rubber drainage-tube. The funnel is kept constantly filled by the nurse, and the soft tube is readily moved from place to place within the abdomen. If peritonitis has been set up by the irritant fæcal fluids, drainage is always necessary. If, however, the case has been operated upon early, the abdomen may be closed at once.

The application of omental grafts or flaps may, at times, be of great advantage. Parts of the omentum, if bruised, may have to be removed.

RUPTURE OF THE COLON.

Rupture of the large intestine occurred five times in Makins' series of 21 cases of intestinal injury, occurring at St. Thomas's Hospital in a period of ten years. The injury involved the cæcum once, the lower part of the ascending colon once, the transverse colon twice, the sigmoid flexure once. In all these cases the point struck in the abdominal wall was below

the umbilicus. The general symptoms of rupture of the colon are indistinguishable from those of rupture of the small intestine. One sign alone is characteristic of lesions of those portions of the bowel which are not wholly covered by peritoneum (parts of the duodenum and the ascending and descending colon)—that is, emphysema. If there are the usual symptoms of intestinal injury and emphysema in the right flank, a diagnosis of rupture of the ascending colon or of the duodenum may safely be made. Emphysema spreading from the descending colon is noticed first in the left flank. In one case of ruptured duodenum, in Makins' series, the emphysema was first observed in the left flank. In a case of rupture of the ascending colon which involved both the serous and the unprotected parts emphysema was present, but was discovered only at the operation; it had not passed the limits of the ascending colon.

PROGNOSIS AND RESULTS OF TREATMENT.

It may be taken as an unquestionable fact that complete rupture of the intestine, unless treated by operation, is invariably fatal. It has been stated, upon utterly insufficient evidence, that patients have recovered under expectant treatment. A close enquiry into all such cases shews, as might have been anticipated, that there is no warrant for any diagnosis of rupture. All the cases collected by Curtis, 116 in number, were fatal. All the cases in Homer Gage's series, 45 in number, which were not submitted to operation, died similarly in the series of Berry and Guiseppi. Spontaneous recovery after a complete primary rupture of the intestine is not only improbable—it is incomprehensible.

Angerer ("Congress of German Surgeons," April, 1900) collected the records of 160 cases of rupture of the intestine treated expectantly: 149 died and 11 recovered. Of the 11, 10 developed fæcal fistulæ. The probability is that these were examples of secondary rupture, where adhesions had surrounded the wounded bowel and had sequestrated the part, which gave way later.

In operation lies the only hope of successful treatment. The first laparotomy for rupture of the intestine was performed by Bouilly in 1883. The first successful case was operated upon by Croft in 1889. The following are the notes of this classical case ("Clin. Soc. Trans.," vol. xxiii, p. 141):

"Charles A., aged fourteen, admitted into St. Thomas's Hospital, under Mr. Croft's care, on May 21, 1889, at 10.30 P. M.

"The boy had been kicked in the abdomen by a horse, about half-past seven in the evening. He fell when struck and became 'unconscious,' and was carried to his home in the same street and put to bed. He had taken his tea at half-past four, and he passed water about that time. As he was in pain, his friends gave him some 'senna' to act on the bowels. This he fortunately vomited. As his pains increased he was brought to the hospital. On the way there he vomited twice, and in the waiting room he brought up a little light-coloured fluid which was said to be streaked with blood. A catheter was passed in the admission room, and about eight ounces of normal urine was drawn off. When admitted, it was not thought that he was suffering from shock. It was observed, however, by the nurse, that he doubled up his knees and laid himself on his side. He had been kicked below the umbilicus, and the lower part of the belly was tender to the touch. Ice was applied to the abdomen. Morphine was administered hypodermically. Fluids and solids by the mouth were forbidden. The temperature taken after admission was 99.2°, and his pulse was steady at 80. During the night the temperature rose to 103.6°.

"On the following morning, May 22, at 9.45, Mr. Croft was called to see the boy, and found his expression anxious, the lips dry, temperature 103°, pulse quick, and tongue furred. The legs were drawn up, the abdominal wall flat, rigid, and very tender. The muscular resistance was very marked. The pain was chiefly below the umbilicus. There was slight dulness in the left loin, none in the right, and none over the bladder. He had not been sick since he had come into the ward, and he had not been delirious.

"The diagnosis was in favour of ruptured intestine and acute peritonitis. Exploration of the abdomen by median laparotomy was immediately determined upon and carried out.

"The patient was kept under ether, the operation lasting an hour and three-quarters. Mr. H. B. Robinson rendered very valuable assistance.

"On dividing the linea alba an œdematous condition of the subperitoneal tissue was observed. As soon as the peritoneal cavity was opened a faint fæcal odour was observed. When the omentum was drawn aside, about an ounce and a half of turbid, dirty-brown fluid escaped, with a distinctly fæcal odour; its under surface was adherent to some coils of intestine, and was coated with exudation and the same dirty-brown fluid. The coils of bowel were matted together and more or less stained. On breaking through these adhesions and separating the coils on the right side, about two inches below the umbilicus, the region of chief injury became more evident. A small rupture was found on the under surface of the ileum, measuring about three-eighths of an inch in diameter. This lesion was in the centre of a small areola of ecchymosed and inflamed tissue. On the opposite wall of the gut there was another ecchymosed spot, corresponding with the first lesion. After cleansing and examining this portion of the bowel Mr. Croft determined to resect it, as he deemed it unsafe to return the contused as well as the ruptured pieces.

"Makins' forceps were applied below the spot at which the incision was to be made, and Mr. Robinson took charge of the upper portion. A V-shaped segment of the gut was cut out with scissors and snipped from its mesenteric attachment. Immediately after excision the mesenteric wound appeared to be not more than three-eighths of an inch in width.

"When bleeding had been arrested, the mesenteric wound was carefully closed from side to side by eight sutures, passed after Lembert's manner, four above and four below. The cut ends of the intestine were next carefully adjusted, and opposite the attachment of the mesentery sutures were passed, so as to draw together the muscular coats, applying these coats *dos à dos*. Five sutures were needed for this. In bringing together the rest of the bowel Lembert's sutures were employed, about twenty being inserted. Extra sutures were put in where they seemed to be indicated, bringing up the total to over forty.

"As the piece of omentum opposite the injury was the re-

verse of pure, it was thought best to cut it right away. It was, therefore, ligated and excised.

"After this the peritoneal cavity was carefully purified with hot boracic solution, about 20 per cent. in strength, and the toilet of the peritoneum was completed. The external wound was closed by silk sutures. No drain was put into the peritoneal cavity. Antiseptic precautions were observed throughout. The operation lasted an hour and three-quarters."

The publication of this remarkable case naturally attracted a great deal of attention, and it soon became recognised that the only treatment likely to give the patient a chance of life lay in operation. Siegel has collected in all 376 cases submitted to operation. The mortality was 51.6 per cent. An analysis of the cases with reference to the time of operation gave the following result:

Cases operated upon within the first 4 hours had a mortality equal to.....15.2 per cent.
Cases operated upon within the first 5–8 hours had a mortality equal to.....44.4 "
Cases operated upon within the first 9–12 hours had a mortality equal to.....63.6 "
Cases operated upon later than 12 hours had a mortality equal to.....70.0 "

Several other small series of cases have been collected by Gage, Eisendrath, Petry, Kirstein, and others, but Siegel's list probably includes all cases recorded up to the time his paper was published. One has, of course, to discount such an estimate, for successes are more likely to be published than failures.

At the Leeds Infirmary between 1898 and 1906 there were 17 cases of ruptured intestine treated by operation. Of these, only 3 recovered. In all the cases save 2 over twelve hours had elapsed from the time of the injury. In Makins' series of 21 cases operated upon at St. Thomas's Hospital in ten years—1889 to 1898—there were 3 recoveries. In Berry and Guiseppi's series of 132 cases, 17 recoveries.

The following are the records of the 3 successful cases in the Leeds Infirmary:

Case 1.—E. H. L., a boy aged six, was admitted to the Leeds General Infirmary, September 9, 1899. The patient had sustained an abdominal injury which caused collapse and gave rise to the signs of increasing fluid in the peritoneal cavity. Without entering into details, it may be said that the case clearly demanded surgical intervention. The following operation was performed:

Operation.—An incision, 5 inches in length, was made to the right of the middle line, extending from about 1 inch below the ensiform cartilage downwards. On opening the abdomen there was an escape of blood, and blood was seen lying everywhere among the intestinal coils. A rapid search soon revealed the fact that there was a complete rupture of the intestine at the duodenojejunal flexure. The jejunum appeared to have been torn out from the duodenum in such manner that the divided end of the duodenum was beneath the peritoneal level, and was ragged and irregular. The jejunum in its upper 4½ inches was torn away from its mesentery; this portion was removed. An end-to-end approximation was clearly impossible, as the cut duodenum was inaccessible. The duodenum was, therefore, closed as securely as possible with a continuous catgut stitch, and the peritoneum around it sutured over this stitch. In order to ensure a complete closure the upper part of the mesentery which had been torn away from the jejunum was stitched as a sort of lid over the obliterated end of the duodenum. The jejunum was implanted in the anterior wall of the stomach with the aid of a Murphy button. After doing this it was my intention to make an anastomosis between the lower portion of the duodenal loop and the jejunum so as efficiently to drain the former, but the child seemed on the verge of death, and I had to complete the operation as speedily as possible. Stimulants, in the form of saline infusion, strychnine, and a hot-water enema, were given during the operation, and one minim of strychnine was given every hour for the first twelve hours. The patient gradually rallied and made a good recovery.

After-history.—After the first ten days we had a skiagraph taken, and three were subsequently taken. On each occasion the button shewed a different position, and we were inclined to accept this as an indication that it was passing along the intestinal canal. The patient gained weight, ate ordinary diet, and was quite well, and his condition was in every respect satisfac-

tory. One untoward incident alone was observed, and that was a copious attack of vomiting, which we ascribed to a pork pie injudiciously given by a friend on the visiting day. The question of a second operation, the performance of an anastomosis between the duodenal loop and the jejunum, was frequently discussed, but the condition of the child was so satisfactory that we were unwilling to interfere. The stools were examined and pronounced in appearance and constitution normal.

Perforation.—On the one hundred and fourth day after operation the patient was suddenly seized with acute and overwhelming abdominal pain, and I was urgently summoned. I found him pale, pulseless, and utterly collapsed. He died an hour subsequently.

Postmortem Examination.—A perforation of the duodenum at the lowest point of the loop was found, the perforation being due to the Murphy button, which lay in the ulcer its pressure had produced.

Case 2.—Under the care of Mr. Lawford Knaggs.

History.—R. L., aged thirteen, was swinging on a rope fixed to two gate-posts when they collapsed, and a portion of a wall fell upon her, striking the pelvis and abdomen. The accident occurred on April 17, 1900, at 2.30 P. M.

Condition on Admission.—When admitted she was suffering from Colles's fracture of the right wrist, some hæmorrhage from the vagina, and a contusion of the left hip. The next day she complained of pain in the body, and at midnight I was sent for. The pain had been getting worse during the day, and now the abdominal wall was rigid and there was great tenderness over the lower part. Below the iliac spines the resonance was impaired and there was a doubtful thrill. The urine passed had been free from blood, and the bowels had not been open since admission. The pulse had risen from 100 to 120. The cause of the peritonitis was suspected to be perforation of a hollow viscus, possibly the bladder.

Operation.—At 2.30 A. M. on April 19, or thirty-six hours after the injury, median laparotomy was performed. Extravasated blood was found in the subperitoneal tissues. On opening the peritoneum pus escaped, but no gas. The intestinal coils were found matted together with yellow lymph, and very offensive pus lay between them. This was wiped away gradually as the

coils were separated towards the pelvis. At last a portion of bowel was seen with a hole in it from which bloody fæces were exuding, and further escape of its contents prevented, whilst the cleansing away of the pus continued until the lowest collection containing fæces was found in Douglas's pouch. When the disturbed parts had been well cleansed, the hole in the small intestine, through which a pea could have been passed, and which was situated opposite the mesenteric attachment, was closed by a single catgut suture, and two continuous Lembert sutures applied longitudinally made all safe. The lumen was considerably narrowed. The kidney pouches were now wiped out—and the left one needed it. Gauze drains were carried down to both, and another, as well as a rubber tube, was inserted into Douglas's pouch. The damaged coil was placed beneath the wound, which was then closed.

Progress.—For two days the patient's condition was very uncertain. She was very noisy and restless, complained of great pain in the body, and vomited occasionally, but the pulse shewed a tendency to fall. On the twenty-first she was distinctly better, and had two spontaneous evacuations. On the twenty-second, the gauze drains were removed, and from this date her progress to convalescence was uninterrupted. She left the hospital well on June 6.

Result.—All trouble, however, was not at end when she ceased to attend hospital. For a long time she had good health, but in January, 1902, nearly two years after the operation, and after a week of abdominal pain, an abscess pointed in the abdominal cicatrix, and burst, and a large quantity of most offensive matter escaped. The opening closed in about three weeks, and there has been no local trouble since. It does not appear that this abscess was associated with a silk suture in the parietes, but it is very possible that the Lembert sutures in the gut had something to do with it. The abdomen now looks quite healthy. There is no protrusion at the cicatrix, and there is no induration or thickening to be felt. Though at present the patient suffers from pain and vomiting after food, suggestive of stomach ulcer, and easily controlled by simple treatment, the only inconvenience which can be definitely attributed to the injury is the pain which follows the taking of aperients. This is no doubt due to the intestinal adhesions resulting from the peritonitis.

Case 3 was under the care of Mr. Walter Thompson. The record of this case has not been published.

Six cases of rupture of the intestine with 4 recoveries are reported by Lund, Nicholls, and Bottomley ("Boston Med. and Surg. Jour.," November 27, 1902, and "Year-Book of Medicine and Surgery," 1904, p. 112). The first 3 cases in the series were operated upon by Lund. In the first case the small intestine was torn from its mesentery for about three inches, and in the centre of the bowel, which was denuded of its peritoneum, there was a large perforation. This patient received his injury from a fall from a bridge. He was operated upon twenty-four hours after the receipt of the injury and soon after his admission to the hospital. The damaged bowel was quickly excised, and an anastomosis was made with a Murphy button. The patient died two and one-half hours after the operation. The second case was one of rupture of the small intestine due to the kick of a horse. Operation in this case was performed sixteen hours after the accident, and the patient recovered. The rup ture in this case was about the size of a lead-pencil, and was partly closed by the pouting of the mucous membrane through it. The third case was also one of rupture of the small intestine due to the kick of a horse. The operation in this case was done nine hours after the injury, and the patient recovered. The fourth case, operated upon by Nicholls, was one of rupture of the ileum due to the kick of a horse. Operation was done three hours after the injury, and the patient recovered. The fifth case, operation by Bottomley, presented all the signs of diffuse general peritonitis, and shewed a perforation in the jejunum opposite the mesenteric attachment. This patient died seventy-two hours after operation. The interesting feature, and the one which makes the case unusual, is that neither from the patient's story nor from that of the witnesses, nor from external sign, could any evidence be obtained of direct contusion of the anterior abdominal wall. The patient was knocked

down upon a flat surface by being struck on the back, just below the shoulder-blade, by the shaft of an approaching patrol wagon. The sixth case, also operated upon by Bottomley, and which recovered, was that of a boy eight years of age who was run over by a wagon. The rupture in this case was at about the midpoint of the ileum, one inch from its attachment to the mesentery. The mucous membrane was pouting through the everted edges of the opening and had prevented the escape of much fæcal matter. It is stated that the one thing which means most to both surgeon and patient in these cases is the length of time which is allowed to elapse from the hour of accident to the hour of operation. Beyond the fourth or fifth hour every additional moment of delay adds greatly to the danger of a fatal issue.

Late Results of Incomplete Rupture of the Intestine.—In some instances it would appear that a rupture of the intestine involved the mucous coat only, the peritoneal coat remaining intact. For several days after the injury there may be melæna, which results from the hæmorrhage from the torn surface. In the healing of the intestinal wound contraction occurs, and a stricture of the intestine thereby results. The following case is recorded by Barker ("Lancet," 1900, vol. i, p. 164):

"A man aged twenty-eight years, a sawyer, was admitted into University College Hospital on February 5, 1900. He had always enjoyed good health until seven years ago, when he was run over by a loaded wagon. The two near wheels, which were broad, passed over the lower part of the thorax, breaking, it is stated, five ribs and splintering another. This was followed by 'pleurisy and inflammation.' He was ill for fourteen weeks, and after this began to have the attacks now complained of. There was no history of syphilis, rheumatic fever, or tumours, but the patient had always suffered from 'heart-burn,' which had been worse since the accident. The patient had always been quite temperate. He had been well fed and had lived among healthy surroundings. His reason for seeking treatment now was extreme weakness and anæmia with periodic attacks of pain

and vomiting which set in soon after the accident, seven years ago. These had occurred at intervals of from a week to a month, and lasted from a week to a fortnight. During these attacks pain and swelling began about two inches to the right, and below the umbilicus, and spread from there all over the abdomen. At the same time the patient had vomiting and diarrhœa. The vomit consisted of food and green fluid which tasted bitter and sour.

"Operation was performed on February 22. The abdomen was opened in the midline above the umbilicus. The first thing noticed was a coil of enormously distended and thickened small intestine of white colour, which, for the moment, was taken to be the stomach. It was seen, however, on nearer inspection to lie below the colon, but to overlap it above. The distension terminated to the right of the spine in a sharp kink among many old smooth adhesions, and below this the intestine was normal and empty. On pushing the finger into the distended coil so as to invaginate it a narrow stricture could be felt at the kinked spot. To the left the dilated coil was held down to the spine by adhesions with the first part of the jejunum as it emerged from under the plica. These adhesions, too, were all smooth and evidently old. I now anastomosed the distended loop with the empty portion below the kink and stricture. This was done by a double row of silk sutures in the usual way. In making the openings in the contiguous loops the contrast between the thick-walled upper portion and the thin-walled normal viscus below was very striking. The abdomen was now closed in with silk sutures. The operation lasted fifty minutes, and towards the end the condition of the patient was not very good. Death took place at 5.15 on the twenty-fourth.

"On opening the distended bowel, at the postmortem, the stricture was found to be due to the contraction of an ulcer produced by the crushing of the mucous membrane where the cartwheel caught it against the spine. It was annular, and the lumen was only about the size of a cedar pencil. Other healed ulcers were seen above it, and some partially healed. The seven feet of bowel between the stricture and the duodenum were enormously dilated and full of pale yellow fluid, like thin custard."

REFERENCES.

Le Conte, "Annals of Surgery," April, 1903.
Homer Gage, "Annals of Surgery," vol. xxxv, p. 331.

TABLE OF 44 CASES OF RUPTURE OF INTESTINE WITHOUT EXTERNAL WOUND, OCCURRING IN TWELVE LARGE LONDON HOSPITALS DURING THE YEARS 1908 TO 1912 INCLUSIVE. (PREPARED BY THE SURGICAL REGISTRARS.)

(Trans. Roy. Soc. Med., 1914, vii, 3, page 96.)

No.	Hospital	Name	Age	Sex	Date of			Nature of Injury	Symptoms and Signs	Treatment	Result	Site of Lesion	Condition Found at Operation or Post-mortem
					Accident	Admission	Discharge or death						
1	Charing Cross	S. J.	52	M.	June 5, 1909, 10.30 p.m.	June 6, 1909, 10.30 a.m.	June 7, 1909	Fell in alighting from omnibus; truss slipped and was pressed against abdomen	No bruising; temperature normal, pulse 80; abdominal movements good; slight tenderness; temperature rose to 100° F.; at 2.30 a.m., June 7, suddenly worse; abdomen rigid; temperature 100.8° F., pulse 120	Laparotomy, June 7, 3 a.m. (29½ hours); rupture sutured; abdomen washed out, drained	Death 1 hour after operation	Ileum	Tear ¾ in. in length; commencing peritonitis; œdema of lungs; fluid in pleural cavities
2	Guy's	F. R.	29	M.	May 1, 1908	May 2, 1908	June 6, 1908	Kicked by horse	Vomited almost at once and throughout following night; abdominal pain, expecially at site of injury; rigidity; much shock; temperature 96° F., pulse 64	Laparotomy; sutured; irrigation; no drainage	Recovery	Jejunum	Rupture of jejunum about 5 in. from duodeno-jejunal flexure
3	Guy's	A. W.	44	M.	Oct. 13, 1910	Oct. 13, 1910	Oct. 14, 1910	Struck by barrel falling from crane	Shock; great pain in lower part of abdomen; pulse 126; fracture of left side of pelvis and left femur	No operation	Death	Ileum	Small rupture; fæcal matter in peritoneum
4	Guy's	W.P.	14	M.	June 3, 1910	..	June 4, 1910	Run over by light cart	Great abdominal pain, little bruising; steady increase of pulse-rate	Laparotomy; suture	Death	Duodenum	Duodenum completely severed intraperitoneally; suture sound; fractured spine
5	Guy's	A. S.	3	F.	Oct. 25, 1910	Oct. 26, 1910	Oct. 29, 1910	Run over by light cart	Much abdominal pain; slight bruising on left side; frequent vomiting and increasing pulse-rate (160)	Laparotomy; two ruptures sutured; a third was treated by excision and anastomosis with Murphy's button.	Death	Small intestine	Purulent fluid in abdomen

6	Guy's	E. R.	9	M.	Feb. 23, 1910, 8 a.m.	Feb. 23, 1910, 2 p.m.	April 8, 1910	Squeezed between two carts	Pallor; abdominal pain and rigidity; pulse-rate rose to 130	Laparotomy Feb. 23 (14½ hours); sutured; drained	Recovery	Jejunum	Rupture about 18 in. from duodeno jejunal junction; commencing general peritonitis
7	Guy's	K. S.	23	F.	Aug. 26, 1912	Aug. 26, 1912	Aug. 27, 1912	Run over by motor-omnibus	Much abdominal pain; vomiting; skin on left side of abdomen grazed; bruise in lumbar region	Laparotomy at once; hemorrhage from tears in omentum, mesentery and transverse meso-colon; rupture of intestine not found	Death	Jejunum	Jejunum severed 30 in. from pylorus; commencing general peritonitis
8	King's College	D. D.	75	M.	July 1, 1910	July 1, 1910	July 5, 1910	Run over by taxicab	Shock; abdominal tenderness; pulse rapid; symptoms subsided and for three days apparently well; on fourth day collapse and death	No operation	Death	Jejunum	Leaking perforation of jejunum 2 ft. from upper end, surrounded by localized collection of pus
9	London	G. R.	5	M.	May 9, 1909	May 10, 1909	May 11, 1909	Fell and struck abdomen with crutch; wearing Thomas's splint for hip disease	Pain in upper abdomen, with tenderness and rigidity; temperature 98° F., pulse 104; no loss of liver dullness; no evidence of free fluid; next morning pulse 130, had vomited, hiccough; liver dullness diminished	Laparotomy; rupture sutured; drained with four tubes	Recovery	Lower jejunum	There were signs of commencing general peritonitis
10	London	M. S.	32	M.	May 31, 1909	June 1, 1909, 3 p.m.	June 16, 1909	Fall on abdomen	Abdominal pain, vomiting, difficulty in micturition; temperature 99.5° F., pulse 84; abdomen slightly distended, tender, rigid, immobile; liver dullness lost	Laparotomy; fæcal fluid and free gas; rupture sutured; drained	Death	Ileum	Rupture 12 in. above ileo-cæcal valve; acute purulent bronchitis and broncho-pneumonia; general plastic peritonitis
11	London	W.W.	42	M.	July, 1909	. .	Same day	Run over while drunk	No evidence of ruptured viscus	No operation	Death	Hepatic flexure of colon	Two ruptures about 1 in. long; small laceration of liver; fracture of seventh to eleventh ribs on right side; fracture of radius and ulna

TABLE OF 44 CASES OF RUPTURE OF INTESTINE WITHOUT EXTERNAL WOUND.—(*Continued.*)

No.	Hospital	Name	Age	Sex	Date of			Nature of Injury	Symptoms and Signs	Treatment	Result	Site of Lesion	Condition Found at Operation or Post-mortem
					Accident	Admission	Discharge or death						
12	London	D. G.	16	M.	1909	..	Same day	Not noted	Moribund on admission	No operation	Death	Ileum	Fractured pelvis; laceration of thigh with rupture of femoral artery; small perforation in ileum 2½ ft. above ileo-cæcal valve
13	London	I. C.	9	M.	Dec., 1909	..	Same day	Run over	Shock; temperature subnormal, pulse running; abdomen rigid and tender, bruising and laceration of skin of abdomen and thighs	Laparotomy; ruptures of stomach and duodenum sutured	Death in a few hours	Duodenum	Rupture of right kidney; fractured ribs; hemothorax
14	London	J. .	..	M.	July, 1910	..	Same day	Heavy iron railing fell on abdomen and leg	Collapsed; temperature 97° F., pulse 120; restless; vomiting; abdomen not distended, tender, partially fixed; no evidences of free fluid; fracture of right femur	No operation	Death in a few hours	Ileum	Blood and fæces in peritoneum; two ruptures 13 ft. from duodenum
15	London	F. L.	23	F.	Nov., 1910	..	..	Not noted	Dead on admission	..	Death	Jejunum	Two ruptures of jejunum 3 ft. apart; fractures of spine, pelvis and rib
16	London	A. D.	5	F.	May, 1911	..	Same day	Run over	Not noted; temperature 99° F., pulse 110	Laparotomy; end-to-end anastomosis of torn jejunum and suture of two other adjacent ruptures	Death in a few hours	Jejunum	The jejunum was torn across 1 in. from duodenum; fractured ribs; ruptured kidney
17	London	W.D.	25	M.	Oct., 1911	Same day	..	Fall, 49 ft.	Severe abdominal pain; rigidity; dullness in flanks; no bruising; temperature 97° F., pulse 88	Laparotomy; rupture sutured; drained	Death in 16 hours	Ileum	Small rupture 3 ft. above ileo-cæcal valve; hæmorrhage into mesentery; slight laceration of spleen; bruising of left kidney; fractured pelvis

18	London	E. C.	31	M.	Jan., 1912	Same day	Third day	Fell from van and run over	Some shock; abdomen resistant and slightly bruised in lower part; no loss of liver dullness; no dullness in flanks; temperature 98.2° F., pulse good, 78; vomited once soon after admission; in 24 hours temperature rose to 100.6° F. and pulse to 104; on third day sudden severe abdominal pain; liver dullness absent; dullness in flanks; frequent vomiting; temperature fell from 102° to 99.6° F., pulse 140	No operation	Death on third day	Jejunum	General peritonitis; small perforation in jejunum 5 ft. from upper end
19	Middlesex	W.H.	16	M.	June 15, 1908	June 15, 1908	June 17, 1908	Crushed between cart and wall	Abdomen nearly immobile; tenderness and hæmaturia over right rectus; pulse 90, temperature 98° F.; vomiting began later; next day pulse 140; abdomen very tender and rigid; dullness in both iliac fossæ; vomit fæcal	Laparotomy day after accident; bile-stained fluid in pelvis; fat necrosis; peritonitis; rupture not discovered; drainage	Death 11 hours after operation	Duodenum	Retroperitoneal rupture of third part of duodenum
20	Royal Free	A. T.	16	M.	July 2, 1908	July 3, 1908	July 3, 1908	Kick by horse	Admitted in state of profound collapse 24 hours after injury; abdomen distended and rigid	Laparotomy performed at once	Death during operation	Jejunum	Complete rupture of jejunum 5 in. below duodeno-jejunal flexure; general peritonitis
21	Royal Free	J. S.	22	M.	May 7, 1911	May 7, 1911	..	Kick in lower abdomen	Admitted 12 hours after injury; severe pain; vomiting and diarrhœa; abdomen rigid; pulse rapid	Laparotomy performed at once; sutured; drained	Recovery	Ileum	Perforation size of pin's head in ileum close to ileo-cæcal valve; gas and free fluid in peritoneum
22	Royal Free	L. V.	6	F.	Jan. 14, 1912	Jan. 15, 1912	Jan. 15, 1912	Knocked down by taxicab	Pain and vomiting began 12 hours after injury; admitted 24 hours after injury; collapse; abdomen distended, tender and rigid	Laparotomy; suture	Death in 12 hours	Jejunum	Rupture, 1 in long, 2½ in. below duodeno-jejunal flexure; general peritonitis
23	St. Bartholomew's	F. H.	32	M.	Nov. 9, 1909	Nov. 9, 1909	Nov. 10, 1909	Kick by horse	Severe pain; abdomen tender and rigid; moving dullness in right flank; temperature 99.6° F., pulse 96 to 104	Laparotomy; blood and little intestinal contents in peritoneum; ends of ruptured bowel closed and lateral anastomosis; irrigation; no drainage	Death 24 hours after operation	Jejunum	Complete rupture 12 in. from duodeno - jejunal flexure; general peritonitis

TABLE OF 44 CASES OF RUPTURE OF INTESTINE WITHOUT EXTERNAL WOUND.—(*Continued.*)

No.	Hospital	Name	Age	Sex	Date of			Nature of Injury	Symptoms and Signs	Treatment	Result	Site of Lesion	Condition Found at Operation or Post-mortem
					Accident	Admission	Discharge or death						
24	St. Bartholomew's	H.L.	32	M.	Nov. 22, 1912	Nov. 22, 1912	Nov. 22, 1912	Crushed between wagon pole and wall	Collapse; abdomen rigid, motionless, tender; liver dullness present; no sign of free fluid; two hours later worse; dullness in both flanks; pulse 88	Laparotomy; blood in peritoneum; torn omentum removed	Death in a few hours	Ileum	Perforation size of shilling in upper part of ileum; general peritonitis
25	St. Bartholomew's	A. F.	29	M.	Aug. 8, 1912	Aug. 8, 1912	Aug. 8, 1912	Knocked down by motor-van	Not stated	Laparotomy; tear in mesentery sutured; no rupture of intestine found	Death in a few hours	Duodenum	Two small holes in posterior wall of second part of duodenum, from which much blood and bile had escaped retro-peritoneally; commencing general peritonitis
26	St. George's	..	8	M.	Jan. 18, 1908	Jan. 18, 1908	Jan. 19, 1908	Run over by motor car	Cold; collapsed; pulseless; no signs of abdominal injury; vomited frequently during night; on following day shock less; slight abdominal pain; later, upper part of abdomen was distended and liver dullness diminished	No operation	Death	Jejunum	Rupture ½ in. long at upper end of jejunum; fracture of base of skull
27	St. George's	..	39	M.	Jan. 7, 1911	Jan. 8, 1911	..	Knocked down by motor-cab	Temperature 98° F., pulse 100; scrotum œdematous, discoloured and painful; extravasation extends to inguinal regions; rest of abdomen normal; next day abdomen distended, with signs of free gas and fluid	No operation	Death	Ileum	Large oval rupture in loop of gut lying just above right inguinal canal; large right inguinal hernia
28	St. Mary's	W.M.	45	M.	Jan. 6, 1908, 8 a.m.	Jan. 6, 1908	Jan. 6, 1908, 6 p.m.	Struck in umbilical region by pole of cart	Alcoholic and bronchitic; general abdominal pain; slight hypogastric tenderness; resistance; movement good; 9 p.m., fluid thrill	Laparotomy; ruptured part of jejunum resected and second rupture sutured; irrigation; drainage	Death	Jejunum	General peritonitis

29	St. Mary's	R.H.	19	M.	Feb. 10, 1908	Feb. 10, 1908	Feb. 11, 1908	Knocked down by motor-car	Collapse; nausea; abdominal pain and tenderness; pulse rose 80 to 100	Laparotomy; sutured; peritoneum mopped out and drained	Death	Jejunum	General peritonitis; sutured rupture 12 in., and another, not sutured, 3 in. below upper end of jejunum; fracture of left second rib
30	St. Mary's	C. P.	39	M.	Oct. 18, 1908	Oct. 18, 1908	Oct. 18, 1908	Crushed between engine and platform	Profound shock	No operation	Death in 1½ hours	Ileum	Extensive tear of mesentery extending into lower ileum; fractures of pelvis, spine and ribs
31	St. Mary's	F. W.	33	M.	June 2, 1909	June 2, 1909	June 3, 1909	Run over by cart	Much shock; no signs of abdominal injury	No operation	Death ten hours after accident	Jejunum	Complete tear of jejunum 1 in. from upper end; rupture of liver; fracture of several ribs
32	St. Mary's	W.H.	9	M.	June 11, 1909	June 11, 1909	June 11, 1909	Run over by motor-car	Profound shock	No operation	Death soon after admission	Jejunum	Complete tear of jejunum 3 ft. from upper end; fractured pelvis
33	St. Mary's	W.R.	65	M.	Sept. 14, 1909	Sept. 15, 1909	Sept. 17, 1909	Fell, striking truss and abdomen against a chair	Temperature 100.6° F., pulse 108; vomiting, abdominal pain and rigidity; on second day, general abdominal distension; no pain; no dullness; temperature, 100° F., pulse 116	Laparotomy on second day; sutured; irrigation; drainage	Death	Ileum	Sutured small perforation 8 in. above ileo-cæcal valve; general peritonitis
34	St. Mary's	W.L.	44	M.	Dec. 27, 1910, 10 a.m.	Dec. 27, 1910	Dec. 27, 1910, 6 p.m.	Knocked down by taxi-cab	Pulse small; abdominal pain; epigastric tenderness; no rigidity	No operation	Death	Jejunum	Small rupture 8 in. from upper end of jejunum; turbid fluid and free gas in peritoneum
35	St. Mary's	J. H.	15	M.	Mar. 30, 1912	Mar. 30, 1912	April 7, 1912	Crushed between cart and wall	Acute general abdominal pain; tenderness and rigidity right side; abdomen fixed; vomiting; temperature 96.8° F., pulse 80 to 112	Laparotomy 5 hours after accident; suture of retroperitoneal tear of duodenum; gastro-enterostomy and closure of pylorus	Death	Duodenum	Broncho-pneumonia; extensive retroperitoneal cellulitis

TABLE OF 44 CASES OF RUPTURE OF INTESTINE WITHOUT EXTERNAL WOUND.—(*Continued.*)

No.	Hospital	Name	Age	Sex	Date of: Accident	Date of: Admission	Date of: Discharge or death	Nature of Injury	Symptoms and Signs	Treatment	Result	Site of Lesion	Condition Found at Operation or Post-mortem
36	St. Mary's	H. C.	19	M.	April 18, 1912	April 18, 1912	April 19, 1912	Run over by motor-omnibus	Abdominal pain and rigidity; pulse 60 to 160	No operation	Death	Jejunum	Small rupture below upper end of jejunum; general peritonitis; fractured pelvis
37	St. Mary's	J. H.	13	M.	July 3, 1912	July 3, 1912	July 3, 1912	Run over by cart	Profound shock; great abdominal pain and general rigidity, tenderness in right loin and hypogastrium	Laparotomy; suture of two ruptures in anterior wall of rectum and one in fundus of bladder	Death on 3rd day; sudden collapse and dyspnœa	Rectum	No peritonitis; fractured pelvis
38	St. Mary's	H. O.	Cases recorded above by Mr. V.					Zachary Cope	.. ..	..	Recovery	Jejunum	..
39	St. Mary's	W. H.								..	Recovery	Jejunum	..
40	St. Thomas's	F. G.	13	M.	June 24, 1910	..	..	Pitched over handle-bars of cycle	..	Laparotomy 24 hours after accident; suture, irrigation, drainage; free gas, bile-stained fluid in peritoneum	Death in 4 hours	Jejunum	Rupture ¾ in. long was 50 in. below duodeno-jejunal flexure; general peritonitis present at time of operation
41	St. Thomas's	T. G.	24	M.	May 16, 1910	..	..	Pitched over handle-bars of cycle on to shaft of cart	Walked to hospital 20 hours after accident; vomited once; pulse 108; very slight rigidity	Laparotomy 24 hours after accident; suture, irrigation, drainage; general peritonitis	Death in 5 hours	Jejunum	Complete transverse rupture at upper end of jejunum
42	St. Thomas's	J. B.	5	M.	Dec. 31, 1910	Dec. 31, 1910	3 weeks	Knocked down by horse	..	Laparitomy 3 hours after accident; suture; no drainage; free blood in peritoneum; bronchopneumonia after operation	Recovery	Ileum	Small rupture 3 ft. from ileo-cæcal valve

43	University College	J. H.	18	M.	Aug. 30, 1910	Aug. 31, 1910	..	Crushed between buffers of train	Great abdominal pain; hæmatoma lower left abdomen; pulse 80; later vomited; pulse rose to 120; abdomen retracted and rigid, upper part only moved; left flank dull	Laparotomy day after accident, ruptured bowel excised; end-to-end anastomosis; drainage	Recovery	Ileum	The rupture was close to the ileo-cæcal valve
44	Westminster	H. L.	24	M.	Oct. 2, 1908, 6.30 p.m.	Oct. 2, 1908	..	Kick in left iliac region	Walked half a mile to hospital 45 minutes after accident; vomited; 85 minutes after accident became collapsed; later abdomen tender and rigid; dullness left flank; liver dullness normal	Laparotomy; suture	Recovery	Jejunum	Rupture 1½ in. long 6 in. from duodeno-jejunal flexure

CHAPTER XXVIII.

INTESTINAL OBSTRUCTION.

When called upon to deal with a case of acute intestinal obstruction the surgeon is confronted with one of the gravest and most disastrous emergencies. The patient may be, and often is, a man or woman in the prime of life, in full enjoyment of vigorous health, who, without warning, is suddenly seized with the most intolerable pain in the abdomen, followed by collapse and vomiting, at first slight, but later unremitting. The abdomen distends, intestinal action ceases, and the bowel above the block, loaded with retained and septic contents, becomes a vehicle for the absorption of products whose intensely poisonous action hastens the patient to his end.

It is still, unfortunately, true that in the very great majority of cases the surgeon is called upon to act in too late a stage of the disease. It is not too much to say that in a consecutive series of twenty cases of average intensity, the condition disclosed at the operation will shew that in at least fifteen operation has been too long deferred. To operate early in a case of intestinal obstruction is an experience that few surgeons often enjoy. Allowance must, of course, be made for the early difficulty in diagnosis. There are many cases of acute abdominal pain which a dose of morphine permanently relieves or a brisk aperient drives away. And in its earliest development a case of acute obstruction may differ in no perceptible degree from any of these. The administration of morphine in such a case of acute onset is held to be necessary—to be, indeed, inevitable. But it is not the one dose of morphine which does the harm; it is the needless repetition of the dose. It is not altogether unsafe to say that an acute abdominal pain which a small dose of morphine does not wholly remove is not rarely due to a lesion

within the abdomen that only an operation can relieve. For many of the patients who suffer an acute seizure of abdominal pain a hypodermic injection of morphine is the too-ready refuge of the surgeon. In administering morphine the surgeon is acting with the sanction of the highest authorities, a sanction which, it has seemed to me, has been too readily given. An eminent authority, in a chapter more beautifully written and more pregnant with harm than almost any other chapter in the literature of modern surgery, has said: "Morphine is an absolute necessity in acute intestinal obstruction and should be administered with as little delay as possible," and behind this opinion of one whose word is weighty many of us have been content to shield ourselves. The advice is bad. There is no absolute need to administer morphine—there is no justification for repeating the dose unless means are taken to obtain the opinion of a surgeon, or unless the diagnosis is clear and the practitioner is fully aware of the condition which he is deliberately treating—if, that is to say, morphine is a remedy and not merely a refuge. It is true, as I have said, that many apparently serious cases of acute pain of sudden onset, attended by sickness and perhaps by slight collapse, are relieved of all present troubles by the giving of morphine. But if the condition of the patient is such that a second or larger dose of morphine is speedily called for, the suspicion of the surgeon should be on the alert and the probability (for it is no less) of the condition being one of mechanical block of the intestine or other grave surgical catastrophe should be borne in mind. It is in no small degree the administration of morphine which is responsible for the disastrous results in cases of acute obstruction. The comfort and repose thereby induced mislead the practitioner into the belief that the disease is of trivial import; and yet, during every hour, the pathological conditions within the abdomen are changing for the worse. When the exact state of affairs is revealed on the operation table, it will constantly be found that precious time has passed away, and that the opera-

tion, whether ultimately successful or not, has been performed too late. The surgery of acute obstruction is disheartening work.

The mortality following operations in all cases, early and late, is very large—far larger than it ought to be. Upon this point the evidence of statistics, culled from the literature, is practically worthless. I should be quite prepared to hear that for one success recorded in the current periodicals there are at least five failures. There are few surgeons who, in a series of twenty or more cases, can shew a lower mortality than 50 per cent. Anything over a 10 per cent. mortality (which should be attainable) is the mortality of delay.

An examination into the conditions found at an operation or at an autopsy shews that in all cases two factors are at work in determining the fatal issue. Of these, the first and least important is the mechanical block in the bowel—the actual obstruction. The second, and incomparably the more serious, is the septic absorption from the distended, congested, and perhaps ulcerated bowel above the place of stoppage. It will be clear, therefore, that in operating upon patients so afflicted the relief of the mechanical obstruction is but a part—and that the smaller and less significant part—of what the surgeon must needs do. The overloaded bowel must be emptied of its putrid contents; and no operation should be considered complete until this has been done.

During the operation the surgeon will need all his dexterity, rapidity, and judgment if he is to be successful. In all abdominal operations speed is a desirable thing: here it is an imperative necessity. The surgeon must discover what has to be done, and must do it with all possible despatch.

Two points in the preparation of the patient need to be emphasised. The stomach must be emptied and washed out, and the skin of the abdomen must be carefully cleansed. The stomach is often greatly distended, being filled with a turbid, yellow or brownish-yellow, highly offensive fluid. Some fluid

of this kind has probably been vomited upon many occasions within the few hours preceding operation, but the stomach rapidly fills up again with similar material. If the patient is anæsthetised with the stomach overfull, it often happens that as soon as general relaxation is produced there is a profuse gush of this fluid through the mouth and nostrils of the patient, and if a deep inspiration be taken, the trachea is filled. The patient, indeed, is drowned in his own vomit. The stomach, therefore, must always be emptied. If necessary, the throat may be wiped over with cocaine solution before the tube is passed. After the stomach is emptied it is washed out with two or three pints of hot salt solution until the returning fluid is clear. The anæsthetic is then administered.

Cleansing of the skin of the abdomen must be thoroughly attended to; the application of many linseed poultices, with the imperfect removal of each, may have left a crust of dried linseed over the abdomen; or hot stupes or turpentine may have caused the skin to blister. A general careful cleansing and shaving may be done before the anæsthetic is begun, but a more scrupulous attention may be paid as soon as the patient becomes unconscious.

So far as the anæsthetic is concerned, it must be pointed out that the less there is given, provided insensitiveness is produced, the better. It is too much to ask to have the patient profoundly anæsthetised so that his abdominal muscles may be relaxed or free from the turbulent movements of deep breathing. The previous administration of morphine will have lessened the need for a free administration of either ether or chloroform. If the condition of the patient is bad, the operation may be done under local anæsthesia, spinal anæsthesia or under ethyl chloride.

The incision is made in the middle line, unless there are the strongest indications to the contrary. In some few cases, more particularly in those where there is a palpable block in the large bowel, an incision over the exactly determined site may be made.

In all other cases a central incision is preferable. In by far the majority this will render easy access to all the parts that require to be dealt with; in some few, a second incision will have to be made. The first incision, however, will not then have been purposeless, but will have revealed to the surgeon the need for the second, and the position in which it should be made. The central incision, therefore, is generally made between the umbilicus and the pubes. The cut made in the skin is one or two inches longer than that in the peritoneum, in order to allow the edges of the wound to fall away and therefore to avoid impeding the easy movements of the surgeon's fingers, and also to permit, if need be, of a rapid enlarging of the wound.

The incision in the peritoneum should be about three or four inches in length—sufficiently long, that is, to allow the easy introduction of the hand, should this be necessary. Especial care must be taken when the peritoneum is cut, for, owing to the intestinal distension, the bowel-wall may be so closely pressed against the anterior abdominal wall that it may be difficult to avoid wounding it.

When the peritoneum has been opened, the fingers of the surgeon are introduced into the abdominal cavity. As a rule, all the exploration, and all the subsequent manipulations necessary to discover and display the involved gut in the wound for appropriate treatment, can be effected by the three fingers passed through the incision. But occasionally it is necessary to pass the whole hand up to the wrist within the abdomen so as to explore, with precision, some otherwise inaccessible corner of the abdomen. With gloves, there is very little likelihood of wounding the gut or of doing any damage whatever by gentle manipulation. The introduction of the whole hand has been described as a brutal and a clumsy procedure, certain to damage the gut and to split its peritoneal surface. With reasonable care, however, no damage need be done. When the fingers or hand are within the abdomen, the cæcum is first sought. If it is distended, the block must be in the large bowel. If it is collapsed and

empty, the block will be in the small intestine. I have found that it is then the safest course to explore the pelvis, for it is remarkable with what persistence the involved loop finds its way into this region. The counsel is generally given that, after the cæcum has been explored, the hernial rings and the umbilicus should be examined, for in these places the strangulation is not rarely discovered. But in my own experience a search in the pelvis has been more quickly rewarded.

It is probable that there are few occasions in surgical practice which are so much simplified by previous experience as the search for the cause, within the abdomen, in a case of acute obstruction. In one's early cases the fingers within the abdomen seem to meet with no part that is capable of being recognised; there is no landmark, and the fingers are apt to wander aimlessly. But by degrees experience comes, and after a few cases have been explored it is easy to feel at home in the abdomen and to recognise any obstruction without serious difficulty. If after three or four minutes the surgeon is unable to define the obstruction, it is better to follow the plan of Kümmell and to allow much of the intestine to escape from the abdomen. Before this is done a towel wrung out of hot sterile salt solution is placed on each side of the wound, and as the bowels escape, the towels are folded around them to keep them warm and protect them. The towels are changed when cooled, but, as a rule, with a deft and speedy operator, the intestines are out of the abdomen only a very short time and a change of towels is not necessary. As soon as the point of obstruction is located the constriction is relieved, in a manner to be specially considered. When this has been done, the distended coils are relieved of their contents by an incision. This is performed in a manner which has already been described. The bowel into which the opening is to be made is lightly clamped by an assistant's fingers, and a longitudinal incision, about 1 inch in length, is made in the line opposite the mesenteric attachment. The edges of the wound so made are lightly seized with small vulsellum forceps,

and are held apart, while a glass tube, about 8 inches in length, is introduced and passed upwards in the lumen of the gut. I have a tube of special design for this purpose. This tube has an oblique opening at one end, and a double-ringed flange at the other. The smaller flange holds tight a rubber tube which is threaded over

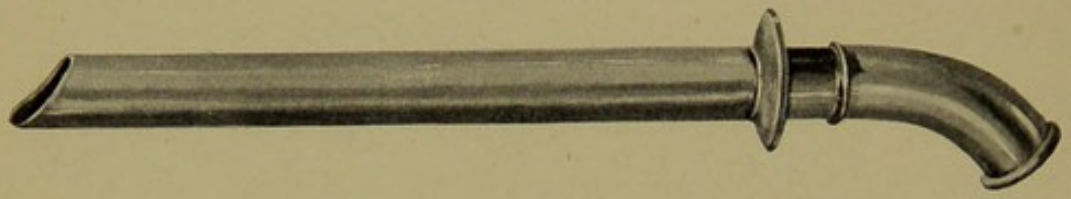


Fig. 233.—The author's tube for use in intestinal obstruction.

it. The larger marks the limit to which the bowel is ondrawn. To the outer end of this tube a long, thick rubber tube is attached, and this leads into a receptacle beneath the table. The tube is pushed gently upwards in the distended gut until its outer end reaches the margins of the wound in the bowel. The tube and gut are then seized in a wrap of sterile gauze and held

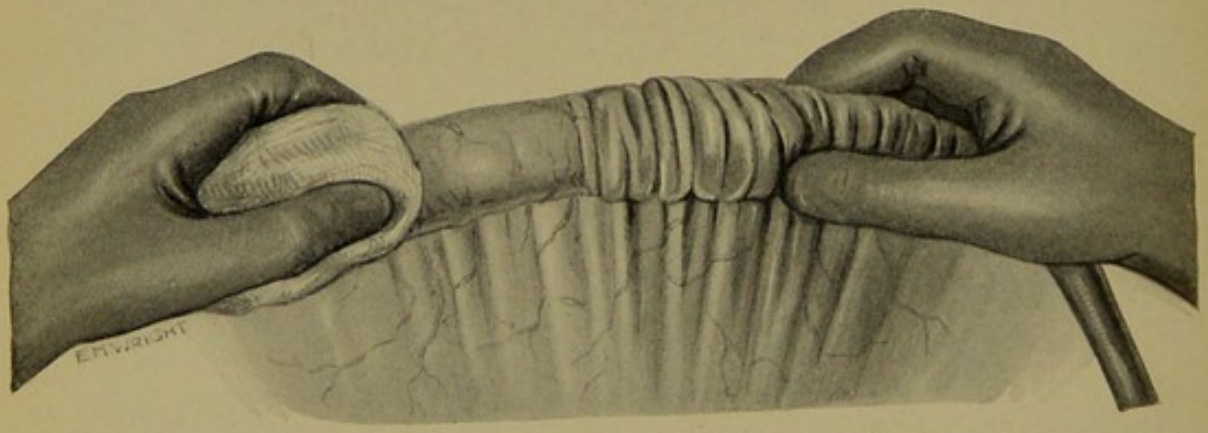


Fig. 234.—The bowel being pushed gently along the tube.

firmly by an assistant so that no leakage occurs by the side of the tube. The surgeon then, with the greatest gentleness, pulls the intestine on to the tube and thereby empties the bowel a little higher up. Gradually more and more of the bowel is pulled onwards until as much of it as the tube will take has been emptied. It will be found that upon a tube six inches in length a

portion of the bowel six feet in length can easily be held. In pulling the gut gently on to the tube it will be found to make matters easier if a piece of gauze be used to hold it. If the whole of the distended gut cannot be pulled upon the tube, a piece of the bowel at the highest point which can be reached is seized, secured by an assistant, and "milked" steadily downwards by the surgeon. All this can be, and must be, done very rapidly. The tube is then gradually withdrawn, and the opening in the bowel covered over by a gauze swab until all the rest

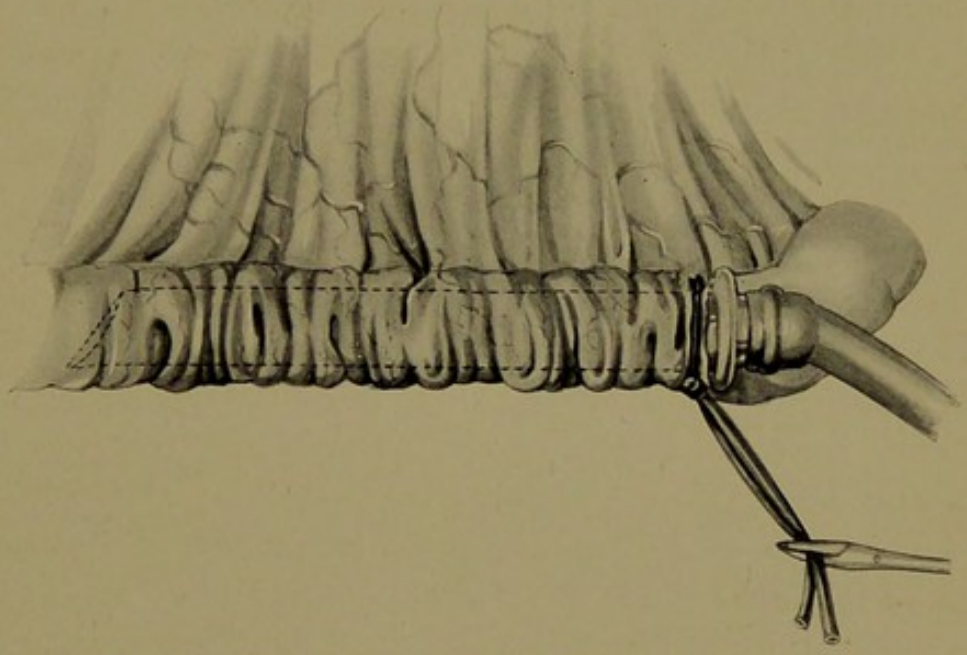


Fig. 235.—To shew the position of the tube when as much of the gut as possible has been drained by it.

of the intestine has been returned within the abdomen, where it is covered with a hot gauze swab. The bowel opening is now closed by a double layer of stitches (the wound being stitched transversely), the whole loop carefully washed and cleansed, and returned gently within the abdomen.

Such is the procedure in the simplest of all cases. There is no need for such an operation to last for more than twenty minutes. The only time-expending part of the operation is the search for the obstruction—it is better not to delay in the

search, but if there is doubt or difficulty, to allow the intestines at once to escape. The fixity of a loop, the appearance, side by side, of a distended and of a collapsed coil, will often give the clue to the affected part.

During the manipulations necessary for the freeing of the involved loop and for the emptying of the bowel the closest possible protection of the remainder of the abdominal contents must be ensured. Hot gauze swabs are packed round, and covered in turn by mackintoshes, which if soiled, are changed as speedily as possible. The utmost daintiness must be observed throughout. If the glove of the surgeon or of his assistant is soiled, it should be changed at once. In the majority of the cases of intestinal obstruction upon which I operate I find it necessary to change my gloves at least once during the operation.

THE OPERATION IN SERIOUS CASES.

In the operation above described, though speed is important, yet the search for the cause of the obstruction and its removal can be carried out deliberately. In some cases, however, unhappily too frequent, the patient is so prostrate and is suffering so profoundly from toxæmia that any investigation within the abdomen, or any, even the slightest, exposure of viscera, cannot be borne. In such circumstances relief must be afforded to the patient by the simplest and speediest procedure. No enquiry can with prudence be made into the cause or conditions of obstruction; treatment begins, and for the time being ends, with the emptying and draining of the acutely distended bowel.

The patient will probably not be in a condition to bear a general anæsthetic, and cocaine or ethyl chloride will then be used locally. The stomach should always be washed out if it is at all possible for the patient to bear the ordeal.

The abdomen is opened through a very small incision, the peritoneum being incised with care. At once a distended and deeply congested coil will present itself in the wound. This,

by a curious and most fortunate chance, will prove to be in almost every instance that portion of the gut which subsequent events will shew to be best adapted for the purpose of forming an artificial anus. As the intestine gradually distends above the point of obstruction, it is found that the coils which are first most widely distended—those, of course, immediately above the stenosis—seem always to force their way to the front of the abdomen and to press against the anterior abdominal wall. The first coil, therefore, selected at random, as it lies beneath the median incision, seems, with few exceptions, to be that which a prolonged and arduous search would justify as the one to be selected for opening and draining.

In cases of acute obstruction in the small intestine supervening upon chronic obstruction, as in growth or tuberculous disease, it will always be found that the mesentery of the distended coils above the stenosis is decidedly longer than that below. In extreme cases the mesentery may be doubled in length.

The small opening in the abdominal wall being made, a prominent and distended coil is selected and stitched all round to the parietal peritoneum. The stitch should be continuous, and should be passed with scrupulous care, so that any wounding of the mucosa or a deep puncture of the gut with leakage may be avoided. The stitches are close together and secure a mechanical partition between the bowel in the wound and the general peritoneal cavity. The suture being completed, a small incision is made in the bowel in the centre of an oval area marked off by a purse-string stitch. As soon as the bowel is opened, a glass or thick rubber tube is passed into the gut and the purse-string suture is tied snugly around it. This secures, for a few hours at least, the passage of all the intestinal discharges and prevents the soiling of the abdominal wound. The stitch gradually loosens, and the tube may then fall out, but by this time the line of suture of the bowel to the parietal perito-

neum is effectively sealed off, and no peritoneal contamination is possible.

The tube will probably drain away a very large quantity of flatus and thin, fæculent fluid for many hours, with the result that the patient's condition may slowly improve, the symptoms of intense toxæmia disappear, and some measure of health and vitality be restored.

When the experience of the profession prior to the last fifteen years was collated, it was found that the operation here described—the simple formation of a fæcal fistula, without the investigation of the obstructing cause—was attended by the best ultimate results. A larger number of recoveries followed upon this than upon any other method of treatment. Recent advances, both in the understanding of the pathology of obstruction and in the means of dealing with all abdominal diseases, have relegated this measure to its proper place—that of a procedure to be practised only in desperate straits.

It cannot be said that the method is one to be generally commended. That lives are saved by this means is undoubted, but it is not improbable that many of the cases formerly believed to have been rescued from impending death were not cases of mechanical obstruction at all, but were cases of acute appendicitis with spreading peritonitis, that, by the practice of to-day, would be treated differently and with greater success by an operation directed to the removal of the cause.

The formation of a fæcal fistula in the small intestine, though, as has been said, it may rescue the patient from a seemingly inevitable death, leaves him with perils of considerable magnitude to face. The death-rate among successful cases of enterostomy when submitted to subsequent operations is large. There are cases in which no further operation is necessary. The fæcal fistula which has been formed gives vent to an abundance of fluid and flatus, and gradually closes spontaneously. Such cases were more common twenty or thirty years ago than they are to-day. This is almost certainly owing to the fact,

previously mentioned, that the cases were not veritable examples of mechanical obstruction. In the great majority of the patients a second operation is needed.

In cases of mechanical obstruction of whatever variety the performance of enterostomy may leave behind a condition of things from which recovery is not possible. Though the patient rallies from his prostrate or even moribund condition, an ensnared loop of gut—a volvulus—or an intussusception may be progressing steadily towards gangrene. The patient, though relieved from one of the two factors which make for death, is left to die, without chance of escape from the other. A successful enterostomy, therefore, may still be unable to avert death, which may come from a condition unrelieved by the operation or from the necessary surgical measures which must be adopted for the closure of the drainage opening.

The operation of enterostomy, therefore, though undoubtedly a life-saving measure, to be remembered, and to be employed when circumstances dictate, is, nevertheless, one to be used with reluctance, to be considered only in the last extremity of the patient's distress.

The opening into the bowel should not be allowed to discharge any longer than is necessary. As soon as the patient has rallied, measures should be adopted to close the fistula.

Before the secondary operation is undertaken the surgeon will endeavour to satisfy himself of the permeability of the bowel below the fistula. The administration, by the opening, of food or of aperients will shew whether the passage through the bowel, temporarily interrupted, has been restored. If, happily, this is the case, the secondary operation will be simple and will be concerned only with the closure of the unnatural opening by methods already described. If, however, the bowel remains impermeable,—if, that is to say, the mechanical impediment still persists,—the secondary operation will include a necessary investigation of all the bowel below the obstruction and the relief of any gross lesion which may therein be discovered. At-

tention has already been called to the fact that after the establishment of a fæcal fistula the bowel distal to the new opening undergoes a remarkable change. The coils of which it is composed become thin, flaccid, empty, and contract adhesions with each other and with any structures in contact with which they lie. The disentangling and unravelling of these may be a difficult, even an impossible, matter, so that a restitution to activity of the bowel has to be abandoned and a short-circuiting operation is performed.

SPECIAL CIRCUMSTANCES IN OPERATIONS FOR INTESTINAL OBSTRUCTION.

The special circumstances concern themselves with the removal of the cause of the obstruction. Each case must be treated as necessity demands.

Strangulation by Bands.—Bands are almost invariably attached by one end to the mesentery, and are generally solitary. They may be short or long; as a rule, the shorter they are the more intense is the strangulation produced by them. They are generally vascular, and if divided, may bleed from both cut ends. As a rule, bands develop in connexion with enlarged glands in the mesentery or from adhesion of the omentum to some acutely inflamed organ, such as the appendix, the ovary, or the Fallopian tube. It will often be found that the manipulations necessary to the proper disclosure of the part of the gut strangled by the band suffice to tear the band, and so to set free the entangled coil. If possible, however, the band should not only be broken through, but entirely removed. Two clips are placed on the band, one at each end, and the band is divided between them. A ligature is then applied on each clip, and the loose portion of the band at each end is snipped away with the scissors. Unless a band be removed in this fashion it is not improbable that it may reform or the tags be the means of leading to the deposit of new bands of lymph, which eventually become organised.

Although a band is usually solitary, the possibility of there being two bands must always be remembered. Gibson found that in 17.5 per cent. of cases ($\frac{33}{186}$) there were more bands than one. When a band very tightly constricts the bowel, and especially if operation has been unduly delayed, all the coats of the bowel except the serosa may have given way, and the serosa itself, if not actually perforated, may be so flimsy and friable that the slightest manipulation will tear it. Leakage from the intestine will then occur, and unless the surgeon be on his guard, the wound may be flooded with the septic intestinal contents. It should be the surgeon's aim, therefore, so to surround the band and the intestine it compresses with a layer of protective swabs and mackintoshes that any escape of contents may not soil the surrounding viscera. Especial care should also be taken to see that an assistant's fingers are closely compressing and clamping the gut before the ensnared loop is free.

In tuberculous disease of the peritoneum involving the glands in the mesentery a long loop of intestine may be compressed by bands at several points. There may be an intricate mesh of adhesions, difficult or impossible to disentangle. After the division of two or three strands a further pursuit of them will be found inadvisable, and a short-circuiting operation will then probably be considered necessary.

Meckel's diverticulum may cause obstruction in several ways. That with which we are now concerned is the form in which the pouch acts as a band, its extremity, normally free, being attached at the umbilicus, to the mesentery, or, indeed, to any point within the abdominal cavity. It may be difficult to recognise the diverticulum, owing to its resemblance, sometimes very close, to a piece of normal intestine.

After the diverticulum has been freed at its extremity it should be removed a short distance away from the intestine. A clamp is applied and compresses the diverticulum as tightly as possible, until, at the line clamped, only the serous coat re-

mains. A single catgut ligature is then applied in the groove left after removal of the clamp, tied tight, and the diverticulum beyond it cut away. A continuous seromuscular stitch is then passed, so as to bury and infold the catgut ligature and the portion of gut which it controls.

Internal Hernia.—The whole subject of internal hernia is dealt with fully in the author's work, "Retroperitoneal Hernia," to which the reader is referred.

In instances of either right or left duodenal hernia the orifice of the hernial sac is bounded in front by vessels—the superior mesenteric artery in *right*, the inferior mesenteric vein and the left colic artery in *left, duodenal hernia*. In the examination of the neck of the sac great care must, therefore, be taken to avoid wounding of these vessels. It will perhaps be found that the acute intestinal obstruction is due not so much to an actual compression at the neck of the sac as to a volvulus of the bowel; all the gut within the hernial sac is twisted round the entering and returning loops. A gradual disentanglement of the intestine at the neck of the sac will then permit the withdrawal, little by little, of the imprisoned coil. The neck of the sac may sometimes be enlarged by gradual traction of the finger or by a nick made in the neck at a point where no vessels are. When the gut has been withdrawn from the hernial sac a few stitches must be passed at the neck so as to close, as nearly as possible, the entrance to the cavity.

Cases of retrocolic hernia and of intersigmoid hernia are dealt with in a similar manner.

With regard to hernia into the foramen of Winslow, the difficulty of even a partial reduction of the hernia and the impossibility of reducing the whole of it are well shewn by Treves's case.

Hernia through abnormal openings in the mesentery or in the broad ligament have occasionally been observed. As a rule, the reduction of the bowel offers no difficulty, for the margins of the opening are readily enlarged by stretching with the fingers or by cutting at a point free from vessels. The com-

monest point of the mesentery to shew an opening is that which runs to the lower ileum, and it is this portion of the bowel which most often passes through the opening.

Intussusception.—The relative frequency of the various forms of intussusception has been investigated by Sargent. In 109 consecutive cases occurring at St. Thomas's Hospital there were—

Of the ileocæcal variety	75
" enteric "	12
" ileocolic "	5
" colic "	5
Double or unusual forms	12

Leichtenstern, dealing with a total of 593 recorded cases, found the following proportions:

Ileocæcal	44 per cent.
Enteric	30 "
Colic	18 "
Ileocolic	8 "

Of the 593 patients, 134 were under twelve months, and of these, 80 were between the fourth and sixth months.

Males are more frequently affected than females. It is still a common practice to attempt the reduction of an intussusception by inflation. The method is uncertain—deceptive, in that reduction may be apparently complete and in reality be only partial—and by no means devoid of risk. The tendency of surgeons is very properly to abandon it, or to use it only in conjunction with an abdominal operation. If the abdomen be opened and inflation employed, the surgeon may watch the gradual reduction of the invagination until only the first portion of it remains. The reduction of this, as can be seen, is a matter of great difficulty and is frequently never achieved. It is then supposed that the intussusception "recurs" after reduction, the truth being that the intussusception has never been reduced. Inflation may, if it is thought desirable, be used to reduce the greater part of the reduction, the undoing of the last

portion being effected through an abdominal incision. Otherwise the method of inflation is one to be abandoned. It is the relic of an age of ruder surgery.

Mr. Eve ("Brit. Med. Jour.," September, 1901, p. 582), in reviewing his record of cases at the London and Evelina Hospitals, sums up the arguments against inflation and injection in this way: (1) They are very rarely efficacious. Of 24 cases so treated, not one was cured by these methods alone. Eighteen cases were subsequently operated upon, and 6 died without operation. Of the 18 cases subjected to operation, in 14 reduction was effected, although inflation or injection had failed in procuring it. (2) Injection or inflation was not infrequently followed by an illusory or partial reduction. So-called recurrence of the displacement was inevitable, and the consequent delay in performing the operation usually led to a fatal result. (3) Injection or inflation was haphazard, and, therefore, unscientific.

In all cases of intussusception the child must be safeguarded from the effects of shock by special care in the preparation and conduct of the operation. The limbs must be swathed in wool and bandaged with a flannel bandage, the room must be warm, and the operator must be speedy in all his movements.

When the abdomen is opened, the intussusception is, if possible, reduced. In the early stages reduction will offer no difficulties; after three days or longer it may be impossible.

Reducible Intussusception.—The abdomen is opened through an incision about 1½ to 2 inches in length, between the umbilicus and the pubes. Sufficient room must be given at once for the introduction and free movement of the fingers. When the lower limit of the intussusception has been defined, the bowel immediately below is gently grasped with the fingers and thumb of the right hand and upward pressure is exerted. With very gentle squeezing of the apex of the intussusception it will be pushed a little upwards, and the invagination, therefore, will be

a little reduced. As this happens the fingers are made to travel slowly upwards again, compressing the tip of the intussusception and again effecting a slight reduction. Little by little the ensheathing layer is unrolled and the invagination travels backwards, in the ileocæcal variety, from the descending colon along the transverse colon and ascending colon until the cæcum is reached. The same gentle squeezing movement is continued all the time, the hand being slowly moved along the bowel. When the cæcum is reached the main difficulty will be

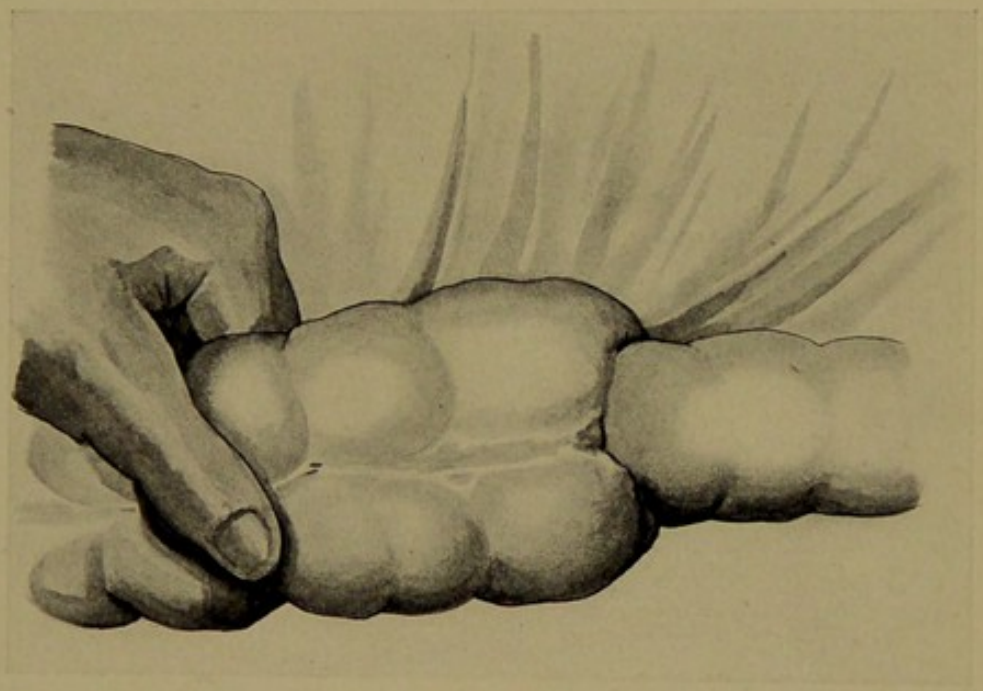


Fig. 236.—Reduction of an intussusception by pressure from below.

encountered. This is in the reduction of the apex of the intussusception, which is often swollen, sodden, and œdematous. To effect the setting free of this last portion the cæcum should be brought up to the wound so that the manipulations may all be carried out under the eye of the surgeon. The same gentle pressure upon the colon and very slight traction upon the ileum are together exercised until all the invagination is undone. The successful completion of the manœuvre is often demonstrated by the appearance of the vermiform appendix.

The gentlest possible manipulation is necessary throughout, in order to avoid a rent in the peritoneum. Should this occur, an avenue will be opened for the escape of organisms from the bowel and a septic peritonitis may result. If any rent be made, it must be closed by a very fine continuous suture of thread.

Instead of using the finger and thumb the two index-fingers may be used for pushing upwards the invagination. A sort of stroking movement, one finger being moved after the other, is used.

After the completion of the reduction it is desirable, if time and circumstances permit, to pass a few sutures uniting the cæcum to the peritoneum of the right iliac fossa. In the very great majority of cases of ileocæcal intussusception there has been an absence of that "secondary fusion" which fixes the ascending colon to the posterior abdominal wall. It is the undue mobility of cæcum and ascending colon which permits the occurrence of the invagination. If the colon and cæcum are fixed by a few points of suture, recurrence of the intussusception is rendered improbable. This operation may be called "typhlopexy."

If the intussusception has been an enteric one, the mesentery may be folded upon itself by suture, with the object of eliminating that undue length of the mesentery which is a recognised predisposing cause of intussusception. Dr. A. N. McGregor, of Glasgow, who first suggested this point, writes ("Glasgow Medical Journal," October, 1903):

"After reduction, a long catgut thread was fixed at a point in the mesentery of the ileum, proximal to the intussuscepted portion, about half-way between the bowel and the root of the mesentery. Thence a continuous Lembert suture was applied so as to tack together a fold produced by approximating the distal and proximal edges of the mesentery. The fold was gradually increased from the commencement of the suture to a point opposite the apex of the intussusception, and then gradually diminished to a point distal to the lower end of the lesion. By this method

the blood-vessels of the mesentery are not interfered with, the stitches only involving peritoneum. No loophole is left for an internal hernia. It has the advantage of requiring no new apparatus, and need not increase the time of operation by more than five minutes.

"The effect of this procedure seems to be twofold. In the first place, the shortening of the mesentery removes one of the admittedly common predisposing causes; and, secondly, the three-ply of mesentery—and œdematous mesentery, too—may act as a splint, and so prevent the doubling in of the bowel at the seat of the old lesion."

Irreducible Intussusception.—In some cases, despite the earnest effort of the surgeon, the invagination may prove to be irreducible. The following courses are then open:

If *irreducible, but not gangrenous*, the intussusception may be ignored, a short-circuiting operation being performed, the bowel above the mass being anastomosed with that below. This, as a rule, is permissible only in cases of chronic intussusception, where gangrene is not only not present, but is not to be feared. If *irreducible and gangrenous*, one of three operations may be done: (*a*) The whole mass may be excised, and an end-to-end or side-to-side anastomosis performed; (*b*) or Jessett's operation, removal of the invagination alone, through an incision in the sheath, may be practised; (*c*) or resection and the formation of an artificial anus may be performed.

(*a*) *Resection with end-to-end union of the bowel* does not differ from the same operation when practised for stricture or tuberculous ulcer of the intestine. Where the disparity in size between the cut ends of the bowel is very marked, it is better to close both ends and perform a lateral anastomosis.

(*b*) Jessett's operation is thus described by its originator:

"In three experiments on dogs I made an artificial intussusception by invaginating a considerable length of small intestine into another portion of intestine lower down. I then fixed this in position by means of a few Lembert sutures. At the end of a week I opened the abdomen of the dog again (under an anæsthetic) and found the invagination firmly adherent in two cases.

I then made a longitudinal opening into the intestine, on the side furthest from the mesentery, directly over the intussusceptum, about 1½ inches long, or of sufficient length to allow of my

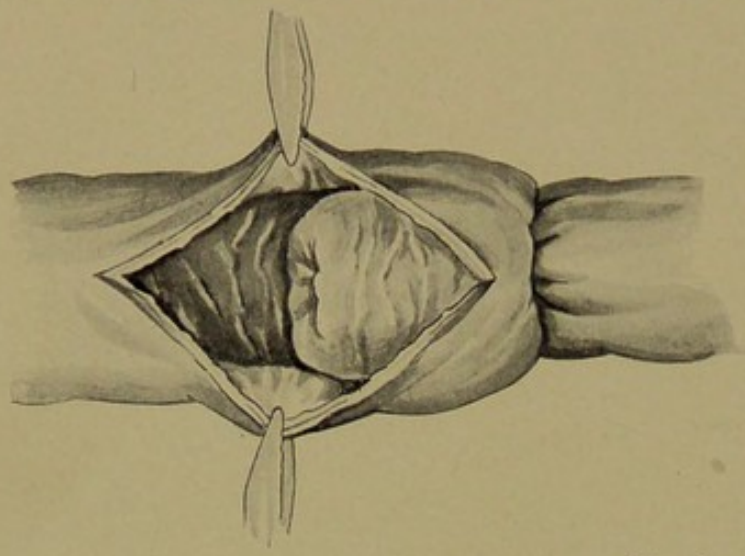


Fig. 237.—Jessett's operation for intussusception. The sheath opened to expose the intussusceptum, which is dragged downward as far as possible before removal.

being able to have a good view of, and room to cut across, the root of the invaginated portion through the opening. I next,

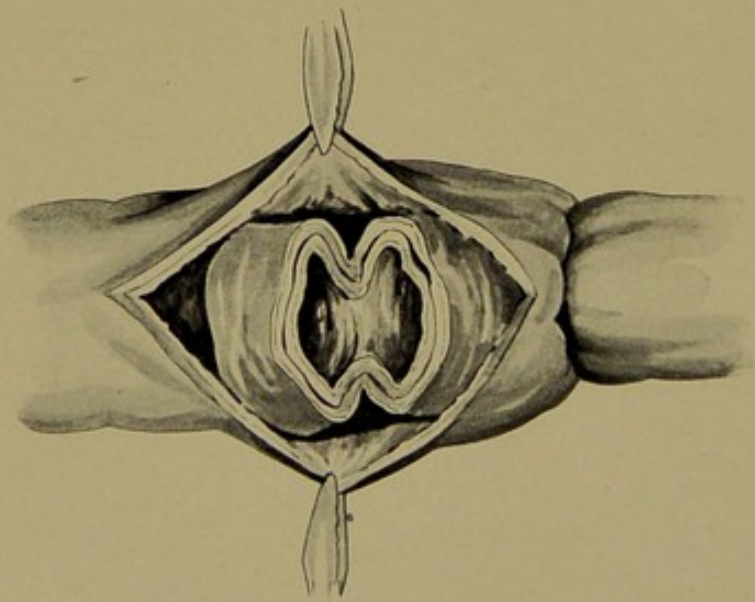


Fig. 238.—Jessett's operation. Removal of the intussusceptum. The division is made a little closer to the neck than in the diagram.

with a pair of scissors, cut this through close to its fornix, and, drawing it out of the intussuscipiens, ligating any vessel that required tying; then, with a few sutures, I stitched the cut ends

together. The stump was then returned into the intestine, and the opening through which it had been drawn out was closed by a double row of quilt sutures, and the part dropped back into the abdomen. In one case I sutured the intestine together at

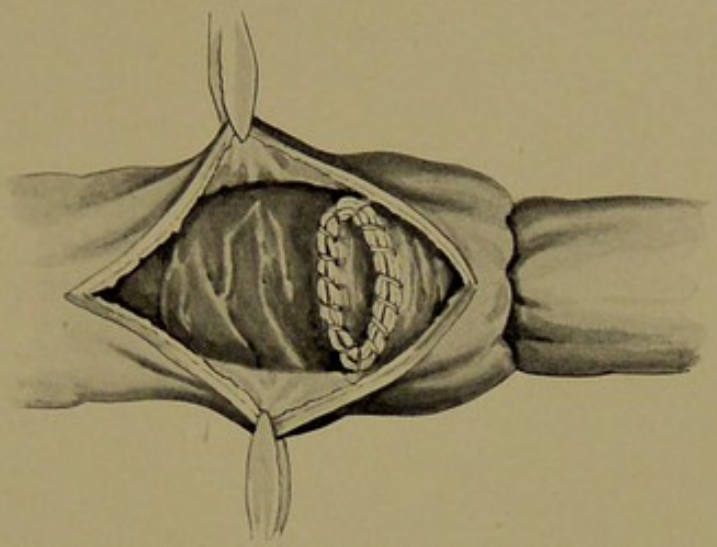


Fig. 239.—Jessett's operation. Suture completed. The stump of the intussusceptum is now withdrawn and the incision in the sheath closed.

the junction of the intussusception part with the lower portion of the bowel, but this is not, I think, at all necessary. These experiments were successful, and there were no bad symptoms afterwards."

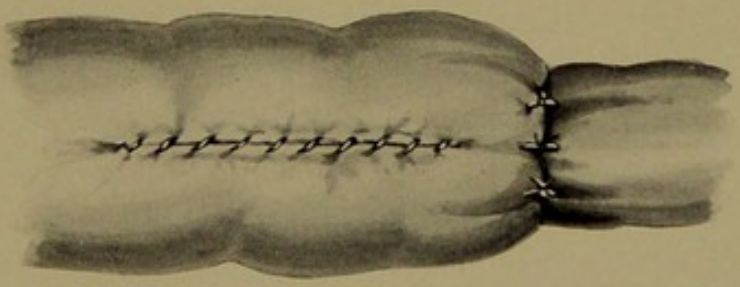


Fig. 240.—Jessett's operation completed. A few interrupted sutures are placed at the neck, and the longitudinal incision is closed by continuous sutures.

The operation was first practised by Mr. Arthur Barker, who independently devised an almost exactly similar procedure. The following is his description:

"At the point at which the intussuscipiens receives the intussusceptum, the two portions of the bowel are at once united by a continuous circular suture of fine silk, taking up the serous

and muscular coats of each, and carried on to the mesentery. A longitudinal incision is then made for about two inches through all the coat of the intussuscipiens on its free margin. This gives access to the sausage-like intussusceptum within. The latter is then drawn out through this incision, and is cut across close to its upper end, or, if too long to be first drawn out, it may be cut across *in situ*. A few stout silk sutures are, however, passed through all the walls of the stump as the mass is gradually cut off, and are tied tightly so as to keep the serous surfaces in contact and control all bleeding from the vessels entering it at its mesenteric attachment. The stump is now cleansed. dried. and dusted with iodoform, and is allowed to drop back through the incision into the lumen of the intussuscipiens. Then the longitudinal incision in the latter is closed by a continuous suture from end to end. Toilet of the surrounding parts and closure of the abdominal wound complete the operation, which in my first case only lasted half an hour, and in my second, a little longer. In a future case I shall look forward to finishing the whole operation in a much shorter time and with much less manipulation. Now, in this operation the resulting junction of the bowel is just what we aim at in the far more elaborate procedure of direct resection of the bowel. But we have the great advantage, besides the saving of time, of not interfering with possible adhesions at the point of strangulation or with the mesentery. Moreover, the vessels of the latter are probably blocked by the strangulation at a point above that at which they are cut, and, if they are not so, they are closed by the same sutures which bring together the divided edges of the stump."

(*c*) *Resection with the formation of an artificial anus* is unsuited to the conditions of childhood, and should, therefore, be practised only when other measures are, for some reason, utterly impossible. A later closure of the anus will, of course, be necessary. A successful case of this kind has been recorded, but the method is not one to be commended.

E. A. Codman ("Boston Med. and Surg." Jour., April 2, 1908) reports a case of W. B. Conant, of an ileocæcal intussusception in which a tight band of impacted mesentery was ligatured and divided a tube tied into the ileum whilst the intussusception was walled off so as to be practically outside the abdominal wall.

Codman thinks that tying off the blood supply of the intussusception is likely to shrink it so as to allow removal by gentle traction three or four days after the operation, and he advocates this method for irreducible cases in which the small intestine is invaginated into the large. The steps of the operation are:

First Step: Division of the small intestine between clamps just above the mass.

Second Step: Clamping the tight band of mesentery as close to the mass as possible.

Third Step: Tying mesentery on proximal side of the clamp in bundles as large as safety permits, and dividing bundles between tie and clamp after the application of each tie. This process to be continued until the (region of) the blood supply of the outer coat is reached.

Fourth Step: Mixter enterostomy tube tied into proximal end of intestine and another into distal end.

Fifth Step: If practicable, the clamp might be removed from the distal portion of the mesentery so as to allow the venous blood to drain out and thus diminish the size of the intussusception.

Sixth Step: Packing the wound in such a manner that the ends of the intestines may be readily manipulated, leaving ends of bowel long enough to try anastomosis later.

Seventh Step: When the drainage from the intussusception through its lumen or through its veins has sufficiently diminished its size it may be drawn out of the intussuscipiens by gentle traction. This would occur immediately or within a few days.

Eighth Step: When sloughed intestine is drawn out, if the patient's condition permits, an immediate anastomosis (perhaps without ether) may be considered.

This suggestion may possibly prove valuable for desperate cases in replacing resection and hopeless efforts at reduction, it certainly is easy and would probably produce less shock than any other operation.

It is, however, suited only for ileocæcal intussusception, as it is only here that the vascular conditions lend themselves to such a procedure.

These tetra cloths are maed of four layers of hydraulically compressed gauze. They are soft, lie evenly on the abdomen, and while their thickness is only equal to that of a fine linen handkerchief, they have the absorptive properties of four layers of gauze without their bulk; thus they protect the hands of the operator and his instruments from any sweat there may be.

After the reduction of the invagination has been accomplished an examination of the bowel should be made in order to determine whether any polypus, projecting into the lumen of the bowel, is the cause, or whether a Meckel's diverticulum, inverted, has formed the starting-point. If a growth be found, the intestine must be opened and the polypus removed, or, as in a case recorded by Mr. Rutherford Morison, the whole of the portion of the bowel bearing the polypus may be excised.

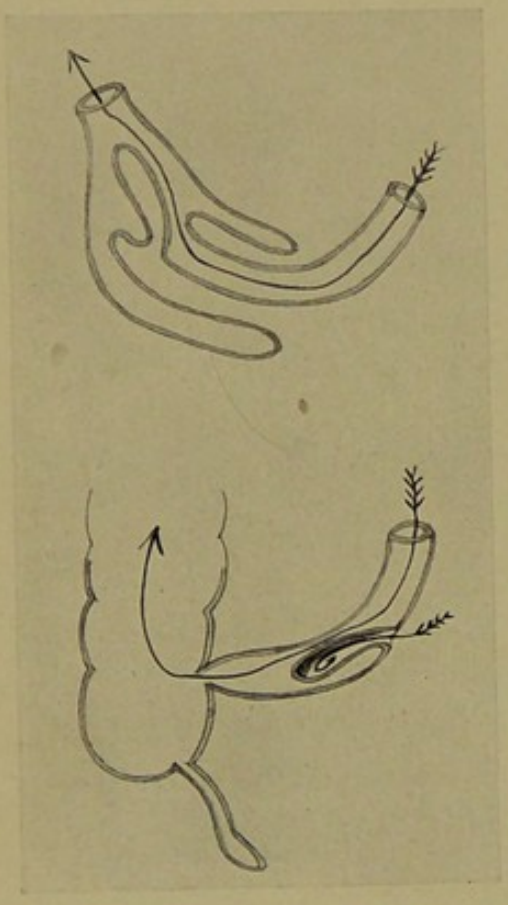


Fig. 241.—Intussusception due to an inverted Meckel's diverticulum (Rutherford Morison).

Mr. Rutherford Morison records a case of intussusception occurring in a boy aged five, due to a Meckel's diverticulum ("Lancet," June 14, 1902, p. 1689):

"A tumour was felt in the left loin, and over it an incision was made and the invagination, which was six inches in length, was withdrawn from the abdomen. The mass was wrapped in a large warm flat sponge and steadily and firmly squeezed until its size was evidently lessened. The bowel was then steadily reduced by gentle traction from above and pressure from below. On its reduction a firm tumour of about the size and shape of the little finger could be felt through the intestinal walls in the lu-

men of the bowel fixed to the wall opposite to its mesenteric attachment. At the site of attachment a definite dimple was observed, and this suggested that the tumour was an inverted Meckel's diverticulum which had formed the apex of the intussusception. A longitudinal incision one inch long was made in the intestine, and the diverticulum, for this it turned out to be, was excised. The intestinal opening was closed transversely by a continuous catgut suture through all the coats, and outside of this was inserted a row of Lembert's interrupted sutures of catgut. The specimen shewed an intestinal diverticulum turned completely inside out, measuring one and a half inches in length, becoming wider from base to apex and ending in a somewhat bulbous extremity. There were patches of gangrene in its wall affecting chiefly its mucous membrane. The patient recovered."

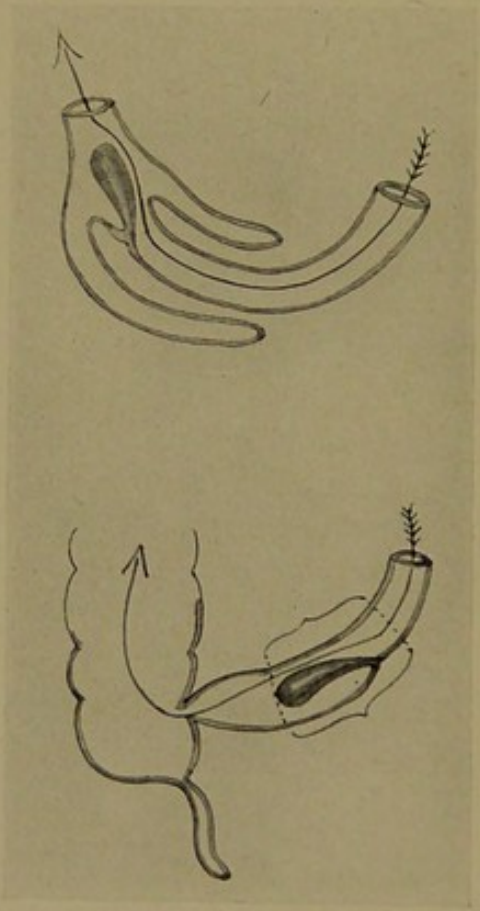


Fig. 242.—Intussusception due to a polypus of the intestine (Rutherford Morison).

A second case of intussusception due to a polypus is also related:

"The patient was a man aged sixty-two. On opening the abdomen a large, rounded, firm swelling was found in the ascending colon—evidently an intussusception. It extended from the right iliac fossa to the middle of the transverse colon. By expression and traction the intussuscepted gut was readily reduced, except the last two or three inches. This was towards the end of the ileum, and contained a firm, rounded tumour which was at this time suggested to be a carcinoma invading the ileo-cæcal valve. The portion of intestine including it, along with the thickened mesentery and some enlarged glands, was ex-

cised. The mesentery and intestine involved in the intussusception were so thickened and altered by old adhesions that until the excised portion and cut ends were carefully examined it was not recognised that the portion removed concerned the ileum only and that the distal incision left two inches of ileum attached to the cæcum. The divided intestine was thickened and friable and was too rigid to allow of a lateral anastomosis. An end-to-end union was effected by a continuous suture of catgut through all the coats, and outside of this an interrupted layer of catgut sutures. The loose omentum was drawn down and wrapped around the anastomosis. The opening in the abdominal wall was entirely closed by four tiers of interrupted catgut sutures. The portion of gut resected measured three and a half inches in length and had a diameter of one and three-quarter inches. The intestinal wall was very thick. The mass in its interior was found to be a rounded polypus of the size of a large walnut, which sprang from the antimesenteric border. On the outside of the intestine, opposite the attachment of the growth, there was a distinct pucker on the peritoneal surface, but it led into no channel, as in the previous case. A microscopical report by Dr. R. A. Bolam states that 'the tumour consists of young connective tissue with numerous vessels. In parts, the appearances suggest myxomatous change, but this may be accounted for by the œdema. The surface of it is covered by normal mucous membrane.' The patient recovered."

The following table, shewing the results of operations at different times from the onset of symptoms, is given by Sargent:

Day.	Number of Operations.	Percentage of Reducible Tumours.	Resections, etc.	Mortality.
First,	35	94 per cent.	2 resections.	37 per cent.
Second,	36	83 " "	3 resections. 3 artificial anus.	39 " "
Third,	33	61 " "	9 resections. 4 artificial anus.	61 " "
Fourth,	15	40 " "	9 resections.	67 " "

The fifth and sixth days shewed respectively a mortality of 73 per cent. and 75 per cent.

Clubbe ("Brit. Med. Jour.," April, 1901, p. 689) records 45

cases of intussusception upon which he had operated during seven years. Of these, 24 recovered and 21 died. In the successful cases the time which elapsed from the onset of symptoms until the operation averaged twenty-four hours, whereas in the fatal cases the average time was fifty-six hours.

The experience of all operators coincides with this, and the imperative necessity of early diagnosis and early operations is universally admitted.

At the Clinical Society of London a discussion was held on December 9, 1904, on the treatment of intussusception. The following report is quoted from the "Lancet," December 17, 1904, p. 1719:

"Mr. Cuthbert S. Wallace read a paper on the 'Treatment of Intussusception in Children,' based on a series of cases of intussusception in children treated at St. Thomas's Hospital and the East London Hospital for Children between the years 1898 and 1904. There were 20 cases in all, the ages varying between three months and thirty-three months. There were 12 males and 8 females. Of the 20 cases, 19 involved both the small and large guts; the remaining case was one of the colic variety. Eleven were single tumours and 9 were double. Mr. Wallace believed that double tumours were more common than was generally supposed, and he referred to the difficulty of nomenclature that was encountered if a complete classification was attempted. The diagnosis was clinched by the finding of a tumour, and if there was any doubt of the presence of a tumour, an anæsthetic should be given and the matter settled at once. The treatment was primary cœliotomy, the most convenient incision being through the right rectus beside the umbilicus. Mr. Wallace did not lay any great stress on the reduction of the tumour within the abdomen, but thought that time was the most important element in the treatment. The after-history of the cases seemed to shew that, as far as the ultimate result was concerned, the method of suture of the abdominal wall was immaterial. The method favoured was by deep sutures through the whole thickness and buried sutures through the sheath of the rectus. By this method the danger of the incision coming

open from failure of union was reduced as far as possible. Of the 20 cases, 4 died, giving a case-mortality of 20 per cent. If the 2 cases of resection were excluded, the case-mortality fell to 11.11 per cent. Mr. Wallace finally referred to the great fall in the case-mortality that had taken place of late years. Statistics drawn from the records of St. Thomas's Hospital shewed that there was a marked increase in the number of cases of intussusception admitted to hospital.

"Mr. C. H. Fagge read a paper on the 'Treatment of Intussusception in Children by Laparotomy,' founded on the results of 18 laparotomies, of which 17 were primary and 1 was undertaken after two attempts at reduction by inflation had failed. In 16 a tumour was discovered either per abdomen or per rectum. He drew attention to the variable position occupied by the tumour, and insisted on the importance of routine rectal and bimanual examination, if necessary under an anæsthetic, as aids in coming to a prompt diagnosis. The time which elapsed before operation in his cases varied from five hours to three weeks; and though there was no direct relation between this and ease of reducibility, he pointed out that no case in which the duration was less than forty-eight hours had been irreducible. Eleven were single and 7 double intussusceptions, of which at least 10 were ileocæcal and 3 colic-ileocæcal. He did not regard a minute division of intussusceptions into many varieties as of much clinical value. Probably 8 of his cases would not have been, owing to their origin above the ileocæcal valve, in any way affected by inflation or irrigation. Reduction was by laparotomy, carried out with all possible speed through an incision, usually in the right semilunar line, and this was aided, if necessary, by an assistant's finger in the rectum, which reduced the intussusception well into the descending colon. Five cases were irreducible and all of these were fatal; in one an artificial anus was formed, and in all the others resection was performed and the ends of the bowel were united—in one, by Maunsell's method and in the other three by simple end-to-end anastomosis with two rows of sutures, the inner passing through all the coats and the outer through the muscular and peritoneal coats. In another fatal case in which the invagination was reducible no surgeon had been called in for twenty-four hours, and though reduction was easy, the patient, a boy nine

years old, died on the fourth day. Of the 18 cases, 7 died, giving a mortality of 39 per cent.; of the reducible cases (13 in all), 2 died, a mortality of 15.4 per cent.; in the 14 cases under one year the mortality was 21.4 per cent., or, excluding the 2 which were irreducible, there was only one death, giving a mortality of 8.3 per cent. In all the fatal cases a considerable time had elapsed between the occurrence of the intussusception and the operation. A table of the cases was submitted.

"Mr. A. E. J. Barker remarked on the large number of double intussusceptions recorded in the papers. He had never seen a case of this nature, although he had operated on between twenty-five and thirty cases. He agreed with Mr. Fagge that escape of the bowel from the abdomen at the time of operation was a most undesirable complication. He differed from both Mr. Wallace and Mr. Fagge as to the length of incision necessary, and it was rarely advisable, he thought, to make one over two inches long. He attributed the cases just described of bursting open of the wound to this factor, as he had never seen such an occurrence in his cases. In this connexion he believed it was important to conduct the first dressing under opium and chloroform. Some cases incurred toxæmia after the operation; it was probably explained by intestinal sepsis in and around the injury. He had several times noted a rise of temperature on the following day to 105° F., and even 107°, there being no diarrhœa, distension, or other symptom. He had never seen recovery after resection in gangrenous cases, and never expected to see it. The only hope lay in early operation."

Clubbe ("British Med. Journal," vol. i, 1905, p. 1327) reports 100 consecutive cases of intussusception in children. He writes:

"I find that up to November, 1904, I had performed 100 laparotomies for intussusception in children, with 63 recoveries and 37 deaths.

"The first 50 cases occurred from August, 1893, to April, 1901 (a period of 7 years and 8 months); of these 25 lived and 25 died. The second 50 cases occurred from April, 1901, to November, 1904 (3 years and 6 months); of these 38 lived and 12 died. The great difference in the mortality in the second 50 cases is probably due to the fact that the children were sent into the hospital earlier.

	Cases that Lived.	Cases that Died.
Average time from onset of symptoms to operation, first 50	28 hours	68 hours.
Average time from onset of symptoms to operation, second 50	23 hours.	48 hours.

"The varieties were as follows:

	Cases.	Cured.	Died.
Ileocæcal	64	43	21
Ileocolic	12	7	5
Double	20	11	9
Colic	3	2	1
Enteric	1	—	1
	100	63	37

"In my cases the relative frequency of the various forms differs considerably from those collected by Weiss, who gives us the following statistics: Ileocæcal, 43; iliac, 23; ileocolic, 14; colic, 26."

Volvulus.—Volvulus is either simple or compound (see "Medical Chronicle," February, 1903)—simple, when a coil of intestine is twisted around its mesenteric axis, compound, when two coils are mutually intertwined. The sigmoid flexure is most commonly affected, but the ileum, jejunum, or cæcum may also be separately or conjointly involved. In the majority of cases some anatomical abnormality is the determining factor—a mesosigmoid of undue length, with a narrow base; the cæcum and ascending colon suspended by a mesentery continuous with the mesentery of the small intestine. The coil involved in the twist may become enormously distended. The sigmoid flexure, for example, may fill the whole abdomen and press the diaphragm up to the level of the fourth rib (Kuttner's case). The ease or difficulty of reduction of a volvulus will depend in great measure upon the degree of distension. If a short loop of the intestine alone be involved, uncoiling is generally easy, but if the sigmoid be grossly distended,

the untwisting may be a physical impossibility, or the gut, when untwisted, may at once spring back into the former condition.

Volvulus shews a decided tendency to recurrence. This is due to the fact, already mentioned, that its onset is to be attributed to some mechanical abnormality in the disposition of the gut or of the mesentery. When, in such circumstances, a volvulus has occurred, the untwisting of the bowel does nothing to remove the disposing conditions. The bowel, in fact, is rather more likely than it was before to undergo a twist. Something more, therefore, may have to be done in an attempt to prevent a recurrence—and in certain cases even resection of the involved loop may be necessary.

When the abdomen has been opened and a volvulus found, it is brought outside the wound and its position and extent determined. If readily untwisted and the gut in fair condition, the bowel may be returned forthwith. If, however, the case is of long standing, an enormous distension of the coil may be found, and unravelling may be impossible until the bowel has been incised and its contents evacuated. This is the desirable course in many, if not in all, instances, for the emptying of the gut allows of easy reposition of the bowels, lessens the likelihood of septic absorption from the distension ulcers of the gut, and permits an early restoration of the peristaltic movements of the intestine. In some instances the overdistended loop may be emptied into the bowel below by gentle squeezing. In the case of the sigmoid flexure this may well be done. The sphincter is stretched first, and the contents, gas and abundant liquid fæces from the sigmoid and the higher colon, may be pressed out of the rectum. In a few cases the condition of the involved loop may leave the surgeon in doubt as to its vitality. If so, a Paul's tube may be inserted into the gut, or the loop may be placed immediately beneath the abdominal wound and a drainage-tube or ample gauze packing passed down to the gut. In one such case the volvulus, a coil

of bowel twelve inches in length, was picked out as a slough from the wound, and the fæcal fistula which resulted was closed by a later operation ("Lancet," February 18, 1899, p. 430).

If the involved loop be actually in a state of gangrene, or if the volvulus prove to be due to a mesenteric growth which is perhaps malignant in nature, or if there be many adhesions to the loop and the bowel become lacerated in separating them, an excision of the affected gut should be performed. In these cases of mesenteric growth which have been recorded the removal of a large segment of the bowel has been necessary, for the growth may extend far back to the root of the mesentery, and the intestine, supplied by the vessels passing through a narrow area there, may be several feet in length. This is, of course, obvious if one remembers that the posterior attachment of the mesentery measures only six inches from the commencement, at the duodenojejunal angle, to the termination in the right iliac fossa, whereas the length of intestine to which the mesentery runs is over twenty feet. After enterectomy has been performed, the divided ends of the bowel should be forthwith united. Schlange has reported the successful removal of 135 cm. of gangrenous ileum forming a volvulus.

After the untwisting of a volvulus there may be, as I have said, a marked tendency to recoiling: the bowel may seem to spring back at once into its former twisted position. This tendency is decidedly lessened by the emptying of the gut, but even after this, it may be manifest and uncontrollable. In such cases it has been suggested by Braun that the loop should be stitched to the anterior abdominal wall, or, in the case of the sigmoid, that the ends of the loop should be sutured to the iliac fossa and the side of the pelvis. In this way not only may the immediate retwisting be prevented, but also the tendency to later recurrence, which has occasionally been experienced. In all instances of chronic or recurring volvulus it is probable that excision of the implicated loop will prove the most satisfactory treatment.

Senn has suggested, and successfully adopted, the practice of shortening the mesentery for the purpose of preventing a recurrence of the twist. "Shortening of the mesentery," he writes, "can be effected by folding the mesentery upon itself in a direction parallel to the bowel, and suturing the apex of the fold to the root of the mesentery." In this way a pleat is formed in the mesentery without interfering with the blood-supply of the bowel.

In all operations for volvulus it must be borne in mind that a mere reposition of the twisted loop will not suffice to remove the abnormal anatomical condition upon which the volvulus depends. After uncoiling the twist an examination must be made to elicit the cause of the displacement. An attempt at the removal of this determining cause is in all cases desirable.

The following are amongst the cases of volvulus which have been under my care:

CASE 1.—*Volvulus of the ileum associated with mesenteric cyst; untwisting; excision of the cyst; recovery.*

M. R., æt. eighteen, female. When first seen by me she was suffering from symptoms of intestinal obstruction. The following history was obtained: Nine days ago the patient went to an evening party and ate a "great many nuts." During the following night she woke with severe abdominal pains and vomited twice. Eight days ago she still had some slight abdominal discomfort, but from that day until three days ago she was comparatively well. On this latter day a slight bulging was noticed in the right iliac region. Pain, tenderness, vomiting, and complete constipation were present, and gradual increase in the size of the swelling was noticed. A few hours before I saw her the severity of the symptoms had swiftly increased. On examining the abdomen I found a little distension and slight tenderness everywhere. To the right of the umbilicus was a slightly movable lump, the size of an orange. This was dull on percussion, had a fairly well-defined edge, and was very tender. On opening the abdomen I found a cyst, of the size described, in the mesentery of the twisted lower ileum. I removed it and stitched the opposing layers of peritoneum at the base

together, folding the edge over, so that the peritoneal surfaces were apposed. The volvulus was untwisted and recovery was uneventful.

CASE 2.—*Volvulus of the ileum; large hæmatoma of mesentery, simulating new-growth; enterectomy; death.*

Mrs. B., æt. sixty. Seen with Dr. Mason, Gomersal. For several weeks the patient had noticed an increasing discomfort in the abdomen, and had been subject to attacks of pain and constipation. About a month before being taken ill she had felt a "lump" in the body, at the lower part. There had been no vomiting, and food had been well taken, but some loss of flesh had been observed. Menses had ceased twelve years before, and there had been no vaginal discharge of any kind since the menopause. On January 25 there was an acute attack of abdominal pain, of greatest intensity in the hypogastric region. The pain was very severe, and caused some collapse and a sharp attack of vomiting. There was no action of the bowels after this attack, and vomiting was observed on several occasions, and always after any food or drink had been taken. The abdomen had become rapidly distended. On examination by me on January 29 the patient looked very ill, the temperature was 98.2°, the pulse 112. The skin was cold and there was decided collapse. Vomiting was severe and persistent, and hiccough had been observed during the few hours before my visit. On palpation of the abdomen a central tumour, equal in size to an adult head, was felt. It was tense, hard, and very tender. It was only slightly movable, and on vaginal examination was found to occupy the upper part of the pelvis, but to be free from the uterus. Nothing abnormal was felt on rectal examination. There was free fluid in the peritoneal cavity. A diagnosis of ovarian tumour with a twisted pedicle was made, and the patient was at once sent into a nursing home for operation. The abdomen was opened in the middle line between the umbilicus and the pubes. Immediately on opening the abdomen a serosanguineous fluid escaped from the peritoneum; and on introducing the finger a dense, hard, slightly nodular tumour was found. There were some loose, lately formed adhesions to the omentum and small intestine. On separating these the tumour could be delivered through the wound. The loop of gut, in whose

mesentery it grew, was twisted round an axis at right angles to the bowel through one and a half turns, so that a volvulus, with a very tightly twisted pedicle, was formed. It was not safe to return the growth, on account of the hæmorrhage from the surface, which was freer after uncoiling of the twist. Removal of the whole segment of the bowel was therefore determined upon. The growth and 73 inches of involved small intestine were removed, and end-to-end suture performed. The patient rallied well from the operation; but on the second day an acute attack of bronchitis supervened, and ended fatally on the fourth day. The gut had healed well, and no secondary abdominal growths were found. On examination the tumour was found by Dr. Cairns Forsyth to be composed entirely of blood.

Case 3.—*Volvulus of the sigmoid; untwisting; enterotomy; recovery.*

Mrs. M., æt. thirty-six. Seen July 23, 1900, in consultation with Dr. Norman Porritt and Dr. Webster. On July 20 the bowels were moved naturally. Soon after this act an intense pain was suddenly experienced in the abdomen, most marked in the umbilical region. Vomiting followed soon and was copious and persistent. The abdomen rapidly distended, and absolute constipation was present. On examination of the abdomen one large coil was seen, of a horse-shoe shape, with the convexity towards the hepatic region. The respirations were very shallow and rapid; the pulse was 122. The abdomen was opened in the middle line, and an enormously distended sigmoid was found. The gut was opened and emptied, and there was then revealed a twist at the base of the sigmoid to rather more than a complete turn. The gut was untwisted and replaced, and the abdomen closed. A good recovery followed.

Case 4.—*Recurring volvulus of the sigmoid; excision of the sigmoid flexure; recovery.*

F. L., male, æt. twenty-one, was admitted to the Leeds General Infirmary, under the care of Mr. Ward, on September 16, 1899, suffering from intestinal obstruction.

First Attack.—Down to a month before admission he had been quite well. He was suddenly seized with abdominal pain, not very severe or prolonged, and sickness. From that time up to admission he had been absolutely constipated; neither

flatus nor fæces had passed for one month. The abdomen gradually enlarged, and on admission was greatly distended. Ten days before admission he vomited, and almost every day since he has vomited more or less. Pain had become gradually more severe. Enemata of oil, turpentine and water, and soap and water had been given without any effect.

First Operation (by Mr. Ward).—The abdomen was opened on September 17, 1899. A median incision was made below the umbilicus, and a condition of volvulus of the sigmoid flexure was found. The coil was untwisted, and the patient being placed in the lithotomy position and the sphincter stretched, the sigmoid and colon were partially emptied. The apex of the loop of the sigmoid was stitched to the middle line to prevent retwisting.

Second Operation (by Mr. Ward).—On September 19, as neither fæces nor flatus had passed, the sigmoid was opened in the middle line and an artificial anus established. On October 10 the bowels acted naturally for the first time, and subsequently the abdominal wound gradually closed, the bowels were moved regularly and naturally, and the patient left the infirmary on November 4.

Recurrence.—On September 3, 1901, the patient was sent to me by Dr. Waugh, of Skipton, on account of a recurrence of the intestinal obstruction. There had been some slight difficulty in getting the bowels opened for several months; this difficulty had become acute about a month earlier. He was confident in his statement that neither fæces nor flatus had passed for one month before.

Operation.—On examination he looked sallow and earthy in tinge. The abdomen was moderately distended. There was no localised bulging or any coiling. Nothing abnormal could be felt on rectal examination. The patient said that he had vomited a few times during the previous week, but he had continued to take food. I opened the abdomen on September 5, 1901, and found the following condition: The apex of the sigmoid flexure was adherent at the middle line. On separating it the sigmoid was opened; the opening was at once closed by suture. It was then seen that the upper part of the sigmoid loop —that portion between the end of the descending colon and the part of the loop adherent to the anterior abdominal wall—had be-

come enormously distended, and had fallen into the pelvis of the lower portion of the loop. A kink had thus been produced in the gut at the upper part of the abdominal incision. When the heavy, hugely distended upper part of the sigmoid was lifted out of the pelvis, the lower portion of the loop was seen; this was quite empty. The ends of the loop—that is, the end of the descending colon and the beginning of the rectum—were very much nearer together than in the normal condition. The base of the sigmoid loop was approximately 1½ to 2 inches in length. I therefore decided to remove the whole sigmoid. The upper end of the rectum and the descending colon were clamped with my stomach clamps, the sigmoid arteries ligated, and the whole loop removed. The cut ends of the bowel were closed by simple suture, applied after the method I always adopt—a continuous suture for the peritoneum and muscular coats outside and a continuous suture taking all the coats (to act as a hæmostatic) within. The abdomen was then closed without drainage. The patient made a perfectly uneventful recovery and is now (April, 1903) quite well.

Case 5.—*Compound volvulus of ileum and sigmoid flexure; untwisting; death.*

Mr. N. M., æt. 24. Seen in consultation with Dr. Hebblethwaite and Dr. Berry, of Keighley. For some weeks before this illness the patient had not been in his usual good health. He had given up active exercises, of which he was very fond, had ceased to ride horseback and to cycle, and had been capricious in his appetite. Three days before I saw him he complained of great abdominal pain, chiefly in the lower part of the abdomen, and nausea and occasional vomiting were present. When seen by Dr. Hebblethwaite his temperature was 100.6°, his pulse 110, he looked ill, and was obviously in great pain. The abdomen was distended everywhere and was a little tender. The bowels had not acted, but a little flatus had passed in response to an enema. On the subsequent day there was slight improvement in all the symptoms, but the condition gradually got worse and during the twelve hours before my visit there was an acute exacerbation of all the symptoms.

When I saw him his face was pinched and anxious, the skin cold, the breathing rapid and shallow, and the pulse 136, of feeble character. The abdomen was uniformly and tightly distended.

Palpation caused pain, which was chiefly elicited in the lower part of the abdomen, but not especially on either side. The abdomen was motionless on respiration. A rectal examination revealed only a sense of pressure upon the anterior wall of the bowel. Intestinal occlusion had been absolute for over forty-eight hours. I diagnosed an acute general peritonitis, and suggested, as the most likely explanation, the rupture of an acute exudation around the appendix into the general peritoneal cavity.

The abdomen was opened at once. The peritoneum was everywhere acutely inflamed, and there was blood-stained fluid free in the peritoneal cavity. A careful examination disclosed the fact that there was a volvulus of the sigmoid flexure, around which, as an axis, a loop of the ileum had been wrapped. The point of crossing was near the base of the sigmoid. There was therefore an intertwining of two loops—one in the sigmoid and one in the ileum. For this condition I have suggested ("Medical Chronicle," February, 1903) the name "compound volvulus." The loops were freed as speedily as possible, replaced, and the abdomen closed. The patient rallied from the operation better than might have been expected, but the following day hæmatemesis set in and he died on the third day.

Intestinal Obstruction due to Gall-stones.—Gall-stones which cause acute obstruction pass from the gall-bladder into the intestine by ulceration. There are only two exceptions to this —one recorded by Abercrombie, the other by Lynn Thomas (see "Medical Chronicle," August, 1903). The small intestine, from the duodenojejunal flexure to the ileocæcal valve, is funnel-shaped, narrowing by degrees. A stone which will readily pass down the jejunum may, therefore, become blocked in the ileum. Cases of gall-stone obstruction of the pylorus and duodenum are recorded.

The narrowest part of the bowel from the pylorus to the anus is at the ileocæcal valve. The valve may cause the arrest of a stone or may be ruptured or damaged by its passage. Thus Maclagan ("Trans. Clin. Soc.," vol. xxl, p. 87) records a case in which a woman, after four attacks of intestinal obstruction, passed spontaneously four large gall-stones, each one inch in

diameter, and at the postmortem only the fringes of the ileo-cæcal valve remained. It would appear that the gall-stone may, by the irritation of its rough surface, induce a spasm of the bowel and thus cause intestinal blocking, for Duplay and Reclus state that on postmortem examination the stone has often been found lying quite loose in the flaccid intestine. Israel has recorded a case of obturation due to a gall-stone whose largest diameter was barely ¾ inch; muscular spasm was considered a potent factor causing the obstruction. The conditions present in a case of gall-stone ileus differ from those present in most cases of intestinal obstruction. There is a block in the lumen of the bowel, but there is no interference with the circulation. The experiments of Kader have shewn clearly that the intensity and severity of the symptoms of strangulation are in no small measure due to the interference with the vascular supply of the involved loop. In gall-stone ileus we have to reckon only with a plugging of the lumen.

In operations for obstruction due to a gall-stone, the coil of bowel containing the stone nearly always presents in the wound at the moment when the peritoneum is incised. The loop containing the stone is then withdrawn from the abdomen, clamped above and below, or nipped by an assistant's fingers. The stone is then removed by an incision down on to it through the intestinal wall, the cut being of such length as the size of the stone demands. If the bowel below the stone be very empty and narrow, the stone may be displaced upwards two or three inches into a distended portion of the gut, to make the subsequent suture of the bowel easier. The stone being extracted, the incision is stitched by two layers of continuous sutures, the bowel cleansed and replaced, and the operation completed in the usual manner.

C. L. Gibson, in a study of 646 cases of intestinal obstruction, recorded between 1888 and 1898, found that 40 were due to gall-stones ("Annals of Surgery," October, 1900, p. 506); of the 40 cases, 21 died. There were 9 males and 27 females—

in the remainder the sex is not mentioned. The youngest patient was thirty-five years of age; only 7 patients were under fifty, and 8 were seventy years or over.

The obstruction was only once found below the ileocæcal valve; once the stone was impacted in the valve. In 21 cases the history distinctly states the site of its arrest as the ileum, in 2 as the jejunum, and in 1 at the junction of jejunum and ileum.

There was a clear history of gall-stones in 18 cases; in 5 cases it is distinctly stated that there had never been any suspicion of cholelithiasis. The largest stone weighed $3\frac{1}{2}$ ounces.

There can be no doubt that obstruction caused by a gall-stone is the simplest form with which the surgeon can meet. The block affects only the lumen of the bowel and causes no interference with the vascular supply of the gut. The results of operations are, however, not so satisfactory as could be wished. The cause of this is the usual one—delay. In not a few cases of obstruction due to a gall-stone the patient, when desperately ill, or even, as in one case, moribund, has recovered after the passing of the stone. It has, therefore, become the practice, accepted and authorised by the best writers, to postpone any surgical treatment until other measures have been tried and failed. Then when death is imminent, an operation is sanctioned. Here, as in all forms of obstruction, it is early operation alone which can remove the reproach that belongs to the treatment of this disease.

CHAPTER XXIX.

EMBOLISM AND THROMBOSIS OF THE VESSELS OF THE MESENTERY.

The occurrence of occlusion of the vessels of the mesentery by pathological processes was first described in 1847 by Virchow. The clinical manifestations were considered in a paper by Litten in 1875. A large number of cases have been described, and in a series of papers in the "Journal of the American Medical Association" (vol. i, 1904, p. 1469; vol. ii, 1904, pp. 29, 110, and 183) Drs. Jackson, Porter, and Quinby have analysed the records of 214 cases.

It is a remarkable but an undoubted fact that in occlusion of the mesenteric arteries the collateral circulation is very rarely established. The anastomosing vessels are of small size, and do not effect more than the carrying of blood in the smallest quantities to the impoverished area. The result is that this area becomes by slow degrees overloaded with blood, which is brought slowly to it but cannot escape from it; diapedesis occurs, and a hæmorrhagic infarction is established. Faber (quoted by Dr. Jackson) explains the infarction as being due to "back pressure of blood in the portal system, which overcomes and is greater than the pressure in the anastomosing vessels. The reason why the inferior mesenteric artery does not take up the work of the closed superior artery he explains by saying that it is a smaller vessel and cannot suddenly assume the functions of a larger one. Further, after closure of the superior mesenteric artery the pressure in the superior mesenteric vein necessarily sinks to *nil* immediately. The pressure in the portal system is thus lowered, making the flow from the inferior mesenteric vein easier. It is thus easier for blood in the inferior mesenteric artery to flow by its natural channel."

In some few cases, nevertheless, the evidence of the complete establishment of the collateral circulation is unmistakable. Chiene ("Jour. Anat. and Phys.," 1868, part iii, p. 65) describes a condition met with in the postmortem room which leaves no doubt upon this point. The cœliac axis was represented by a fibrous cord, the clear result of an old embolism. The upper portions of the mesenteric arteries were obliterated, yet the branches of both were filled with injection material. The collateral circulation had been established through the left and middle colic vessels. The plexus of arteries behind the peritoneum was much dilated, and formed a communication between the internal iliac artery and the arteries of the mesentery. Karcher records the case of a patient who lived at least two months after the superior mesenteric artery had been blocked. Similar instances are mentioned by Cohn, Virchow (two cases), and others. It is possible that in these cases the occlusion was very slow in formation, and that the collateral circulation had meanwhile become established.

The results which follow closure of the superior mesenteric artery alone, of the vein alone, or of both simultaneously, are identical. This has been shewn by postmortem investigation and also by experimental work conducted by Cohnheim.

As soon as the blood-supply of the intestine is interfered with, the wall of the bowel becomes readily and rapidly invaded by microörganisms, and putrefactive processes, ending in gangrene, are begun. The appearances presented by the bowel vary much according to the time that has elapsed. If the vessel or vessels be ligated, the first change that is apparent in the walls of the gut is that they are flaccid and anæmic; gradually they deepen in colour and become at last deep purple or black. The mesentery becomes turgid and thickened, and by slow degrees there occurs a distension of the implicated bowel.

The causes of the embolism or thrombosis are numerous. In the great majority of the cases of embolism there is endocarditis, and it is from the diseased valves that the fragment

which plugs the vessel is detached. Gallavardin asserts that the cardiac affection which is most commonly present is mitral stenosis. Atheroma of the mesenteric arteries has occasionally been found.

In cases of venous thrombosis the thrombus may be primary or secondary; it may originate in the vessel or may be secondary to portal thrombosis. Primary thrombosis has followed upon acute or chronic enteritis, upon the infection of a wound, upon the occurrence of intra-abdominal suppuration—as, for example, in inflammation of the appendix or Fallopian tubes. Secondary thrombosis has occurred as the result of cirrhosis of the liver, pylephlebitis, and syphilis. The extent of the necrosis or gangrene of the intestinal wall varies within the widest limits—in some cases there is no more than a narrow annular slough; in others many feet of the bowel are involved.

SYMPTOMS.

The symptoms vary greatly in different cases. There are two groups of cases, the acute and the chronic, of which the former is the larger.

In the acute cases the symptoms are ushered in with absolute abruptness at a time when the patient is in good health. There is a sudden, intense, abdominal pain, at first colicky in character, later becoming almost unremitting, which is speedily followed by nausea, vomiting, and perhaps collapse. There may be diarrhœa or constipation: if the former, the motions are frequent and blood-stained; if the latter, obstruction is absolute, neither flatus nor fæces being passed. In both, the abdomen becomes distended, rigid, and tender. There are occasionally the signs of free fluid in the peritoneum. The general condition of the patient is poor from the first and rapidly becomes worse. The temperature is often subnormal. The pulse is always rapid, and its quality is bad. Blood-stained motions are found in 41 per cent. of the cases, but even when

no blood has been passed, the intestinal contents are always found to be deeply blood-stained.

The second smaller group is formed by cases of quiet, insidious origin, with a prolonged and varying course. Jackson and others have shewn that the belief that the acute cases were dependent upon embolism and the chronic upon thrombosis is fallacious. In the series of cases collected by Jackson, Porter, and Quinby there were 7 marked chronic cases dependent upon thrombosis and 7 dependent upon embolism.

The cases are almost twice as common in men as in women, and the majority are found between the ages of thirty and sixty years.

There is always the greatest doubt as to the nature of the illness from which the patient suffers. A diagnosis of intestinal obstruction is generally made, and it is only at the operation or at an autopsy that the exact condition of affairs is revealed.

Gerhardt considers the following signs as necessary to the making of a diagnosis:

1. The presence of a source for an embolus.
2. Copious intestinal hæmorrhages, not to be explained by disease of the wall of the bowel or by impediment to the portal circulation.
3. A rapid and marked fall of temperature.
4. Colicky pains in the abdomen.
5. The simultaneous or previous occurrences of embolism in other parts. Falk collected the records of 17 cases of embolism of the superior mesenteric artery; in every one there was evidence of embolism having occurred elsewhere.
6. The occasional presence of a tumour in the abdomen, due to the infiltration of the mesentery by blood.

Not all of these signs are present in any cases, but the existence of some of them is necessary to the making of a diagnosis.

J. Amos ("Zeitschrift f. Geb. u. Gyn.," Bd. 55), in recording

two cases of thrombosis of the superior mesenteric vein, reviews the whole literature of the subject and concludes that in a case where the symptoms are those of intestinal obstruction, one should think of superior mesenteric vein thrombosis if (*a*) there are present any conditions favouring an increased rate of coagulation of the blood, such as pregnancy, eclampsia, and thrombosis of veins elsewhere; (*b*) there be stagnation in the portal circulation; (*c*) there have been any artificial thrombus formation (as, for example, after operation) in the vicinity of the affected vessels; (*d*) there have been any purulent processes in the areas drained by the radicles of the portal system.

The **prognosis** is bad. The mortality in reported cases is 94 per cent. Neutra, quoted by Jackson, Porter, and Quinby, writes:

"In cases of acute onset the prognosis is indeed very grave, but by no means absolutely bad, since behind these severe symptoms there may be hidden a chronic process which favors the formation of a collateral circulation, and on this the prognosis depends. If, on the other hand, the course is a chronic one and only a few exacerbations are present, between which there is complete absence of symptoms, the prognosis, nevertheless, is moderately bad, since in these cases it must be assumed that because of some hindrance a competent collateral circulation cannot be formed. Accordingly, thrombosis of mesenteric arteries is of relatively better prognosis than embolus."

TREATMENT.

In the surgical treatment of these most serious cases the first and most essential point to remember is that the gangrene of the bowel may be in a state of progression. A well-defined line of demarcation between the healthy and the involved may be seen, but more often there is no abrupt transition from one to the other. Unless, therefore, a needlessly extensive resection is made, it is impossible in all cases to be certain that the whole of the involved loop of bowel has been removed.

It is, accordingly, reasonable to suppose that the safest measure to adopt in all cases is the resection of the bowel which is undoubtedly involved and the establishment of an artificial anus. If an end-to-end anastomosis is completed, a subsequent extension of the process of gangrene may cause an otherwise satisfactory operation to fail. Moreover, the patients who suffer from this affection are often seriously ill, and an extensive removal of the bowel with the suturing of the cut ends together will occupy so much time, and will involve so much handling of the parts, that the strain may be beyond the patient's endurance. In the cases quoted by Jackson there were 47 which were dealt with by operation. Of these, 4 recovered. This deplorable result is probably due to the performance of an operation unsuited to the patient's condition.

The case, as I have said, will probably be considered as one of acute intestinal obstruction, and will be submitted to operation for the relief of that condition. All the measures of precaution that have been described before will be adopted in order to shorten the operation and to prevent the occurrence of shock.

When the abdomen is opened, there is generally an escape of fluid which is more or less blood-stained and may be offensive. The fluid resembles very closely that which we are accustomed to see in the sac of a long strangulated hernia. A rapid but careful examination of the intestine will reveal the exact condition of affairs. A deeply congested purple segment of gut will be found, and there will be no evidence of mechanical constriction or of volvulus to account for the condition. The mesentery to the implicated bowel may be immensely thickened by blood-clot, so that a large tumour may be felt at once. The gangrenous gut is withdrawn from the abdomen, and the whole loop involved is resected in the usual manner. Clamps are applied well above and well below the disease; the bowel is divided, and with its mesentery the whole involved part is removed. The two cut ends of the bowel are then brought

out from the wound side by side, and their peritoneal surfaces stitched to the parietal wound; or a Paul's tube may be placed in each end; or the cut edges of the mesentery above and below may be approximated and a few sutures passed uniting the mesenteric portion of the bowel, the remainder of the circumference being left open and being brought up to the surface. In all cases drainage of the intestine must be ensured. The contents of the bowel resected will be seen to be deeply blood-stained, and a blood-stained discharge may flow from the artificial anus for several days after the operation. When the bowel has been secured to the abdominal wall, the parietal wound is closed as rapidly as possible.

If the operation prove successful, the patient will rapidly gain strength. A second operation for the closure of the fistula must then be performed as soon as it appears prudent to attempt it; for the fistula in the bowel may be high in the small intestine, and the discharge may be of an intensely irritating nature. The patient, then, suffers severely from inanition, as a result of the escape of food-material from the fistula.

CHAPTER XXX.

OPERATIONS FOR FÆCAL FISTULA AND ARTIFICIAL ANUS.

Openings between the intestine and the surface of the skin are of three kinds:

1. A small opening upon the skin leads by a direct or tortuous path to an opening in the bowel. There is, that is to say, a fistulous tract between the skin-surface and the gut (Fig. 243).

2. A larger opening in the intestine has an edge formed by the direct continuation of the mucosa with the skin. Such a condition would result from making an incision into a portion of the bowel and stitching the edges to the skin-margin. At the bottom of this opening can be seen the mucosa of the opposite side of the bowel, and a finger passed into the opening can be made to pass in two directions—upwards and downwards; there is no spur and no prolapse (Fig. 244).

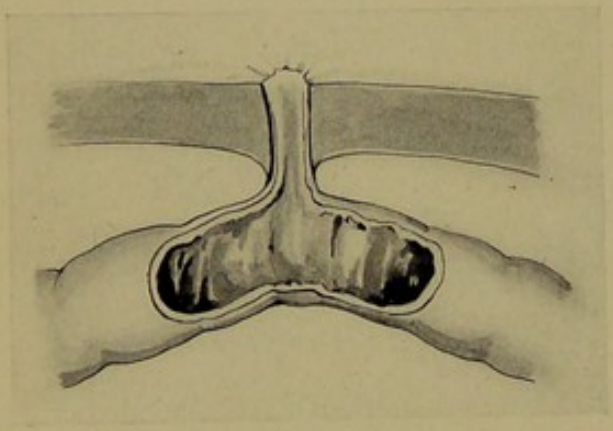


Fig. 243.—Fæcal fistula.

3. The intestine, as it comes to the surface, has two limbs which join at an acute angle. A well-marked spur is formed. On the proximal side of this the bowel is wide and readily admits the finger. On the distal side the bowel is narrowed from disuse. All the intestinal contents coming downwards escape at this artificial anus; none, or very little, passes over the spur into the distal segment. The spur is approximately on a level with the skin (Fig. 245).

The closure of a fæcal fistula is accomplished with ease or with difficulty, according as there is an abundant or a deficient supply of peritoneum. If the wound in the bowel can be closed

in securely with a suture of the serous coat, its firm healing will undoubtedly follow. If no peritoneal investment can be obtained, the closure of the wound is problematical. It follows, therefore, that an opening into the small intestine or into the

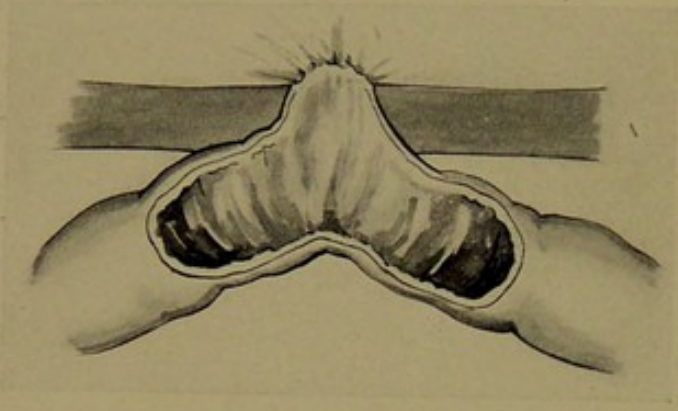


Fig. 244.—Artificial anus, without spur.

transverse colon or the sigmoid flexure (all of them completely clothed in peritoneum) is more easily dealt with than an opening into the ascending or descending colon, especially if the

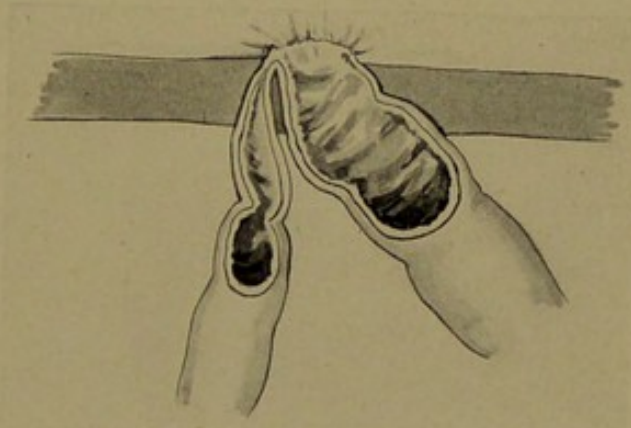


Fig. 245.—Artificial anus, with spur.

posterior surfaces, bare of peritoneum, are only or chiefly involved.

In all cases some considerable attention must be paid, perhaps for many days beforehand, to the preparation of the skin. The discharge, from the small intestine especially, has a most

irritating effect, producing a florid, intensely red, raw, excoriated appearance. Such a condition of skin often causes the patient intense misery. The intestinal contents escaping over it seem to scald, and by their irritant action to intensify the already grievous suffering of the patient. If the skin be constantly cleansed, kept dry, and covered with an ointment (the ung. zinci oleati in my experience is the best) thickly applied, some improvement of the condition may result. Prevention, however, is better than attempted cure, and it is, therefore, desirable that the skin should be protected from the time the opening into the bowel is made. This may be effected by covering the skin with some rubber dam (as used by Murphy) or by daubing the skin with a four per cent. solution of pure rubber in benzine or acetone. An impenetrable covering to the skin may thus be made, which can be washed off with benzine at any time. Plugging of the bowel, in order to prevent it emptying on to the skin, is generally ineffective. For twenty-four hours before the operation very little should be given by the mouth, so that peristalsis is not excited. The precautions suggested by Harvey Cushing, to which reference has already been made, are carefully observed.

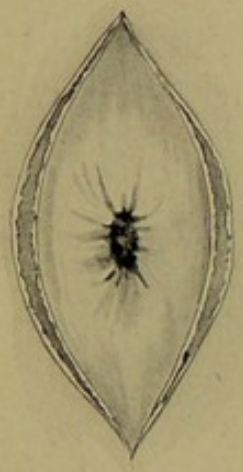


Fig. 246.—Fæcal fistula. Lines of skin incision.

1. In cases where a fæcal fistula of the first type mentioned is present, the following operation will be found the most satisfactory:

An elliptical incision is made through the skin at some little distance from the margins of the skin opening. The skin-edges are always unhealthy, sodden, and eczematous, and their free removal is desirable. The incision is carried through the skin, subcutaneous tissues, and muscular layer of the abdominal wall until the peritoneum is reached. If there is any fear

of leakage from the fistula, the cut edges of the skin surrounding may be turned over and sutured very tightly together with a running stitch of stout thread, so as to cause accurate apposition and prevent leakage. It is better to do this than to plug the bowel with wool or gauze which will have to be removed at a later stage of the operation. The peritoneum is then opened with care, for adhesions of those parts of the bowel below the fistula to the abdominal wall are not infrequent. When the peritoneum is freely opened, the loop of bowel is withdrawn. With it will be the ellipse of skin surrounding the fistula and the fistulous tract. The bowel is surrounded by moist gauze swabs and is held by a single clamp, which prevents hæmorrhage and leakage. A pair of scissors now snips through the gut at the margins of the fistula, so that an oval opening is made, and the fistulous tract, skin, etc., are removed. The opening into the bowel will be found to be of small size, and generally in the longitudinal axis of the gut. This opening is now sutured, at right angles to the axis of the gut, with a double layer of sutures, one embracing all the coats, the outer picking up the seromuscular coats only. The clamp is removed, the parts thoroughly cleansed, and the gut returned within the abdomen. Over it the omentum, if accessible, is care-

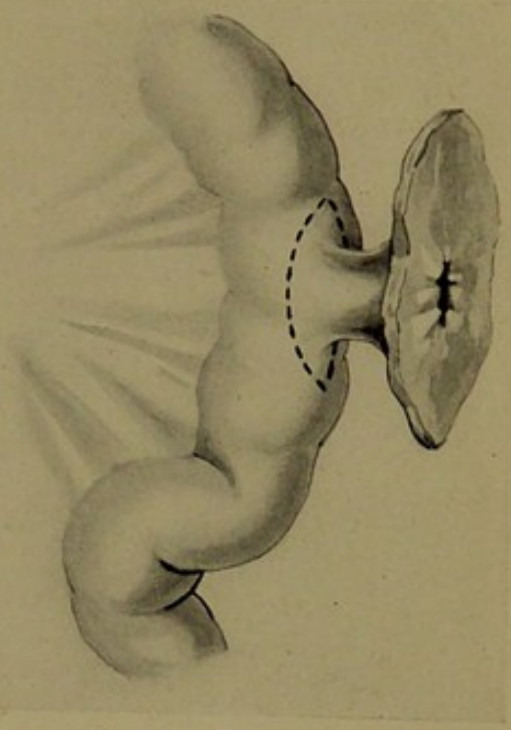


Fig. 247.—Fæcal fistula. The dotted line shows the portion of bowel removed.

Fig. 248.—Fæcal fistula dissected out (after Treves).

fully laid. The parietal wound is now closed, after further trimming, if such be necessary.

2. In the second variety of intestinal fistula the following operation may be practised. An elliptical incision around the mucous margin of the opening is made and deepened until the adherent wall of the bowel is met with. The adhesions of the gut to the surface are then gently separated, and the bowel isolated and the peritoneum protected as before. The clamp is applied for the controlling of the blood-supply in the bowel and to prevent the escape of intestinal contents. The margins of the fistula are trimmed, and the size of the gap in the intestinal wall can then be seen. It will be found that the loss of substance chiefly involves the portion of the bowel most distant from the mesentery, the mesenteric border being almost always quite intact. Even after a considerable loss of substance an end-to-end approximation of the gut may be made, the strip of the bowel-wall along the mesenteric border being allowed to remain. It is rarely necessary in this form of fæcal fistula to do more than trim freely the edges of the intestinal opening and afterwards to suture the opening transversely to the long axis of the intestine. The intestine is then found to be bent upon itself at an angle, the apex of which is at the mesenteric margin of that strip of the wall of the gut which was not removed. Two continuous sutures are used to close the opening—an inner, which

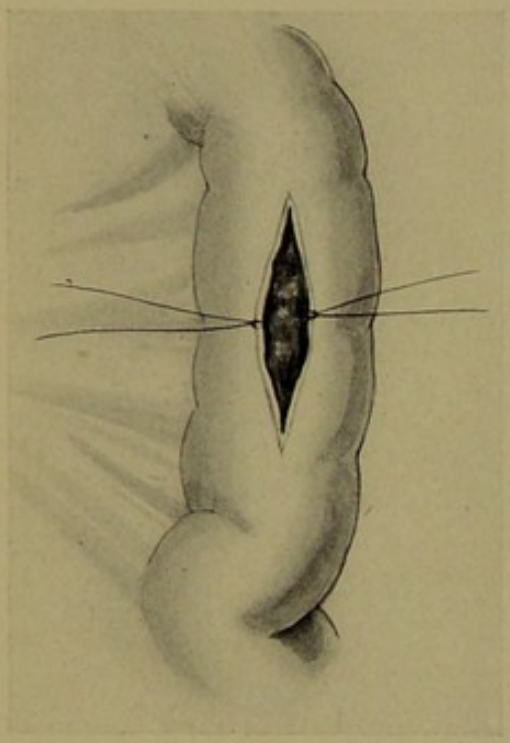


Fig. 249.—The fistulous tract is excised and the wound is drawn open transversely.

includes all the layers, and an outer, which includes only the seromuscular coats.

When the loss of substance is considerable, this method of operating is not possible. Under such circumstances a complete resection of the involved segment of the bowel, followed by end-to-end union, must be performed.

3. In the third form of fistula, that in which an artificial anus, with the formation of a spur, is found, a resection of the involved portion of the gut is generally necessary.

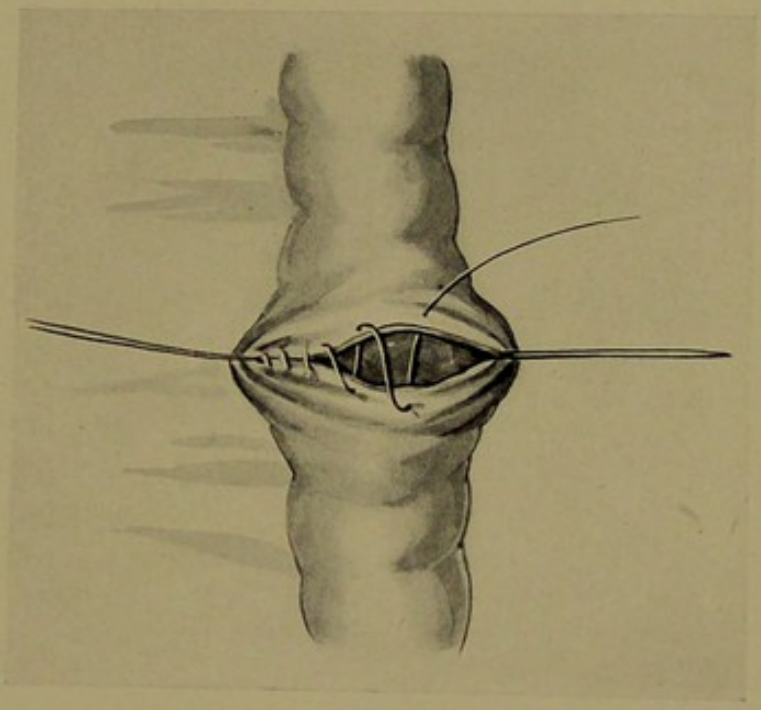


Fig. 250.—The opening in the bowel closed in the manner shewn.

In some instances, however, as in cases of Paul's operation, previously described, and in cases of colotomy, or of fæcal fistula, following upon strangulated hernia, it is possible to destroy the spur and to convert the abnormal opening in that manner into a fistula of the second class, which can be closed by the paring of the edges and suture. The destruction of the spur, or its obliteration, may be effected in one of two ways: When the spur is slight, the suggestion of Sir Mitchell Banks may be adopted. This distinguished surgeon introduced a piece

of thick rubber tubing into the bowel, pushing one end of the tube into the upper end and the other into the lower end of the bowel. The tube, being elastic, tended to straighten itself, and in so doing exerted a continuous pressure upon the spur, which was gradually borne down. The tube was secured by a long silk thread.

A more effective method of dealing with the spur is that in

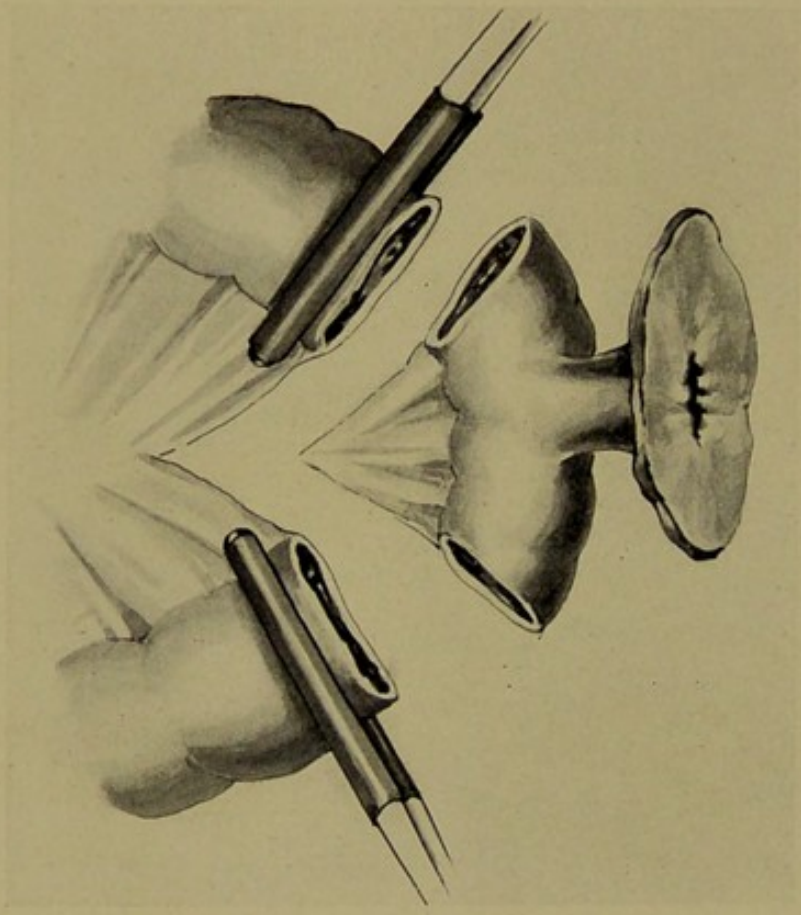
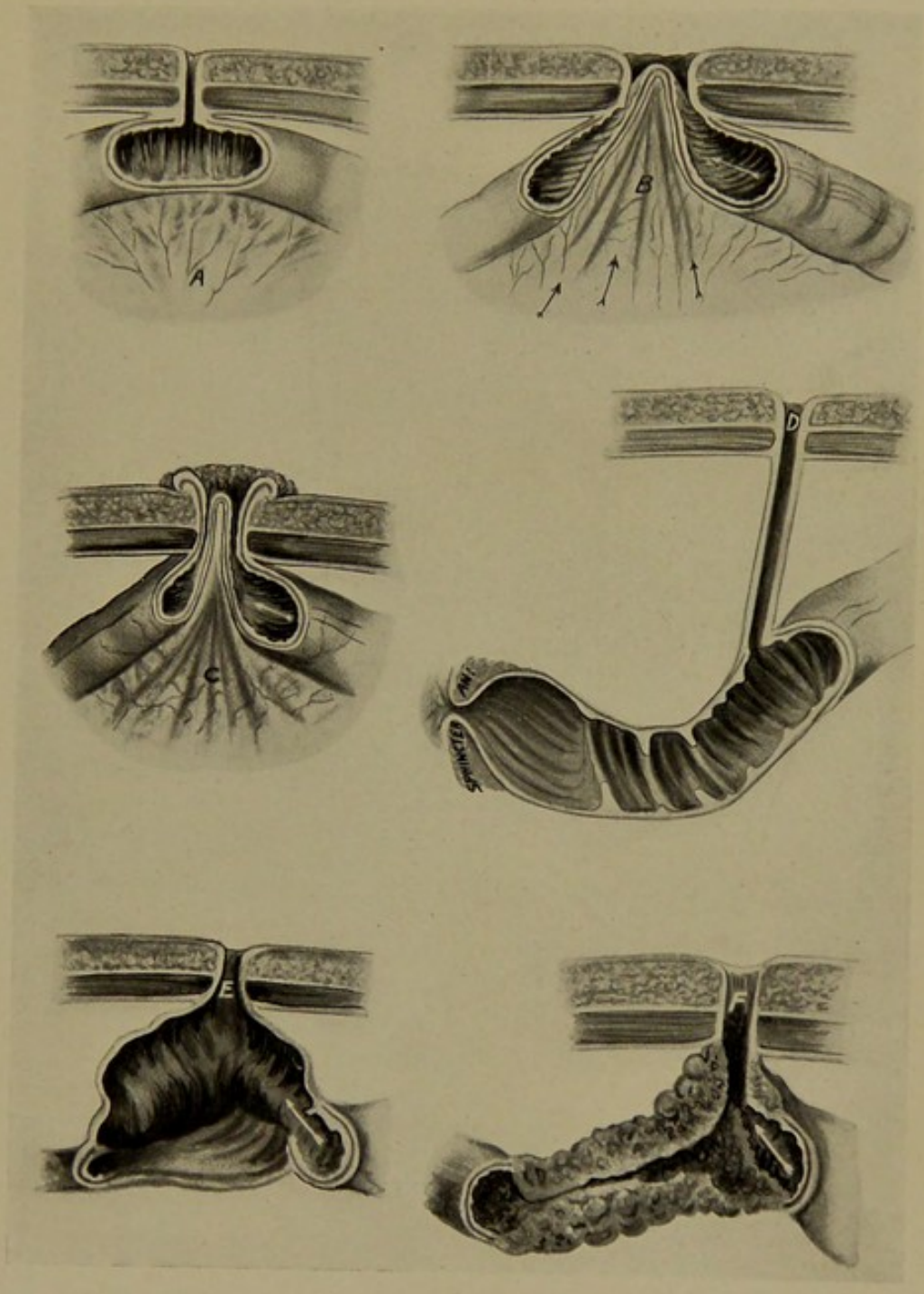


Fig. 251.—Fæcal fistula necessitating enterectomy.

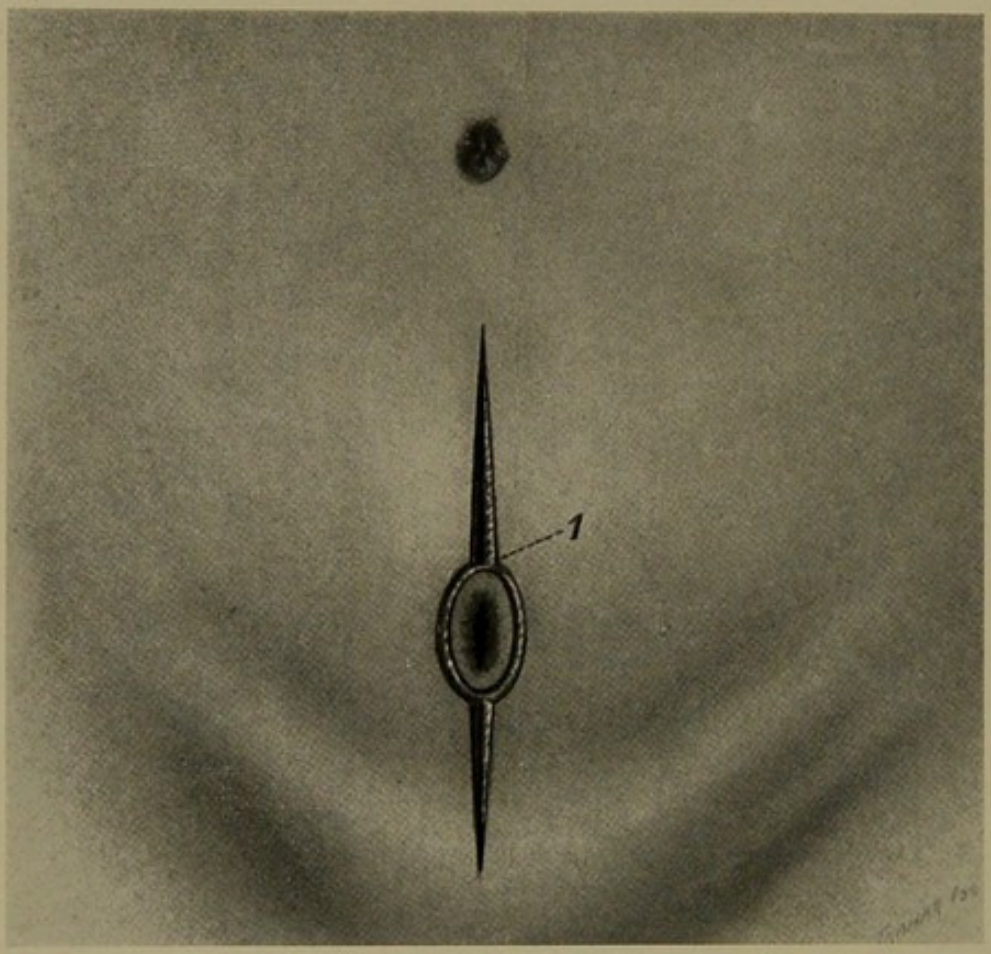
which an instrument of the type of Dupuytren's enterotome is used. This instrument consists of a pair of forceps with long, roughly serrated blades which are pressed together and held by a clip or a screw in the handle. One blade of the forceps is introduced into the upper opening and another into the lower opening, so that when the blades are closed, the spur is grasped between them. The pressure of the blades is tightened daily

PLATE IV



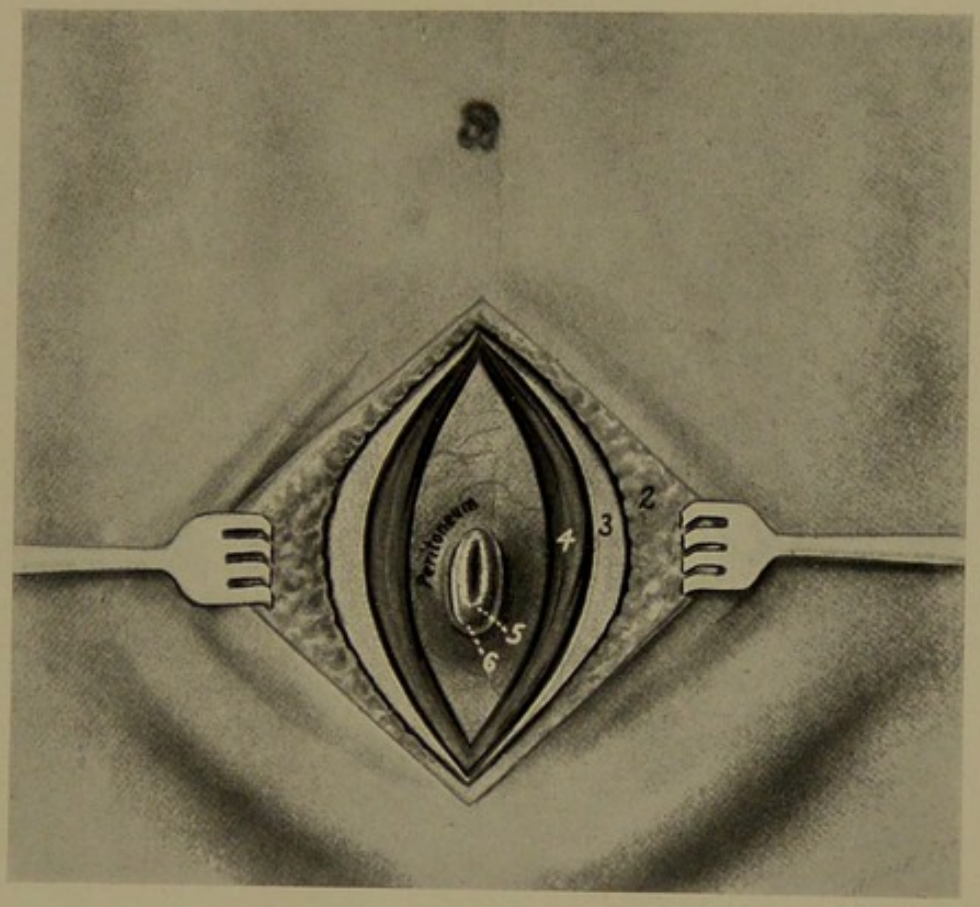
Types of fæcal fistulæ. *A*, Simplest form; *B*, spur formation or reducible hernia type; *C*, artificial anus or irreducible hernia; *D*, fistula leading to intestine remote from abdominal wall; *E*, fistula leading to large cavity resulting from gangrene due to mesenteric embolism; *F*, fistula leading to intestine above cancer (Coffey in Annals of Surgery).

PLATE V



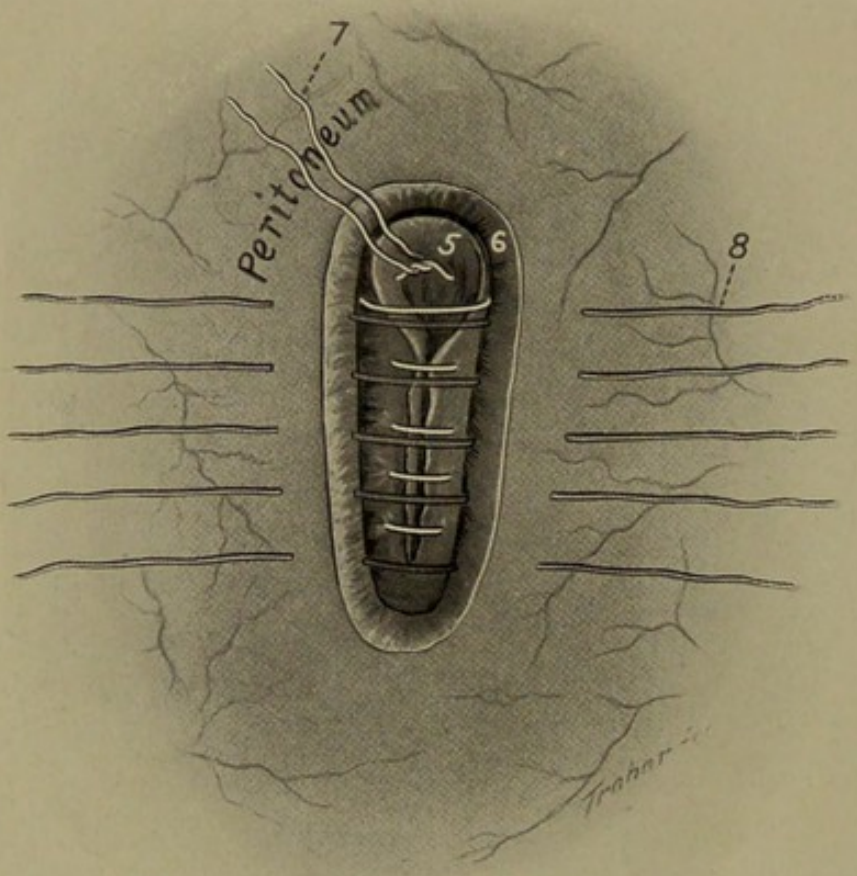
Skin incision. 1, Incision through skin, forming long wound, and surrounding the fistula (Coffey in Annals of Surgery).

PLATE VI



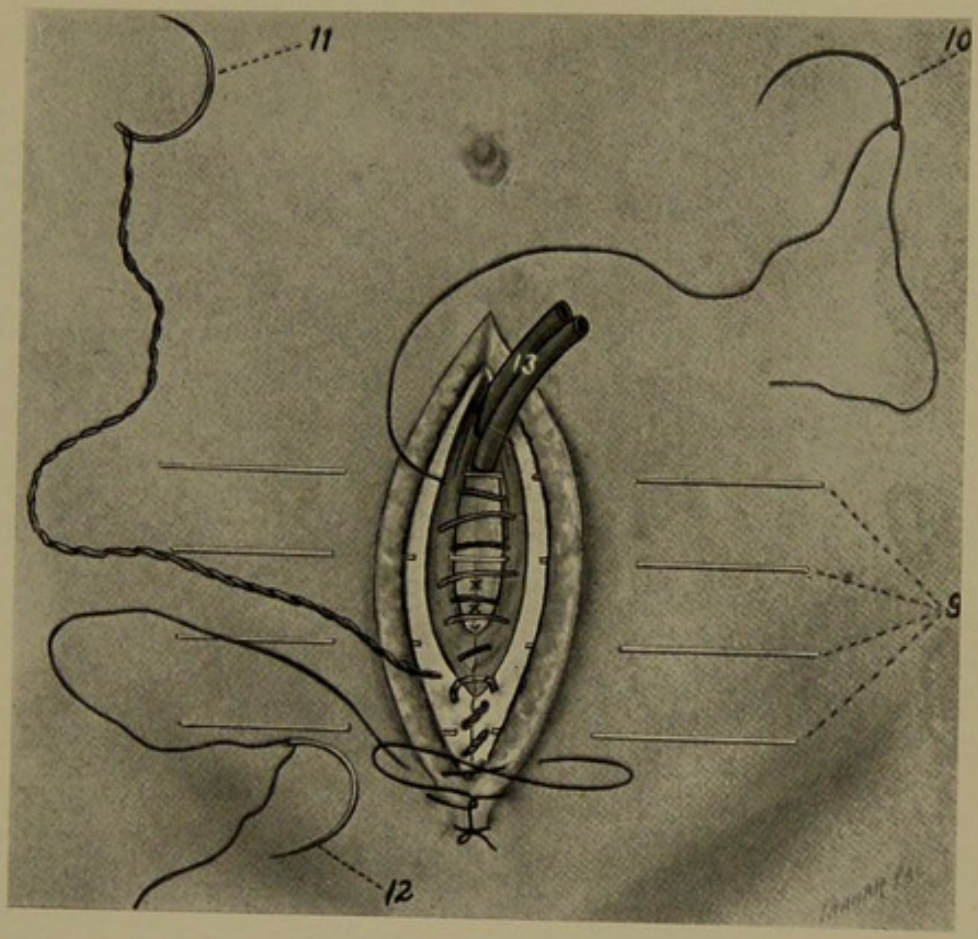
Wound dissected and layers separated ready for suturing. 2, Dissect fat off the fascia for two inches away from the wall; 3, separate fascia from muscle; 4, dissect the peritoneum away from the muscle for two inches on every side; 5, remove margin of skin around fistula which has been left; 6, make superficial incision around cicatricial canal (Coffey in Annals of Surgery).

PLATE VII



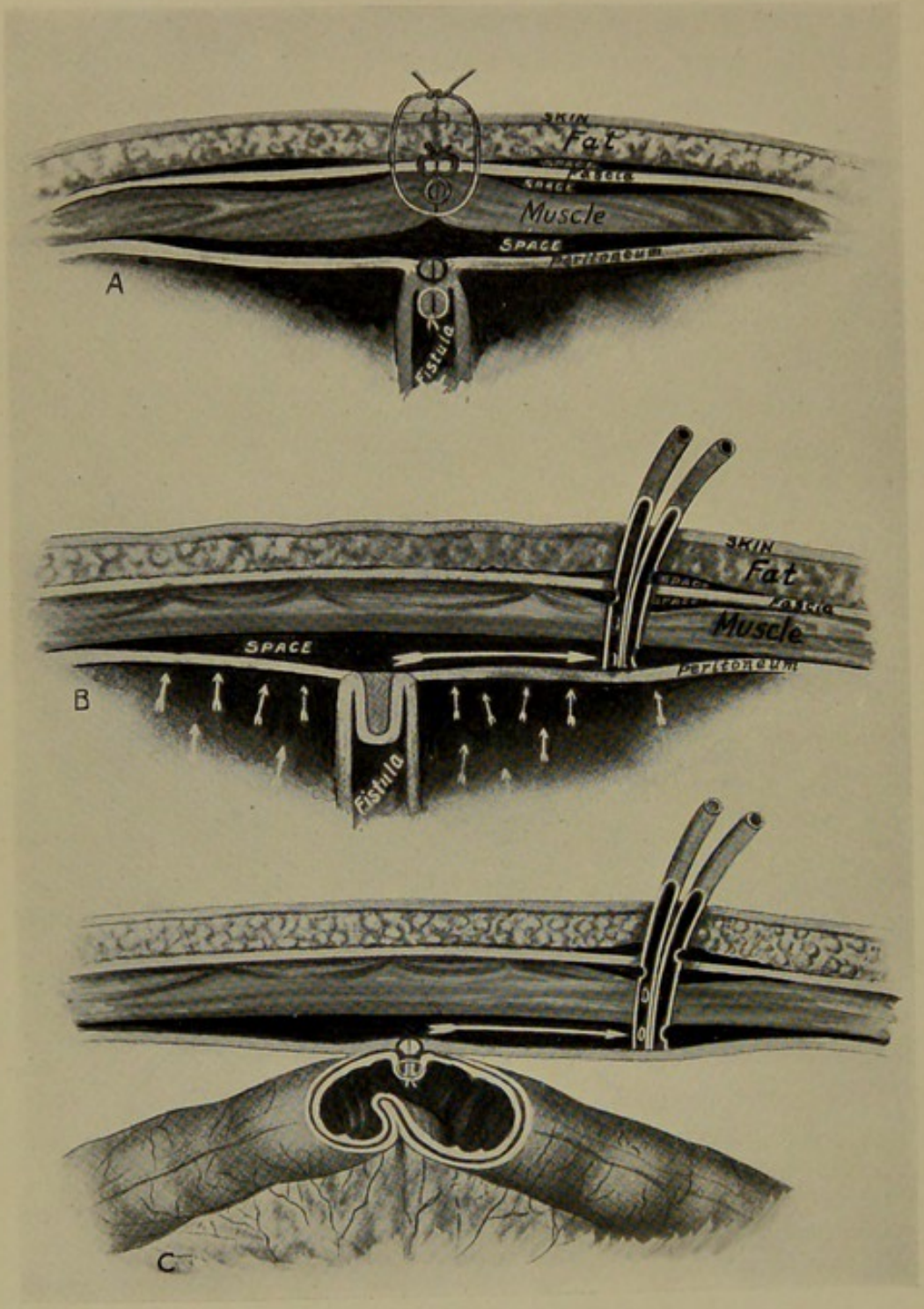
Closure of the fistula proper. 7, Turn in fistula proper with linen suture knotted on the inside after method of Connell; 8, bring the raw edges of the cut together with catgut sutures, including connective and cicatricial tissue (Coffey in Annals of Surgery).

PLATE VIII



Closure of the abdominal wall with layer sutures. 9, Silkworm gut sutures left untied; 10, bring the muscular layer together loosely with catgut suture; 11, suture fascia with heavy double catgut; 12, suture the skin with button horse-hair suture; 13, place drainage in the upper angle of the wound (Coffey in Annals of Surgery).

PLATE IX



Diagrams shewing sectional views to illustrate the mechanism of the suturing and drainage. *A*, Transverse section through the fistula and layers of the abdominal wall; *B*, longitudinal section in line of the incision shewn in the previous picture; *C*, result following closure of artificial anus (Coffey in Annals of Surgery).

until the spur is destroyed. An ordinary pair of broad clips acts quite as efficiently as the specially devised instrument.

When the spur is destroyed and the lumen of the proximal and distal segment of the gut is again patent, the fæcal current is restored, and a spontaneous closure, or closure by the method of partial resection just described, may be effected.

Failing these, the only satisfactory method is resection of the bowel involved in the fistula.

In performing the operation of resection the preliminary stages are the same as those already described. An oval incision through the skin, rather wide of the opening, is made and deepened cautiously until the peritoneum is opened. The bowel is made free from all surrounding adhesions, withdrawn from the abdomen, and packed round with swabs. The gut to be excised is then clamped at each end, and the typical operation of resection, previously described, is performed.

In resection operations in cases of fæcal fistula, wherever situated, it is often a matter of some difficulty to free the bowel involved from the intricate complexity of adhesions by which it is surrounded. These adhesions affect more especially the distal segment of the gut—that which has been relieved of a portion of its function by the existence of the fistula. As a result of this relief the distal bowel is wasted, shrunken, and empty. The coils contract adhesions, one with another, and when an end-to-end anastomosis has to be performed, the disparity in size of the ends may be remarkable.

EXTRAPERITONEAL CLOSURE OF FÆCAL FISTULÆ.

R. C. Coffey ("Annals of Surgery," June, 1907) describes an extraperitoneal method of closing fæcal fistulæ. Up to the time of the publication of this paper he had closed seven consecutive fistulæ of from four months' to two years' duration without a failure by the method. His description is as follows:

"1. Dissect out the old scar down to the fat and make an incision around the fistulous tract, including a small strip of skin;

direct the front of the knife slightly away from the fistula, so that it first comes in contact with the fascia about half an inch away from the fistula, in order to avoid any possibility of opening the peritoneum.

"2. Dissect up the fat from the fascia for as much as two inches from the incision; draw it back clean off the fascia.

"3. Make an incision through the fascia, beginning at the upper end of the wound, and coming toward the fistula. Dissect the fascia from the muscle for at least two inches in every direction.

"4. Dissect the muscle from the peritoneum in the same manner so that the peritoneum hangs loosely with the fistula, standing up in the center like a volcano and its crater.

"5. The little margin of skin which has been left with the edge of the fistula is now trimmed off.

"6. If the wall of the fistula is hard and cicatricial, making it difficult to turn in, it is well to make an incision part of the way through the cicatricial tissue so that it may be turned in easily.

"7. The edges of the fistula are turned in with linen sutures which are knotted on the inside.

"8. A second layer of sutures brings the edges of this incision and the connective tissue covering the peritoneum, along with the scar tissue covering the turned-in fistula, to add temporary strength and bulk to the closure. The peritoneum and the rest of the wound is now thoroughly mopped or irrigated with salt solution to make it as clean as possible.

"9. Silkworm-gut sutures are passed through the skin, fat, fascia, and muscle, about half an inch or more from the wound edge, and left untied, space being left at the lower end of the wound for drainage.

"10. Suture the muscle loosely with a continuous catgut suture.

"11. Suture the fascia with a strong double catgut suture.

"12. Suture the skin with a horsehair button-hole stitch."

The final stage consists in placing the drainage-tubes in position.

The chief adverse criticism of this method is that there is, in the cases of fistulæ leading to intestine remote from the abdominal wall, a possibility of leaving a fibrous band connecting gut and parietal peritoneum after the fistula has healed, and that this band may be the cause of a future obstruction.

CHAPTER XXXI.

OPERATIONS UPON THE APPENDIX.

1. REMOVAL OF THE APPENDIX.

The removal of the appendix in the interval of quiescence which follows the last of a series of attacks was advocated in 1887 by Sir Frederick Treves. It is now more frequently performed than any other abdominal operation.

Position of the Appendix.—The appendix cannot be said to have any normal position. Its position, doubtless, changes in the individual from time to time. When a series of bodies are examined, the appendix may be found in any of the following positions:

(*a*) Lying with its tip pointing towards the spleen, being behind the termination of the ileum.

(*b*) Hanging over the brim of the pelvis.

(*c*) Lying in the iliac fossa, with its end near Poupart's ligament.

(*d*) Lying along the outer side of the ascending colon.

(*e*) Lying behind the cæcum and ascending colon in the retrocolic fossa.

The first two are the positions in which the appendix is most commonly found at operations. The place in which the appendix will be found can often be conjectured before the operation is commenced. If, during the acute attack, there has been the "symmetrical" pain,—pain, that is, over an area on the left side corresponding to McBurney's point on the right side,—the appendix will be found to hang over into the pelvis or to be adherent across the middle line. If there has been pain spreading upwards from the iliac fossa to the gall-bladder region or backward to the loin, the appendix will probably lie along the outer side of the colon.

Operation.—The abdomen is opened by an incision which does not divide the muscles, but splits them, each in the direction of its fibres, or by an incision which displaces the rectus muscle to the inner side. I greatly prefer the latter. The former incision was first suggested by McBurney ("Annals of Surgery," 1894, vol. xx, p. 38). The skin is divided along an oblique line about three to four inches in length which begins about an inch and a half above, and internal to, the anterior superior spine, and passes downwards and inwards. When the skin and subcutaneous tissues are divided, it will be seen that the line of the incision corresponds precisely with the line

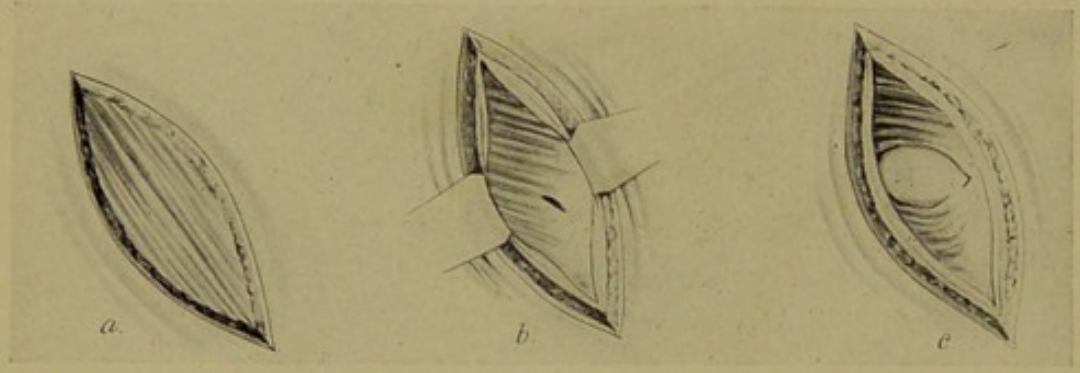


Fig. 252.—McBurney's incision for removal of the appendix: *a*, Fibres of external oblique before the splitting; *b*, fibres of external oblique separated; a small incision made through fibres of internal oblique and transversalis near outer border of rectus; *c*, fibres of internal oblique and transversalis separated; peritoneum exposed.

of direction of the fibres of the external oblique. These fibres are split by making a small cut through them, and then, with the fingers, tearing them apart. The internal oblique and transversalis are now split in the direction of their fibres—that is, at almost a right angle with the fibres of the external oblique. This separation of the fibres of the two muscles is most easily effected by making a small incision through their common aponeurosis, just at the outer margin of the rectus muscle, and by enlarging this small cut by the introduction of a clip or the tip of a finger, and then gently pulling the fibres apart. The separation of the muscular bundles should be cleanly and neatly

done and should leave them smooth and unfrayed. The fingers of an assistant or a couple of retractors are now placed in the wound to drag apart the edges, and the peritoneum is seized with dissecting forceps and incised, an opening about 1½ to 2 inches being made. The surgeon now introduces his forefinger into the wound and searches for the cæcum and appendix, and the retractors are taken away.

In some cases more room than is afforded by this incision may be necessary. If so, the prolongation of it first suggested by Harrington may be found useful.

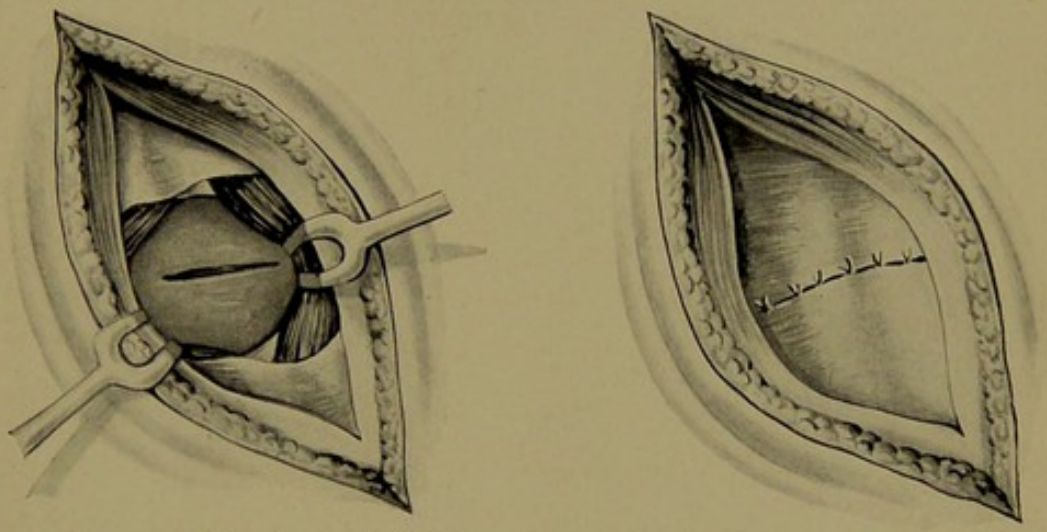


Fig. 253.—Harrington's incision for the removal of the appendix. The McBurney incision is made, and the sheath of the rectus afterwards opened, the rectus being drawn to the inner side. The method of closure of the wound is also shewn.

The following description of his method of incision is given by Francis B. Harrington ("Boston Med. and Surg. Journal," 1905, clii, 342).

"Make an incision in the skin four to five inches long in a line with the fibres of the external oblique muscles, at such a distance from the anterior superior spine of the ilium as is desirable. Separate the muscle and its tendon without cutting for a like distance, then insert retractors one and a half inches broad at either end. The middle of the incision should correspond to the usual position of the base of the appendix. At

this point the internal oblique and transversalis muscles run nearly parallel and horizontal. These muscles should be separated, without cutting down to the transversalis fascia, and from the ilium to the linea semilunaris. If this does not give sufficient room, the sheath of the rectus may be separated in front and behind the muscle in a line continuous with the separation of the internal oblique and transversalis muscle.

"The sheath of the rectus muscle is formed by the aponeuroses of the internal oblique and transversalis muscles. The direction of the fibres of the sheath is horizontal, being at right angles to the line of muscular fibres of the rectus. At the semilunaris line it will be necessary to use the knife or scissors, since at this point the union of the various aponeuroses is very compact. The rectus muscle can then be drawn toward the linea alba, and considerable room obtained.

"Care should be taken not to cut the deep epigastric artery which at this point lies inside the rectus sheath in the posterior part of the muscle. If necessary, it may be tied. Two retractors, each about two inches broad, should be inserted, one at either end of the deep incision; the retractors which have been used for the external oblique can now be dispensed with."

The search for the appendix may be easy or may be supremely difficult. If the cæcum can be felt at once, it is hooked forwards into the wound, and the longitudinal muscular bundles are followed down upon it until the appendix is reached. It is important to remember that the longitudinal striæ of the ascending colon lead downwards to the appendix. They are not rarely the only landmark the surgeon may have. When the finger is first introduced into the abdomen, the appendix may be felt at once—may forthwith be pulled forwards to the wound. Or a small irregular swelling may be felt, which is recognised as the appendix involved in a mass of inflammatory exudate. If any stripping of dense adhesions has to be done, it is desirable to pack off the operation field by means of sterile gauze. This will secure that in case an infected area is opened up no septic matter can escape into the general peritoneal cavity. Ad-

hesions, when present, are gradually separated without much difficulty, but in some cases the patience and skill of the surgeon may be tried to their utmost.

If the omentum is found to form a protecting hood over the appendix or to enclose it in a wrap, it should not be stripped away, but should be clipped, divided, and ligated at a little distance from the appendix. The latter, with the omentum around it, is then removed *en masse*.

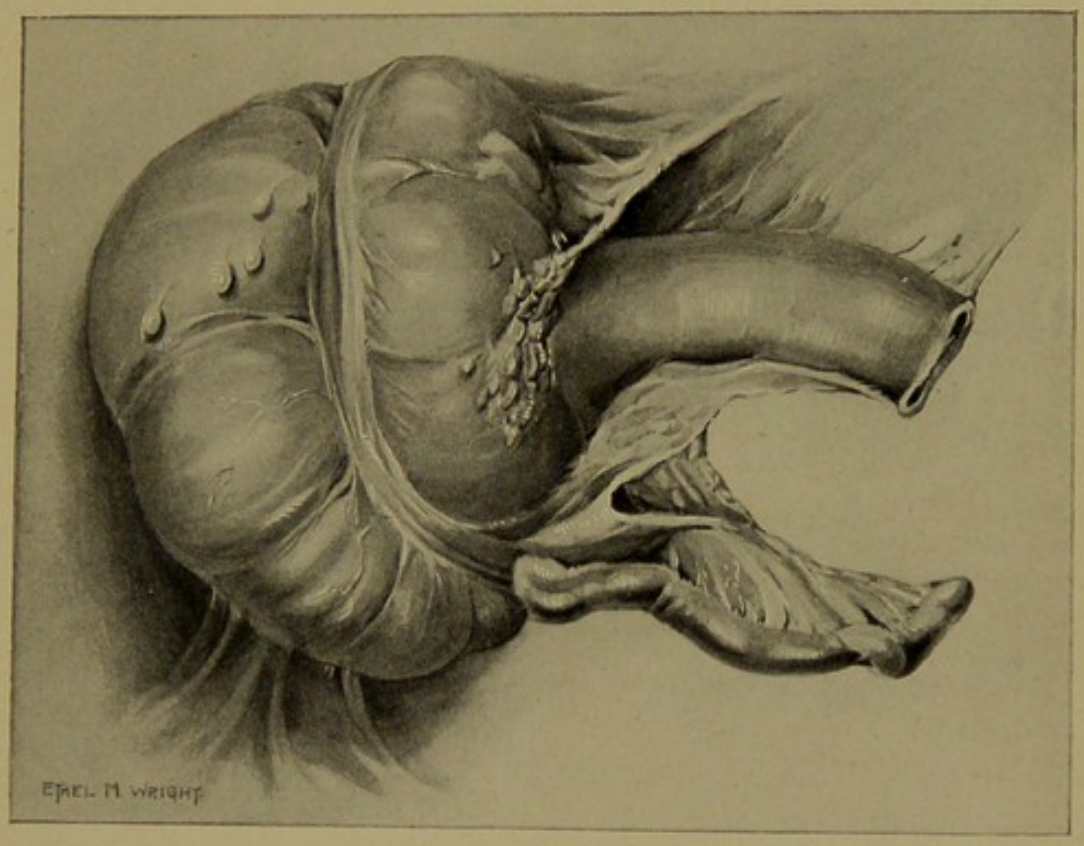


Fig. 254.—Cæcum, ileum, and appendix. Appendix to be removed.

In separating off the complex and firm adhesions of structures which are perhaps unrecognisable at the moment, the use of gauze will be found of great service. A single or double layer of sterile gauze is wrapped around the finger, and with gentle pressure the adhesions are, as it were, wiped away. It is a safe rule to keep near the appendix and to separate all other structures from it, not to detach the appendix from them. As much roughness as necessary may be displayed towards the

appendix, but all other structures must be handled with the finest care. By rough or clumsy handling the ileum or the cæcum may be torn open. The appendix may have to be dislodged from the retrocolic fossa or to be shelled out from a snug retreat beneath the enteric mesentery. It may be intimately adherent to the ovary or the uterus, or it may be flattened against the wall of the pelvis. Whatever its position, and however unyielding its adhesions may prove to be, the stripping of it must continue until its tip is reached. The points to bear

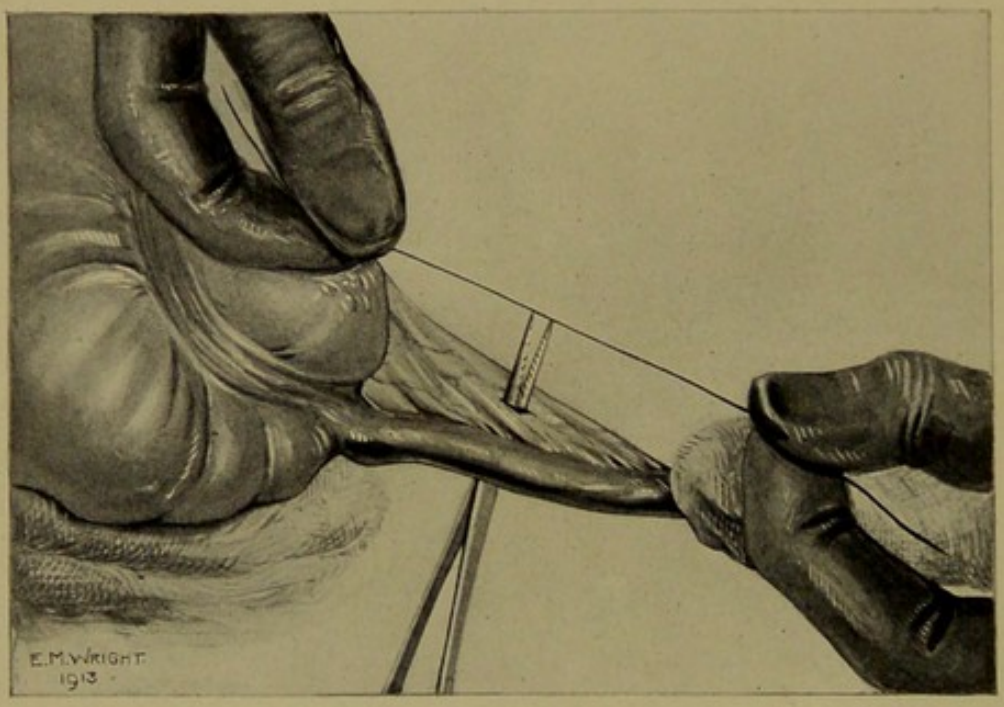


Fig. 255.—Meso appendix perforated by a clip which seizes a ligature.

in mind are: to pack off the cavity of the abdomen with gauze or swabs; to strip *from* the appendix; to use gauze wrapped around the finger to facilitate the separation of adhesions, and to inflict damage and to exert traction only upon the appendix. In certain instances, when the separation has seemed unusually difficult, I have first freed the appendix from the cæcum (in the manner to be presently described) and then proceeded with the search for the tip of the appendix. This often makes matters very much easier; it is a point worth remembering when the difficulties are great.

Treves recommends the following plan in difficult cases: "In many cases of difficulty I have divided the undisturbed peritoneum of the right iliac fossa well to the outer side of the disturbed area, and, by working along in the retroperitoneal tissue, have reached the adherent bowel and have readily detached it, stripping off the peritoneum with it." I have never found it necessary to do this, though I have occasionally made matters

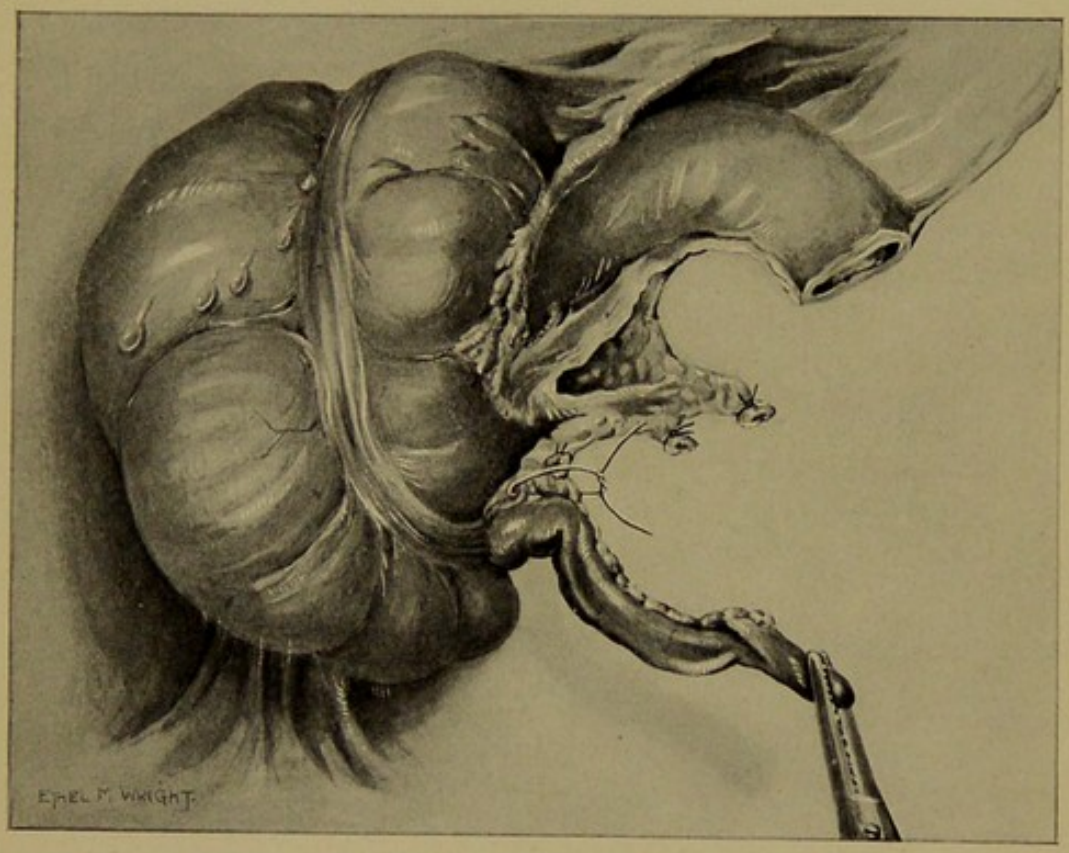


Fig. 256.—Meso appendix ligatured in two parts.

easier by dividing the appendix at its attachment to the cæcum, first closing the cæcal stump, and then, by degrees, disentangling the appendix from its difficult adhesions. When the appendix is being disentangled from its many adhesions, an old abscess cavity may be discovered. The contents are generally dry and may resemble cream cheese; they are usually sterile. The cavity should be cleansed by gentle scraping, wiped repeatedly with sterile dry gauze, and finally washed out with a swab moistened

in sterile salt solution. There is no need for drainagein such a case. I am generally content to pull the omentum over and to leave a tag of it within the cavity. If any pus be found, then drainage may be necessary, but the dried remnant of pus is generally not infective.

When the appendix has been liberated, it is withdrawn, together with the adjacent part of the cæcum, from the ab-

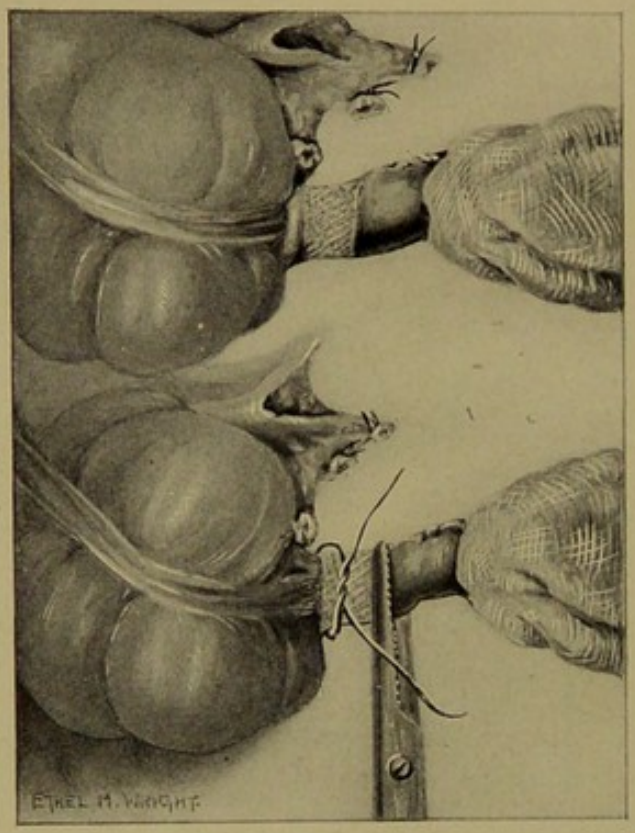


Fig. 257.—The base of the appendix crushed, and ligatured.

domen and surrounded by a hot mackintosh. The appendix is then removed in the following manner:

The assistant wraps the appendix around with gauze or seizes the mesentery near the tip of the appendix with a clip, so as to expose the mesoappendix more readily. An artery clip is then made to pierce the mesoappendix about an inch from its apex, to seize a catgut ligature and is then withdrawn. The ligature is tied and the mesoappendix divided distal to it. This procedure is repeated till the base of the appendix is reached. The

appendix is then held vertically by means of a clip by the assistant whilst the surgeon crushes it at its junction with the cæcum in a Doyen's clamp. Removing the clamp it will be found that the mucosa has been pressed away and that only a ring of the serous coat remains. At this point a fine ligature is applied, and about ¼ inch beyond this a clip is placed. The appendix is divided just distal to the ligature; the clip prevents any escape from the appendix. It is important to remove *all* the appendix. In cases related by Treves, and in several upon which I have operated, a portion of the appendix, a stump ¾ or 1 inch in length, has been

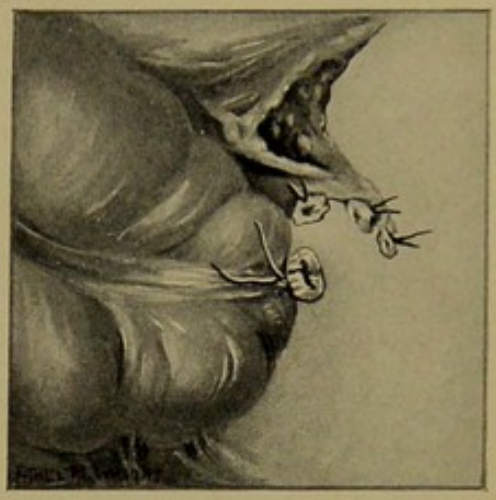


Fig. 258.—The crushed stump of the appendix to be buried.

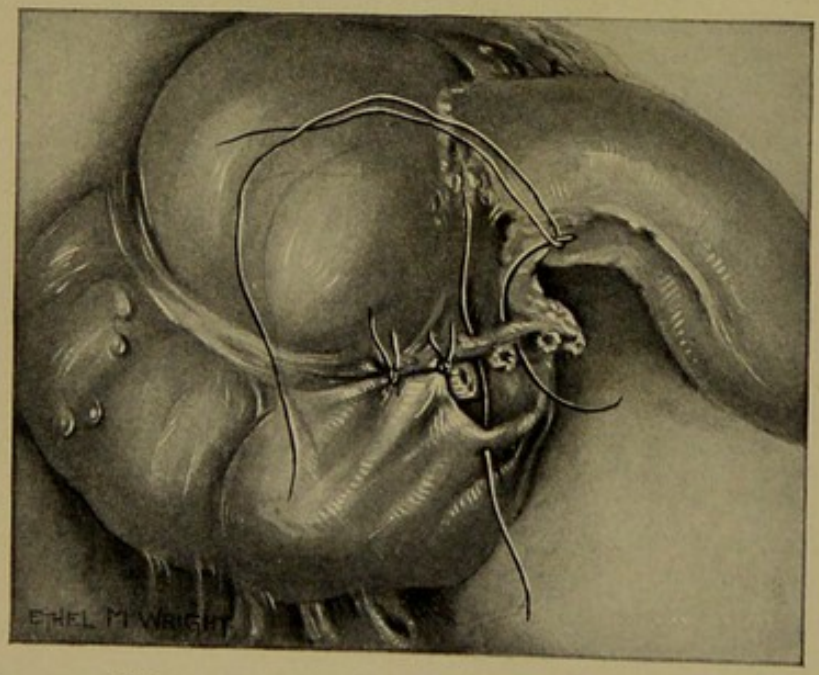


Fig. 259.—The appendix stump is buried in the wall of the cæcum.

left behind by a former operator, and, owing to the presence of a stricture at the valve of Gerlach or a calculus or con-

cretion the symptoms had persisted, unaltered, after the operation.

The ligature at the cæcum is now buried either by a purse-string suture or by a continuous Dupuytren suture of fine catgut—preferably the latter. The stitch infolds about 1 inch in length of the cæcal wall; in the centre of the line of suture is the ligature, applied at the base of the appendix. This ligature can be buried by either a clip or a special "pointer," which is withdrawn at the moment the invaginating suture is being pulled tight. As

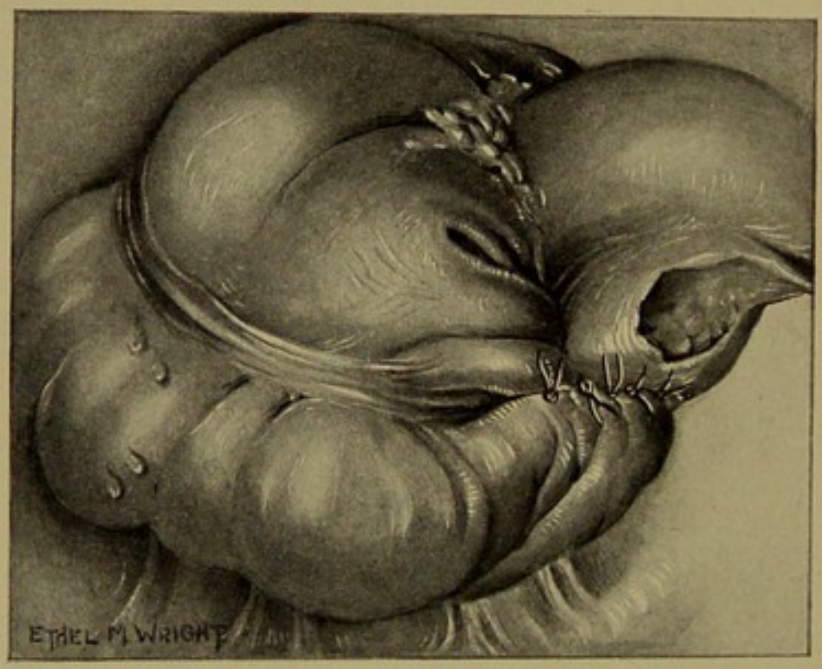


Fig. 260.—Operation complete.

a rule, it is desirable to put in several interrupted sutures so as to make the sealing-off secure.

This is the operation as practised in the ordinary case. It may have to be modified to meet altered conditions in various cases. In one patient upon whom I operated the appendix had become very adherent to the cæcum near its junction with the ileum. On separating the adhesions the raw surface left behind had to be covered in by a continuous suture. As a result, a high degree of narrowing of the ileocæcal junction

resulted, for which I performed a lateral anastomosis between the termination of the ileum and the cæcum.

It is important, as has been said, to ensure a complete removal of the appendix. I have more than once removed the whole or a part of the appendix after it had been said to have been taken away.

W. Hessert ("Jour. Amer. Med. Assoc.," 1906, xi, p. 2009) reports three cases of hæmorrhage from the stump with one fatal result, following appendicectomy. He points out that the base of the appendix may receive its blood-supply via the appendicular artery or through the cæcal vessels—when by the latter, hæmorrhage may result. It is for this reason that a ligature is necessary round the stump of the appendix, even after crushing. Statistics from Kelly's "Anatomy of the Appendix" show that in 62 per cent. of cases the line of division between the territories of the cæcal and appendicular vessels lies on the cæcum itself; in 32 per cent. of cases the separation is exactly at the base of the appendix, whereas in 5 per cent. of cases the cæcal vessels supply of the base of the appendix. It is in these latter that ligature of the stump is so essential. The following is the account of the operation and post-operative condition in Hessert's first case:

"*Operation.*—Gas and ether anæsthesia. The operation was well borne. Short muscle-splitting incision was made. The appendix was free in the abdominal cavity; it was moderately acutely inflamed, not perforated. The mesenteric artery was ligated with catgut, and the appendix was divided between two forceps clamped in the base. A silk purse-string suture was inserted, with inversion of the stump and tying of suture. A second row of Lembert sutures was applied. No oozing from the mesentery or stump was noticed at the time. The colon and the base of the appendix were in a healthy condition. Operation was concluded in a short time, and the patient left the table in excellent condition. There was no drainage.

"*Post-operative History.*—The girl recovered quickly from the anæsthetic and vomited little. In the evening of the day of the

operation the nurse noticed a slight bloody stain in the bed, and believing it to be menstrual blood, she applied a pad, the patient's condition being so good as to excite no suspicion. Next morning, twenty-four hours after operation, when I saw her, it was at once apparent that she was suffering from internal hæmorrhage and that the blood she had passed in small amounts during the night had come from the bowels. She was very pale, clammy, restless, taking deep sighs at intervals. Temperature was 98° F., pulse 120, small and thready; she was given Dover's powders and dermatol by mouth; food was withheld; strychnine and adrenaline were given hypodermically. The foot of the bed was elevated, and an ice-bag placed over the seat of operation. During the day she passed about 600 c.c. of fluid red blood; later it was dark and clotted. After twelve hours, towards evening, reaction set in; she warmed up and the skin became dry. The pulse, which had gone up to 140, became 110; she was not so restless. She was not pale. The bleeding was evidently checked, for she steadily improved. No blood was passed for another day, and then the clots were very dark. After several days she showed no signs of the hæmorrhage save some weakness and pallor. Cathartics were withheld for some days longer. The wound healed by primary union; ultimate recovery complete."

Probably the modern appendix clamp crushes the base of the appendix and the artery to the base sufficiently to prevent any hæmorrhage. The forceps used when Hessert wrote were very feeble compared with this instrument.

Of late years I have given up the McBurney incision except for cases of suspected appendix abscess, and have used the Battle incision for all "interval" cases. This incision, if not too small, allows adequate examination to be made of the other abdominal organs.

The following is Mr. Battle's original description of his method (Battle and Corner, "The Surgery of the Diseases of the Appendix Vermiformis," p. 77):*

* This operation has been attributed to several other surgeons, but there can be no doubt whatever that Mr. Battle was the first to perform and to describe it.

An incision is made through the skin and subcutaneous tissues down to the sheath of the rectus; this section is made obliquely downwards midway between the anterior superior iliac spine and the umbilicus, is about four inches in length, varying with the deposit of fat in the abdominal wall of the individual, and is placed so that it is equally extended above and below this line. The outer margin of the rectus sheath can now be easily defined, and during inspiration the direction of the action of the external oblique aponeurosis seen. The inner

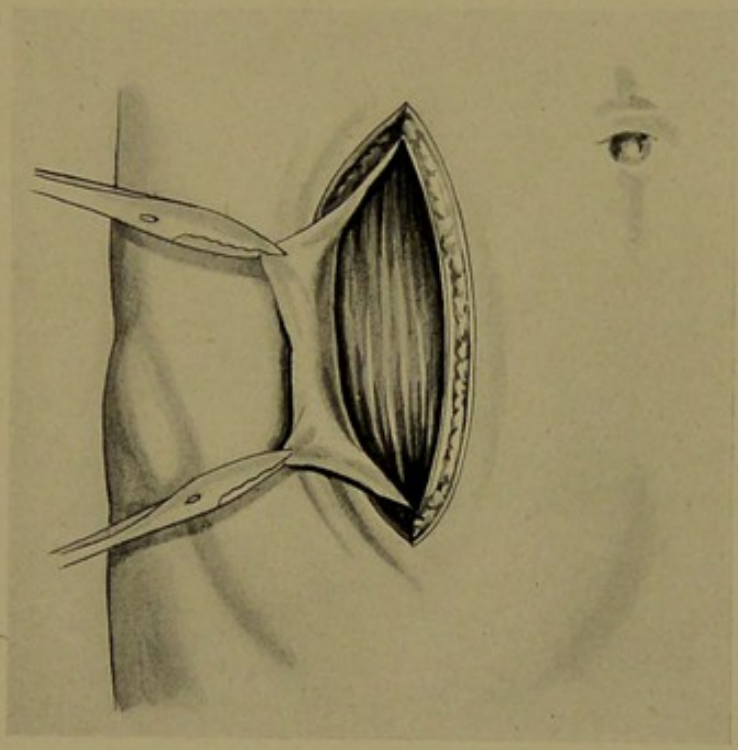


Fig. 261.—Removal of the appendix (Battle's method). The anterior sheath of the rectus incised, and the outer part stripped up from the front of the muscle.

margin of the wound is retracted about half an inch, and the anterior sheath of the rectus opened close to the retracted inner margin for the full extent of the incision. The rectus muscle is now drawn inwards, being separated from the outer part of the sheath with a few touches of the knife. Occasionally one of the lineæ transversæ requires to be separated from the sheath. Running across the posterior layer of the sheath can usually be seen the dorsal nerves, with accompanying vessels. The deep epigastric artery and vein run upwards under the retracted

muscle to the inner side, and it is well to define these vessels, otherwise the vein may be punctured in the later suturing of the sheath. Another anatomical point of importance is the level of the transversalis fascia as regards the wound, for it strengthens the posterior layer of the sheath and makes the hold of the sutures much firmer if the opening into the peritoneal cavity can be confined to the part covered by it. In most instances the incision can be made through the posterior sheath

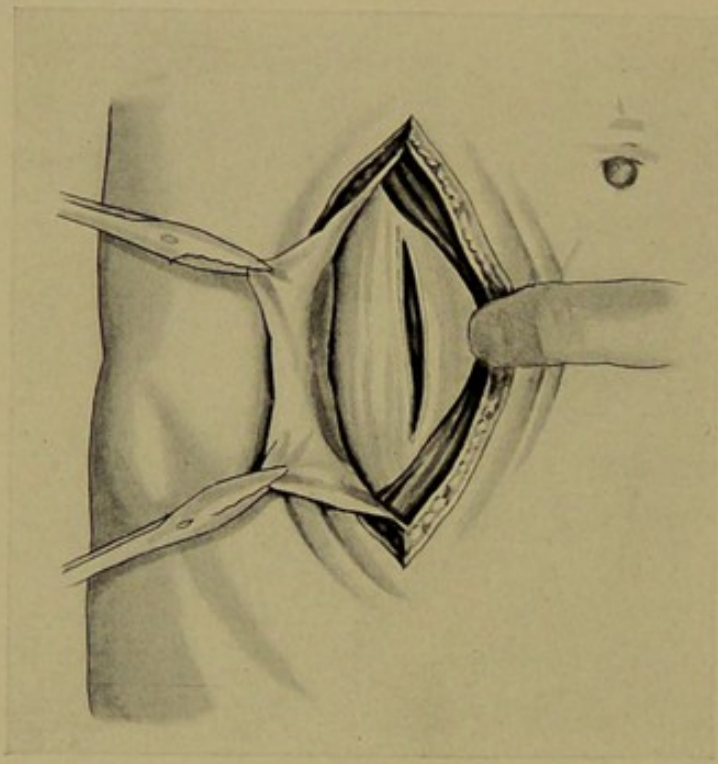


Fig. 262.—Removal of the appendix (Battle's method). The rectus muscle pulled inward. The posterior incision through the transversalis fascia and peritoneum is shewn.

between the nerves and through the fascia. We have not, however, seen any ill effects from division of these nerves, although it has been suggested that partial atrophy or paralysis of the rectus muscle might ensue. If the case is uncomplicated by any adhesions and the appendix is lying in a normal position, the operation can be completed through an inch-long incision of the posterior sheath; but if there are complications and it is considered necessary to do so, the wound, both superficial and deep, can be extended to any required distance. After

the appendix has been removed by the method which is considered best, and the peritoneum cleansed, the posterior layer of the sheath and peritoneum can be sutured in the usual manner. . . . The uninjured rectus is now permitted to fall back into its usual bed; the anterior layer of the sheath is closed by three or six interrupted (.00) silk sutures, and the skin and superficial wound by a continuous horsehair stitch. Union takes place throughout by first intention, and the horsehair stitch is removed on the eighth day.

The procedure I follow differs from Mr. Battle's only in that I make an incision about three inches in length in the peritoneum in order to ascertain the condition of affairs in the region of the gall-bladder, stomach, and elsewhere.

OPERATION IN ACUTE APPENDICITIS.

When an operation is performed during an acute attack of appendicitis, the problem which confronts the surgeon may vary very greatly. There may be an acute generalised peritonitis, the whole, or virtually the whole of the peritoneal cavity being invaded by the inflammatory process. Or there may be a spreading inflammation which has not yet involved more than a comparatively restricted area in the appendix territory. Or, again, the appendix may be so securely wrapped in a mantle of omentum that the inflammatory activity has been kept within its immediate area. If there be a general septic peritonitis, the operation is conducted in the manner described in detail in Chapter VI. It is with the other forms that I wish especially to deal now. For operations in the acute stage I prefer Battle's incision to any other. These are not cases in which the surgeon must be niggardly in the length of his incisions, for a free opening into the abdomen is necessary to allow of adequate exposure, to ensure that no infected areas, isolated it may be from the main area of inflammation, are overlooked, and to permit of a sufficient protection of the remainder of the peritoneal cavity. Battle's incision falls upon the abdomen at a most convenient point, it is easily en-

larged upwards or downwards, and it permits, with a little adjustment, of very satisfactory drainage being subsequently employed. The incision then is of good length,—approximately 4 inches at the first,—and through it the peritoneal cavity is opened. Before the peritoneum is incised the wound is held widely open, and melted vaseline, just sterilised, to which formalin has been added, is rubbed well into the walls of the abdomen. This seals off all lymph-spaces and prevents a wound infection. When the peritoneum is incised a little clear fluid may escape at once, or an inflamed piece of intestine or omentum may bulge into the wound. A finger is at once introduced with the utmost gentleness, and something made out as to the position and relations of the appendix, and as to the extent of involvement of the peritoneum in the inflammation. The operation area is then isolated by gauze packing. Long strips of gauze are tucked into the abdomen, whilst an assistant holds up the abdominal wall. The gauze may be pushed into position with the finger or with a pair of blunt-pointed scissors curved or bent on the flat. The barrier I first erect is that to the upper and outer part of the wound to the outer side of the ascending colon, so that all fluids are prevented from escaping into the kidney pouch. Then the pelvis is shut off in a similar manner, and finally the parts to the inner side of the wound. There must be no stint in the amount of gauze introduced, for by its means not only is the peritoneal cavity securely protected from any fresh infection during the subsequent manipulations, but the inflammatory exudates already present are freely soaked up. In all these movements great gentleness is necessary, for roughness or haste may result in the rupture of some recent limiting adhesions, with the instant overflow of a highly infective exudate into all the parts around. Should this occur, an abundance of gauze is at once tucked into the wound, removed, a fresh supply introduced to remain till it is soaked, to be then discarded for a fresh one, and so on till the area is dry. Gauze packing with clean material is then proceeded with as before. The barrier finally built up should be one against which a

highly infected exudate will beat in vain; it should be thick, and it should be continuous. Its most superficial layer should consist of a sheet of rubber and gauze, *i. e.*, a mackintosh cloth. The barrier now isolates the inflamed appendix and the parts immediately around it. The condition of things in this area is now investigated, the omentum or intestine or abdominal wall being slowly separated from the turgid and inflamed appendix. The direction which the finger should take is not difficult to discover, as a rule, for a definite line of cleavage is soon apparent, and along this the finger slowly pushes its way until the appendix is free, or until a gush of fluid, turbid or purulent and always offensive, escapes. It is the business of the assistant to be ready instantly to mop this up, and to discard the soiled gauze swab at once for a fresh one laid ready to his hand. The operation area is made thoroughly dry before the next step, which is the isolation and delivering of the appendix. This may be easy or may be excessively difficult. When the appendix is greatly distended, it may be difficult, even for an expert finger or even an educated eye, to distinguish it from a piece of small intestine. Some help may be derived from the recognition of a hard, solid concretion in the appendix; indeed, this has been to me the most useful of all points. By careful palpation of this nodule and of the parts around it a line of cleavage between the appendix and its immediate neighbours can be felt, and by gentle persistence the appendix is separated little by little until all its length is isolated. At times the incision must be enlarged in one direction or another, the gauze barrier strengthened, and a fresh search made. If difficulties still perplex one, the cæcum is brought into the wound and its longitudinal muscular bands traced downwards; since they lead to the appendix, they are a certain guide. But adhesions or old distortions may make matters difficult even now, and the only advice to be remembered is to search in the right direction, and to search carefully, persistently, and with infinite gentleness. This is no occasion for display. The appendix will reveal itself at the last, and it is well to know then that no harm

has been done by rough impatience. As soon as it is delivered, a gauze strip is pushed well down into the bed in which it lay to soak up any exudate there. If a perforation, or a gangrenous, green, and friable patch be found, a clip is at once put on the base of the appendix, to prevent any escape from the cæcum. Into the groove left when the clip is removed a stout catgut ligature is tied and the appendix cut away. The mucous membrane in the appendix stump is touched with the actual cautery, and if need be, a suture or two of catgut taken over the stump to bury it. This, however, I rarely do, for it is not necessary, seeing that the wound is to be drained, and the inflamed and often stiffened walls of the cæcum do not readily hold a stitch. In those rare cases where the base of the appendix or the cæcum is gangrenous, the wound left by the removal of the slough must be closed: it is best secured by a double layer of continuous catgut sutures.

The operation area is now thoroughly dried, and little by little, and with unvarying care, the gauze barrier is removed, and the omentum, if visible or easily secured, is brought into the operation field. When all the gauze is taken away, a split-rubber tube is passed down to the appendix; if necessary, another tube is passed down into the pelvis or up towards the kidney.

Some surgeons prefer gauze wicks to drainage-tubes; but I have no liking for unprotected gauze as a drain in any part of the abdomen or under any circumstances.

The wound is then closed, either above or below the tubes, or both, so as to lessen the gap which is left in the abdominal wall.

After the operation there is usually a fairly copious discharge of a thin, turbid, or sanious fluid, for three or four days, when the tube may be shortened, and a day or two later removed.

3. ABSCESS IN CONNEXION WITH DISEASE OF THE APPENDIX.

It has already been pointed out that the position of the appendix varies greatly in different individuals, and also, probably, in the same individual at different times. In whatever

position the appendix lies, an abscess may form in connexion with it. The position of an appendix abscess, therefore, is as varied as that of the normal appendix. An appendix abscess may occupy a part or the whole of the iliac fossa; it may push the cæcum upwards, or upwards and inwards. If the appendix lies behind the cæcum, occupying the retrocolic fossa, the abscess may be completely covered by the cæcum and ascending colon.

When the appendix lies to the outer side of the ascending colon, an abscess may be placed a little internal to the anterior superior spine, or above the iliac crest, or it may occupy the loin, or extend upwards along the colon and have its larger part immediately beneath the liver, or, finally, the abscess may be beneath the diaphragm. If the appendix lies with its tip pointing upwards and inwards to the spleen, in front of the ileum and the mesentery, but behind the omentum, the abscess spreads towards the middle line, forming a tumour which occupies the inner part of the iliac fossa and which increases along its upper and inner boundaries. If the appendix hangs with its free end over the brim of the pelvis, the abscess may lie along the iliopectineal line or at the side of the pelvis; or when the appendix is of greater length, the abscess may occupy the space between the bladder and rectum in the male or between the bladder and uterus, or uterus and rectum, in the female.

An appendix abscess, it will be seen, may be placed in any position in which the appendix may lie. In rare instances, when the enteric mesentery is continued on to the ascending colon and the cæcum is freely movable, the appendix may be found at any part of the abdomen. In a few cases I have operated for appendicular abscess on the left side of the abdomen and many such cases are recorded by others. In 44 cases Barnard noted that the position of the abscess was as follows:

External Abscesses.		Internal Abscesses.	
Lumbar	4 cases.	Iliac (behind the mesentery)	10 cases
Subhepatic	4 "	In front of sacral promontory	2
Subphrenic	4 "	Pelvic	14 "
Retrocæcal	4 "	Above Poupart's ligament	2 "
Total	16 cases.	Total	28 cases

When the abscess occupies the iliac fossa, there is rarely any difficulty in recognising or in defining its exact limits. This is done by gentle palpation; percussion gives no information that is not misleading. An abscess whose margins are clearly defined may be resonant on percussion, and may, when opened, be found to contain at least a pint of pus. Conversely, dulness or diminished resonance may indicate nothing more than an overfull cæcum. There may perhaps be a difficulty in deciding whether the increased resistance felt in the right iliac fossa is indicative of a protective tightening of the muscles when a limited peritonitis is present, or whether there is a mass of inflammatory deposit in the centre of which an abscess lies. Gentle but firm and prolonged palpation with the hand laid flat upon the abdomen will almost always enable an accurate decision to be made. It will gradually be recognised that in the one case the resistance is only superficial, and that in the other there is a mass beneath the resisting muscles; that the hardening, in the one case, is in the form of a square, and in the other, in the form of a cube.

When the abscess lies to the outer side of the ascending colon, palpation over the iliac region may reveal no abnormal condition. When the definite symptoms of appendicitis are present, this may cause some perplexity. When, however, the loin is examined bimanually, as is done in the investigation of kidney tumours, it will be recognised at once that a considerable mass lies between the two hands. Very often, in such cases, the patient may give the surgeon a lead by complaining of pain in the loin or of pain spreading up the right side of the abdomen.

When the abscess lies deep in the pelvis it may be wholly unrecognisable upon abdominal examination. Upon rectal or vaginal examination or upon bimanual examination it is at once perceived. It may, at times, bulge into the rectum, and lie so thinly covered that on making a rectal examination the finger may open the abscess cavity, however gently the manipulation is conducted.

When the abscess lies along the intestines at a distance of an inch or more from the abdominal wall, it may not be possible to recognise it, however carefully the examination be made. Such a position, for this reason among others, renders the case more serious perhaps than any other.

Operation.—In treating an abscess in connexion with the appendix by operation two points are of great importance: *In the first place*, it is necessary to make the incision over the most projecting or superficial part of the abscess. The usual incision for the removal of the appendix is by no means always the proper incision for the opening of an abscess. The abscess, in fact, should be dealt with as an abscess elsewhere would be—that is to say, the incision must be made into the part of it most easily accessible. *In the second place*, it is essential to provide for free drainage from the lowest part of the cavity. It is found by experience that those abscesses which empty themselves spontaneously through the rectum or vagina heal more rapidly than similarly placed abscesses opened through the abdomen. The drainage from the lowest point hastens the closure of the cavity. This procedure should be imitated as closely as possible when the surgeon operates. Efficient drainage in the easiest direction must be secured, and in many cases two or more outlets for drainage must be provided.

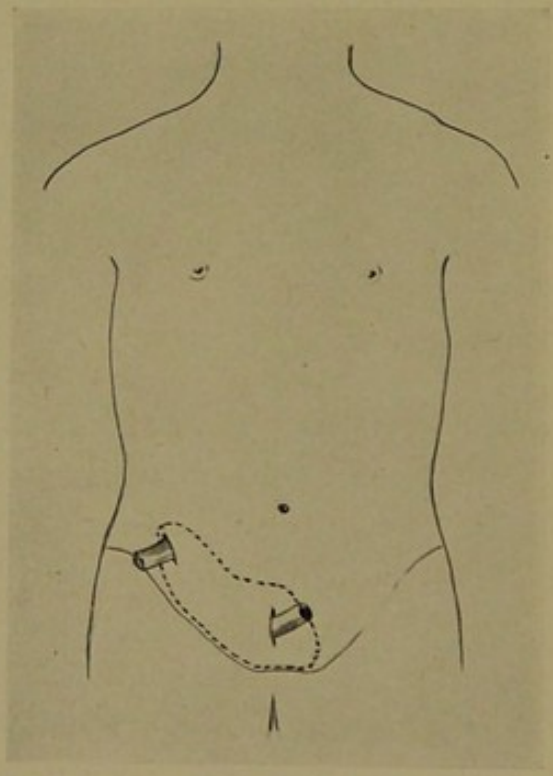


Fig. 263.—Appendix abscess, drained at each extremity.

The abscess, having been carefully examined and its limits

clearly defined, an incision is made over its most projecting part. As the incision is deepened, it will often be noticed that there is œdema of the abdominal wall. This œdema is a sure indication of the presence of a high degree of inflammation and that pus is present in the parts beneath; and it is an evidence that the incision is being made in the proper place. The incision is deepened by degrees, and with more than the ordinary care, for if a coil of bowel be adherent to the abdominal wall, there is a risk of wounding it. When the thickened peritoneum is incised, the abscess will be opened and pus will escape at once. If by any chance the general cavity of the peritoneum is opened, a packing of gauze is at once introduced

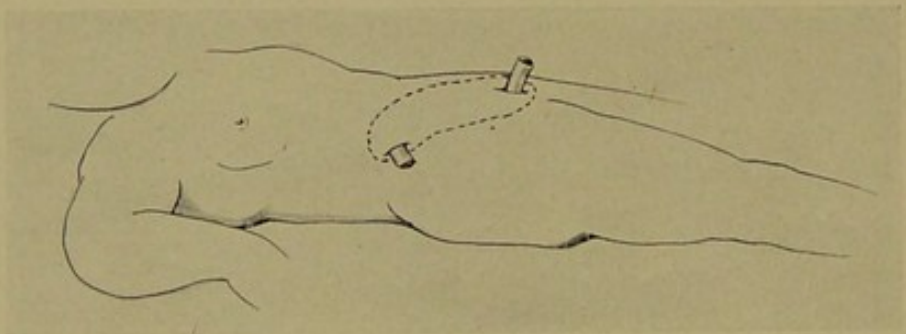


Fig. 264.—Appendix abscess drained above the pubes and through the loin.

to make a barrier around the abscess. The gauze should be in long strips about two inches in width, and with five or six layers if the gauze be thin. While the wound-edges are held apart the gauze is packed in a thick layer all around. Such a barrier affords the completest protection to the peritoneum; even if much soiled upon the side towards the abscess, the outer side will remain clean. The abscess being opened, the finger is at once introduced and an examination, sufficient yet scrupulously careful, is made. When the finger is discovering the limits of the abscess, the greatest gentleness is necessary, for rough handling may break down the limiting adhesions, and pus may escape into the general peritoneal cavity and start an acute peritonitis. In the investigation of the cavity it is

of great importance to determine that which is the lowest limit of the abscess with the patient in the recumbent position. For if the abscess be of large size, the opening which has been made into it may suffice for the drainage of the greater part of the cavity, but may yet leave undrained a pocket at the upper or at the lower limit. If this is so, then one or two more incisions may be needed. These are made at such points as will secure the easiest drainage.

The question as to the need for the removal of the appendix has been hotly debated. My own practice is this: if the appendix comes into view at once, or after the simplest examination, I remove it; if, however, a prolonged search, during which adhesions have to be freely separated, be necessary, I do not make any attempt to remove it. In the search a small fæcal concretion may be discovered or an offending foreign body of different character; this, which has escaped from the perforation in the appendix, should always be carefully sought and removed. There can be no doubt, I think, that in many cases of abscess the removal of the appendix is unnecessary, and that in almost all its removal involves far too much risk to be desirable.

The recurrence of appendicitis after an abscess of the appendix has been opened and drained has been estimated to occur in 2 per cent. of cases. This is the number which is mentioned by Treves. Coley, as the result of the examination of a large number of cases, came to the conclusion that 20 per cent. was a more accurate estimate. The former estimate is certainly far too low; the latter is perhaps rather too high. The probability is that approximately 10 per cent. of patients suffer from attacks of appendicitis after the drainage of an appendix abscess. In this 10 per cent. a secondary operation will be needed in perhaps the majority, but it can be performed in the quiet interval after an attack, and the risk is accordingly very small.

If the appendix be found in the cavity of the abscess, it will be thickly covered with lymph, turgid and greatly thickened.

It may then be removed by applying a single ligature to the mesentery and by applying a clip to the base of the appendix, tying a ligature in the groove left when the clip is taken off, and cutting through the appendix and its mesentery distal to the ligatures.

When the abscess cavity is thoroughly exposed, it may be washed out with hot sterile salt solution or may be sponged as clear as possible. In either case the finest care is necessary to prevent the breaking-down of adhesions. As a rule, I do not employ lavage unless the abscess is excessively foul.

The abscess having been emptied, cleansed, and the appendix removed if readily accessible, the drainage-tubes are introduced and the wound is closed. It is in the freedom of drainage that the success of the operation mainly depends. The drain must be of a large size, and as many separate tubes must be introduced into the cavity as will ensure that a free escape of pus is permitted. If the abscess extend upwards and backwards to the loin, a drainage-tube may with advantage be introduced through a separate incision through the side or through the iliocostal space. A split-rubber tube affords the best drainage. It is essential that the drain should not be hastily removed. A too early removal may lead to a closure of the skin-wound before the abscess cavity has granulated, and a fresh collection of pus may form, requiring a further operation. Rapidity of healing is not to be desired unless the wound is closing soundly throughout and unless the abscess cavity is slowly contracting.

The only differences in treatment which are necessary in other abscesses developing in connexion with a diseased appendix have reference to the position of the incision and to the insertion of drainage-tubes. If the abscess be in the pelvis, an incision through the linea semilunaris or through the middle line will give access to it. In cases such as these a bulging of the abscess into the rectum or vagina may be felt, and, if necessary, a second incision may be made into the abscess from these

points. There is no doubt that when an abscess bursts spontaneously into the rectum or into the vagina it drains very freely and closes more rapidly than it would do if an incision had been made through the abdominal wall. I have on several occasions drained a pelvic abscess in the female through the vagina, and on three occasions have drained an abscess through the rectum as well as through an abdominal opening. The heal-

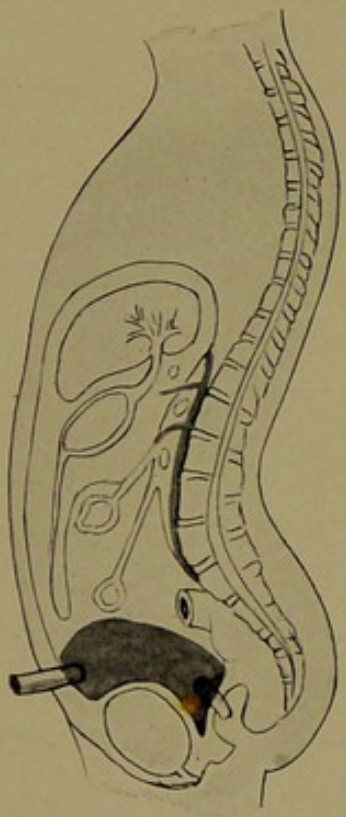


Fig. 265.—Appendix abscess; drained above pubes, and through the rectum (in the male).

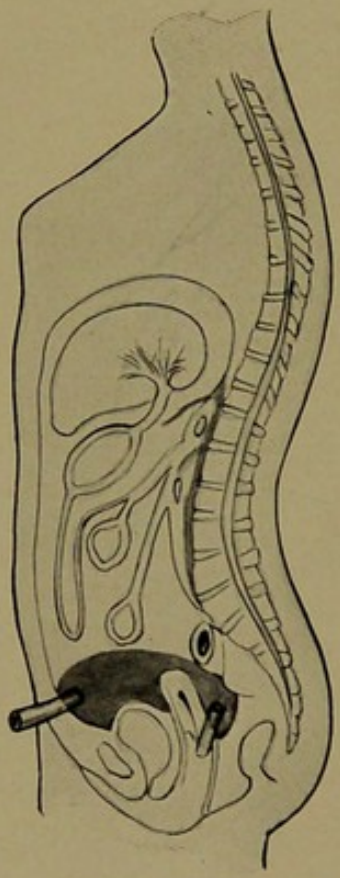


Fig. 266.—Appendix abscess; drainage above pubes, and through vagina.

ing in all has been very much more rapid than it would have been if only one incision had been made.

When the abscess lies at a little distance from the anterior abdominal wall, it must be opened through an incision made over the point which is most accessible. After opening the abdomen and before setting free the pus the general cavity of the peritoneum must be carefully protected by substantial bar-

riers of gauze packed snugly all around the margins of the incision. When this has been done, the finger is passed gently down to the abscess, disentangling adherent coils of bowel until pus is seen to flow. The discharge is rapidly mopped up and the swabs at once thrown away. This is continued until the abscess is empty. A large drainage-tube is then passed to the centre of the abscess; and a barrier of rubber tissue placed so as to protect the general peritoneal cavity until the formation of adhesions. The drains are left for several days before being disturbed, in order to ensure that an impenetrable barrier of adhesions has been built up around the track.

4. APPENDICOSTOMY (WEIR'S OPERATION).

The first mention of the surgical employment of the appendix for drainage of the large intestine is due to C. B. Keetley. In a debate at the Medical Society of London ("Brit. Med. Journal, vol. ii, 1894, November 17, p. 1112) he recommended the opening of the appendix as a substitute for typhlotomy in the treatment of acute obstruction in the large intestine. The suggestion passed unheeded, and it is only since a paper by Dr. Weir, of New York ("Medical Record," 1902, August 9, p. 201), was written that the operation of "appendicostomy" has become a recognised procedure. The following is an abstract of Dr. Weir's description of his case:

A young man, aged thirty-one, had had for nearly three years persistent diarrhœa, associated lately with the passage of blood. An exploratory incision above the umbilicus shewed thickening and congestion of the colon. It was then determined to resort to a cæcal fistula, and the usual incision with intermuscular separation was made. "As the cæcum was exposed the appendix rose so suggestively into view that I determined to employ it to make the desired fistula." It was fastened to the skin and the wound closed. The tip of the appendix was opened and a No. 12 English catheter passed into the cæcum. The tip was then closed by a temporary ligature. Three days later, irrigation was resorted to with most satisfactory results.

The first operation in England was performed by myself on August 5, 1903, in a case of mucomembranous colitis. The patient, a girl of twenty-one, made a good recovery. Saline injections were used daily for about three months; during this time the mucous discharge and the blood ceased entirely and the girl gained weight. The injections were then discontinued and the appendix opening scabbed over and closed. For eighteen months the improvement was maintained, but latterly there has been a recurrence of the sanguineous and mucous discharge and the patient is losing strength.

Indications for the Operation.—The appendix, when brought to the surface and opened, may be used as a means of entrance to, or of exit from, the large intestine; as the former, when it is necessary to flush out the colon or to administer fluids for any purpose; as the latter, when a means of escape, a vent, is needed in cases of obstruction in the large intestine.

The indications for the operation therefore are:

1. As a means permitting local treatment of certain conditions of the large intestine.
2. As a vent in cases of acute obstruction in the large intestine in place of typhlotomy.
3. It has been suggested that nourishment may be given, in certain cases of rectal intolerance, by this avenue.

1. As a means for the treatment of various conditions of the large intestine; of such are, according to Keetley:

(*a*) Mucomembranous colitis.

(*b*) Dysentery (that is, amœbic colitis).

(*c*) Obstinate chronic constipation.

(*d*) Ileocæcal intussusception; to prevent recurrence, to prevent collapse, and to treat hæmorrhage and inflammation.

(*e*) Syphilitic ulceration of the colon.

Mucomembranous colitis is a peculiarly intractable disorder. It is generally recognised that the administration by the rectum of various drugs expected to exert a local influence upon the

mucous membrane of the colon has proved on the whole most unsatisfactory. The opening of the appendix certainly ensures that the whole length of the colon can be treated, and that the lodging of fæcal material in a diseased colon can be prevented. It is for this purpose, chiefly, that the operation of appendicostomy will be useful.

Keetley mentions ("Brit. Med. Journal," vol. ii, 1905, p. 863) a case in which, after reducing an intussusception, he performed appendicostomy. He mentions cases recorded by Dawbarn, Meyer, Spencer, Hutchinson, myself, and Armour.

2. As a substitute for typhlotomy in cases of acute obstruction in the large intestine. This, I venture to think, will be the chief use to which the operation will be put in the future. In a case of carcinoma of, say, the hepatic flexure, in which a chronic obstruction has become acute, a short-circuiting operation may be done—ileosigmoidostomy; or the appendix may be brought to the surface and opened; or the two operations may be done at the same time, the former to allow of emptying of the small intestine, the latter to allow the escape of a large amount of thin fæcal material always found between the ileocæcal valve and the growth. I have three times performed the operation in such circumstances, and the drainage through the appendix (which readily permits of dilatation by a catheter) has been free and sufficient. As compared with typhlotomy the operation has enormous advantages. As every surgeon knows, the opening of the cæcum or of the ileum, low down, is a cause of great distress to the patient by reason of the excoriation of the skin. In my cases of appendicostomy there has been no leakage for the first three or four days, and very little, not more than a few drams, daily after that. This leakage could be prevented by removal of the catheter for a few hours daily, or perhaps by its introduction for an hour three or four times a day. When the catheter is out there is no leakage.

3. For purpose of administering nourishment. There are certain cases of gastric disease in which rectal feeding must be

carried out, to the exclusion of feeding by the stomach. If in such a case there be rectal intolerance the question of opening the appendix may be considered.

Operation.—The operation is carried out precisely in the same manner as is necessary when the appendix is to be removed. McBurney's incision is used, a very small opening—just large

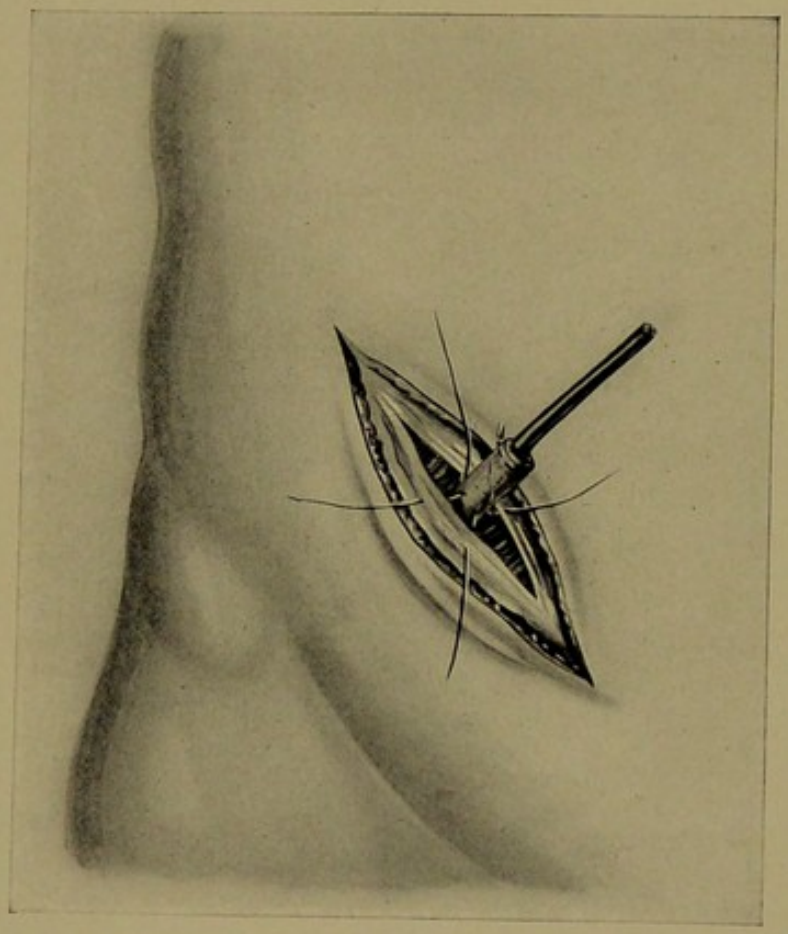


Fig. 267.—Appendicostomy. The incision in the skin is made long to shew the details of the operation. It need not be longer than 1 to 1½ inches when the operation is performed during life.

enough for two fingers—being made. The appendix is sought and brought to the surface. If adherent, the adhesions are separated; in themselves they are no bar to the operation. When the appendix is free it is brought out of the wound and dragged upon gently until its base is on a level with the parietal peritoneum. The mesoappendix is then secured to the peritoneum by a

single catgut stitch and a similar stitch is then passed through the opposite portion of the appendix, securing it to the peritoneum. The muscles are then allowed to return to their natural position, and if need be, a stitch ensures good apposition of their fibres. The skin wound is closed, and each side of the appendix is attached to the skin by a silkworm-gut suture which picks up its serous and muscular coats. The opening of the appendix may be performed forthwith, or may be delayed for a couple of days. All that is necessary is then to snip off the end of the appendix and to thread into its lumen a silk or rubber catheter. It is at first a great surprise to one to find how much the appendix will dilate to permit of the passage of the catheter. A No. 12 catheter passes quite easily.

The catheter may be left in, in cases of acute obstruction, or may be passed and removed as often as is desirable in cases of mucous colitis. There is never leakage when the catheter is out. When it is desired to discontinue the use of the appendix, the abdomen may be reopened and the appendix removed. In my own patient the little opening scabbed over, and dried up completely in about a fortnight after the injections were stopped.

CHAPTER XXXII.

INTESTINAL PERFORATION IN TYPHOID FEVER.

This subject has been most ably and most exhaustively dealt with by Dr. Richard Harte and Dr. Ashhurst, of Philadelphia, in a paper published in the "Annals of Surgery" in January, 1904. Any surgeon interested in this subject will find in this paper all the information at present available. The examination of all recorded cases is given in detail, and there is abundant internal evidence that the paper is based upon an ample personal experience. The description which follows is borrowed largely from this very admirable article.

The frequency of perforation of the intestine in typhoid fever is variously estimated by different writers. The estimates vary between 1 per cent. and 11 per cent. Griesinger, in the following table, shews the number of cases in which perforation occurred and the percentage occurrence (Harte):

	Cases.	Perforation.	Percentage.
Liebermeister	2000	26	1.30
Murchison	1580	48	3.03
Griesinger	118	14	11.01
Flint	73	2	2.70
Curschmann	829	22	2.70
Montreal (Armstrong)	932	34	3.66
Episcopal Hospital (Harte)	1556	34	2.18
Pennsylvania Hospital	1793	49	2.50

The perforation is generally found to have occurred at the base of a small, deep, punched-out ulcer. It is in the great majority of cases found in the last twelve inches of the ileum. In 190 cases in Harte and Ashhurst's series of 362 cases it was found in 140 (73 per cent.) within twelve inches of the cæcum. In only 4 cases (2.1 per cent.) was it distant more than 3 feet from the cæcum. In 7 cases the colon was perforated; of these, 5 were perforations of the ascending colon, 1 of the

transverse, and 1 of the sigmoid flexure. There were 3 cases of perforation of Meckel's diverticulum and 8 of perforation of the appendix. The perforation is generally single, but there may be more than one; in a few recorded cases the perforations have been numerous.

Perforation, as a rule, occurs in the more severe cases of typhoid fever, but it may also occur in examples of the ambulatory form. It is in the third week that the danger of perforation is greatest. The chief points of diagnostic importance are the sudden increase of pain or the onset of pain which previously was absent, and the muscular rigidity. The abdominal wall is hard and rigid. The gentlest palpation shews that the muscles are tightened and on guard. The rigidity is seen earlier and to a more marked degree in the right side of the abdomen.

The **operative treatment** of perforation in typhoid fever was initiated by Professor von Mikulicz (who was also the first surgeon to operate for the perforation of an ulcer of the stomach and for hæmorrhage from a gastric ulcer). The first operation was performed on April 7, 1884, and was followed by recovery. As a rule, very little anæsthetic is needed for these patients. Their condition of prostration is such that but very little chloroform or ether is necessary to produce unconsciousness. Local anæsthesia has, in practice, been found unsatisfactory, though if the plight of the patient is desperate, the operation may be performed under cocaine and a whiff of chloroform may be given if pain is intolerable. The skin of the abdomen is cleansed as thoroughly, but as gently, as possible. Speed is a matter of the utmost importance. As Harte and Ashhurst say: "In too many instances it is a race with death, and there are often anxious moments when it is questionable who will win."

The abdomen is opened through either a median or a right lateral incision. My own preference is for the median incision, for no matter where the perforation may prove to be, a ready access to the lesion is attainable. Harte and Ashhurst, how-

ever, advise the lateral incision, through the outer half of the right rectus muscle, for "it is a route that gives direct access to our landmark, the cæcum, and to that part of the small gut most often affected; it affords quite sufficient room for exploring nearly the whole abdomen; it can be extended in either direction at need, and it offers excellent drainage facilities." If the incision first made does not permit of an adequate exposure of the bowel, a second must be made in a more convenient place. When the abdomen is opened, the portion of the ileum affected may present at once in the wound. If there is a larger quantity of lymph clinging to the bowel, it is probable that a very minute perforation will be found, and that some thick deposit of this lymph will seal it; if there is a large quantity of thin fluid fæcal exudate, the probability is that the opening in the bowel is a large one.

If the damaged gut does not at once present, the cæcum is sought, and the ileum traced upwards from it, the appendix being first examined. As a rule, the lesion is almost at once disclosed; but if it is not, the search must be rapidly continued, the lower three or four feet of the ileum being gently pulled towards the wound, and, if found intact, the ascending colon is explored. In all these manipulations the greatest gentleness is necessary, for other spots may be the seat of ulcers which are prone to perforation. The affected area may sometimes be quite limited, a patch of inflamed peritoneum with an abundant lymph deposit being seen on the right side of the pelvis when all other parts are unhurt. If this be so, a protective barrier of gauze is erected around it, so as to avoid any soiling of the general peritoneum.

As soon as the perforation is disclosed the loop of bowel is pulled out of the wound, packed round with gauze swabs wrung out of hot sterile salt solution, and sutures are applied. In cases of extreme distension of the bowel, the opening may be used as a vent, and through it much liquid fæces and gas may be emptied away, due care being taken to avoid any soiling of the operation area.

If the opening be small, a purse-string suture may be used to close it, and this may be buried by one or two points of a Lembert stitch. If the opening be larger, it must be sutured, in the usual manner, by a double layer of continuous stitches, the inner taking up all the coats of the bowel, the outer the seromuscular layers only. There is no need to excise the ulcer. The sutures are applied in the long axis of the gut, or, if it seems likely that the lumen will, in that way, be narrowed, they may be placed in the transverse axis. The opening being securely closed, the bowel is washed over with hot saline solution and returned to the abdomen. Other perforations are then sought.

The closure by suture in the simple manner described is not always possible, owing to the large size of the perforation, the existence of many perforations close together, or to the extremely prostrate condition of the patient. Alternative methods of treatment have then to be considered. These are the formation of a fæcal fistula, by bringing the opening up to the surface and stitching the bowel there, or by leaving the perforated loop at the bottom of the wound and packing round it; lateral anastomosis or resection with end-to-end anastomosis. Harte and Ashhurst write: "Of four cases treated by the establishment of a fæcal fistula, every one died. This tremendous mortality, however, does not prove that the operation is necessarily fatal in cases of typhoid perforation, but merely that it has been employed only in exceedingly ill patients. On the other hand, of those sixteen patients who withstood the immediate shock of the operation and in whom a fæcal fistula developed in the wound after operation, only two died—the surprisingly low mortality of 12.5 per cent." Intestinal resection in their series of cases was employed five times, with only one recovery.

When the openings have been dealt with, in what seems the most appropriate manner, the abdominal cavity is cleansed. The most satisfactory manner of accomplishing this end is by the washing out with hot saline solution. A soft-rubber tube

attached to a funnel is used, and, as the fluid is poured in, the tube is gently moved among the coils of bowel until the fluid, wherever directed, returns clear. The temperature of the fluid should be 105° to 110° F.

With regard to the bacterial conditions present in the various forms of perforation, Harte and Ashhurst write:

"With regard to the bacteriology, it has been found that in cases where the typhoid bacillus alone is the infecting cause, the usual lesions are a low-grade peritonitis, frequently lemon-coloured exudation, few adhesions, and not much lymph. Where the streptococci or the staphylococci abound, the lymph is more abundant, and adhesions are the rule if the peritonitis has lasted more than a few hours. The prognosis is much more grave in the streptococcic infection than in the typhoid. An interesting case in this connexion was observed at the Johns Hopkins Hospital. At the first operation in a patient suffering from typhoid perforation bacteriological examination of the peritoneum shewed no organisms, while the intestinal contents contained streptococci in abundance; this patient was later subjected to a second laparotomy, at which time the peritoneum was found to be infected by the streptococci, and death soon followed from the peritonitis. Evidently in this case the time which elapsed between the initial symptoms of perforation and the operation—five and a half hours—was not sufficient to infect the peritoneum extensively with intestinal contents; whereas forty-three hours later, when the second operation was performed, general purulent peritonitis was well advanced."

When the peritoneal cavity is clean, the abdominal wound is sutured in the usual manner. Drainage is always adopted. For almost all cases I prefer the split-rubber tube. Two of these may be placed side by side in the central incision, one passing to the right side of the pelvis and being directed to the sutured wound in the bowel, the other trailing along the left side. If the iliac fossæ are deeply soiled, they may be drained through separate lateral incisions, though this is rarely necessary.

The gauze wicks may be removed after the third day. Removal before this is painful, difficult, and unnecessary. If, at the first trial, the gauze does not readily come away, it may be left another twenty-four or forty-eight hours before the attempt to withdraw is renewed. The patient is propped up with two or three pillows in the Fowler position.

So far as the after-treatment is concerned, nothing more judicious has been written than the advice given by Harte and Ashhurst. They say:

"After twenty-four hours a teaspoonful of hot water may be given by the mouth every ten or fifteen minutes. Thus taken it is less apt to nauseate, and is probably all absorbed before reaching the stomach. No food should be given by the mouth until the third or fourth day at least, nutritive enemata being meanwhile continued. One or two cleansing enemata of plain water in the twenty-four hours are usually sufficient to remove all fæcal matter. When mouth-feeding is begun, it should be borne in mind that the patient has both typhoid fever and a sutured area in his intestine, and he should be fed accordingly. Those cases do best where, the acme of the disease being past, a fairly liberal diet can be allowed early. Those patients, on the other hand, who, although they were in fairly good condition at the time of perforation and so have borne the operation well, but have yet several weeks of fever with which to contend, are very apt to die during the second or third week after the operation."

The following tables are copied from Harte and Ashhurst:

ANALYSIS OF WHOLE NUMBER OF CASES.

Recovered	94
Died	268
Total	362

Mortality, 74.03 per cent.

ANALYSIS OF CASES WHERE AGE AND SEX ARE KNOWN.

Age.	Male.			Female.			Total.			Mortality Per Cent.		
	Recovered.	Died.	Total.	Recovered.	Died.	Total.	Recovered.	Died.	Total.	Male.	Female.	Total.
Under 10 years...	3	2	5	1	3	4	4	5	9	40.0	75.0	55.5
10–15 " ...	9	10	19	3	3	6	12	13	25	52.6	50.0	52.0
15–20 " ...	6	29	35	1	2	3	7	31	38	83.0	66.6	81.8
20–30 " ...	16	70	86	8	19	27	24	89	113	81.4	70.3	78.0
30–40 " ...	13	44	57	6	6	12	19	50	69	77.2	50.0	72.4
40–50 " ...	8	10	18	1	2	3	9	12	21	55.5	66.6	57.1
50–60 " ...	0	3	3	0	1	1	0	4	4	100.0	100.0	100.0
Total	55	168	223	20	36	56	75	204	279	75.3	64.2	73.1

ANALYSIS ACCORDING TO DURATION OF PERFORATION BEFORE OPERATION.

Cases Operated on.	Recovered.	Died.	Total.	Mortality.
First 12 hours after perforation....	35	95	130	73.0 per cent.
Second " "	22	62	84	73.8 " "
Third " "	2	29	31	93.5 " "
Over 36 hours after perforation.....	18	37	55	67.2 " "

ANALYSIS AS TO THE PERFORATION.

Number of Perforation.	Recovered.	Died.	Total.	Mortality.
Single.....	65	171	236	72.4 per cent.
Multiple.....	5	30	35	85.7 " "
Size of Perforation.				
Under ½ (½) inch.....	35	37	72	51.3 per cent.
Under ½ inch.....	17	56	73	76.7 " "
Over ½ "	7	16	23	69.5 " "
Site of Perforation.				
Within 12 inches of cæcum.....	32	108	140	77.1 per cent.
" 24 " " "	7	32	39	82.0 " "
" 36 " " "	1	6	7	85.7 " "
Over 3 feet from cæcum.....	1	3	4	75.0 " "

ANALYSIS AS TO SITE OF INCISION.

Site.	Recovered.	Died.	Total.	Mortality.
Median hypogastric.....	21	75	96	78.12 per cent
Right iliac.....	44	97	141	69.5 " "
Left iliac, abscess pointing.....	2	0	2	
Median epigastric.....	1	3	4	75.0 " "
Right hypochondriac.....	0	1	1	100.0 " "
Multiple incisions.....	3	11	14	78.5 " "
Drainage through loin, flank, or vagina.....	1	4	5	80.0 " "

ANALYSIS OF CAUSE OF DEATH IN EIGHTY-NINE CASES IN WHICH IT IS GIVEN.

Causes of Death after Operation.	Under Twelve Hours.	Under Twenty-four Hours.	Under Three Days.	Under One Week.	Under Two Weeks.	Over Two Weeks.	Total.	Per Cent. of Whole Number.
Pre-existent peritonitis	17	6	16	4	1	0	44	49.4
Toxæmia of typhoid fever	2	0	5	2	0	0	9	10.1
Peritonitis from subsequent perforation	0	0	3	2	3	2	10	11.2
Exhaustion	0	0	0	1	3	1	5	5.6
Intestinal hæmorrhage	0	0	1	2	0	0	3	3.4
Intestinal obstruction	0	0	3	0	0	0	3	3.4
Other causes, uninfluenced by operation	7	0	8	0	0	0	15	16.8

Dr. W. D. Haggard, in a paper containing a review of many recorded cases, writes:

"The facts about intestinal perforation, which I have deduced from a statistical study of the cases, may be summarised as follows:

"1. It occurs more often in men than in women—80.9 *vs.* 19.1 per cent. It is, like hæmorrhage, rare in children.

"2. It occurs in about 2.5 per cent. of all cases of typhoid fever.

"3. 3.31 per cent. occur in the first week; 20.19 per cent. in second week; 38.94 per cent. in third week; 14.90 per cent. in fourth week; 9.13 per cent. in fifth week; 5.75 per cent. in sixth week; 7.21 per cent. from seventh to eleventh week, and has been observed as late as the one hundredth day (Curschmann). Holmes operated on one case after four months.

"4. It naturally occurs more frequently in severe attacks, but may occur in mild attacks, and it may be the first real symptom of so-called walking typhoid.

"5. It occurs in the ileum in 95.5 per cent., usually in 18 inches of cæcum (Osler), always in 3 feet (Loison); in the large intestine in 12.9 per cent.; and is most often situated in the ascending, transverse, and descending colon, sigmoid, and rectum, in the order named. It may occur, also, in the appendix, Meckel's diverticulum, and jejunum.

"6. The perforation is single in 84 per cent. There may be two or more, and in one case there were twenty-five (post-mortem). Cases with diarrhœa and tympany are more likely to have perforation. Six out of thirty cases occurred with hæmorrhage (Osler).

"7. The death-rate given by Murchison is 90 per cent. to 95 per cent. Osler says he could not recall a single case in his experience that had recovered after perforation had occurred."

CHAPTER XXXIII.

INTESTINAL EXCLUSION.

By the term "exclusion of the intestine" is meant the rendering inactive any part of the intestinal canal by surgical means. When entero-anastomosis is performed, the length of intestine which lies between the two openings is "excluded." When the intestine is cut across, the distal end closed, and the proximal end united to the side of the distal, the part of the gut which lies between the two points dealt with is "excluded." When, finally, the intestine is divided at two points and the proximal end of the upper and distal end of the lower are united, the intervening portion is "excluded."

In the operation of entero-anastomosis as suggested by Maissoneuve, the exclusion is certainly not always complete. Le Dentu ("Rev. de Gyn. et de Chir. Abdom.," Paris, 1899, vol. iii, p. 81), in two cases of intestinal fistula, united the gut above to the gut below the opening, in the hope that the current of intestinal matters might be caused to deviate, and that thereby the fistula might close spontaneously. The fistula, however, continued to discharge in each case. Similarly, in a case of ileosigmoidostomy performed for obstruction due to a growth in the hepatic flexure, I made a small opening in the cæcum to give vent to a large collection of fæces and flatus. The growth in the colon was subsequently excised, but for several weeks there was some escape of fæces through the typhlotomy opening.

The following forms of intestinal exclusion are recognised:

1. Partial exclusion.
   (*a*) Entero-anastomosis of Maissoneuve.
   (*b*) Entero-anastomosis, with constriction of the part distal to the upper opening, by suture.

2. Complete exclusion.

(*a*) Bilateral exclusion. When the bowel is divided at two places and the intestinal channel restored, leaving a segment of the bowel detached. Of this segment one end may be left open and the other closed, or both ends may be left open and stitched to the skin, or both ends may be closed when a fistula exists in the bowel lying between them, or both ends may be united to a segment of intestine into which the loop between them will drain.

(*b*) Unilateral exclusion. When the gut is divided completely across and the proximal end implanted into the side of the distal. The distal end may be closed or may be left open.

In all operations of this kind it is desirable to open the abdomen, if possible in the middle line. The incision should be made at a distance from any fistula or any skin involvement. In such circumstances it may be impossible to obtain a clear view, owing to complex adhesions, or even to open the peritoneal cavity without wounding or perhaps opening some adherent coil of the bowel.

When the peritoneum has been opened, the intestine leading to and coming from the involved segment is defined. This is not always an easy matter, especially when many adhesions are present. It is desirable to work from some fixed point—the cæcum, by choice, or the duodenojejunal flexure. The rules already given for the recognition of any part of the intestine will be found of service.

When the proximal and distal portions of the bowel have been recognised, the former is divided completely across. The method of dividing it depends upon the purpose of the operator. If an end-to-end or end-to-side anastomosis is to be performed, it is divided between two clamps whose blades are sheathed with rubber tubing. If the ends are to be closed and a lateral approximation made (which is the method of choice when the

small intestine has to be united to the large), then the bowel

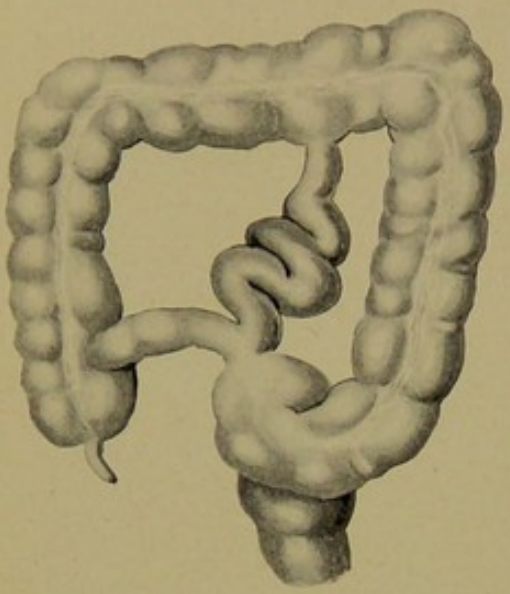


Fig. 268.—Intestinal exclusion, entero-anastomosis.

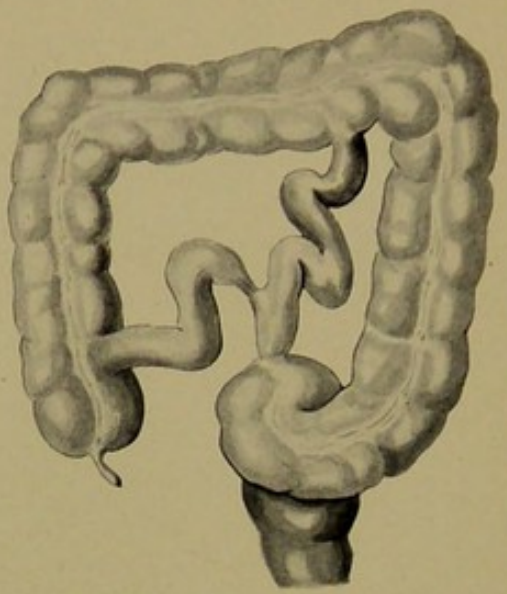


Fig. 269.—Entero-anastomosis with constriction by suture of the part distal to the upper opening.

is crushed by forceps which divide all the coats except the peritoneum; two catgut ligatures are applied in the groove left

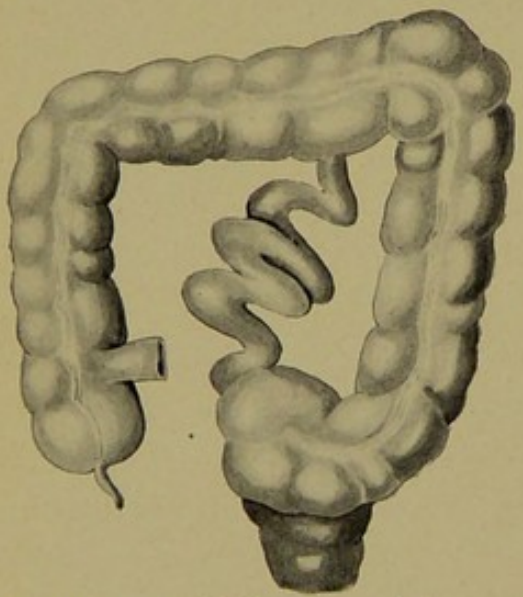


Fig. 270.—Unilateral exclusion.

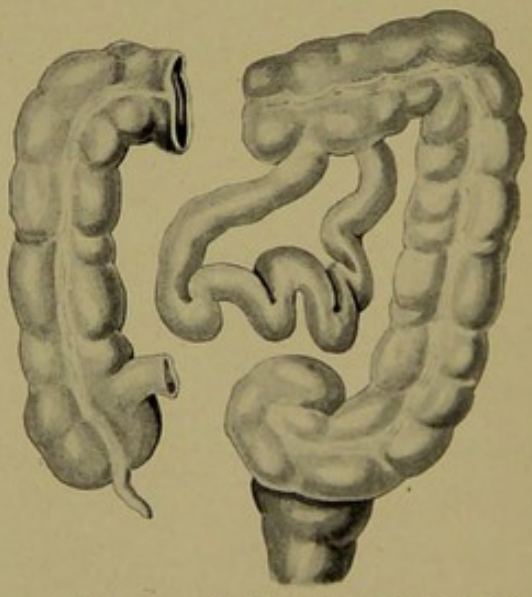


Fig. 271.—Bilateral exclusion, the distal end of the excluded gut left open.

when the forceps are removed, and the bowel divided between the ligature. The stump on each side is then buried by a con-

tinuous suture, or, as I prefer now, the gut may be divided between two pairs of grooved forceps, and each end of the gut closed by the continuous suture taken over the forceps in the manner described elsewhere.

In unilateral exclusion an end-to-side anastomosis is performed. As a rule, the distal end at the point of division of the bowel may be closed, but in certain circumstances it may be left open, either for purposes of drainage or to afford an opportunity for the irrigation of a septic area.

In bilateral exclusion one end at least of the sequestrated

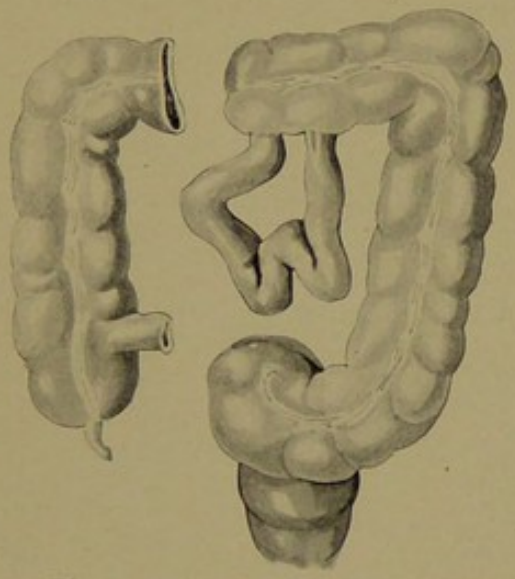


Fig. 272.—Bilateral exclusion. Both ends of excluded gut closed—fistula.

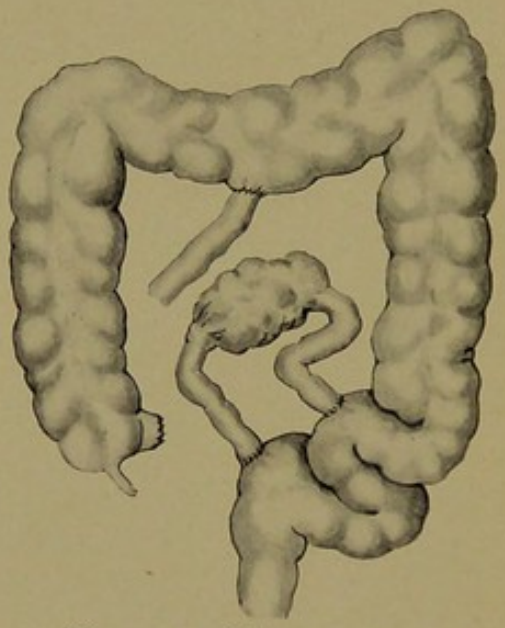


Fig. 273.—Bilateral exclusion, both ends of excluded segment joined to the sigmoid flexure.

segment must be left open. As a rule, this should be the distal opening, so that peristalsis may help in its emptying. If both ends are to be left open, they may be brought out side by side through the same incision,—not necessarily the original incision,—or a separate opening may be made for each. In rare cases the loop thus cut off may be short and may have a free opening with the surface; both ends may, therefore, be closed. This, however, is neither prudent nor desirable. Vautrin has urged that when the excluded portion of the gut is in-

fected, or sloughing and foul from cancerous ulceration, the two ends should not be laid side by side, so that the channel from one to the other is circuitous, but that two openings should be made—one for each end of the gut, which should lie untwisted and free from kink between them. Free irrigation of the coil is then possible.

When bilateral exclusion has been performed, some operators have closed both the ends of the sequestrated coil. This practice had, indeed, been advocated by Obalinski, but in a later publication he decides that it is inadvisable in the case of the small intestine, though permissible when the large intestine alone is involved. The practice has led to disaster. In many cases (Eiselsberg, Delagèniére, Roux) the excluded intestine has had to be opened, as symptoms of urgency were arising from the distension of the bowel. There can be no hesitation in condemning unequivocally any adoption of this method. It is unsound in theory and disastrous in practice.

In cases of unilateral exclusion, the question has arisen as to whether the bowel between the point of division and the point of the lateral anastomosis undergoes any change. Experimentally it was found by Senn and others that it tended to undergo atrophy; the bowel withered, its lumen lessened, and its vessels became thin and shrunken. In the majority of recorded cases, however, it has been found that the intestinal contents have tended to pass backwards, and fistulæ in the excluded coil have continued to discharge. According to Delore and Patel and Hartmann, the only occasions upon which the excluded bowel remains absolutely empty are those in which the ileum has been divided near its termination and the proximal end implanted into the colon. The ileum between the point of section and the ileocæcal valve then remains permanently empty, for regurgitation is stopped at the valve.

There is, without doubt, some difference in this regard between unilateral exclusion performed upon the large and upon

the small intestine. When performed upon the small intestine it is known, both by experimental evidence and as the result of operations upon man, that the excluded loop is constantly filled with fæcal material. If the proximal end of the excluded loop remains open to the surface, the discharge from it rarely ceases for more than a few hours. A fistula therein does not close. Unilateral exclusion of the small intestine does not offer, therefore, any advantages, either immediate or remote, over the entero-anastomosis of Maissoneuve. In the large intestine the conditions are slightly different. When the ileum is divided near its termination and the proximal end implanted into the ascending colon, there is some backward flow, as from the ileocæcal valve. The lower end of the ileum remains empty. If the proximal end be implanted into the sigmoid, there is little or no flow backwards along the descending and transverse colon during the early period. At a later stage of the case there may, however, be some passage of fæcal material backwards towards the cæcum. Drucbert, in his experimental work upon dogs, found that during the first few weeks after the operation the motions were frequent and fluid in character. As time passed they became less frequent and more solid, and eventually the bowel movements were natural both in frequency and in character. If the intestine was examined during the early stage, the colon was always found empty and flaccid; during the later stage the colon had come to act as a reservoir from which a surplus quantity was from time to time discharged. These observations are confirmed by the experiences in man. In a case of unilateral exclusion, the ileum being joined to the sigmoid, Jaboulay found that at first the motions were frequently discharged and were always fluid; after a time they became semisolid, and at last normal. Körte has recorded a case of tuberculous disease of the cæcum treated by excision, followed by the implantation of the ileum into the sigmoid. After the anastomosis had been completed the colon was narrowed by sutures in order to prevent regurgitation towards

a fistula in the ascending colon. For six and a half months there was no discharge from the fistula; at the end of that time, however, fæces again passed through it. Körte then cut across the colon at the splenic flexure and closed both ends. The fistula ceased to discharge.

The conclusion to be drawn from the evidence furnished both by experimental work and by experience of cases in man is that unilateral exclusion of the small intestine offers no advantages over entero-anastomosis, and in the large intestine does not prevent, at any rate for more than a short period, the backward flow of fæcal matter.

The operation of bilateral exclusion has long been known as a laboratory method of cutting off from the intestinal current a segment of intestine for the purpose of studying the nature of the intestinal juice. A certain length of intestine is cut out, the intestine above and below it united, and both ends of the loop completely closed. A fistula is then made to the middle of the loop. This method of investigation was first suggested by Thiry in 1864. It was modified by Vella, who, instead of closing the ends, left them both open and brought them to the surface. The fistula is generally known as the "Thiry-Vella fistula."

Lance has collected the notes of 76 cases of bilateral exclusion performed in man. In 8 cases it has been practised upon healthy intestine for the purpose of causing to close a fæcal fistula resulting from operation or from strangulated hernia. All the cases recovered; in three a subsequent removal of the fistulous loop was successfully performed.

In the remaining 68 cases the exclusion was practised for various lesions, such as chronic invagination, chronic colitis, tuberculosis of the large intestine, cancer, pyostereoval fistula, and vaginal fistula. In no cases was there any ill effect attributable solely to the method. As a rule, when a fistula from the excluded loop was not already present, the two ends of the intestine were brought to the skin. Sutured there this procedure

is sometimes known as "Hochenegg's method" of exclusion. The pre-existing fistulæ closed rapidly in all the cases except those in which malignant disease was present. As a rule, only one end of the loop remained permanently open, the other gradually dwindling in size and eventually becoming quite closed.

Exclusion of the intestine was first performed on man by Trendelenburg on December 2, 1885. It is, however, to von Hacker that we owe the first deliberate suggestion, put forward in 1888, that complete exclusion of the intestine might be a successful means of treating certain lesions of the bowel complicated with adhesions and fistulæ. The suggestion did not attract general attention; it had, indeed, passed almost without recognition until Salzer, in 1891 and in 1892, gave it prominent advocacy. In reviewing a series of clinical records, Salzer endeavored to shew that in cases of diffuse phlegmon in the right iliac fossa complicated by adhesions and fistulæ the operation of enterectomy, always serious and not seldom fatal, might be avoided by an operation which detached the involved segment from the intestinal current. The bowel, relieved of the constant irritation aroused by the passage of fæces, would then tend to heal and the patient be thereby restored to health. A series of experiments performed upon animals demonstrated the possibility of the successful performance of the operation. Salzer himself, however, did not perform the operation in man.

Terrier and Gosset consider that exclusion of the intestine is indicated in all cases where there is a mechanical obstruction to the onward passage of the intestinal contents. The opinion, however, is not borne out by practical experience, for it is well known that in certain instances a lateral anastomosis is attended by most satisfactory results.

Exclusion of the intestine has been practised for the following conditions:

Tuberculous or simple ulcers of the intestine, which have led to the formation of external fistulæ; the purpose of the

operation being the diverting of the fæcal current, and giving rest to the diseased portion of the bowel.

In intestinovaginal fistula following hysterectomy a bilateral exclusion is performed and the sequestrated loop drains into the vagina. The discharge soon lessens, and within a few weeks becomes almost imperceptible.

In chronic invagination the operation has been performed on three occasions.

In cases of artificial anus and fæcal fistula: In these conditions other operations are always to be preferred.

In cases of colitis an entero-anastomosis or a unilateral exclusion, the ileum being joined to the sigmoid, has been performed, with marked relief to the inflamed and perhaps ulcerated bowel.

In chronic intractable constipation, unilateral exclusion has been performed; the ileum has been divided about one foot above the ileocæcal valve and the proximal end implanted into the sigmoid or the upper end of the rectum.

The operation of exclusion of the intestine is chiefly necessary in cases of chronic inflammatory disease, probably tuberculous, involving the bowel and leading to external fistulæ; in cases of inoperable carcinoma of any part of the large intestine, especially of the cæcum and ascending colon; and in rebellious cases of mucomembranous colitis. From what has been said it will be recognised that unilateral exclusion, save in cases of disease affecting the lower end of the ileum, offers no advantages over lateral anastomosis; and that bilateral exclusion affords the best means of dealing with certain diseases, chiefly tuberculous and malignant, in the cæcum and colon, and with fistulæ between the small intestine and the bladder or vagina.

REFERENCES.

Lance, "Thèse de Paris," 1903, No. 348 (contains a list of all recorded cases).
Terrier and Gosset, "Revue de Chirurgie," 1901, vol. xxii, p. 29.
Delore and Patel, *ibid.*, 1902, pp. 669 and 797.
Hartmann, "Gazette des Hôpitaux," October 3, 1903, p. 1125.

SECTION IV.

OPERATIONS UPON THE LIVER.

CHAPTER XXXIV.

OPERATIONS UPON THE LIVER.

Access to the liver for surgical purposes may be obtained in the following directions:

1. Through an anterior incision opening the peritoneal cavity, as in exposure of the gall-bladder.

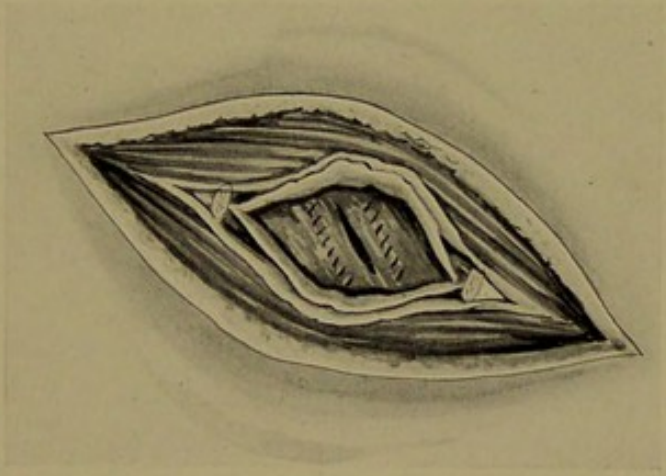


Fig. 274.—Exposure of liver by resection of a portion of rib and suture of the diaphragm to the liver (after Bickham).

2. Through an *anterior* incision along the seventh or eighth ribs, which are resected. The pleural cavity is traversed and the diaphragm incised.

3. Through a *posterior* incision along the eighth or ninth ribs, which are resected. The pleural cavity is traversed and the diaphragm incised.

4. Through a similar posterior incision. The pleural cavity is not traversed, but is avoided, the pleura being lifted upwards out of the way.

1. The first incision mentioned is that which is used for the exposure of the gall-bladder for the purpose of performing operations upon it or upon the ducts. A full description of Mayo Robson's, Kocher's, and Bevan's incisions is given elsewhere. Resection of the costal margin, as shewn in the annexed figures, gives a free exposure to the upper surface.

2, 3. The **transpleural** methods are performed in the same manner, wherever the incision may lie. In some instances the anterior incision, in others the posterior, may be necessary.

The posterior method is thus performed: An incision about

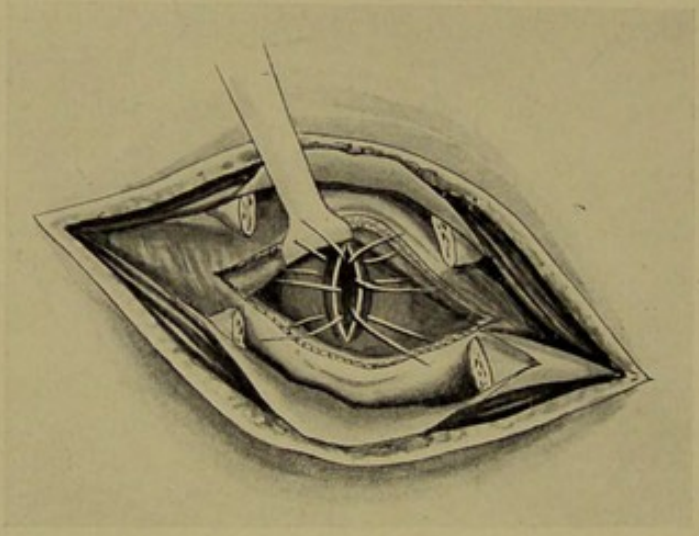


Fig. 275.—Exposure of upper surface of the liver after resection of portions of two ribs (after Bickham).

four inches in length is made along the line of the space between the eighth and ninth ribs; the middle of the incision corresponds approximately to the posterior axillary line, but is made a little further forward or further back if the exploratory puncture previously made should indicate that this is necessary. The latissimus dorsi and the external oblique muscles are divided freely and the ribs are exposed. Along the centre of the outer border of each rib an incision is made through the periosteum, which is stripped upwards and downwards until the outer surface of the bone is bared. The periosteum is then carefully stripped from the inner surface of the ribs with a curved ras-

patory, the greatest care being taken not to wound the pleura. As soon as the periosteum has been stripped at one point the raspatory is pushed sideways and the stripping of all the periosteum is thus rapidly effected. The bared portions of rib, at least 2½ to 3 inches in length, are then excised. The parietal pleura is now exposed. It is sutured, before being opened, to the pleura of the diaphragm by a series of deep stitches taken with a large curved intestinal needle. The stitches are passed through

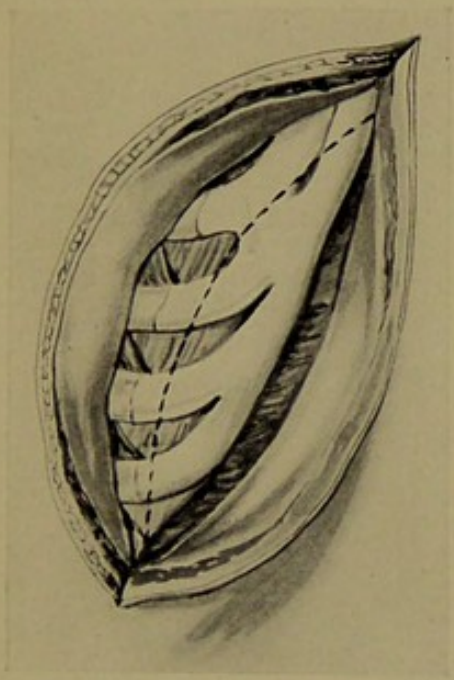


Fig. 276.—Osteoplastic resection. Resection of costal margin to expose the upper surface of the liver: the line of incision.

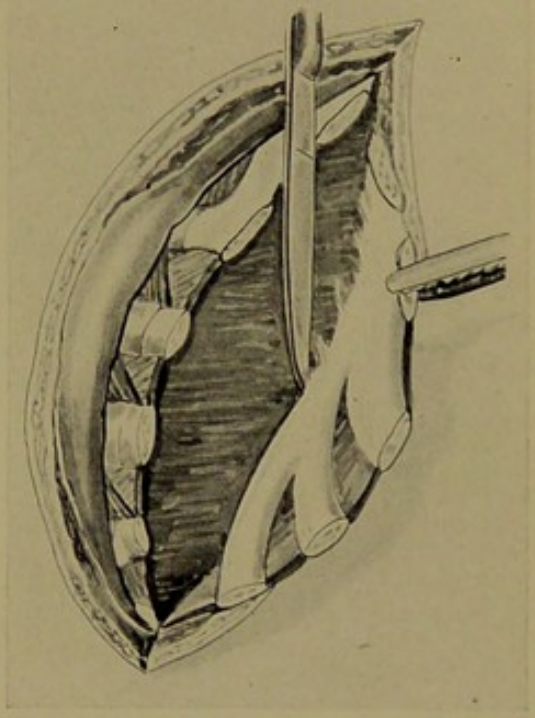


Fig. 277.—The costal cartilages dissected up. They are subsequently replaced.

the intercostal muscles, as well as through the pleura above and below, and, at each end of the divided ribs, through the periosteum. The stitches are deeply passed, are close to one another, and are drawn fairly tight. A continuous suture or interrupted sutures may be used. There is little to choose between them. In the centre of this circle of sutures an incision is made into the pleura, or an ellipse of the pleura is excised. The upper surface of the diaphragm is now seen, and

is at once incised, and the liver is exposed. As a rule, the liver, in those cases where an abscess or an hydatid is present, will be found adherent to the under surface of the diaphragm, the parietal and visceral peritoneum being adherent. If this adhesion is not found, then a few sutures must be passed uniting the two. The liver is then incised.

In certain cases delay may properly be practised between the suturing together of the costal and diaphragmatic pleuræ

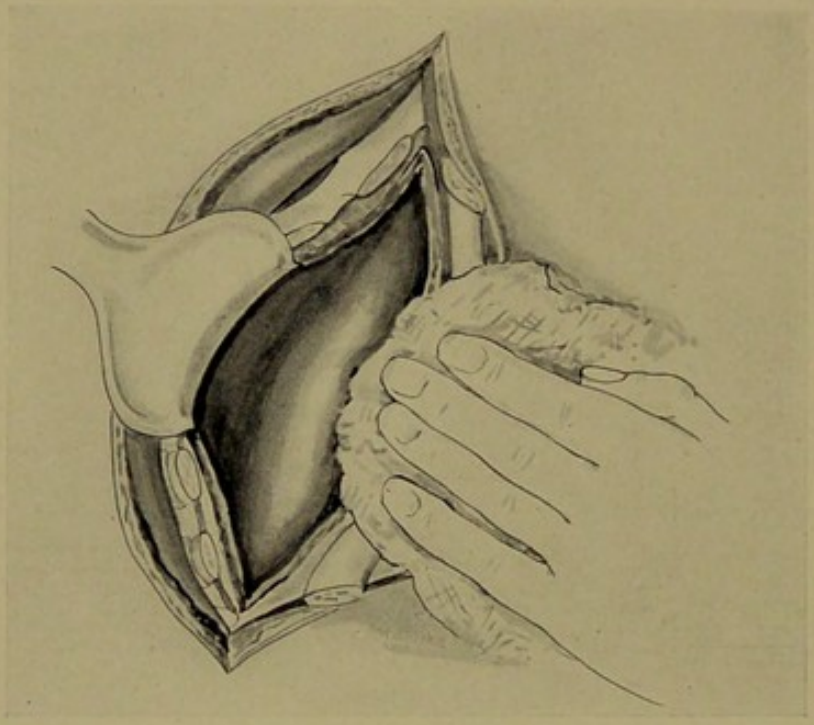


Fig. 278.—The cut margin of the ribs elevated by a retractor. The liver depressed by a hand protected by gauze (after Guibé).

and the incision through them into the abdomen. The wound is then packed with gauze; on its removal firm adhesions will have formed between the two serous surfaces so approximated, and any risk of infection of the pleural cavity is abolished.

4. The **subpleural method** is theoretically the most desirable, as avoiding any chance infection of the pleura. In practice, however, there is little to choose between the two.

The operation is carried out in the same manner as in the transpleural operation until the ribs are excised. The costal

pleura, which is then exposed, is stripped away from the under surface of the ribs by the pressure of the fingers covered with a strip of gauze. When the pressure is evenly and firmly made, the pleura strips away quite readily. When its lower margin is reached, the stripping is continued on the diaphragmatic pleura until a sufficient exposure of the bared diaphragm has been made. The lower thin reflection of the pleura is thus freed from all its attachments and is pushed upwards, and if the operation is to proceed at once, it is held away by a retractor and a pad of gauze. The incision of the diaphragm, which is the next step in the operation, is either carried out at once or is postponed for forty-eight hours, during which the wound is packed. Delay is, however, never necessary. The subsequent steps of the operation are those already described. A combination of the abdominal and of the transpleural incisions has been practised in certain cases. Edler, in one case of a wound of the liver in the tenth intercostal space, enlarged the wound of entrance upwards and downwards, resected the eleventh rib, exposed the diaphragm, in which a wound was found, and finally continued his incision downwards still further for the purpose of incising the peritoneum. Terrier also made both a transpleural opening and an abdominal opening, and connected the two, resecting two costal cartilages and incising the diaphragm in order to gain access to a wound of the liver.

The upper surface of the liver, when wounded, may be exposed either by the transpleural method or after opening the abdomen. The liver can be dragged downwards by an assistant, or, as Hahn has suggested, the suspensory ligament of the liver may be divided and the mobility of the organ be thereby greatly increased.

CHAPTER XXXV.

INJURIES OF THE LIVER.

Injuries of the liver may be due to blows, crushes, or falls, or to gunshot or to stab wounds.

Subcutaneous wounds are of three kinds (Kehr):

1. Rupture of the hepatic tissue, combined with tears in the capsule.

2. Separation of the capsule with subcapsular hæmatoma.

3. Central ruptures, which often give rise to separate or united hæmatomata, which may develop into cysts or abscesses.

Open wounds may be of any conceivable complexity, character, or extent.

The rupture may be small, and the division of the liver substance sharp and clean, or there may be great crushing of the liver substance, or a part of the liver may be detached completely from the rest and be found lying free in the peritoneal cavity.

Wounds of the liver may be single or multiple. It is important in all cases to determine the exact number and the precise extent of the wounds. The right lobe is injured six times as frequently as the left. The two serious features in all wounds of the liver are hæmorrhage and infection—the former is the more grave. Edler, in his statistics ("Archiv f. klin. Chir.," Bd. xxxiv, 1887), has shewn that hæmorrhage, if it proves fatal, does so within twenty-four hours. The need for operation, therefore, in suspected cases of wound in the liver is instant.

Gunshot and stab wounds of the liver may involve other organs also. The order of frequency in which the other parts are injured is given by Edler as follows: the diaphragm, the

ribs, the lungs and pleuræ, the stomach, the intestine, the kidneys, the spleen, the spine, the heart, the pancreas. The dangers of these wounds also are the more immediate one of hæmorrhage, the more remote one of sepsis.

TREATMENT.

In open wounds of the liver there can be no question as to the immediate necessity for operation, for the damage done to the parts is necessarily of such a character as to demand inspection; other viscera also may be injured, foreign bodies may be within the wound, bleeding may still be going on, or the contamination may be such that free opening and adequate cleansing must be performed at once.

In cases of subcutaneous injury the need for operation is by no means so imperative. There can be no doubt whatever that recovery from subcutaneous ruptures occurs by no means infrequently when no operation is performed. When the abdomen is explored for a possible rupture of the intestine a slight tear in the liver, which had not been suspected, is sometimes discovered. If the evidences of a rupture of the liver, such as the signs of shock and hæmorrhage, with the presence of fluid in the abdomen, or dulness in the right iliac fossa, the continuous increase in pain, due to progressive abdominal distension, and muscular rigidity, are absent, no operative intervention can be considered. Nevertheless, in such cases as these there may, afterwards, be undoubted proof, afforded by the symptoms, jaundice, hepatitis, and so forth, or by the inspection permitted in an operation for a different condition, that a slight laceration of the liver has been present.

OPERATION.

The liver, being exposed by some of the routes already described, the indications to fulfil are: the arrest of hæmorrhage and the closure, so far as is possible, of the wound in the liver.

Hæmorrhage may be arrested by suture, by ligation of the larger vessels, by forcipressure, by packing with gauze, by the actual cautery, or by the application of steam.

J. Hogarth Pringle ("Annals of Surgery," October, 1908) has suggested that when the peritoneal cavity is opened, the hepatic and portal vessels should be immediately grasped with finger and thumb and held by an assistant whilst the blood-clots are cleared from the peritoneal cavity and the necessary manipulation on the liver carried out.

He writes:

"In the case of the first patient upon whom I operated, the abdominal cavity was not only found to contain a very large amount of blood, but as soon as the peritoneum was opened, blood welled up in large quantities from an extensive laceration of the right lobe of the liver, and before anything could be done to arrest it, the patient had died, not from the blood lost prior to the operation, but from the profuse and uncontrolled hæmorrhage that took place from the torn surfaces of the liver after the peritoneum was opened and the tension inside the abdomen released. Later it occurred to me that if the portal vein had been compressed in the anterior boundary of the foramen of Winslow, the hæmorrhage might have been so far temporarily arrested as to permit of a thorough treatment of the torn vessels."

The method is one which has been practised and praised by Rutherford Morison ("British Journal of Surgery," January, 1914).

Suture of the Liver.—The stitching up of wounds in the liver was formerly thought to be impossible, owing to the great friability of the hepatic tissue. Experimental work by many observers and the treatment of cases of injury in man have shewn, however, that this belief was unfounded. The very admirable work of Kousnetzoff and Pensky ("Revue de Chirurgie," 1896, pp. 501 and 954) has placed our knowledge of the subject of suture of the liver on a surer basis. They have shewn that wounds in the liver may be stitched up with perfect ease and safety if a proper method be adopted, and that bleeding

from the branches of the portal vein may be prevented by the ligation of each vessel. When the surface of the liver is cut, the chief bleeding points may be seized with a fine clip or an artery forceps, and ligated in exactly the same manner as vessels elsewhere. The walls of the veins are sufficiently strong to carry a clip and to bear the strain of a ligature.

These observers pointed out that when, in the ordinary manner, a sharp needle is passed through the liver substance,

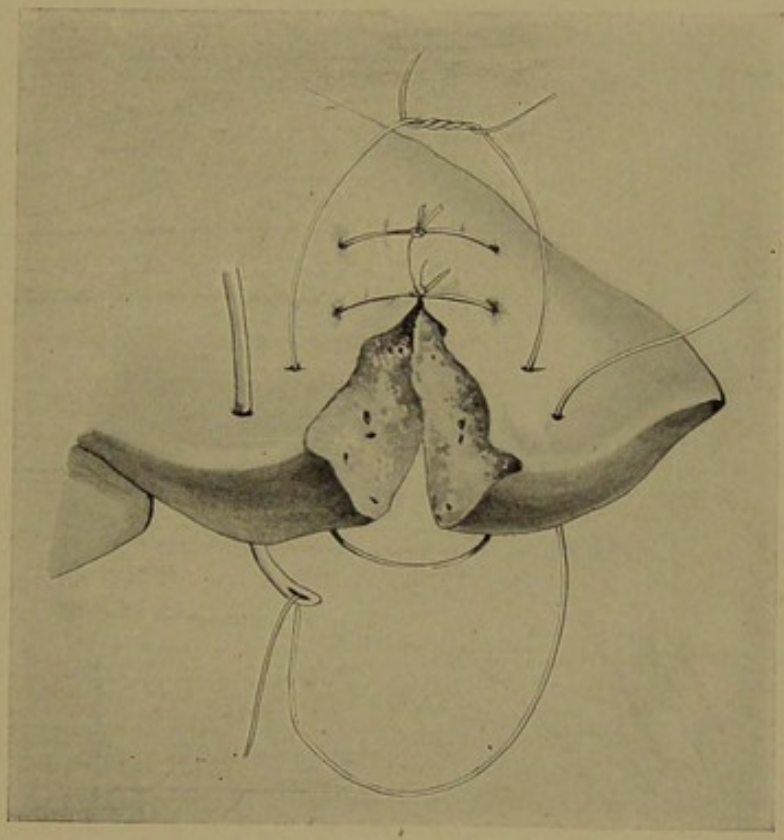


Fig. 279.—Suture of a wound in the liver (Kousnetzoff's needle).

there is bleeding along the track the needle takes. This is due to the wounding of the vessels that lie in the path of the needle. They, therefore, devised a blunt, supple needle, of the type of a Hagedorn needle, which should be pushed aside by, rather than transfix, the vessels that it meets. This needle has been modified by Kader and by Mikulicz, and in any of its forms is, without doubt, the best instrument wherewith to suture the liver substance. In passing the needle it is held near the

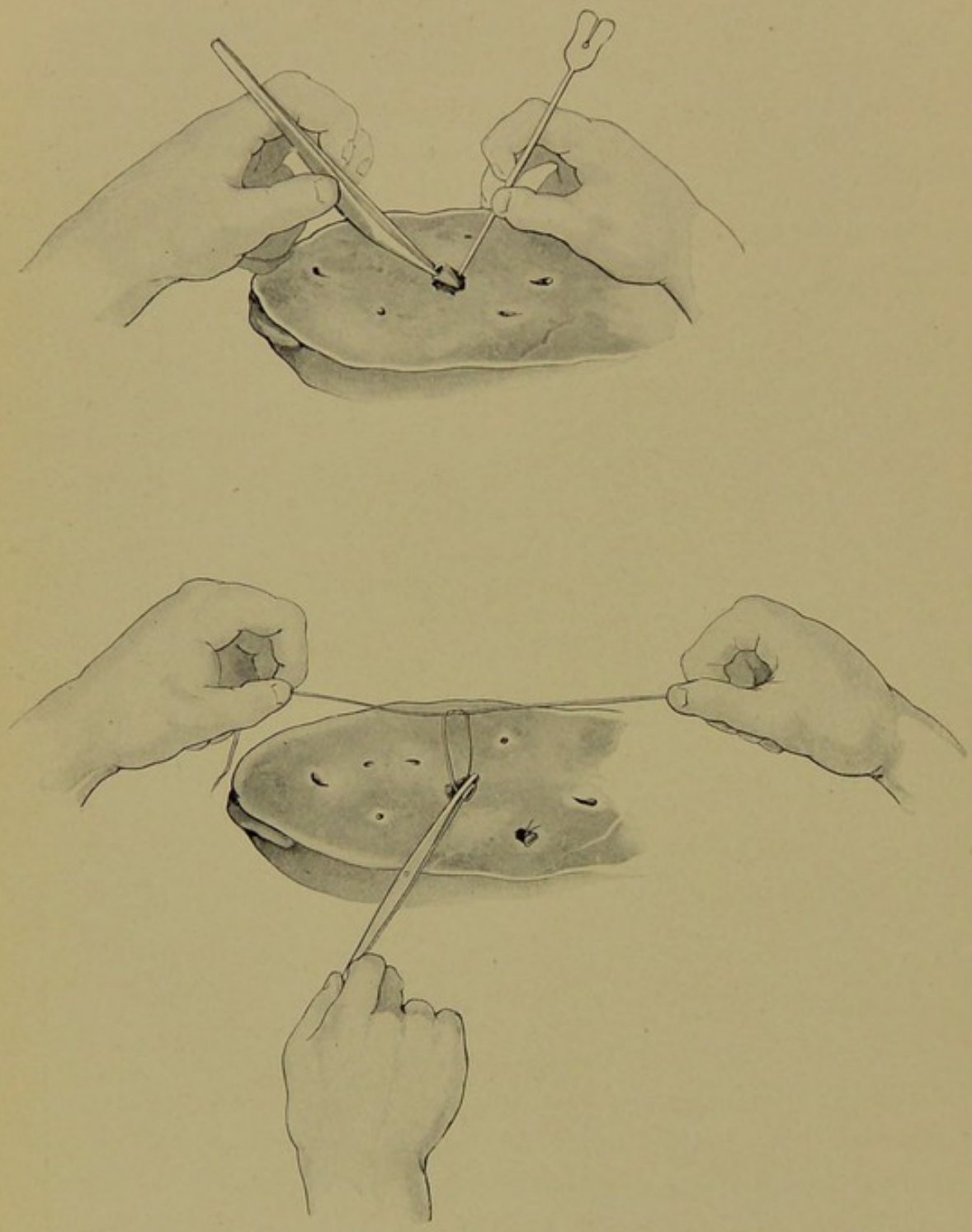


Fig. 280.—Ligation of vessels on the cut surface of the liver (Kousnetzoff and Pensky).

eye and the tip is "wriggled," as it were, from side to side, so that it may the more readily find a way through the soft liver substance, and avoid, in its passage, any of the branches of the portal vein.

Kousnetzoff further shewed that a thick suture material was to be preferred to a thin. Thin catgut or thin silk cuts readily through the liver, dividing all, or many, of the vessels which lie in its way. A stout ligature, on the other hand, crushes the soft substance away from its grip, but leaves the vessels, which

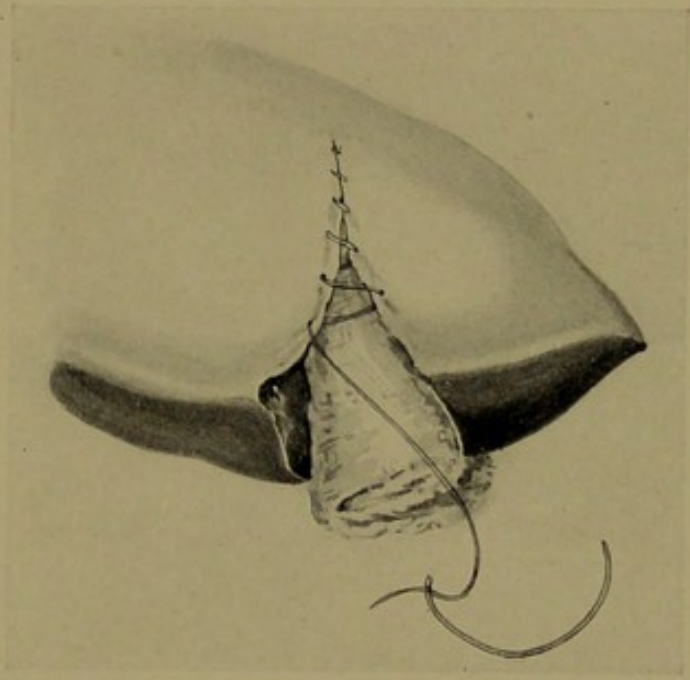


Fig. 281.—Kousnetzoff and Pensky's second method of liver suture.

are therefore secured. This point was taken advantage of in resection of the liver, as will be presently described.

Sutures should be used whenever possible. Even in cases where a complete closure of a wound in the liver cannot be effected, one or more sutures may be introduced and will lessen considerably the size of the rent.

Failing the suture, the only satisfactory method of dealing with wounds of the liver is, in my judgment, that in which gauze packing is used. Sterilised gauze or iodoform gauze is packed into the crevices of the wounds with sufficient firmness

to arrest bleeding. In all contused wounds, extensive lacerations, or gunshot wounds, this method is almost certain to be necessary.

The use of the thermocautery is not a satisfactory method of arresting hæmorrhage from a rupture of the liver.

If blood or bile has escaped into the peritoneal cavity, means must be taken to secure that all parts are made clean before the abdominal wound is closed. The free mopping with sterilised gauze or flushing with saline solution may be necessary. The abdominal wound must always be left open sufficiently to afford an easy escape of fluids from the damaged parts.

RESULTS.

It is very difficult to arrive at a sound conclusion with regard to the results in cases of rupture of the liver, owing to the facts that all cases are not reported and that other injuries more or less serious than that suffered by the liver are present.

Edler's statistics, published in 1887, shew a mortality in gunshot wounds of 39 per cent., in stab wounds, of 37.5 per cent., and in subcutaneous wounds, of 78.1 per cent.

The statistics of Terrier and Auvray are based upon the reports of 45 cases, all submitted to operation. There were 11 cases of rupture with 5 deaths; 14 cases of gunshot wound with 4 deaths, and 20 cases of stab wounds with 5 deaths. The death-rate of all cases was represented by a mortality of 30 per cent., as contrasted with a mortality of 66 per cent. in the cases collected by Edler.

Benjamin Tilton ("Annals of Surgery," January, 1905, p. 27) has collected the records of all the cases treated in the New York hospitals in ten years (1895 to 1905). They are 25 in number, and are divided as follows: ruptures 12, gunshot wounds 9, stab wounds 4. Death occurred in 11 cases—a mortality equivalent to 44 per cent. The cases treated by early laparotomy were 20 in number, with a mortality equivalent to 40 per cent. The mortality in cases of rupture that were operated upon was 62.5 per cent.; in cases of stab wounds, 33 per cent.; and in cases of gunshot wounds, 28.5 per cent.

CHAPTER XXXVI.

INJURY OF THE GALL-BLADDER AND BILE-PASSAGES.

When the gall-bladder or bile-ducts are diseased or distended behind a block due to a stone, to stricture, or to pressure from without, rupture is more likely to occur than when all the parts are sound. The number of recorded cases of traumatic rupture is small. Desrosiers, in a thesis published in 1894, collected the records of 25 cases. Of these, 13 were due to a fall on the abdomen, 10 were due to a blow, 1 was the result of a run-over accident, and 1 the result of a buffer accident.

In all cases extravasation of bile occurs, and may be limited or diffused. The limitation is generally due to the fact that adhesions have been formed and have confined the later, more abundant, effusion to a comparatively small area. The amount of bile extravasated varies considerably: only a few ounces may escape; in one case, recorded by Uhde, there was no less than 14 litres.

Jaundice is met with very frequently when the gall-bladder or any part of the bile-ducts is ruptured, and but rarely when the liver is injured. In rupture of the liver Ludwig Mayer found that jaundice was present only in 4.75 per cent. of cases. Desrosiers, in cases of rupture of the ducts, found jaundice to be present in 65 per cent. In the majority of cases the jaundice appears during the first few days, but in some records it is stated that no jaundice was noticed until the third week. Courvoisier has suggested that it may be possible to distinguish between a rupture of the gall-bladder and a rupture of the ducts by observing the intensity of the jaundice and the amount of bile which is discharged into the intestine. If the jaundice is deep and no bile is found in the fæces, and the urine contains a large quantity, the probability is that the hepatic or common duct

is ruptured. If, on the other hand, the jaundice is comparatively slight and the motions are found to be bile-stained, the probability is that the gall-bladder is ruptured. Theoretically this test is of value, but I am not aware that it has ever proved of service in practice.

It is rare to find that death occurs speedily after a laceration of the ducts. In the series of 25 cases collected by Desrosiers, 13 patients died; of these, 3 succumbed within a few hours as a result of other associated injuries; 10 died after the lapse of a few days from causes—peritonitis, toxæmia, etc.—directly attributable to the implication of the ducts.

The symptoms which are aroused seem to depend in no small measure upon the degree of infectivity of the bile which escapes into the peritoneum. When the bile-passages are healthy and normal bile escapes, the damage done to the peritoneum is slight and is tardy in onset; when, however, as is not seldom the case, the bile is septic as a result of long-standing disease in the bile-passages, inflammation is rapidly started and spreads apace.

In rather more than half the recorded cases there is a slow development of a limited swelling in the immediate neighbourhood of the liver. This swelling contains bile and is sometimes described as a "cyst"; a clear indication of the completeness of its separation from the rest of the abdomen.

OPERATION.

Operation may be resorted to immediately after the accident, though this is rarely the case, indeed, is never the case, unless extensive damage has been inflicted elsewhere—to the liver or stomach or to some part of the intestines. Or it may be considered necessary to operate only after the lapse of several days. The fact that so many patients have lived for seven to twenty-one days before the results of the accident proved fatal is a striking indication that operative treatment should in such circumstances prove successful. The methods of treatment are two:

1. Aspiration of the localised swelling.

2. Abdominal section.

1. **Aspiration** has been very frequently performed; in some cases, as in one related by Kirmisson, a single tapping has sufficed to cure the patient; in other cases the tapping has been repeated on many occasions. The conditions which exist in these cases have been proved at operation and at autopsy to be these: there is a cavity containing bile which has escaped from the rent; the cavity is everywhere shut off from the general peritoneal cavity by a stout barricade of lymph. Into this cavity bile for a time flows freely, but in the course of a few days a lymph deposit occurs around the torn edges of the gall-bladder or duct, and in a short time the rupture may be sealed off, as it were, and the further escape of bile prevented. The search during operation for a rupture under these circumstances may be one of immense difficulty, and it may in the end be fruitless. The treatment by aspiration has, therefore, been accorded a considerable degree of favour. In Desrosiers' series, 12 cases were treated by aspiration, with 4 deaths. In Terrier and Auvray's series there were 18 cases of aspiration, with 8 deaths.

The operation of aspiration is practised in the usual manner.

2. **Abdominal Section.**—In all cases where the bile is infected there can be no question that operation is imperative; for such, aspiration alone is without value. The abdomen is opened at the most prominent part of the swelling. In the majority the incision will fall upon the upper part of the right rectus muscle, at or near its outer border. The peritoneum is opened, and the fluid contained therein is allowed to escape. A view of the cavity is then obtained, and that which at once strikes the surgeon is the abundant deposit of lymph. So copious may this be that it may be difficult or even impossible to make out the position or the extent of the damage which has been done. A careful scrutiny of all parts is made, and masses of lymph are, if need be, gently detached. The conditions found are dealt with as seems best.

If no definite laceration is found, the cavity is drained with a large split-rubber tube.

If a rupture of the gall-bladder is found, it may be sutured, or the opening may be utilised for purposes of drainage, or, finally, cholecystectomy may be necessary. Before the gall-bladder is removed the surgeon must assure himself that the common duct is free. One case is recorded where death ensued eighteen days after the performance of cholecystectomy and the common bile-duct was found blocked by a large calculus. If a rupture of the hepatic or common duct is found, an attempt should be made to draw the ends together, at least in a part of their circumference; into the aperture which remains a drain may be introduced. A slight laceration of either duct could be treated by suture or by drainage, as after choledochotomy. In complete rupture of the common duct Terrier has suggested that the divided ends should be ligated and cholecystenterostomy performed. This method, however, is less satisfactory, and has less to recommend it, than the method of approximation by suture with drainage; but the difficulty of finding the distal end may be insuperable. In two cases, indeed, this end has not been found even after a postmortem dissection of the parts has been made (Porter, Stierlin).

(See "Lancet," vol. i, 1906, pp. 148, 149).

CHAPTER XXXVII.

OPERATIONS FOR HYDATID DISEASE OF THE LIVER.

In the great majority of cases an hydatid tumour of the liver can be, and must be, approached through an abdominal incision. In rare cases an operation through the pleura may be performed, after resection of two or more ribs, as suggested first by Israel; but this route possesses no advantages, and is fraught with infinitely greater dangers than the former.

During the years in which an abdominal operation was very properly considered as a most serious measure a number of alternative procedures for the treatment of hydatid cysts in the liver were suggested. Of such were aspiration, aspiration and injection, and electrolysis. These methods, however, simple though they seemed, were shewn to be by no means devoid of danger. Graham relates that 3 cases, treated by aspiration, died of syncope and shock. And other disasters, such as acute suppuration of the cyst, peritonitis, wounding of large vessels, were by no means unknown. Moreover, it became generally recognised that though the instant benefit of such treatment was often striking, the full story was not told; recurrence, or rather recrudescence, was constantly observed. For these reasons, and for the reason that the methods of abdominal surgery were daily becoming simpler and safer, all these modes of treatment were abandoned. To-day the operations practised are two:

1. Incision and drainage, in one or in two stages.
2. Enucleation.

1. INCISION AND DRAINAGE.

(*a*) **In One Stage.**—An incision is made over the most prominent part of the tumour; at the first the opening into the

peritoneum should not be more than an inch or two in length, and increased length should be obtained by continuing the incision in what seems to be the most necessary direction. As a rule, the incision is vertical, through, or by the side of, the upper part of the right rectus muscle. As soon as the peritoneal cavity is opened a detailed exploration to disclose the exact conditions present is made. It should be found that the most projecting portion of the cyst lies under the incision. Around the liver, as it is exposed in the bottom of the wound, a number of large swabs are packed. To do this satisfactorily requires the expenditure of time and pains. The liver is gently pulled aside and the abdominal wall raised, while, one by one, the swabs are placed in position. When the peritoneal cavity has been adequately protected, a mackintosh on each side covers the edges of the abdominal wall, so that the cut edges are not soiled by contact with any escaping fluid.

An aspirating needle of large size is now introduced into the cyst and as much fluid as possible is drained away. The needle may be partly withdrawn and thrust in two or three different directions, a fresh quantity of fluid flowing on each occasion. As the cyst is partly emptied its walls become flaccid, and the fingers, grasping them, may pull the cyst well up out of the abdomen. By the side of the needle an incision is now made through the cyst-wall, the needle is withdrawn, and the index-finger of the left hand is at once pushed onwards into the cyst. The cut edge of the liver, if of any thickness, may bleed, but in almost all cases the hæmorrhage is slight and is easily arrested by pressure or by a few sutures of catgut. The finger in the cyst now loosens any daughter cysts that may be felt and brings them to the surface for removal. A clip may be attached to each edge of the incision in the liver, so that forward traction may be made on to the cyst, and any possible trickling of fluid therefrom be prevented. The index-finger is also used to hook forward the liver and to cause it to keep in close contact with the abdominal wall, which, at the same

time, may be depressed by an assistant. An attempt should now, or at an earlier stage, be made to detach the endocyst from the ectocyst, by seizing it with a pair of long clips or with sponge forceps. When one part has been loosened it is easy, as a rule, to follow this up by traction and gauze stripping, or by the gentle twisting of the clip which has secured a hold. No force is needed in this manipulation,—force, indeed, should be avoided,—for a rent may be made in the liver which will prove to be a serious complication.

As the contents are emptied, the cyst contracts, and it becomes, therefore, an easier matter to detach the daughter cysts and to roll off the endocyst. If the means already mentioned do not suffice, some help may be gained by flushing the cyst freely with sterile salt solution at a temperature of about 100° F.

The cyst is now emptied as far as possible. Its cavity is then packed with one or more rolls of sterile gauze, to prevent leakage, while the liver is sutured to the abdominal wall. A few interrupted sutures of catgut are passed through the cut edges of the liver and the parietal peritoneum and the muscles or fascia outside it. As the stitches are passed the gauze swabs introduced at the beginning of the operation are, one by one, withdrawn. A continuous catgut suture may be used instead of interrupted sutures—with either a firm and close approximation is secured.

When all the protective swabs are removed and the suturing of the liver is completed, the rolls of gauze with which the cyst cavity has been packed are withdrawn, and the largest sized rubber drainage-tube is passed well into the cavity. A gauze drain, in addition, may be necessary, more especially if there is any hæmorrhage; as a rule, however, the tube alone suffices.

The wound in the abdominal wall may be narrowed by one or two sutures above or below.

Drainage from the cyst, if this has been completely emptied, is usually scanty at the first, but may increase after a brief

period. The fluid is almost always bile-stained from the first. In one case Delbet noticed a free escape of bile into the cavity after enucleation of the endocyst. He was able to recognize the bile-duct from which it came and to close it with a ligature.

The amount of bile contained in the discharge varies greatly; it is not infrequently fairly considerable, while in a few recorded cases there has been an escape of all the bile by this route. The fæces are then clay-coloured. Terrier ("Rev. de Chir.," 1906, p. 26) describes "cholerragie partielle" and "cholerragie totale."

At each dressing a free irrigation with some mild antiseptic (weak iodine lotion is as satisfactory as any) or with sterile salt solution may be necessary. If any part of the endocyst or daughter cysts have been left, they may be cleared away as opportunity offers. Suppuration in the sac should not occur.

(*b*) The **operation in two stages** proceeds in exactly the same manner as in the former method until the liver is exposed. The position of the cyst, if doubtful, may then be determined by aspiration or by exploration with a fine needle. The exposed surface of the liver is stitched all round to the parietal peritoneum, so that accurate apposition between the two serous surfaces is ensured. The wound is then packed with gauze for three or four days. When the gauze is removed, it will be found that adhesions have formed all around, and that the exposed area of the liver is entirely shut off from the general peritoneum. An incision is then made through the cyst-wall and the contents are evacuated, as in the manner already described.

This method is rarely adopted nowadays. By the operation in one stage an absolute protection of the peritoneum can be ensured. The method in two stages is, however, of decided advantage in those cases in which suppuration in the cyst has occurred or when limiting adhesions between the liver and the overlying peritoneum have not formed. The method is, however, a cramping one—there is no freedom left to the surgeon

to carry his investigation or his treatment beyond the part which lies under his hand.

The operation in one stage is, of these two procedures, therefore, the method of choice.

2. ENUCLEATION (KNOWSLEY THORNTON'S OPERATION).

During recent years there has been a tendency on the part of many surgeons to perform a more complete operation than either of the foregoing. This consists in an enucleation of the entire cyst, the closure by suture of the gap and wound in the liver, followed by the closure, without drainage, of the abdominal wound.

The first operation of this kind was done by Knowsley Thornton in 1883; the second, by Bond in 1891. In 1896 Pierre Delbet advocated the more general adoption of the method, and recorded in 1898, in a thesis by Baraduc, a series of 20 cases so treated. Of these 20 cases, 18 healed completely by first intention. In 2 suppuration occurred which necessitated a re-opening of the wound. All the patients recovered. The method is known in France as "Delbet's operation." Delbet, however, was preceded, both in performance and in publication, by Posadas, whose article appeared in December, 1895. The operation, it seems to me, should be known as "Knowsley Thornton's operation," for, as will be seen in the account given below, the reasons advanced by this surgeon for his deliberate choice of the method are those which Delbet himself gave thirteen years later. In many papers this operation is described as "Bond's method," which is again both inaccurate and inappropriate. The part taken by each of these surgeons in the introduction and advocacy of the operation will be seen from the following extracts from their papers.

Knowsley Thornton ("Med. Times and Gazette," 1883, vol. i, p. 89), in describing his operation, says:

"I tapped the cyst, and clear watery fluid escaped, mixed

with flakes of white, lymph-like material. I enlarged the opening, and, passing my hand into the cyst, found it packed with layers of this white material. The notion that it was hydatid was gaining ground, but from what organ it really grew was still a puzzle. As it emptied and contracted the body which I had found by touch deep in the right iliac fossa, and believed to be the ovary, came into view, and I saw that it was the gall-bladder. Other small portions of liver tissue were then found, apparently entirely isolated, in the cyst-wall. I thoroughly cleared out the cyst cavity, sponging the walls well all over. In parts they were calcareous. No fluid had escaped into the general peritoneal cavity, and, as the cyst was very adherent to uterus, intestines, etc., I decided not to attempt any general sponging for fear of causing hæmorrhage. I sewed the whole opening in the cyst into the abdominal incision, and, having taken care to thoroughly dry the sac, closed it up entirely without introducing a drain of any kind. This was an experiment, but it seemed to me that, when once thoroughly cleared of hydatids, the sac would not be a secreting one, as it had not suppurated, and if a little serum was effused into the cavity, it would gradually reabsorb as the sac contracted."

The patient recovered, and at the time the report was made she was perfectly well. In commenting upon this operation, Knowsley Thornton writes:

"In the second case the cyst was single, and seemed so thoroughly to have destroyed the liver that one wondered how the patient had lived; and yet her general health was fairly good, and it was only when the size of the cyst began to interfere with her work that she sought relief. She came to me without previous treatment, and I was able to perform an aseptic operation and to demonstrate what I had hardly hoped—that a large cavity of this kind, if not in a state of suppuration, will entirely contract and disappear, without any drainage, if it is thoroughly cleared out and left to nature without any irritant to cause secretion. It was simply necessary to remove thoroughly the hydatids, and to do this in such a manner as to avoid the admission of any of the causes of putrefaction; and in a few weeks the whole thing had disappeared, without its contraction inter-

fering with the normal action of the liver tissue which had been so long stretched out over its walls. It seems quite likely that the blood which was effused into the cavity during the first hours after the operation clotted, and aided in the consolidation of the cavity."

Bond's case was not one of hydatid disease of the liver. Two operations were performed on his patient. In the first a suppurating cyst between the bladder and rectum was incised, the lining membrane was removed, and a drainage-tube introduced. On exploring the general peritoneal cavity a small cyst, the size of a Tangerine orange, was found in a reflection of the peritoneum in the right iliac fossa. Mr. Bond writes ("Brit. Med. Jour.," vol. i, 1891, p. 795): "As I could not drain it I incised the cyst and removed the elastic membrane and clear fluid. This being a growing cyst, I also scraped away some of the inflammatory wall, but this was, I, think, unnecessary and might lead to hæmorrhage." A cyst in the epigastrium was felt, but operation upon this was postponed. Five months later the cyst had grown and operation was then undertaken. The following account is given:

"A week later I opened the abdomen by a median incision, passing through the umbilicus. I then discovered three cysts—the larger one referred to above, which lay beneath the transverse colon and omentum, and two others, the size of cricket-balls, one in the left renal region, apparently in connexion with the left mesocolon, and one quite movable at the lower part of the cavity, situated entirely in the omentum. The upper cyst was first dealt with, the omentum being gently teased away and the surface of the cyst bared; it was then tapped with a fine trocar and cannula, and most of the clear fluid drawn off without aspiration. I then drew the less tense cyst towards the abdominal wound with artery forceps, and incised it freely. On doing this I found that the white elastic cyst proper had shrunk somewhat away from the walls or ectocyst, and lay, together with daughter cysts, in the cavity; it was easily withdrawn with ring forceps, and came out quite clean, although,

from its brittleness, in several pieces. I then wiped the cavity out dry with a sponge, and allowed the cyst to fall back into the abdominal cavity. I then dealt with the other cyst on the left side of the abdomen in the same way, but the third or omental cyst was removed entirely after tapping by ligating off the portion of omentum in which it grew. I then found, on trying to draw out and fix the openings in the cysts directly to the skin, that a good deal of dragging on the abdominal contents occurred, so I simply closed the abdominal incision in the usual way, allowing two or three of the silk sutures to pass also through the cut edges of the cyst-walls; between these, two drainage-tubes were inserted, one into the lower and one into the upper cyst; but as there was very little discharge, these were removed in sixteen hours, and the abominal incision allowed to close throughout. Union occurred at once, with the exception of a small spot at the umbilicus, which continued to discharge. The temperature remained normal throughout, and in a month's time he was out of doors. Unfortunately, at this date, owing to some strain or chill or other cause, an attack of abdominal pain and violent vomiting occurred, which was followed by some discharge of pus from the incision, and Dr. Serres removed several pieces of the laminated lining of the upper cyst. This ceased in a week's time, and the patient soon became again convalescent."

Delbet pointed out, what indeed had already been well recognised by all operators, that the attachment of the endocyst to the ectocyst was by no means firm. He remarks further that in considering the cases treated by incision and drainage he was struck by two facts—*firstly*, that after the removal of a hydatid cyst which was not suppurating and which had no connexion with the bile-channels in the liver, there was at first no discharge from the cavity which was drained. The dressings were absolutely dry. A slight discharge began to appear only after the first few days, and was then probably due to a slight infection. *Secondly*, that hernia at the site of the wound was by no means infrequent after this operation. If the cavity in the liver persisted and needed to be filled with cicatricial tissue before closing up, one would expect that the

liver would remain adherent to the parietal wound and plug it, as with a cork. The fact that the liver shrank away from the wound, leaving a weak spot at which a hernia could develop, suggested to Delbet that the adventitious membrane was capable of marked retraction. The reasons which determined him to attempt a more radical operation upon hydatid cysts in the liver were, therefore, that the endocyst could always be completely removed; that the ectocyst or adventitious coat secreted little, and that this latter membrane shewed a marked tendency to retract. He planned an operation thereupon which should fulfil certain conditions:

1. The complete emptying of the cyst.
2. The removal of the endocyst.
3. The diminution of the cavity so left.
4. The closure of the opening in the liver.
5. The reduction, within the abdomen, of the liver so treated.
6. The closure of the abdominal wound.

From this procedure there was, he considered, nothing to fear, for retention of contents in the cavity was not possible, as the walls did not secrete, and infection was not likely if the cyst removed was sterile.

He put this operation to the proof on December 13, 1895.

The patient was a women, thirty-five years of age, who for four years had suffered from abdominal pain affecting chiefly the right iliac fossa; for two years she had noticed a steady increase in the size of the abdomen, and during this time she had wasted considerably and had suffered from paroxysmal attacks of dyspnœa. On examination a tumour, dull on percussion and fluctuating, was found to lie entirely below the umbilicus. On vaginal examination it was found that the tumour lay in front of the uterus. A diagnosis of ovarian cyst was made and laparotomy was performed. On opening the peritoneum the cyst presented, and it was found, on attempting to withdraw it from the abdomen, that its pedicle could be traced to the upper part of the tumour, not to the lower part, as had been

expected. The incision was, therefore, prolonged upwards, and it then became evident that the cyst sprang from the under surface of the liver, which was notably dragged down. The cyst was freely opened and emptied of its daughter cysts, and the endocyst was then stripped away. In attempting to resect a portion of the cyst-wall the gall-bladder was opened. The gall-bladder was closed by a dozen points of suture. In order

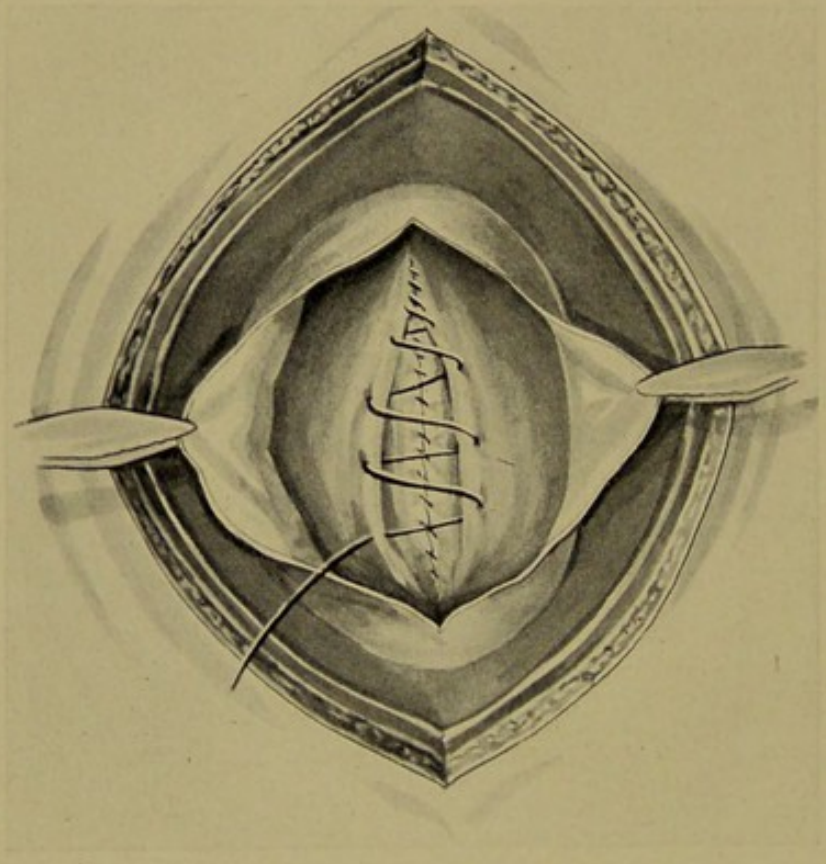


Fig. 282.—Closure of a cavity in the liver by "capitonnage"; all parts of the suture seen are continuous.

to lessen the size of the cyst-cavity a series of sutures were passed which embraced opposing parts of the cyst-wall. Several stitches were passed before any were tied. On tying them the opposing walls were brought into contact and the space between them was obliterated. The margins of the incision in the liver were then brought together by suture, and the abdominal wound was closed, a drain of gauze being passed down-

wards to the gall-bladder. The drain was removed on the fifth day. Recovery was perfect. In the second case the fluid which escaped from the cyst was at first clear, but towards the end of the flow it became bile-stained. At the bottom of the cavity an opening was seen from which bile flowed. The opening was closed by several interrupted sutures and the operation completed as in the former case. The patient made a speedy recovery. This case is most interesting as shewing that the method is applicable also to cases in which a fistulous communication exists between the cyst and the bile-passages.

For the procedure of applying sutures so as to close the cavity by causing approximation of its opposing surfaces Delbet employs the term "capitonnage" (the "Marsupialisation" of the Australian Surgeons).

The contra-indications to the operation are: suppuration in the hydatid cyst; extensive calcareous deposit in the cyst-wall; and profuse hæmorrhage into the cavity left after enucleation of the cyst.

The principles which underlie the operation are these: that the outer layer of the cyst is but slightly vascular, and that if the separation of the cyst is effected along the exact outer limit of this membrane, between it and the adventitious covering formed by the liver, that is, between the ectocyst and the endocyst, hæmorrhage will be scanty or absent; that contraction of the cavity left after removal of the endocyst is both speedy and complete, and that, as proved by those cases in which drainage has been adopted, the secretion from the walls of the cavity is absent or scanty.

The abdomen is opened, the cyst exposed, tapped, incised, and emptied, as in the manner already described. As a rule, as soon as the incision in the cyst-wall has been made, the cut edges may be pulled sufficiently forward to lie in or outside of the abdominal wound. The endocyst is now separated with great care and gentleness. It is seized at some spot where it has been loosened, and is gently drawn away from the ectocyst;

it may, if necessary, be washed away with a fairly powerful stream of sterile salt solution. As soon as it is completely removed, the whole of the interior of the cyst is gently "patted" with swabs until it is completely dry. Then a series of fairly strong catgut sutures are passed with a Hagedorn or intestinal needle. If interrupted sutures are used, many must be passed before one is tied, but a continuous suture is quite as efficient as, and much more easily introduced than, a series of single stitches. When the cavity has been wholly suppressed, the edges of the liver wound are sutured, the liver replaced, all swabs withdrawn from the peritoneal cavity, and the abdominal incision closed in the usual manner. The liver is not sutured to the abdominal wound.

If suppuration should follow upon this operation, it is found that in all cases yet recorded the liver has become adherent to the abdominal wall, and the pus has made its way towards the surface at the line of incision. This accident of suppuration is, however, very rare indeed, and with perfect methods may be considered as negligible.

These are the three methods which are most commonly practised. Whenever possible, the method of enucleation should be performed; it is without question the speediest and simplest, and it is at least as safe as any other method. When, however, the contra-indications already mentioned are present, then the method of incision and drainage in one or two stages may be considered.

In certain rare circumstances incisions through other parts than the anterior abdominal wall may be necessary. When the cyst projects backwards, forming a prominence between the last rib and the crest of the ilium, it may be approached through a lumbar incision. When there is an upward and backward projection, the incision may have to be made over the ribs, one or two of which are resected, and the cyst be sought through an incision in the diaphragm, through or below the pleura. The operation in these circumstances will be performed in two stages, or even, as by Israel, who first suggested it, in three stages.

There are a number of cases recorded in which the hydatid cyst springing from the liver was pedunculated. If this condition be found, the cyst can be extirpated and a ligature or a series of deep sutures be applied to the divided pedicle. The stump of this may be returned within the abdomen or fixed in a part of the wound, and a gauze strand be passed to it for purposes of drainage, and to secure against the possible risk of hæmorrhage.

The whole subject of the treatment of hydatid cyst of the liver may, therefore, be summed up in this way:

The methods of aspiration, of aspiration and injection, and of electrolysis have been abandoned.

For cysts which are suppurating the method to be chosen is undoubtedly that of incision and drainage in one or in two stages: in one stage, if adhesions are present between the liver and the abdominal wall; in two stages, if no adhesions are present. The method in one stage is, however, quite commonly adopted, even when no adhesions are seen.

If the cyst lies at or near the surface of the liver, the method to be preferred is undoubtedly that of enucleation. It fulfils all the essentials of a satisfactory operation, and the convalescence of the patient is much more rapid than after any other operation. In rare cases the cyst must be approached by other incisions than the usual one through the anterior abdominal wall. The incision may fall upon the lumbar region or upon the chest-wall, in which case a resection of two or more ribs, usually the eighth and ninth, will be necessary.

J. P. Buckley ("Brit. Med. Jour.," September 20, 1913), in a paper entitled "True Total Enucleation of Two Hydatid Cysts from the Same Liver," points out that the operation of enucleation as performed by Knowsley Thorton is not a complete enucleation, being only a removal of the endocyst. Psadas, as Buckley mentions, describes two forms of enucleation, "l'extirpation totale" and l'extirpation de la membrane germinative et la suture de la perikystique." The ectocyst, a structure of dual ori-

gin, partly formed by the parasite and partly by the resulting fibrosis in the organ infected, should, strictly speaking, be removed if the operation is to be designated a total enucleation. This total removal, however, is not always possible nor necessary. It is obviously suitable only for small cysts.

Garré has also reported three cases of total enucleation with resection of a wedge-shaped piece of liver.

GRAFTING OF HYDATIDS DURING OPERATION.

In dealing with hydatid cysts by operation it is important to bear in mind the possibility of the grafting of the hydatid upon any exposed surface. This possibility has been repeatedly denied, and as often reaffirmed. Quénu has emphasised the likelihood of its occurrence, and has cited observation by Ricard, Routier, Michaux, Tuffier, and Broca in support of his statements. Experiments carried out by von Alexinsky seemed to prove the point beyond dispute; and they have been confirmed by Devé ("Thèse de Paris," 1901). Devé and Quénu have urged that the possibility of infecting the wound during operation should compel us to employ some method of killing the scolices before the evacuation of the cysts is begun. Devé writes: "The only preventive measure which renders it possible to avoid a secondary post-operative crop of the echinococcus is the killing of the germ within the cyst by an intracystic injection before the opening of the cyst for the evacuation of its contents." He suggested the use of corrosive sublimate and of formol. The latter was selected for trial in the first case operated upon by Quénu. The strength of formol used is 1 per cent., and the quantity 300 to 400 grammes, according to the size of the cyst. The technique is described by Quénu ("Bull. et Mém. de la Soc. de Chir.," 1904, p. 956) as follows: "An incision is made over the most projecting point of the tumour, the openings through the muscle being between 4 and 5 cm. in length. The cyst is exposed, punctured with a fine needle, and the formol injected. After about four or five minutes the cyst is opened and cleared of daughter

cysts and the endocyst is removed. The opposing sides of the cavity are approximated by suture and the opening into it is closed. As a rule, the wound in the liver is secured by one or two stitches to the parietal wound." The sterility of the fluid evacuated from the cyst and from the daughter cysts was proved by a large number of experiments carried out by Devé.

In an interesting discussion at the Society of Surgery in Paris ("Bull. et Mém. de la Soc. de Chir.," 1906, vol. xxxii, pp. 42–50) several of the speakers mentioned that this method of the preliminary sterilisation of hydatid cyst was always used by them.

CHAPTER XXXVII.

HEPATIC ABSCESS.

If in any case there be doubt as to whether or not an abscess of the liver be present, the doubt must be cleared away by an exploratory puncture. If pus be found, it should be evacuated at once by a free incision, and drainage should be facilitated by the introduction of a large tube. Aspiration is allowable only as a diagnostic measure; it is not to be generally commended as a therapeutic resource, though some surgeons of great experience prefer it to any other method. I quote the following paragraph from Sir Patrick Manson's work on "Tropical Diseases" (p. 369), because it seems to me to represent, as accurately as possible, the attitude which the surgeon should adopt in his investigation of a case.

"To facilitate aspiration, as well as the subsequent operation, if such should be found to be necessary, the patient ought invariably to be placed under an anæsthetic. Unless in very special and exceptional circumstances, it is a mistake to attempt exploration without this, for the surgeon ought to proceed with deliberation and to feel himself at liberty to make as many punctures as he may think necessary. A medium or full-sized aspirator needle should be used, as, owing to the nature of the pus, it may not flow through a cannula of small bore.

"If there are localising signs, such as a tender spot, a fixed pain, localised bulging, localised pneumonic crepitus, pleuritic or peritoneal friction, these should be taken as indicating, with some probability, the seat of the abscess and the most promising spot for the exploratory puncture. If none of these localising signs are present, then, considering the fact that the majority of liver abscesses are situated in the upper and back part of the right lobe, the needle should, in the first instance, be inserted in the axillary line in the eighth or ninth interspace, about an inch or an inch and a half from the costal margin, and

well below the limit of the pleura. The instrument should be carried in a direction inwards and slightly upwards and backwards, and, if found necessary, to its full extent. If pus be not struck, the needle must be slowly withdrawn, a good vacuum being maintained the while, in case the abscess has been transfixed and the point of the needle lodged in the sound tissue beyond. No pus appearing in the aspirator, the remainder of the dull hepatic area must be systematically explored, both in front and behind, regard being had for the lung and pleura, on the one hand, and for the gall-bladder, large vessels, and intestine, on the other. The peculiar colour—often like dirty-brown, thick blood—of liver pus must not be allowed to deceive the operator into thinking that he has failed to strike the abscess.

"At least six punctures should be made before the attempt to find pus is abandoned. Provided there is complete absence of breath-sounds, of vocal fremitus, and resonance over the lower part of the right lung, and pus has not been reached from lower down, then the pleura or lung may be disregarded and puncture made anywhere below the line of the nipple and angle of the scapula, or wherever the physical signs suggest.

"The surgeon should be encouraged to make early use of the aspirator by the fact that its employment, even where no pus is discovered, is not infrequently followed by rapid improvement in all the symptoms; many such cases are on record. Hepatic phlebotomy, as Dr. George Harley designated the removal, from the liver, of a few ounces of blood by the aspirator needle, is a measure of proved value in hepatitis. With due care risk from hæmorrhage is small; it is very small, indeed, in comparison with the risk of allowing a hepatic abscess to remain undiscovered and unopened.

"It is hardly necessary to add that strict aseptic precautions, in the way of purifying the patient's skin, the surgeon's hands, and all instruments, must be carefully observed."

INCISION.

Details of the Operation.—When the pus has been localised, relief must be afforded to it by the shortest path. As a rule, the incision is made vertically through the rectus muscle or

parallel to the costal margin. If the upper and hinder part of the liver is chiefly affected, it will be necessary to expose the abscess through an incision in the chest-wall.

The *abdominal incision* having been made, the peritoneal cavity will be opened in the majority of cases; in some fortunate instances adhesions will be found, shutting off from possible contamination the peritoneal cavity. If no adhesions are present, it is desirable to insert a series of sutures, or a continuous suture, which, on the one side, picks up the capsule and some of the substance of the liver, and, on the other, the parietal peritoneum and a part of the rectus muscle. A large area of the liver is then exposed in the bottom of the wound. In some instances the fixing of the liver to the abdominal wall need not be carried out until the abscess has been emptied. The peritoneum must then be walled off with a thick barrier of gauze pads. It is said that the pus from an hepatic abscess is often sterile, and that a little leakage of it into the peritoneum is harmless. This is bad teaching and worse practice. No surgeon is entitled to assume that dirty work of any kind is harmless. The barrier of gauze is an admirable safeguard against the soiling of the peritoneum. When the liver area is thus isolated by gauze or by stitches, an incision is made into the abscess cavity and the pus is allowed to escape. In some cases the cautery may be used to make the incision through the liver, but a small cut with a scalpel and the instant introduction of the finger has seemed to me the simplest method of effecting an opening. The abscess cavity is emptied as far as possible, and a large drainage-tube is introduced (Fig. 232). Some surgeons—Zancarol and Fontan are the chief among them—have advocated the free scraping of the interior of the abscess cavity. They claim that there is a more rapid healing as the result of the entire removal of the loose and shaggy lining of the abscess, which is prone to rapid decomposition. Fontan operated upon 21 cases by the ordinary method, with 17 recoveries; and upon 31 cases, in which curetting was performed, without a

death. Zancarol records 151 cases, with 74 recoveries. There are perhaps exceptional cases where this procedure may seem in the special circumstances to be desirable, but as a routine procedure it is to be condemned.

Resection of Ribs.—If one or more ribs are to be resected in order to obtain access to the pus, the incision must, if pos-

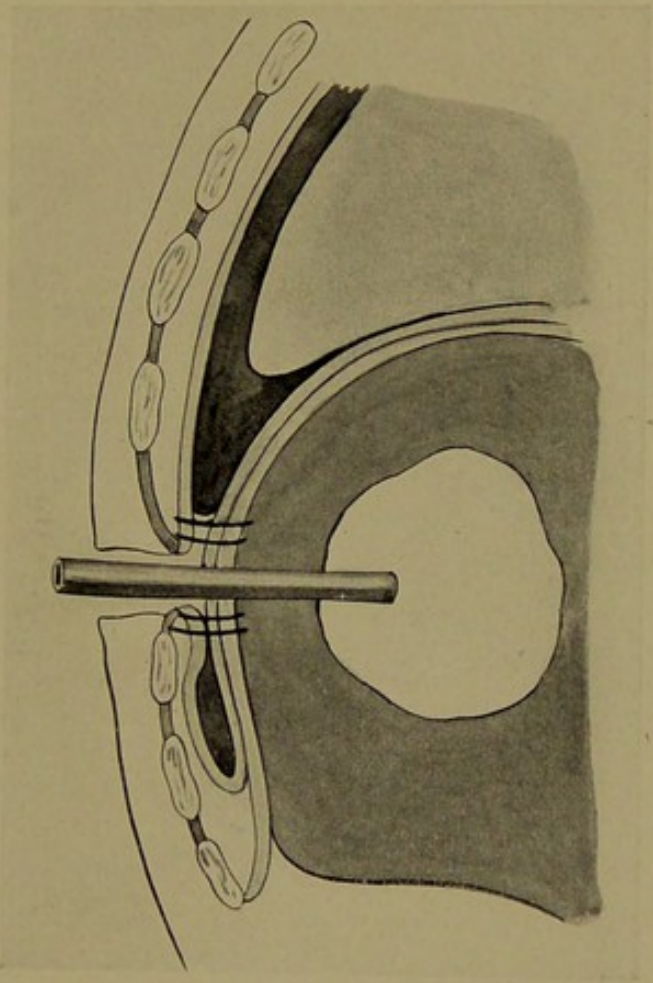


Fig. 283.—Transpleural drainage of an hepatic abscess (after Godlee).

sible, be made so low down on the chest-wall that the pleura is not likely to be opened. As a rule, this is avoided by keeping within a limit of 2 inches from the costal margin. If, however, the abscess has reached a higher level, the pleural cavity will have to be opened. The precautions which have been already described for shutting off the cavity and securing it against any contamination must be scrupulously observed.

The possibility of the presence of more abscesses than one in the liver must not be overlooked. These may, perhaps, be discovered at the time of the original operation, or they may make their presence known at a later stage by the recrudescence of the earlier symptoms. In many cases it has been possible to empty the one abscess from the other. When the original abscess has been emptied, the protrusion of an adjacent abscess has been felt; such an one may be opened by the pressure of the finger or by a puncture with a bistoury. The difficulties in these cases are sometimes extreme, and to illustrate them I cannot do better than quote the following case, which is recorded by Sir Rickman John Godlee ("Brit. Med. Jour.," vol. i, 1890, p. 63):

"E. S., a Bohemian Jew, aged thirty-six, had been resident in Kimberley for eight years, and had enjoyed good health there, without fever or dysentery; but he developed intermittent fever on his way home at Madeira, in July, 1883, and this continued for two weeks after his return to Germany. It was then absent for three months, but returned in April, 1884, accompanied by pain in the right lobe of the liver, and this continued, with slight intermissions, until May 7. The patient was attended by Dr. Dunbar Walker, of Notting Hill, and had seen Sir Wm. Gull and Sir Joseph Fayrer. By this time the liver reached down to the umbilicus, and an abscess was obviously pointing at the epigastrium. He was stout, flabby, of a muddy colour, with a foul tongue and a weak pulse, and a temperature varying from normal in the morning to 102° or 103° in the afternoon. I opened the abscess, after ascertaining the presence of adhesions, and evacuated about half a pint of disagreeably smelling yellow pus. There was a good deal of bleeding. The temperature was normal for all the next day—but on this day only; it afterwards began to rise in the afternoon, the patient always becoming much worse at this time of day; and by the seventeenth it had again a range of from normal to 103°. The pulse was weak and rapid—110 to 150; the tongue, coated and dry, though he continued to take milk. The bowels acted freely, and the motions were plentifully bilious, but the abdomen was distended with gas. Thus, though the abscess behaved quite well, the

discharge being sweet and small in amount, we felt sure he had another. Accordingly, on the fourteenth, a week after the first operation, at Sir Joseph Fayrer's suggestion I first punctured the liver just below the ribs, a little outside the first opening, and, failing to find pus at three inches, I passed the needle through the seventh or eighth space at the lower part of the axilla and drew out three or four ounces of yellow pus from a depth of four inches. The wound was then enlarged, and, using the cannula as a guide, dressing-forceps and the finger were passed into the abscess. This caused terrific hæmorrhage, and I was obliged, in the weak state of the patient, to plug the wound. Two days later I removed the plug and introduced a long tube, which appeared to drain the abscess satisfactorily for a time. But the general state showed no improvement, and ten days later a fine trocar was passed deeply through the lateral wound and evacuated a quantity of pus, probably a third abscess, though this is not quite certain. But none of these evacuations did the patient the slightest good, and on June 3, nearly five weeks after the first operation, he died, and though we could not obtain a postmortem examination, I have no doubt that his liver was riddled through with abscesses."

TREATMENT BY ASPIRATION AND SIPHON DRAINAGE.

Mr. James Cantlie, who speaks with high authority upon the subject of hepatic abscess, prefers the method of aspiration and siphon-drainage to any other. He writes ("International Clinics," vol. iv):

"Having ascertained the presence of pus, what is the next step? There are two courses open—one is to reach the pus by a 'cutting' operation, another by 'trocar and cannula.' I have thrown in my advocacy with the latter method, and as my experience increases the more convinced am I that for *deep-seated* abscesses of either the suprahepatic or intrahepatic variety it is by far the better. It will be noted that the arguments which I subsequently advance are in connexion with *deep-seated liver abscesses*, not abscesses which actually bulge either towards the abdominal wall or at the ribs, so that the pus is close to the surface. The abscesses have in these instances been left so long that the pus has burrowed its way to the surface, and the

so-called 'operation for liver abscess' is merely setting free subcutaneous pus. Therefore I debar all the treatment of such advanced abscesses being considered as 'operations for liver abscess.' Nature has in this instance saved life—not the surgeon, who has done his best to sacrifice it, for the abscess should never have been allowed to advance so far. With abscesses allowed to attain such unjustifiable proportions it matters not which operation is undertaken, and cutting is perhaps the better. With such subcutaneous collections of pus I am not dealing, but with deep-seated pus which does not bulge either towards the anterior abdominal wall or towards the right lower intercostal spaces.

"The chief argument against the employment of the trocar and cannula is that it is 'unsurgical,' whatever that may mean; and the advocates of this use of the knife declare that any other method is 'timid' surgery, that they like to have a 'good view of what they are doing,' and that they like 'to look their enemy in the face.' These are not scientific arguments, but mere statements, and flavour of surgical braggadocio. My chief objections to 'cutting' operations are:

"1. The severity of the operation is calculated to cause a practitioner, especially if he is single-handed, as often happens in tropical countries, to defer it until too late in the disease. To cut down by way of the chest, the pleura, the diaphragm, and the peritoneum to reach a (suspected) abscess of the liver is a line of treatment that the patient, if he knows anything of the operation contemplated, is apt to shrink from, and even the medical practitioner prefers to try every available resource before condemning his patient to so severe an ordeal. This hesitancy to perform a laparotomy or a transthoracic operation may cost the patient his life, and is one of the chief causes of the high mortality attending upon liver-abscess operations. Again, hepatic abscesses occur for the most part in tropical countries, where skilled help may not be available, where trained nurses are unknown, where the appliance for surgical procedures of the 'cutting' kind may be but few, and where, therefore, 'heroic' operations do not commend themselves and can be undertaken only at great risk to the patient.

"2. 'Cutting' operations, either by transthoracic or by laparotomy methods, are 'overheroic.' There is no necessity for

submitting the patient to so severe an ordeal. Neither practice nor results justify these heroic measures, and I have no hesitation in declaring against them. The men whose opinion I most value in this connexion, as well as my own experience, declare in favor of the milder method; and, even though I may be accused of surgical cowardice, I still believe that I am doing the best for the patient.

"*Operation by Trocar and Cannula and Subsequent Siphon-drainage.*—When a liver abscess is suspected, pus ought to be sought for without delay. This is done by introducing the hollow needle (not longer than four and a half inches) of an aspirating syringe or of an aspirator into the liver. If pus be not found at once, the needle may be inserted again and again —say, six or more times—into the liver in different parts.

"In my opinion the pus ought never to be sought for unless the surgeon is prepared to operate at once should pus be found. In many hospitals and in the private practice of many physicians it is customary first to search for pus, and, should it be found, to ask a surgeon to operate at a later date. This is a dangerous and unjustifiable procedure. If the physician wishes a surgeon to operate, the latter should be at hand ready to do so the moment pus is discovered; for, were a thin-walled abscess near the liver surface to be pricked in one or more places by a needle, the pus might quickly escape thence into the peritoneal cavity. Even after pus is found it is well to introduce the needle in one or two other places in the vicinity in order to ascertain the 'lie' of the abscess, so that it may be drained from the lowest part. Never introduce the same needle by which pus has been found into another part of the liver, or, at any rate, do not reintroduce the needle until it has been cleaned; the reason is obvious.

"When the abscess has been found, incise the skin at the seat of the needle puncture for about three-quarters of an inch, to admit the trocar. The trocar and cannula to be used should be not less than one-third of an inch in diameter and have a stem four and a half inches in length. Plunge the trocar and cannula into the abscess, maintaining the direction travelled previously by the hollow needle. Withdraw the trocar and stop the flow of pus through the cannula by placing the thumb over its mouth, as it is unwise at this stage to allow the abscess cavity to empty itself completely.

"Through the cannula introduce an india-rubber tube half an inch in diameter and nine inches long; this may be done by stretching the tube upon a metal rod with a small end hook at one side, in which the rubber tube is caught so that it can be stretched. The tube has, of course, several holes cut in it at the end intended to be pushed into the abscess. When the tube and the rod in which it is stretched touch the bottom of the abscess cavity, withdraw the cannula over the stretched tube; then allow the tube to contract towards the bottom of the abscess and remove the metal rod. The drainage-tube is now in the abscess, and some four or more inches project from the side of the patient's chest. The tube may be cut short, but I prefer to leave it long and to establish siphon-drainage by inserting into its projecting part one end of a piece of glass tubing of suitable size and three or four inches long, the other end of which fits tightly into a rubber tube of sufficient length to reach the bottom of a bucket standing by the side of the bed. The bucket should contain enough carbolised water to cover the outlet of the tube, and into this the pus drains. A weight ought to be attached to the lower end of the tube, to prevent slipping or displacement. The operation is completed by stitching the tube to the skin where it issues from the chest, and covering the wound around it with wet antiseptic gauze.

"The subsequent treatment consists in keeping up the drainage until the fluid that issues, as seen through the glass tube, is no longer purulent or flocculent, but merely bile-stained. If, at any time, pain in the shoulder or side is complained of, raise the bucket off the floor until it is nearly on a level with the bed; this lessens the severity of the siphonage, which probably caused the 'drawing' pain. As pus disappears stop drainage and shorten the tube, reducing its size as the discharge gradually ceases."

CHAPTER XXXIX.

RESECTION OF THE LIVER.

THE INDICATIONS FOR OPERATION IN CASES OF TUMOUR OF THE LIVER.

The experimental work of Glück and Grimm, the elaborate investigations of Kousnetzoff and Pensky, and, later, of Auvray, Frank, Payr and Martina, and others, have shewn that removal of even large portions of the liver can, with suitable methods, be accomplished with complete success. Resection of the liver is, therefore, a legitimate surgical procedure with which it is the business of every surgeon to make himself familiar. The number of cases, however, in which resection is possible or is likely to be attended with either instant or remote success is very small. The knowledge which we possess of the exact nature of tumours of the liver, from inspection only, is but slight. In many recorded cases a tumour removed has been supposed to be of a particular nature,—cancer or sarcoma,—yet future investigation by the microscopist has shewn that the original diagnosis was wrong. In one case Wagner removed a growth of the liver which proved to be a gumma, and the patient died of hæmorrhage, a circumstance entirely lamentable. There can be no doubt, however, that, as with the stomach, increasing operative experience will enhance the surgeon's power of discrimination, and that, at the least, simple tumours will be distinguished unhesitatingly from malignant growths.

When the tumour is exposed, resection should be undertaken only when the tumour is primary and solitary, when its margins are clearly defined, when it is quite certain that the whole of the tumour can be removed, and in malignant cases that such a margin can also be cut away as to make it probable that recurrence will be prevented or will be long postponed.

In simple cases resection should not be undertaken unless there are disabilities due to the growths which are, or are likely to become, of greater account than the risk of operation. Gummata should not be removed unless calcification or other degenerative changes in an advanced stage are discovered. Kousnetzoff and Pensky, for some amazing reason, advocate the resection of syphilomata in the liver, but there can be no hesitation whatever in condemning unequivocally such an opinion. In the majority of cases resection has to be performed when the growth in the liver is in the neighbourhood of the gall-bladder and is secondary to the long-continuing irritation of gall-stones.

There are a few instances of removal of Riedel's lobe recorded. The necessity for such a procedure is extremely rare.

THE OPERATION.

The whole problem in cases of resection of the liver has turned upon the question of the control of hæmorrhage from the wound. In order to secure bloodless resections several methods have been suggested. Chief among them are the following:

1. **The First Method of Kousnetzoff and Pensky.**—These observers have elaborated, by numerous experiments upon animals, a method for the resection of malignant or simple growths of the liver. Professor von Mikulicz has practised the operation with success in man, and I am indebted to his assistant, Dr. Willy Anschütz, for a demonstration of the method.

The growth of the liver is exposed by a free incision, and the general cavity of the peritoneum is walled off with swabs and mackintoshes in the usual manner. The purpose of the operation is to pass a series of sutures through the liver at a line well beyond the limits of the growth. After the stitches have all been tightly drawn and the tumour isolated, the liver-substance is divided between the line of ligatures and the base of the tumour. There is no bleeding from the cut surface. The liver is replaced, a packing of gauze passed down to the raw surface, and the abdominal wound partly closed.

The sutures through the liver are passed by needles of special patterns in the following manner:

A curved Kousnetzoff needle armed with stout silk with equal ends is passed through the liver from the upper to the lower surface near the edge at one extremity of the line which has previously been selected. The silk is drawn through the liver until about 5 inches only remain hanging out from the point of entrance. Of the two strands of silk, one may be called A, the other, B. One strand (strand A) of the silk, of the two which lie between the needle and the point of exit on the under surface, is now divided, so that a loose ligature is left, transfixing the liver. This is now forcibly but slowly tied, and a portion of the liver is thus secured.

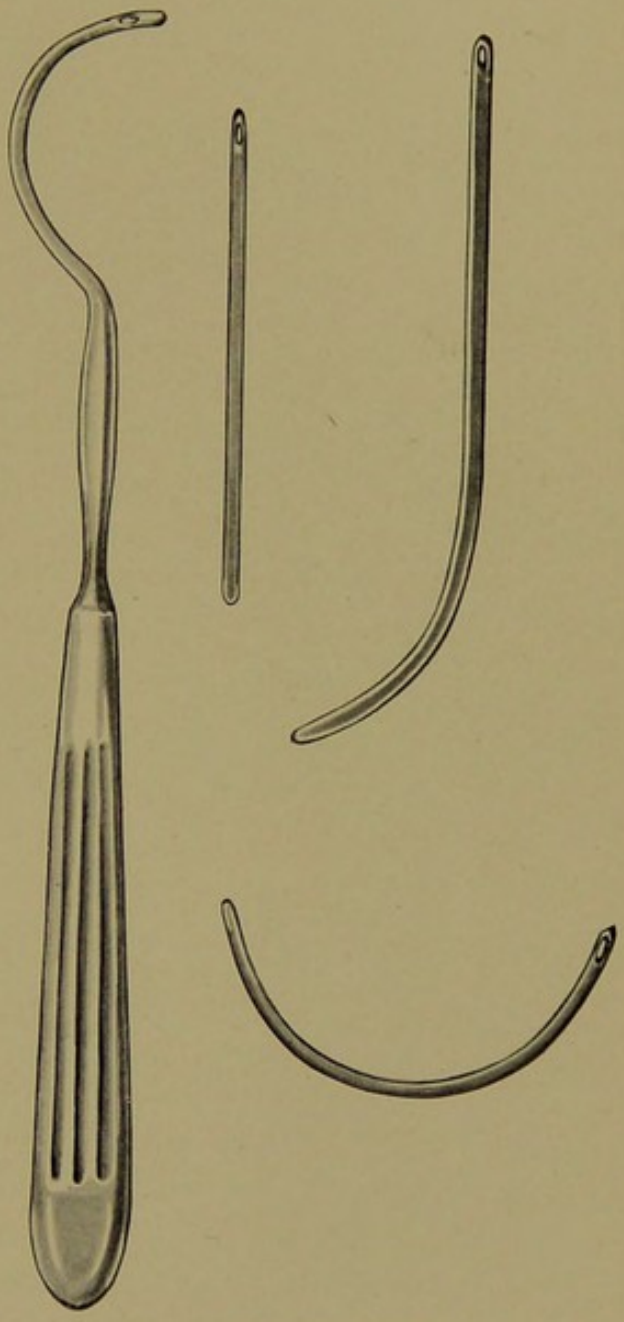


Fig. 284.—Kousnetzoff's needles for liver suture. The needles are blunt and are made sufficiently thin to be flexible.

The cut end of the silk (strand A) is now lengthened by drawing it through the needle for about 4 inches. The needle is then made to transfix the liver again

completely from the under surface to the upper, upon which it emerges about half an inch to an inch distant from the original end of the suture (strand B), which still lies loose. One of the silk strands (strand B) which lies between the needle and the liver is now divided, and care is taken to see that the one now cut is not that strand which has been cut in the under surface of the liver. The two ends of strand B are now tied on

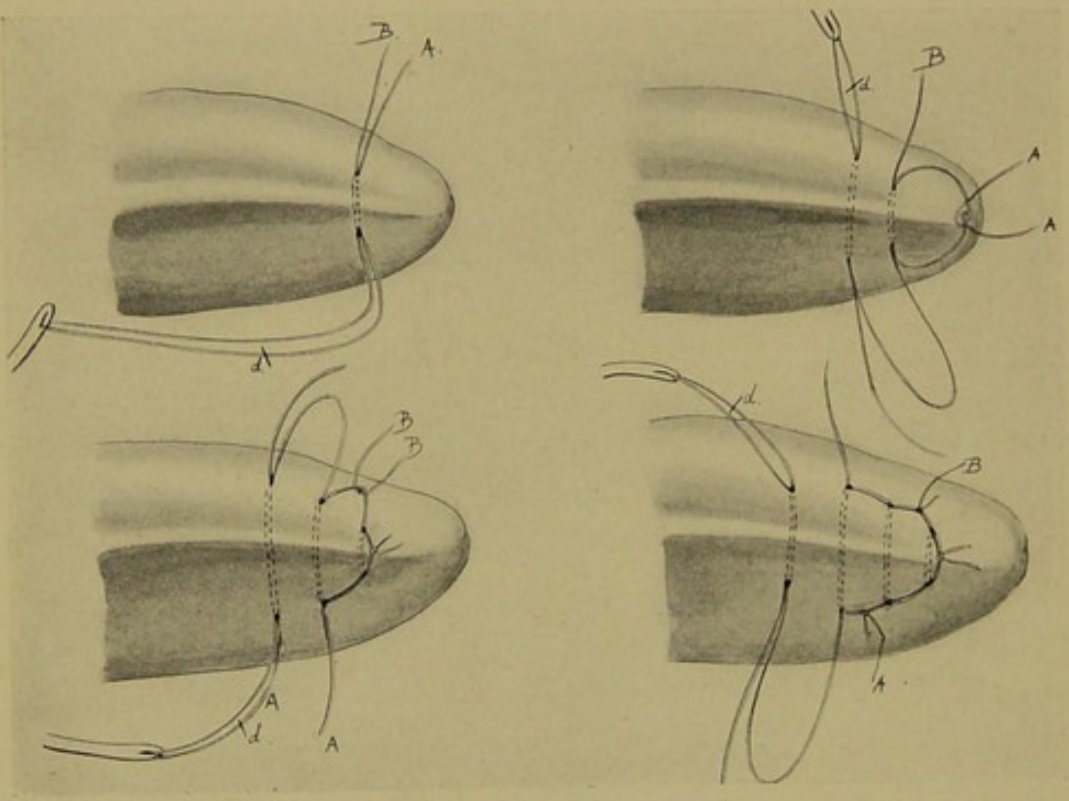


Fig. 285.—Resection of liver. Kousnetzoff and Pensky's suture. A and B are the strands of silk; *d*, the point of section of the threads.

the upper surface of the liver. The end of strand B is drawn through the eye of the needle until an end 4 or 5 inches in length is left. The needle now transfixes the liver to the under surface, where strand A is cut and tied, and so on. All the knots in strand A are on the under surface, all in strand B on the upper surface, of the liver. A verbal description of this suture is difficult to follow, but a reference to the diagram will make matters plain.

1(*a*). **Auvray's Modification of the Above.**—Auvray has mod-

ified the method of Kousnetzoff in the following manner: Through the liver, base of the lobe, or tumour to be removed a long double ligature of silk is passed with a needle which transfixes the liver from the upper to the lower surface. The silk is cut close to the needle, so that two equally long ligatures are left. A single complete turn is given to one end of these ligatures, so that they are intertwined within the liver. Each of these ligatures deals with one-half of the pedicle in the following manner: One-half of the ligature is on the upper surface of the liver; this may be called A; one-half is on the under surface; this may be called B. Ligature A remains on the surface; ligature B penetrates the substance of the liver at several points. A large, specially made needle is passed through the substance of the liver at a point about 1 cm. to the side of the original point of introduction of the ligature. When the eye of the needle (which is of the slot type so well known in Reverdin's needle) reaches the under surface of the liver, ligature B is threaded

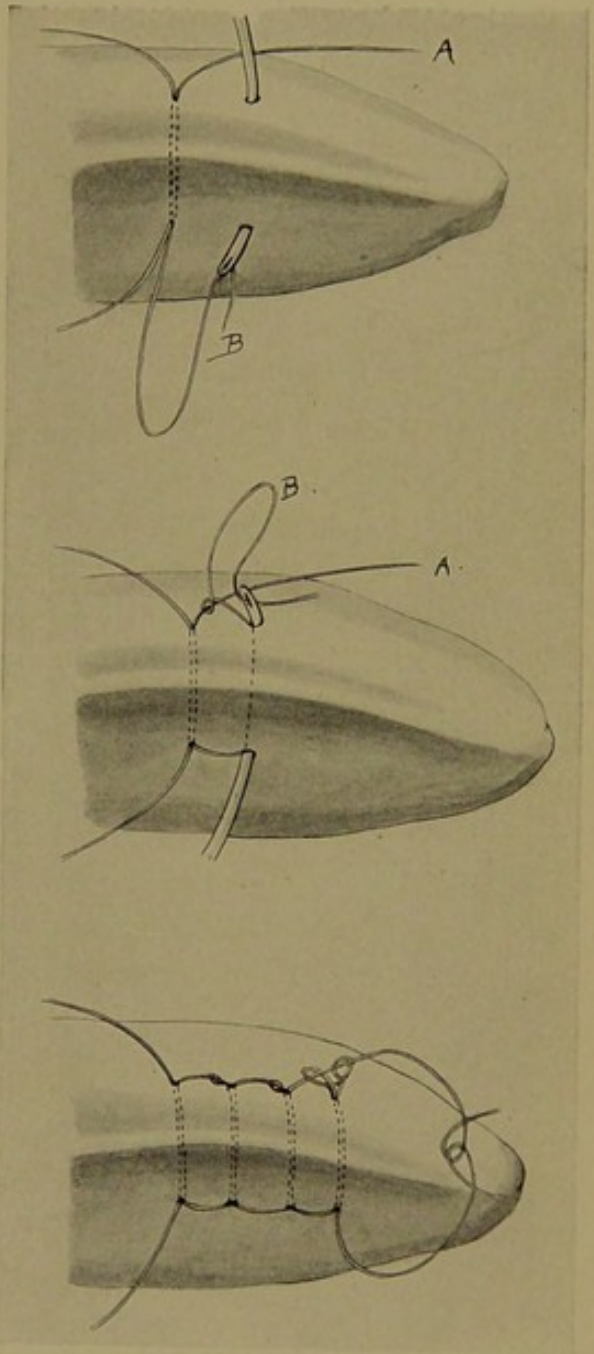


Fig. 286.—Auvray's suture in resection of the liver.

into it and pulled through by withdrawal of the needle on to the upper surface. Ligature B and ligature A are now tied together with a single knot. Considerable force is used to tie this knot, but the strain in tightening must be very gradually applied, so that the hepatic substance is squeezed away from the embrace of the ligature, and only the vessels are left. When the knot can be drawn no tighter, a second knot is tied to fix the first. Then, from the under surface of the liver, the unthreaded needle is passed in the groove or channel in which ligature B lies. When the eye of the needle reaches the upper surface of the liver, it is opened, and ligature B, threaded therein, is drawn back to the under surface. The unthreaded needle is again passed about 1 cm. from the last portion, from the upper to the lower surface, ligature B drawn upwards on it, and again tied with ligature A as before. This procedure is repeated as often as may be necessary until the edge of the liver is reached. Auvray performed this operation frequently upon dogs, and, having proved it, has since used it with success in man.

Dr. Leonard Freeman records (Trans. Amer. Surg. Association, 1904, vol. xxii, p. 196) a case of primary carcinoma of the liver upon which he operated. Interlocking gauze strips were used as ligatures in place of the usual thick silk to arrest the hæmorrhage. The following description is given:

"Operation Jan. 20, 1903. A longitudinal incision through the right rectus revealed a hard, nodular tumour of the left lobe of the liver, just to the left of the notch. It was the size of a large fist, buried almost completely in the substance of the organ, and without a pedicle. The greater portion of the growth lay beneath the free hepatic border, so that a small portion only could be felt by abdominal palpation. There were extensive omental adhesions, but no enlarged glands, and the remainder of the liver was free from involvement as far as could be detected. The gall-bladder was normal.

"After enlarging the incision it was decided to isolate the tumor by means of ligatures formed from narrow, folded strips of gauze, such as are found in every operating room. The liver

was perforated with long, blunt forceps and the strips pulled through, at first two strips, and then through each successive hole, an end of the previous strip together with a fresh one. A series of loops were thus obtained, each one enclosing a considerable amount of tissue. These were slowly and forcibly tightened and tied, thus effectually compressing the liver, but not cutting it as do ordinary sutures. Hæmorrhage from the perforation was prevented by the presence of the gauze.

"The tumour was then removed by cutting through normal liver tissue with a scalpel, no bleeding following the section except from a single vessel not included in the ligatures. After sinking the stump in the abdomen it was packed around with gauze, the ends of which, together with the ends of the strips, being brought out through the partially open wound.

"The progress of the case was uneventful except in one respect,—the removal of the gauze ligatures. The knots being buried deeply in the wound, they could not be untied or even cut with certainty. After some difficulty several strips were finally extracted; but the others resisted all efforts until bands of rubber were attached to them so as to exert constant traction, when they came out promptly and easily and without pain. At another time I should be inclined not to tie the strips, but merely draw them tight and clamp them with forceps, or tie them with catgut, thus admitting of comparatively easy extraction; but in case a strip should stick, elastic traction could still be employed.

"The patient left the hospital in about six weeks, completely recovered. On May 18, 1904, about sixteen months after the operation, he was perfectly well, with no signs of recurrence, no disturbance of any kind, and doing regular work on his engine."

In the discussion which followed the reading of this paper, Dr. W. W. Keen said:

"My experience with tumours of the liver has been limited to three cases. The first was an adenoma, the second an angioma, and the third a carcinoma, there being in each case a single tumour embedded deeply in the tissue of the liver at the anterior border.

"Judging from my experience in these cases the whole ques-

tion of the operative surgery of the liver practically is one of hæmostasis. It so happened that in these three instances I adopted three different methods.

"In the first case, the adenoma, I divided the normal liver substance just outside the limits of the tumour by means of the Paquelin cautery, and I cannot speak too highly of it. I was able in this case, by making small cuts repeatedly, to discover the large vessels of the liver readily before they were cut through by the cautery, and in each case to ligate them by means of catgut without any trouble, with practically no hæmorrhage, and then to suture the flaps thus made as if they were amputation flaps.

"In the second case I adopted a method which I do not think I should adopt again, namely, I incised the liver partially, so as to make an artificial pedicle of the tumour, tied around it an elastic ligature made of rubber tubing the size of a lead-pencil, and treated this extraperitoneally. Although no sepsis followed, and the patient recovered without trouble, yet at the same time I should not adopt it again because of fear of possible infection from the strangulated tissue.

"In the third case I used the knife, and was not as well satisfied with it as with the Paquelin cautery. It answered the purpose, however, and the patient recovered from the operation.

"The first case of adenoma I heard from several years later, and she was perfectly well.

"The second, one of angioma, recovered perfectly, and was well some months afterward, but I do not know the later history.

"The third, one of carcinoma, recovered from the operation, but I have no doubt succumbed from recurrence, which was in progress when I last heard from him."

2. **Kousnetzoff and Pensky's Second Method.**—In certain cases where the first method cannot be performed satisfactorily these observers have suggested the following:

The tumour is removed in such a manner that opposing surfaces of liver-substances can be brought together. This is done by taking a wedge-shaped portion away. Into the wound so left in the liver iodoform gauze is packed and the surfaces of the wound are pressed together on to the gauze. The capsule of the liver is now stitched along the cut margins by a con-

tinuous suture, both upper and lower edges being united up to the point where the gauze comes to the surface of the liver. The liver may be fixed, if thought desirable, to the posterior margin of the abdominal wound, but usually this is not necessary. The gauze pack is allowed to hang out of the abdominal wound, which is closed snugly around it. The gauze comes away in from ten to fifteen days and the wound then slowly granulates.

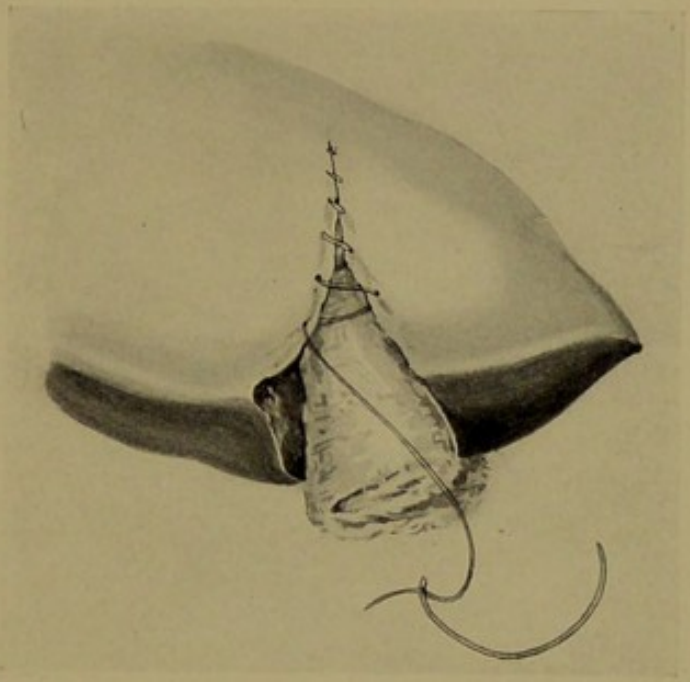


Fig. 287.—Kousnetzoff and Pensky's second method of liver suture.

This method was first put into practice by von Mikulicz in a case of syphiloma of the liver in a woman. The patient made a speedy recovery.

3. The simplest of all methods, though supposed by many to be fraught with danger, is the **excision of a wedge-shaped portion of the liver,** the ligation of all bleeding points exposed on the cut surfaces, and the approximation of the wound surfaces by deep interrupted sutures of large size. The liver, in fact, is treated in precisely the same manner as is the kidney when the operation of partial nephrectomy is performed. In two cases I have operated in this manner, with a good temporary

result, though both patients died after some months from other growths in the liver and elsewhere. As the incision is made through the liver-substance an assistant applies a flat gauze swab wrung out of hot saline solution to the cut surface and temporarily controls the bleeding. When the whole section is completed, the gauze swab is removed bit by bit and the vessels on the exposed liver surface secured with a fine clip. The vessel may then be ligated in the ordinary manner, or an armed needle may be passed beneath it, and the ligature thus buried a little in the substance of the liver.

If after making the section of the liver no arteries are seen to be pumping vigorously, the two cut surfaces are approximated, and are united by deep stitches of stout catgut passed with a Kousnetzoff needle, or an ordinary large intestinal needle. The stitches are placed about half an inch apart. When they are tied all bleeding is arrested. The edges of the wound may then be drawn together by superficial catgut sutures. The operation of partial hepatectomy, in fact, is done exactly like the operation of partial nephrectomy.

During the excision of the wedge of liver an assistant grasps the organ with one hand on each side of the wound to control hæmorrhage. This is as a rule easily secured, for the arteries are not numerous, and the blood-pressure in the portal system is low.

Jacob Frank describes ("Journal Amer. Med. Assoc.," 1905, vol. ii, p. 446) a method in which, if accurate apposition of cut liver surfaces cannot be attained, wedge-shaped pieces are removed from each lip of the wound to enable this to be done.

Dr. Rome ("Annals of Surgery," vol. xxxix, p. 98) has recorded a case of excision of the liver for tuberculosis performed in this manner. He writes:

"Exploration revealed a tumour in the lower right lobe of the liver. The surface of the liver corresponding to the tumour was firmly adherent to the parietal peritoneum. After freeing these adhesions it was apparent that the section in which the

tumour was situated could be removed in the shape of a wedge or triangle. This was mentally outlined, and heavy catgut sutures were introduced, beginning at the apex of the triangle and passed through the thickness of the lobe; the needle was reinserted and brought out opposite the first free end and left untied.

"Sutures were introduced in this manner half an inch apart and half an inch from the margin of the triangle. After inserting a sufficient number of sutures the wedge containing the growth was cut away with scissors, and the cut surfaces of the liver immediately brought together and the sutures tied. Approximating the surfaces in this way promptly checked the hæmorrhage. The size of the tumour removed was that of a goose-egg."

The cautery may be used to effect the separation of the growth.

The following case of removal of a carcinomatous lobe of the liver is worthy of record. The operation was performed by Dr. W. W. Keen, one of the most distinguished of living surgeons ("Annals of Surgery," vol. xxx, p. 267):

"Operation April 23, 1899. As soon as the abdomen was opened in the middle line it became clear that the tumour was hepatic. On drawing it outside of the abdomen I found a number of large nodules occupying the entire left lobe of the liver. My first impression was that it was a carcinoma, but later, on cutting out a piece for microscopic examination, I rather thought it possibly a gumma, or, though less likely, caseous tubercular masses. Passing my hand carefully over the rest of the liver, I found that there were no other nodules that could be discovered, nor was there any involvement of the lymphatic glands. Dr. J. Chalmers Da Costa and Dr. Geo. W. Spencer, who assisted me, reached the same conclusion as to the limitation of the tumour to the left lobe. It seemed to be possible to remove the entire left lobe of the liver and with it the whole of the tumour, and I proceeded at once to its extirpation. The operation was done entirely with the Paquelin cautery. It took from twenty to thirty minutes to sever the left lobe from the remainder of the liver. The hæmorrhage

was not very severe, excepting when I burnt into some of the larger veins. Each of these, when opened, I was able instantly to close by my left forefinger. Then, temporarily laying aside the cautery, I passed a catgut ligature under each by means of a Hagedorn needle, and one of my assistants tied it slowly but firmly. Five ligatures were thus applied. Three of the veins required ligation of both of the divided ends. The hæmorrhage, except from these large veins, was arrested by the Paquelin cautery, except that occasionally, when I laid aside the cautery

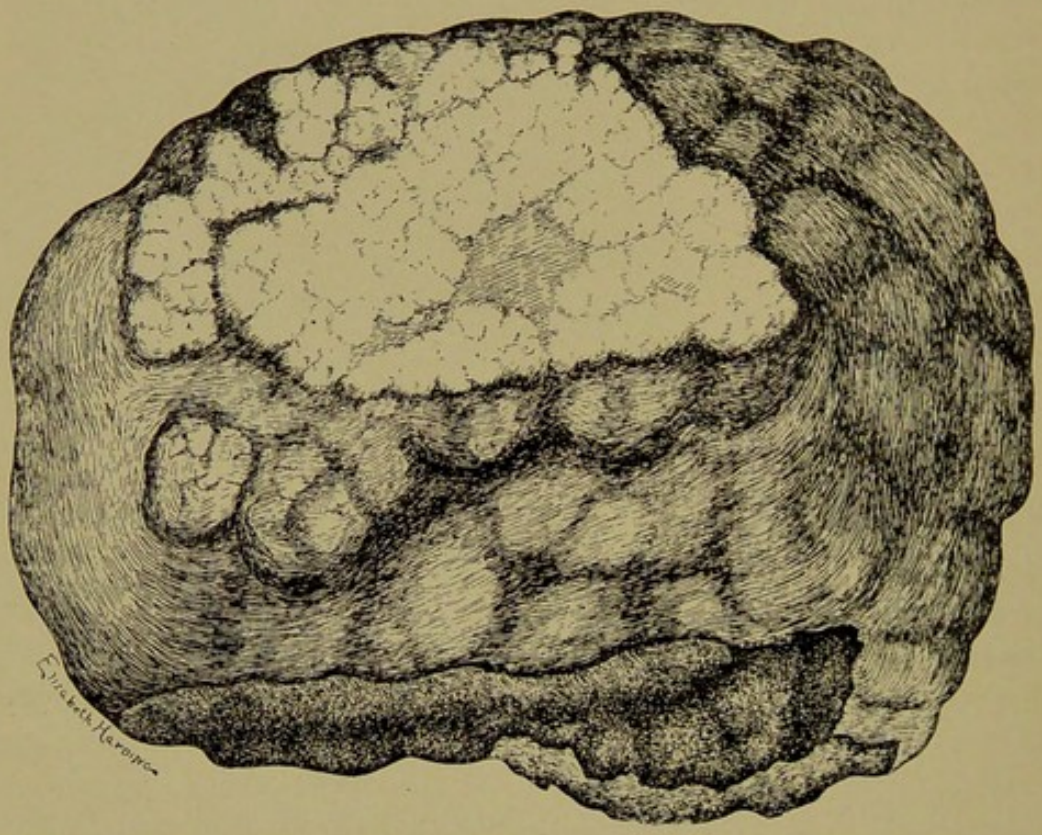


Fig. 288.—Dr. Keen's case of carcinomatous left lobe of the liver removed by operation ("Annals of Surgery").

to apply a ligature, temporary packing with iodoform gauze was of great service in arresting the parenchymatous hæmorrhage. The amount of blood lost I judged to be about eight to ten ounces; but as I feared that there might be a severe loss of blood before I got through, as soon as I began the hepatic portion of the operation Dr. W. J. Roe began an intravenous saline injection, throwing a quart of the solution into the circulation. Of course, the surrounding tissues were well protected against the cautery by wet aseptic gauze pads.

"When the tumour was removed, I found that I was able to obliterate a part of the resulting raw surface by folding the edge of the liver upon itself like the flaps of an amputation, as I had made the cautery incision obliquely. A few catgut stitches approximated these flaps, but still there was left over one-half of the burnt surface exposed in the peritoneal cavity. I feared there might be some hæmorrhage or later adhesions, and to prevent both, as well as to provide for the escape of the bile into the peritoneal cavity, I packed some iodoform gauze against the liver, leaving the end protruding through the abdominal wound. The abdominal cavity was then carefully flushed out with solution (though but few clots were thus removed), and the abdominal wound was then closed, excepting at the point where the gauze packing protruded."

F. S. Hough ("Iowa Med. Jour.," November 15, 1907) describes a liver suture which is a combination of the deep mattress, chain, and ordinary interrupted sutures. He writes:

"The wound is crossed by interrupted sutures—of heavy catgut, deep enough to reach beneath the bottom in ordinary cases—at any rate very deep—and each suture includes considerable liver tissue, as the point of entrance and exit is one-half inch from wound margin. These sutures are one-half inch apart and are all inserted and left with long free ends before the tying process is commenced. Instead of tying the two ends of the same suture, the ends of first and second suture, on the same side of wound, are tied together, leaving the free ends beyond the knot; then the first and second sutures are tied together on opposite side of wound, after drawing up the strands rather taut; also leaving the free ends beyond the knot. After this is done you have a deep mattress suture with two free ends of suture beyond the knot on each side. Tie one of these strands to suture number three on one side of wound and repeat on opposite side. The remaining strand tie *across* the wound with its fellow and continue the process until the wound is closed. This is much more difficult to describe than to do. I will not minutely describe the advantages of this method, as they are palpable if you will but try it. The sutures are firmly anchored and do not cut deeply into the liver tissue, and the method appeals to me to be a good one for suture of such a friable tissue as liver tissue.

4. **Removal with the aid of an elastic ligature around the pedicle.**—Resection may be carried out in the same manner as was

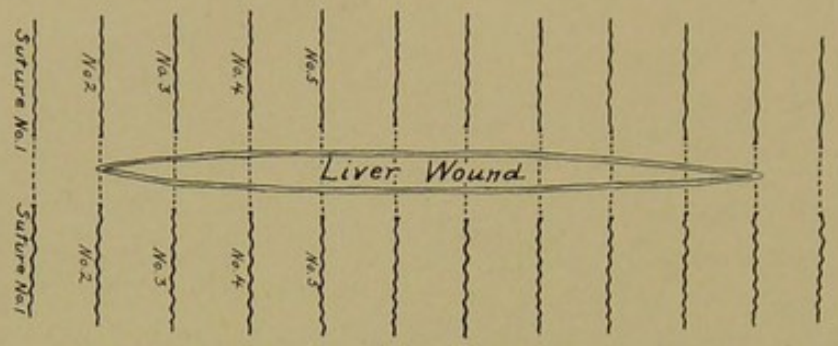


Fig. 289.—Step 1.—Deep interrupted sutures of heavy catgut beneath liver wound, one-half inch apart and one-half inch from wound margin (Hough).

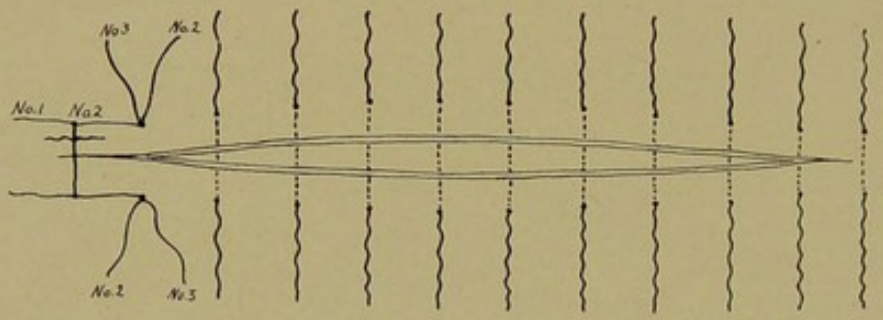


Fig. 290.—Step 2.—No. 1 tied to No. 2 on each side of wound, the knot made as near as possible to where No. 2 (interrupted) crosses beneath the wound. This leaves two free ends beyond knot on each side of wound. One free end is tied above across wound and the other free end on each side of wound is passed on and tied to No. 3, leaving two free ends as before. This process is repeated until all sutures are passed and tied (Hough).

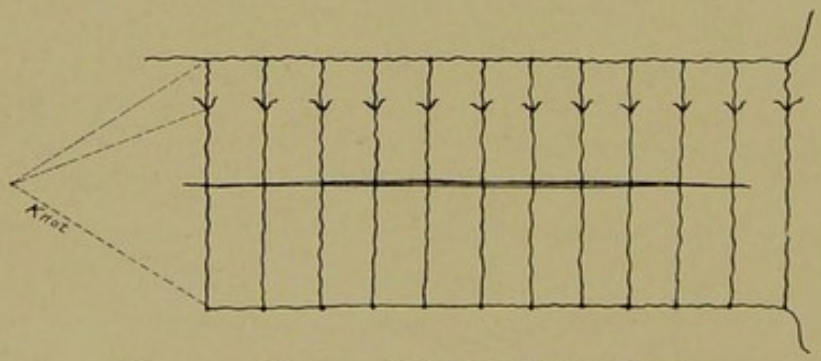


Fig. 291.—Step 3.—Sutures all tied (Hough).

formerly practised upon the uterus in cases of extraperitoneal treatment of the pedicle. The tumour is brought out through the abdominal incision. Through the liver near the base

of the growth large pins (knitting-needles do very well) are passed, and on the proximal side of these an elastic ligature is tied as tightly as possible. The tumour is then cut away with the knife or with the cautery, and the raw surface of the liver covered with boracic powder or iodoform gauze. The

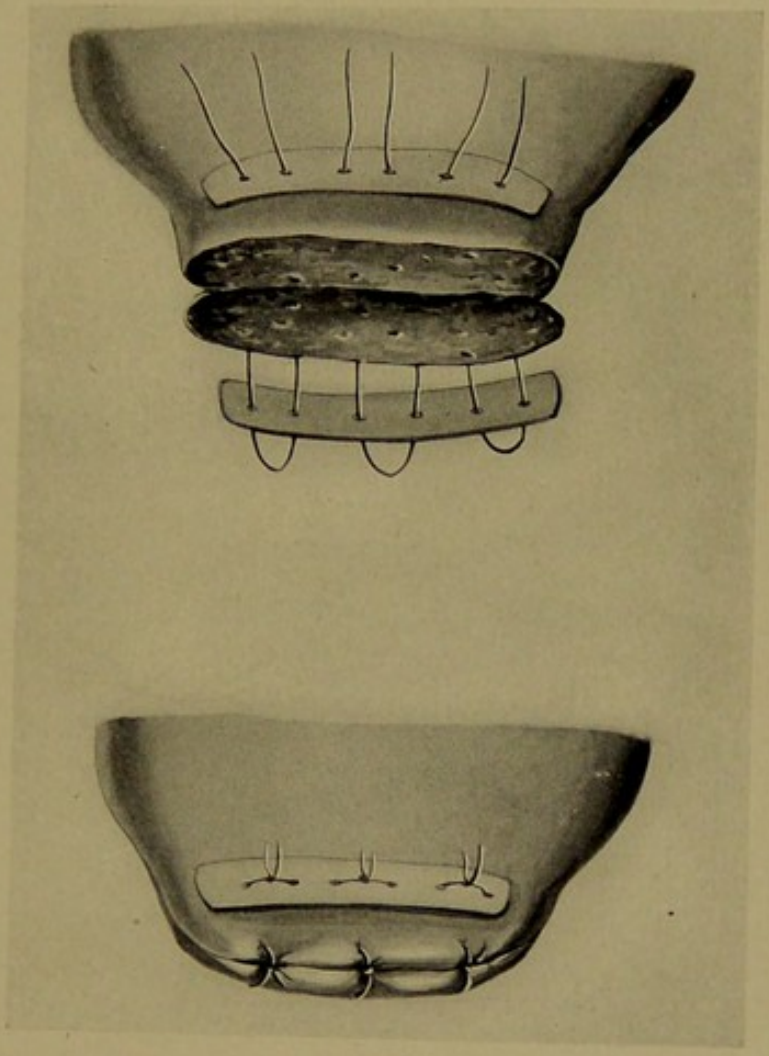


Fig. 292.—Payr and Martina's method of liver hæmostasis and suture, with the use of magnesium plates.

following surgeons have recorded cases operated upon by this method: Lauenstein, Lucke, Terrillon, Tillmanns, Mayo Robson, Küster. The method is unsatisfactory because of the impossibility of preventing sloughing of the pedicle, and septic infection of the wound area.

Payr's Method.—Payr and Martina ("Archiv f. klin. Chir.," Bd. 77, Heft 4, 5, 962) describe a method of ensuring hæmostasis in operations upon the liver resections, or the closure of lacerations, which has been found to answer well in practice, and in extended experimental work.

The method consists in the use of magnesium plates. Pure magnesium is a metal readily cut into the required shape by

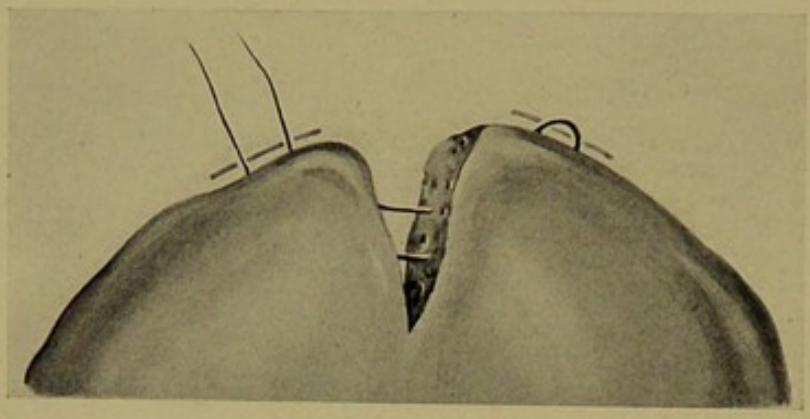


Fig. 293.—Suture of the liver with the aid of magnesium plates (after Payr and Martina).

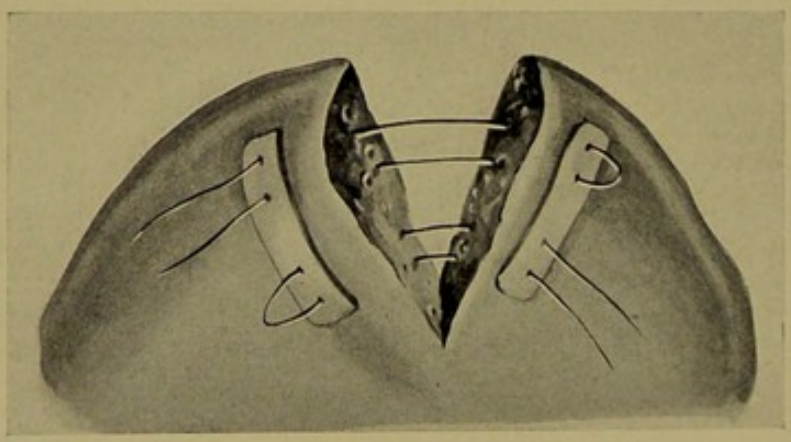


Fig. 294.—Suture of the liver with the aid of magnesium plates (after Payr and Martina).

strong scissors; but specially prepared plates of it of many sizes and shapes can now be obtained. Magnesium possesses many advantages, the chief of which are that it is absorbable, that it can be sterilised, and that it acts as a hæmostatic.

Payr and Martina suggest that their method may be found of

service in operations upon the liver and spleen, both for the repair of injuries and in the removal of tumours.

The principle consists in applying along the side of each margin of the wound in the liver a broad plate of magnesium, through which stout catgut sutures are passed. The sutures are of the "mattress" type, so that each one traverses four holes, two in each plate. As the sutures are tightened, the plates are approximated, and the wound surfaces of the organ are brought closely into apposition. A few superficial sutures for the edges may then be introduced. The use of the plates is well shown in the accompanying drawings.

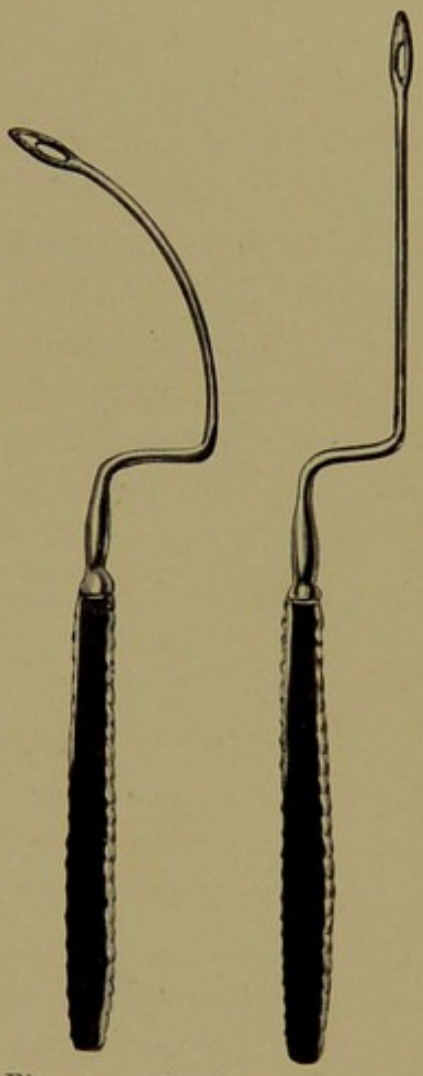


Fig. 295.—Payr's needles for liver suture.

If a large, more or less pedunculated mass is to be removed from the liver an elastic tourniquet may first be tightly applied around the base. The growth is then removed if possible by incisions enclosing a wedge of tissue so that flat surfaces of liver can be easily apposed. The plates and sutures can then be placed in position, all the more easily that there is no bleeding from the wound areas. When the sutures are tightened the tourniquet may be removed.

It is claimed for this method that it ensures a perfect hæmostasis. Even in very large wounds there is no venous hæmorrhage, and if an artery be seen to bleed it can readily be secured by a ligature.

A detailed description of the naked eye and microscopic changes resulting from this mode of treatment are given by

Payr. He asserts that hæmorrhage has never occurred in any of his cases; that the liver heals well; that to the wound the omentum almost invariably becomes adherent; and that after the first hours gas is found ("gas cyst") in the tissues around the plates, which at least become completely absorbed. For all the sutures, stout iodine catgut was used. It is important that the plates should not be drawn too tightly together. Almost all the animals upon which this was done died of pneumonia. Thromboses of the veins in the wound area were found, and emboli were present in the lungs. Moreover, if pressure necrosis be produced, it is not unlikely that the "traumatic hepatic-cell embolism" (described by Lubarsch as being found in cases of traumatism to the liver) might occur.

Stamm has suggested that plates of cartilage obtained from the scapula of the calf might be used in place of magnesium. His experience is limited to experimental work upon the dog.

Ceccherelli and Bianchi (Sixteenth International Congress, Rome, 1894) used whalebone and, later, decalcified bone plates with interlocking perforating sutures in a manner which Payr and Martina closely followed.

It is highly probable that these forms of apparatus will have no permanent place in surgery, but will disappear as the bobbins of intestinal surgery have disappeared.

Magnesia is decomposed with considerable gaseous formation, 1 gram of magnesia producing 1 litre of hydrogen. Gas cysts are formed, and adhesions, with masses of connective tissue; while employment of whalebone or decalcified bone plates may necessitate a further operation for their removal.

Garré ("Surg. Gyn. and Obst.," September, 1907), in an article on resection of the liver, points out that the various elaborate methods formerly employed to obtain hæmostasis in liver resections are unnecessary and useless, simple ligature and suturing giving perfect results. He uses fine silk instead of catgut, for ligaturing, to obviate slipping. For the sutures, thick catgut is employed. Garré gives details of six cases of resection: One for

carcinoma of the gall-bladder invading the liver substance; one of enucleation of echinococcus and extirpation of gall-bladder with resection of wedge-shaped piece of liver; one for sarcoma and three for echinococcus cyst. All these cases recovered from the operation.

Anschütz, in his article to which reference has already been made, gives brief extracts from the records of all cases of partial hepatectomy recorded up to 1903. The following is an epitome of the results obtained:

10 cases were treated by excision and tamponade, with.....1 death.
7 cases were treated by excision by thermocautery, with.....0 deaths.
25 cases were treated by excision with ligation of bleeding points and deep suture, with.....2 "
6 cases were treated by clamping and excision, with.....2 "
20 cases were treated by intrahepatic ligation, with.....6 "
24 cases were treated by elastic ligature and pins, with.....6 "

The immediate results, it will be seen, are decidedly better than might have been anticipated. Of the remote results, there is little satisfactory to say. In many of the records no information is given upon this point, but where full details are given, the frequency with which recurrence takes place is deplorable. This is almost certainly due to the fact that, as in the early days of treatment of malignant disease in all other regions, the removal of the growth has been inadequate. The fear of disaster following a wide removal has checked the surgeon and caused him to remove less of the liver than was necessary. I do not know of any case of malignant disease of the liver in which a cure has been effected by partial hepatectomy. Several cases of simple growths have made permanent recoveries. In the 52 cases related by Terrier and Auvray, only 2 died from hæmorrhage, a fact which is worthy of repetition in view of the general belief that hæmorrhage was the disaster most to be feared.

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CHAPTER XL.

OPERATIONS UPON THE GALL-BLADDER AND BILE-DUCTS.

GENERAL REMARKS.

In all operations upon the gall-bladder or upon the bile-ducts a considerable advantage will be derived from the use of a sand-bag or air-cushion placed under the patient's back at, or a

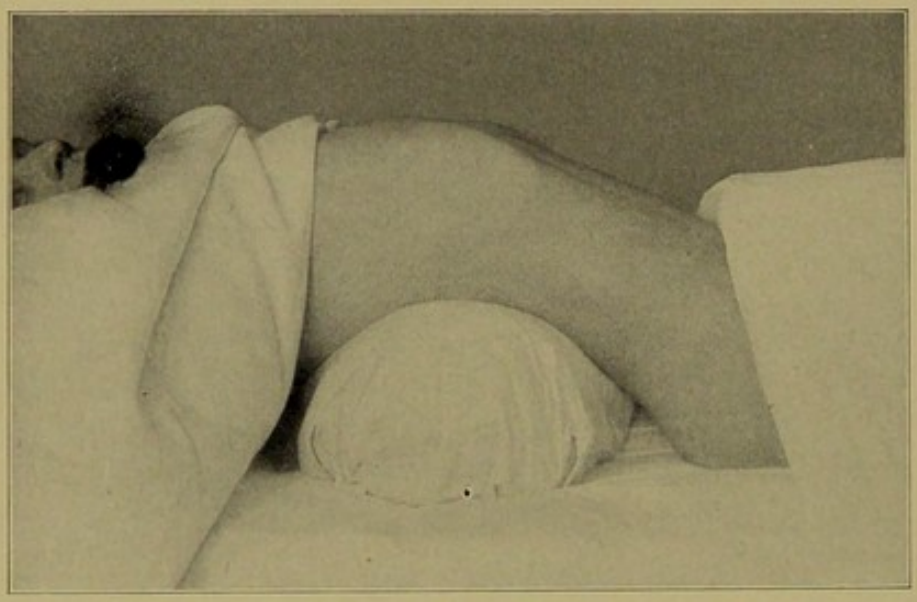

Fig. 296.—Shewing the position of the sand-bag in operations upon the gall-bladder and bile-ducts.

little above, the level of the liver. The liver by this means is made to present in the wound, and easy access is obtained to the cystic and common ducts. The intestines fall away into the pelvis, and the whole operation area is made more accessible. In addition to this use of the sand-bag it will be found a convenience to be able slightly to tilt the table so that the head of the patient is raised and his feet lowered about four to six inches.

It is to Wheelock Elliot, of Boston, that we are indebted

for the first demonstration of the great advantage to be derived from the placing of the patient in this position. He writes:

"The patient is hung by straps under the arms on an inclined plane at an angle of something less than forty-five degrees. A sand-bag is placed under the back, so that the patient is bent over it. In this position the intestines gravitate to the lower part of the abdomen, so that when the liver is held up by a retractor, the air sucks in between the liver and intestines much as it enters the pelvis in the Trendelenburg position."

The only disadvantage of this position is that, when a vertical incision is employed, the edges of the wound are necessarily very tense, owing to the pushing forwards of the rib margin and the consequent tightening of the abdominal muscles. This solitary disadvantage is done away with when Mayo Robson's incision, to be presently described, is used. This position of the patient is, as a fact, indispensable for easy work upon the ducts.

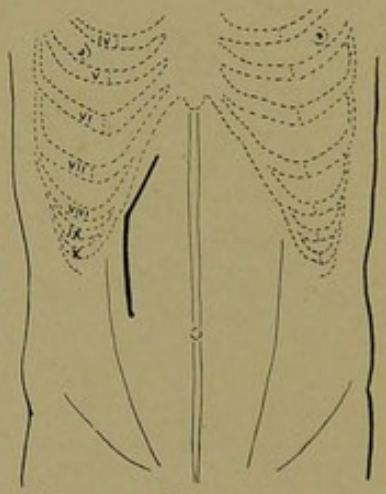

Fig. 297.—Mayo Robson's incision.

The best incision is a vertical one, made at first about four to five inches in length through the right rectus near its outer border. The upper end of the incision starts at the costal margin and extends vertically downwards. If more room is needed than this incision gives, it may be obtained by prolonging the incision downwards, or by carrying the upper end obliquely upwards and inwards, dividing the fibres of the rectus about one-half of an inch from the costal margin. There is rarely any need for a further increase of the incision than these. The incision along the outer margin of the rectus, with the upward and inward extension, is that first suggested by Mayo Robson. Great convenience may often be gained, especially in stout patients, with an abdominal wall three inches or more in thickness, by making the skin incision two or three inches longer

than the incision in the rectus. The sides of the wound then fall away and allow the more ready access of the hand. The longer incision in the skin and subcutaneous fat does not, in any way, weaken the abdominal wall, as a longer incision in the muscles would certainly do.

Dr. Arthur Dean Bevan, of Chicago, has suggested ("Annals of Surgery," vol. xxx, p. 17) the use of an S-shaped incision, the lower end of the vertical incision being carried outwards, and the upper end obliquely upwards and inwards. Dr. Bevan claims that by means of his incision less damage is done to the vessels and nerves of the abdominal wall than by other incisions,

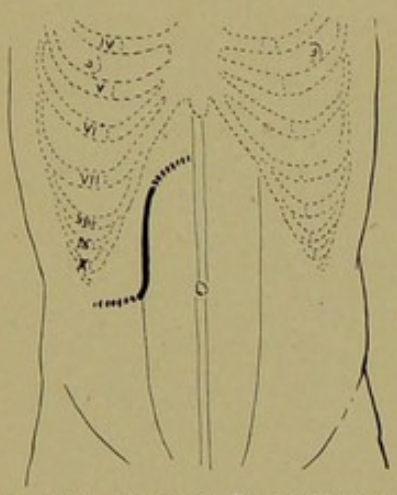

Fig. 298.—Arthur Dean Bevan's incision.

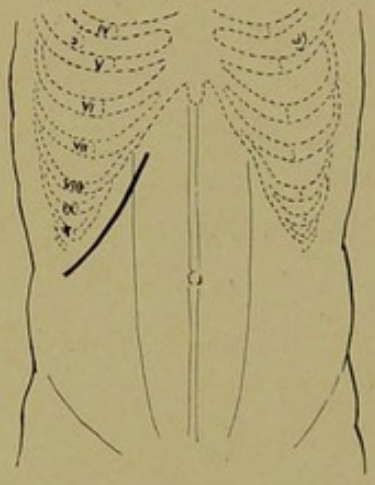

Fig. 299.—Kocher's incision.

and that a better view can be obtained of the bile-ducts. The incision of Mayo Robson is practically the same as the upper part of Bevan's incision.

Alexander Don ("Brit. Med. Jour.," 1909, i, 652) describes an incision which is useful for operations in the biliary region on stout people. He makes a vertical incision a finger's breadth to the right of the middle line, dividing the skin and anterior sheath of the rectus, from opposite the seventh costochondral junction to the umbilicus. The sheath is dissected off the muscle on the mesial side, and the muscle separated from its posterior sheath and retracted outwards. The posterior sheath and peritoneum

are then incised as far out as convenient, parallel to the skin incision. Then, from the lower end of the vertical incision, a curved incision is made upwards and outwards to the lowest point of the costal margin. This incision is through skin and superficial fascia only. The rectus muscle is now divided, preferably at its umbilical intersection, and the whole flap turned upwards and outwards. This operation preserves the nerve supply to muscles and peritoneum and certainly gives a good exposure.

H. M. W. Gray ("British Jour. of Surgery," 1912, i, 325) refers to Perthes' incision. The vertical portion of this incision is similar to Don's, but instead of a curved incision to the right, Perthes makes an almost straight horizontal incision. The access is not so good, and owing to the oblique course of the nerves supplying this region a greater number are divided.

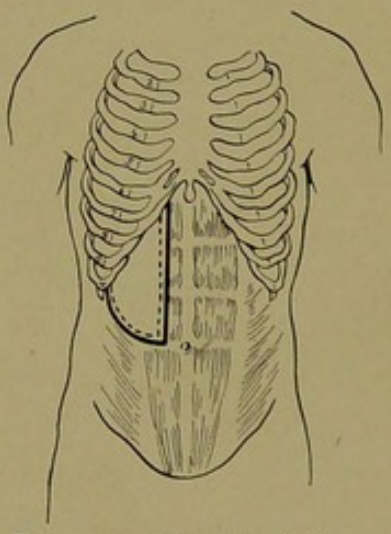

Fig. 300.—Don's incision.

Kocher uses an oblique incision four inches in length, about 1½ inches below the costal margin. The centre of the incision is a little outside the outer margin of the rectus muscle. This is a very useful incision, giving ready access to the gall-bladder and ducts, being readily enlarged either inwards or outwards, and doing little damage to the nerves or muscles of the abdominal wall. Very little weakness of the parietes remains after the operation, and there is little chance of a hernia developing. This incision and the vertical incision, with Mayo Robson's extension, are the only ones I have adopted. So far as I am aware, I have not had a single case of post-operative hernia. This I attribute in part to the method of making the incision (a large skin wound and a small muscle wound), but chiefly to care in stitching up the wound. Courvoisier's incision is eight to ten inches in length, and runs almost parallel with the

costal margin. Kehr makes use of an incision even longer than this. He calls it the "Wellenschnitt."

Such phenomenal incisions as these two latter are never necessary. With a vertical incision, five or six inches in length, and at the most, an oblique upward and inward prolongation of this just below the costal margin, any operation can be performed upon any part of the gall-bladder or the cystic or common or hepatic ducts, provided the ducts are brought within easy reach; then the smaller the incision the better, for the intestine can the more readily be packed away with swabs. A long incision is troublesome, in that it allows the escape of intestines from the wound and makes the retention of the bowels within the abdomen a matter of constant attention. As soon as the abdomen is opened and a preliminary exploration has been made, a large flat swab is packed down towards the upper part of the right kidney pouch. The proper placing of this swab is a matter of the greatest importance. It should fill the upper part of the right kidney pouch, fitting in between the common duct and the duodenum on the inner side and the abdominal wall on the outer side. When fixed in its correct position, it forms an adequate protection against any leakage from the opened bladder or ducts. When the operation is completed and the swab is removed, there should have been no soiling of any part of the peritoneum which it covers.

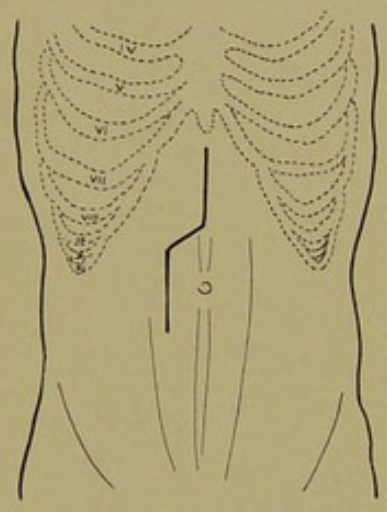

Fig. 301.—Kehr's incision ("Wellenschnitt").

A second swab of smaller size is then passed towards the middle line, to lie above the stomach to the inner side of the common duct. The exact fixing of this is also important, though it is more easily done than is the former. A mackintosh is wrapped round each edge of the wound, and a third is placed

so as to cover the intestines, the gall-bladder area being in this way completely isolated.

The liver and the gall-bladder are then freed from any adhesions. These are sometimes thin, loose, and easily divided; at other times they are exceedingly tough, intricate, and difficult to separate. The greatest care and deliberation must be exercised in disentangling these. Any hurry or any undue force may be fatal; the colon or the duodenum, or even the stomach, may be torn, and leakage from these viscera may contaminate the whole field. A rough separation of the omentum may cause a profuse hæmorrhage, and the torn vessel, retracting, may cause a large hæmatoma to form in the substance

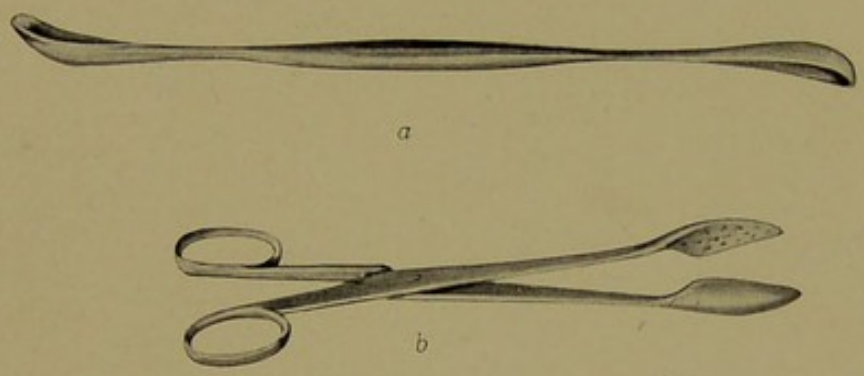

Fig. 302.—Gall-stone scoop (*a*) and forceps (*b*).

of the omentum. In the stripping of all these adhesions great help will be found in the use of gauze, which, wrapped around the fingers, slowly peels the adhesion away. It is most essential that all the ducts and the gall-bladder should be freed and laid bare before the operation proceeds further.

Unless all the bile-tract can be explored, there is a great risk of a small calculus, or even of many calculi, being left behind. Adhesions, even the very firmest, will yield to time, patience, and dexterity. No operation need ever be abandoned because the adhesions are supposed to present an insuperable obstacle. I have, on many occasions, seen adhesions that at first were utterly bewildering in their infinite complexity; but gentle

persistence in separating first one spot and then another has gradually cleared all difficulties away.

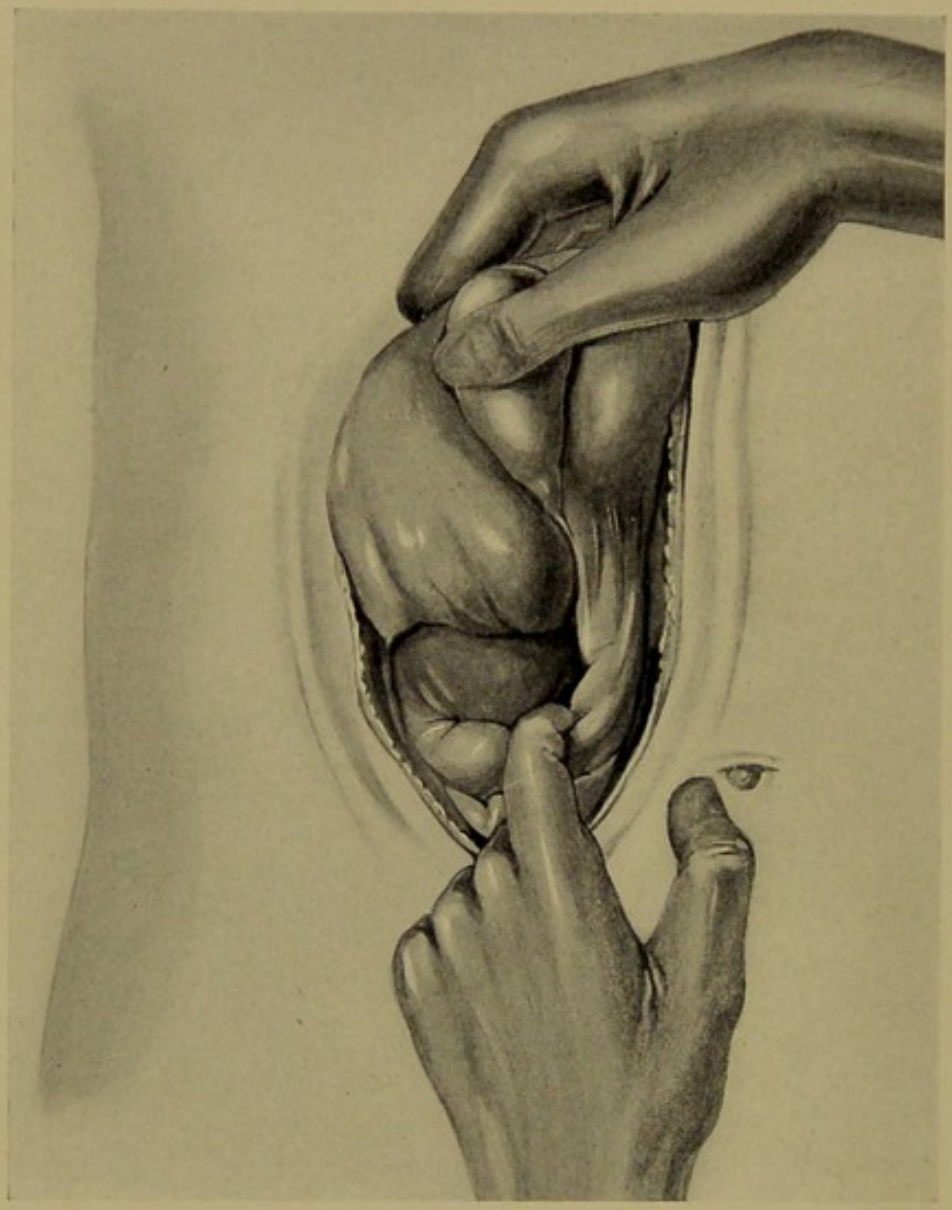

Fig. 303.—Liver rotated through Mayo Robson's incision. When the gall-bladder is pulled upwards in this way the ducts are straightened and put upon the stretch. Access to them is then quite easy.

When all is quite clear, then the gall-bladder, with the liver around it, is seized in the hand, covered with gauze, and gently dragged downwards from under the shelter of the ribs. If this can be effected, it will be found easy to rotate the liver, turning

the gall-bladder upwards, so that what was its under surface now faces upwards and forwards. By this manœuvre the cystic and common ducts are brought almost into a straight line, and the common duct, which at first seemed so deeply hidden in the abdomen, can now be brought forwards until it lies almost or actually on a level with the skin. In this way the ducts can be most thoroughly explored, and the surgeon may satisfy himself of the certainty of being able to remove all the stones.

It is not necessary in all cases to bring the liver and gall-bladder forward in this way, but in case of any doubt it is certainly advisable to do so. In thin patients this may be done through the usual vertical incision, but in the stouter patients the upward and inward prolongation of the incision will first be necessary.

In stout people it is sometimes difficult to make the liver rotate, and thus to bring the ducts forward, but even if the manœuvre cannot be completely effected, it can often be done to such an extent as to make the steps of the operation much easier. If the patient be thin, and if, as in spare women, the liver lies with its edge well below the costal margin, it is perfectly easy to bring the common duct well up to, or even outside, the abdominal wound, and there to incise or suture it.

During the operation it is advisable in all cases, but more especially in those patients suffering from chronic jaundice, to ligate every bleeding point. All superficial bleeding points should be tied before the abdomen is opened, in order to exclude the possibility of infection, which might occur if they were left tied after the intra-abdominal stages of the operation were completed.

After the intra-abdominal portion of the operation is completed it is necessary to remove the sand-bag or air-cushion from beneath the patient's back before stitching the wound. The peritoneal stitch is exceedingly difficult to introduce while the epigastrium is made tense and prominent by the sand-bag.

The preliminary treatment of patients who are to be operated upon for gall-stone disease is the same as in all abdominal opera-

tions. In cases of chronic jaundice Mayo Robson, acting upon the experimental observations of Wright, has administered chloride of calcium, either by the mouth or by the rectum, in the hope that the coagulability of the blood might thereby be increased. I have never been convinced that this drug had any effect whatever in this direction, and though I formerly gave it a fair trial, I have now ceased to administer it. In some few cases I have given gelatine subcutaneously with the same hope, but this also I have abandoned as being useless. I now use horse serum, or, better, rabbit serum, injecting 20 c.c. of the normal fresh serum subcutaneously or intramuscularly five or six hours before operation in cases where there is deep jaundice. W. J. Taylor ("Transactions American Surgical Assoc.," 1906) advocated the use of thyroid extract to shorten the coagulation time. He cites a case of hepatic duct carcinoma in which the time was lessened from twelve and one-half minutes to six and one-fourth without there being any change in the intensity of the jaundice.

He also mentions in the same paper that Murphy and Gould, following the method of Brodie and Russel, "made examinations of the blood in 15 cases of jaundice from various causes,—gall-stones, cancer of the liver, cancer of the head of the pancreas, and chronic pancreatitis, but failed to find that coagulation varied from the normal."

These results would seem to suggest that delayed coagulation is not constantly associated with jaundice due either to benign or malignant obstruction.

The abdominal wound is closed in the following manner:

The parietal peritoneum is seized on each side with two or three pairs of beaked clips, which hold the cut edge of the peritoneum and also the posterior sheath of the rectus muscle. The clips are given to an assistant, who holds them away from the abdominal wound with sufficient force to facilitate the ready introduction of the stitch. Too forcible a drag must not be made or the clip will be pulled away. A continuous

catgut suture is now introduced, beginning at the lower end of the wound. It takes up on each side the posterior sheath and the peritoneum together. If the rectus is very thick, a portion of this may also be included. This is much better than the practice usually followed, of seizing only the peritoneum, for if there be any tension on the stitches, the needle may cut through, or the stitch, after being tightened, may break away. This stitch is continued from the lower end of the incision to the top if the wound is to be closed completely. If a drainage-tube is left in the wound, the stitch is continued up to the tube. The same stitch, having reached the upper end of the wound or the tube, is now introduced from above downwards, seizing the rectus muscle and the anterior sheath; when the lower end of the wound is reached, the end of the suture is tied to that end which was left long when the stitch was begun. The stitch is carefully introduced and accurate apposition ensured. In thin patients this suture is quite enough to ensure a firm cicatrix, but in stout patients or in any patients whom, because of old age or feebleness or old-standing chest disease, I may wish to get out of bed within three or four days of the operation, I first introduce a series of deep silkworm-gut sutures. These are introduced about one-half of an inch from the margin of the wound; they pass through all the structures of the abdominal wall except the peritoneum, being brought out on the one side and reintroduced on the other, between the posterior rectus sheath and the peritoneum. These sutures are placed about three-fourths of an inch apart. They are not tightened until the catgut suture has been passed, as already described. When this catgut suture is completed and its ends cut short, the silkworm-gut sutures are knotted. It is not necessary—it is, in fact, harmful—to draw them very tight. As long as they draw the opposing walls comfortably together that is all that is needed. Tension is to be avoided. These silkworm-gut sutures are threaded in the usual way, through fine rubber tubing cut to the correct length. Michel's metal clips are used to ensure accurate

skin apposition. However carefully interrupted sutures are passed, there is a risk of having overlapping of the skin edge, and, therefore, delay in the sound and perfect healing of the wound.

THE OPERATIVE TREATMENT OF STONES IN THE GALL-BLADDER.

When stones are present in the gall-bladder, they can be removed by cholecystotomy or by cholecystectomy. The operations will be separately considered.

CHOLECYSTOTOMY.

Indications for the Performance of the Operation of Cholecystotomy.—Cholecystotomy is the operation most commonly practised at the present day for stones which are found in the gall-bladder. Under certain circumstances it has been replaced by the operation of cholecystectomy. As to the conditions which demand the latter operation, and as to those in which it will probably be the operation of choice, I propose to speak later. There are, however, certain cases for which cholecystotomy will always remain the only satisfactory operative procedure. Though the experience of many surgeons seems to be urging them to perform cholecystectomy far more frequently than before, there will always be many cases for which cholecystotomy must be performed. The need for this particular operation will be determined in part by the conditions found when the abdomen is opened and the bile-passages explored, but more often by the general condition of the patient. In not a few gall-stone operations, especially in older people suffering from a severe infection, that operation is the most desirable which gives the speediest relief. It is not a permanent cure of the disease that at such a moment is the surgeon's chief desire, but rather some quick and assured means of giving relief to urgent and threatening symptoms, so that the patient may be brought safely through a time of great peril. When the danger is past, then a further step towards the permanent cure of the condition may, if necessary, be safely taken. Broadly

speaking, therefore, cholecystotomy will be demanded where

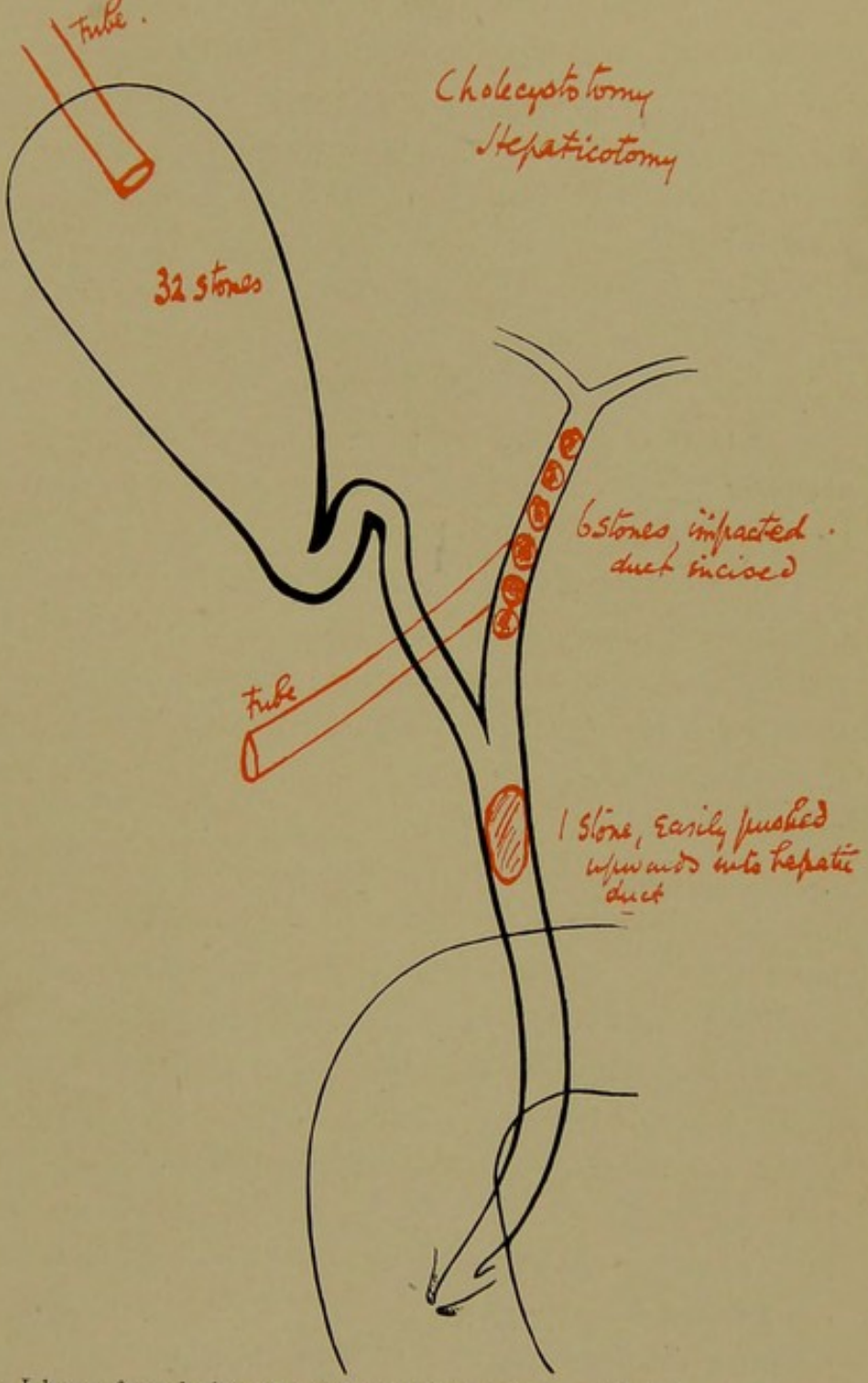

Fig. 304—I have found the annexed outline diagram, which is accurately drawn to scale, very useful in depicting, in a manner which is simple and instantly appreciable, the conditions found and the operation performed in gall-bladder or duct work. The details filled in are copied from a chart of a recent case of hepaticotomy of mine (case 1 in the text).

there are the acute infective conditions for which instant relief

is necessary and in patients whose powers of withstanding the shock of any detailed operative procedure are small. That surgeon will have the best results who does not *always* follow any method, but, taking a just measure of his patient's powers, chooses that measure of relief which seems to him, in each case, to be the best one in the practice of which he is the most expert. This is more especially the case in gall-stone surgery, for so many conditions, each one a menace to the patient's life or comfort, may be present at the same time. A stone in the ampulla, infective cholangitis, cholecystitis with ulceration of stones into the liver, for example, were present in two consecutive cases of my own. For the gall-bladder condition alone, cholecystectomy would have been correct. But whether in such circumstances it should be done in the presence of the other conditions will depend upon the patient's condition, the difficulties or the ease of that particular operation, the surgeon's former experience, and so forth. In these two I performed transduodenal choledochotomy and cholecystectomy, and, after taking away the cystic duct, I left a tube in the common and hepatic ducts. Both patients recovered. To have attempted such an operation in old or weakly patients would have been worse than folly.

One point which requires further investigation is as to the frequency and the character of the after-results of cholecystotomy. It is desirable that we should know of the frequency of recurrence of gall-stones (and this should be distinguished from the spurious recurrence which is the sequel of incomplete removal of stones) and of the symptoms that ensue when adhesions have formed to a chronically inflamed gall-bladder, even after all stones have been removed. Of the former, some evidence is forthcoming, though no doubt it is not all available; of the latter there is also evidence, and Furbringer ("Arch. f. phys. u. diät. Therap.," July, 1903) has said that "post-operative adhesions to the gall-bladder embitter the lives of many patients."

The majority of surgeons will agree with Dr. Maurice Richard-

son when he says ("Med. News," May 2, 1903, p. 817): "The end-results in simple cholecystotomy are certainly as gratifying as end-results have ever been in any class of abdominal operations."

Operation.—The operation of cholecystotomy has been practised in two ways. In one, the gall-bladder, after being opened and cleared of stones, is stitched up and returned within the abdomen; this method is known, most inappropriately, as "ideal" cholecystotomy or as cholecystendesis (Courvoisier). In the other method the gall-bladder is opened, emptied, and drained by means of a tube through the original incision or through a separate stab-puncture. The former method, first performed by Meredith in 1883, is rarely, if ever, practised by experienced surgeons now.

Since it has been recognised that many of the symptoms and all the complications of gall-stone disease are due to an inflammation in the gall-bladder or bile-ducts, it has properly become the custom to drain the bile-passages until the time, varying in different cases, when the inflammatory processes have subsided. The great principle which has to be carried out in gall-stone surgery is drainage. Without drainage there is a risk of imperfect healing of wounds made in the bile-passages, and, therefore, of leakage subsequently of their contents, of small calculi or sand or inspissated bile, or even pus remaining, and of that condition of the mucosa persisting (stone-forming catarrh) which was responsible, in the first instance, for the formation of gall-stones. "Ideal cholecystotomy" is anything but ideal in practice, and is an operation that is mentioned now only that it may be unequivocally condemned.

Cholecystostomy is performed in the following manner: When the abdomen has been opened in the way already described and the gall-bladder and ducts and the head of the pancreas thoroughly explored and freed from all adhesions, the operative area is packed round with gauze swabs wrung out of hot sterile salt solution and the deeper portions of the wound edges,

which are not protected by tetra, covered with mackintoshes. If the gall-bladder is of moderate or large size, it will be found quite easy to draw the fundus up into the wound; another mackintosh, with a hole of sufficient size to admit the fundus, is taken and fitted snugly round the gall-bladder, where it is fastened by special clips, thus completely isolating the site of the intended

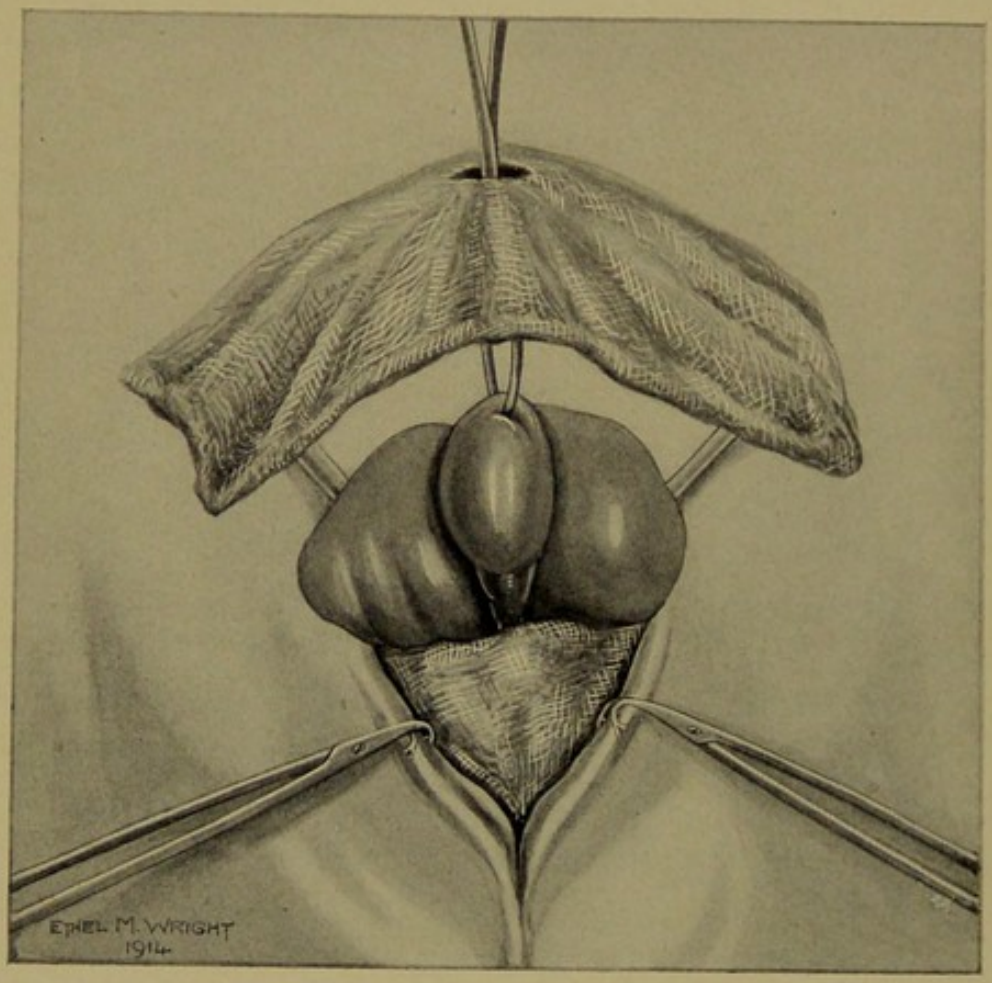

Fig. 305.—Cholecystostomy. Author's method.

cholecystostomy from the remainder of the operation area. An aspirating needle is now thrust into the fundus of the gall-bladder and all the fluid contents drawn away. While this is done the fundus should be seized with vulsella on each side of the puncture to steady the gall-bladder and to hold it forwards when it is empty, and perhaps collapsed, so that it does not slip away when the needle is withdrawn. The fluid removed from the

gall-bladder should be considered septic. The needle, therefore, which has been within the bladder should not be touched, nor should any drop of exudate from the puncture be allowed to soil the hands or any portion of the wound. The swabs used to mop the puncture, or those which, in a later stage, are soiled with the fluid from the bladder, should at once be thrown away. The puncture in the fundus is now enlarged with a snip of the scissors

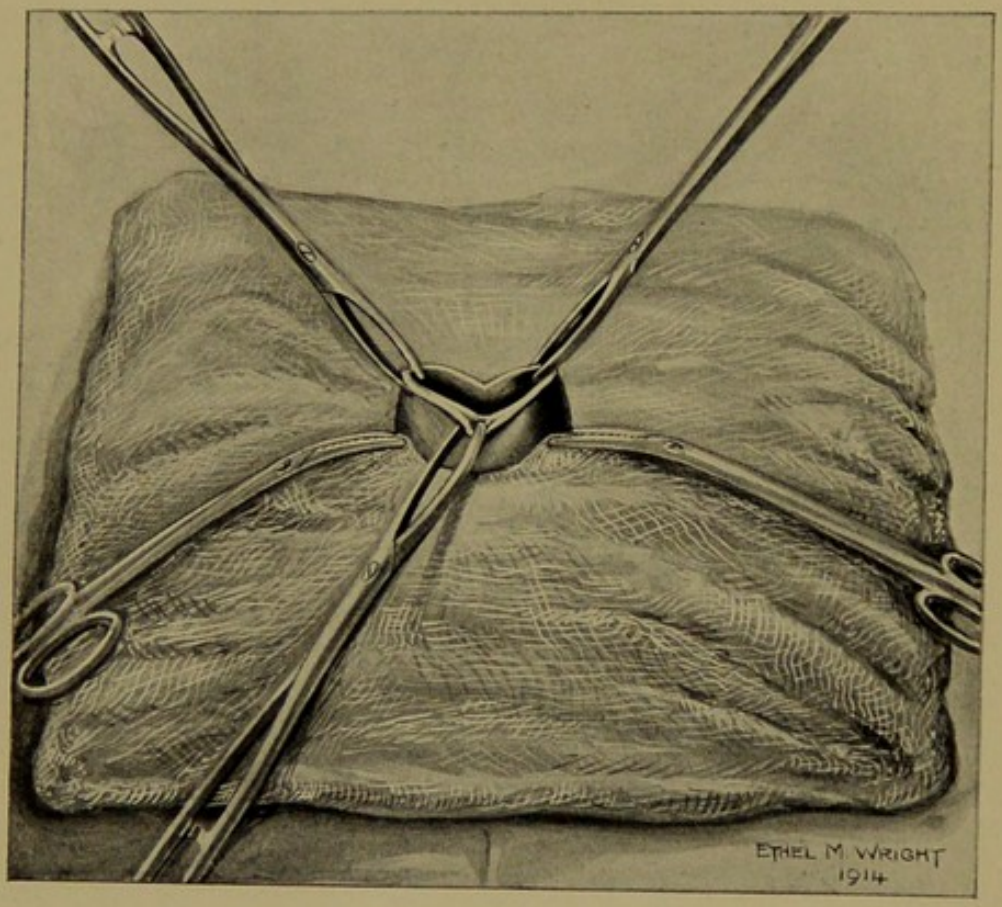

Fig. 306.—Cholecystostomy. Author's method.

until an opening about one-half of an inch or even longer is made. The vulsella which hold the fundus at each side of this incision are now removed and reapplied, so that the edge of the incision is seized. By their means the wound can now be held open, or, when they are crossed over, can be securely closed. Through this opening a large gall-stone scoop is introduced and the stones removed. If there are many stones, it is advisable to remove

only a few at a time; if the scoop be overfull, it is difficult to withdraw from the gall-bladder, and some of the stones may fall away into the swabs and will have to be sought. It will often be found that if many stones are present in the gall-bladder the smaller ones will be near the fundus and one or more larger ones will lie in the pelvis, near to but not occluding the opening into the cystic duct. When all the stones that can be felt

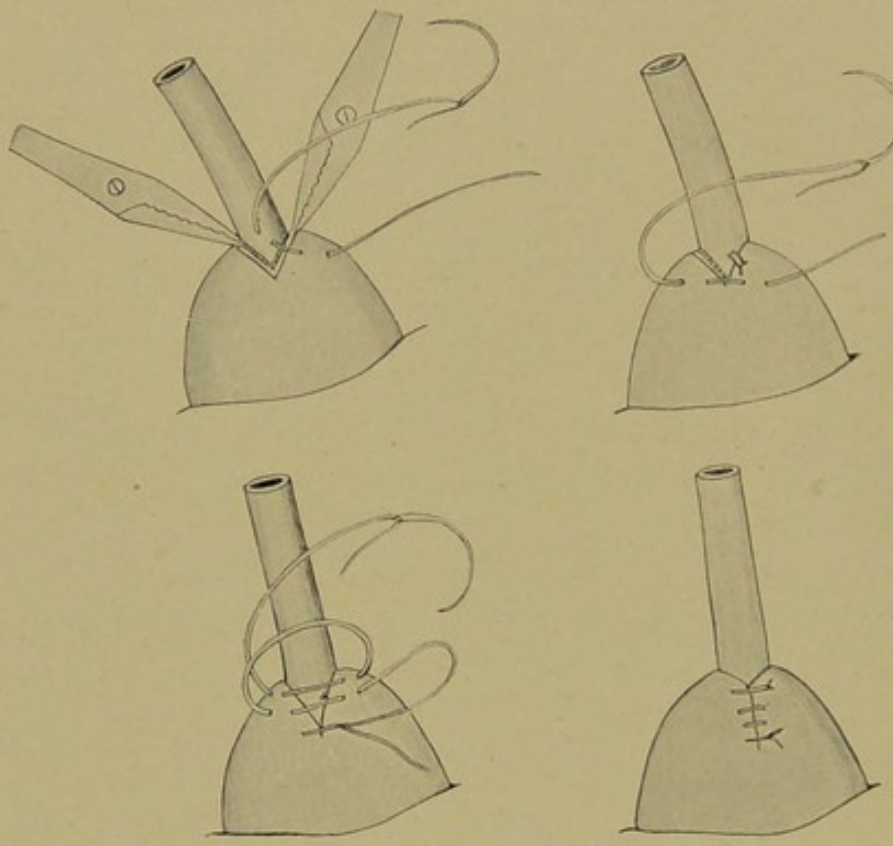

Fig. 307.—Shewing the drainage-tube fixed in the gall-bladder by a single catgut suture, and the method of infolding the edges of the wound in the gall-bladder.

with the scoop are removed, the clips on the edge of the opening are crossed so as to pull the edges together, and the fundus of the gall-bladder is wrapped in gauze. The swabs which lie beneath the bladder are then removed or pushed aside, and while the left hand holds the gall-bladder, the fingers of the right hand are slipped along the under surface and the ducts are again explored. If a stone or stones be felt in the cystic

or hepatic ducts, an attempt is made to "milk" them backwards into the gall-bladder. If any difficulty is experienced with a stone in the pelvis or in the cystic duct, the scoop may be re-introduced, and may be worked within the bladder in concert with the fingers outside. In this fashion a stone which is seemingly imprisoned may be dislodged. A method which I have found useful for the removal of fine "sand" is the introduction of many strips of moist gauze, passing each well down into the

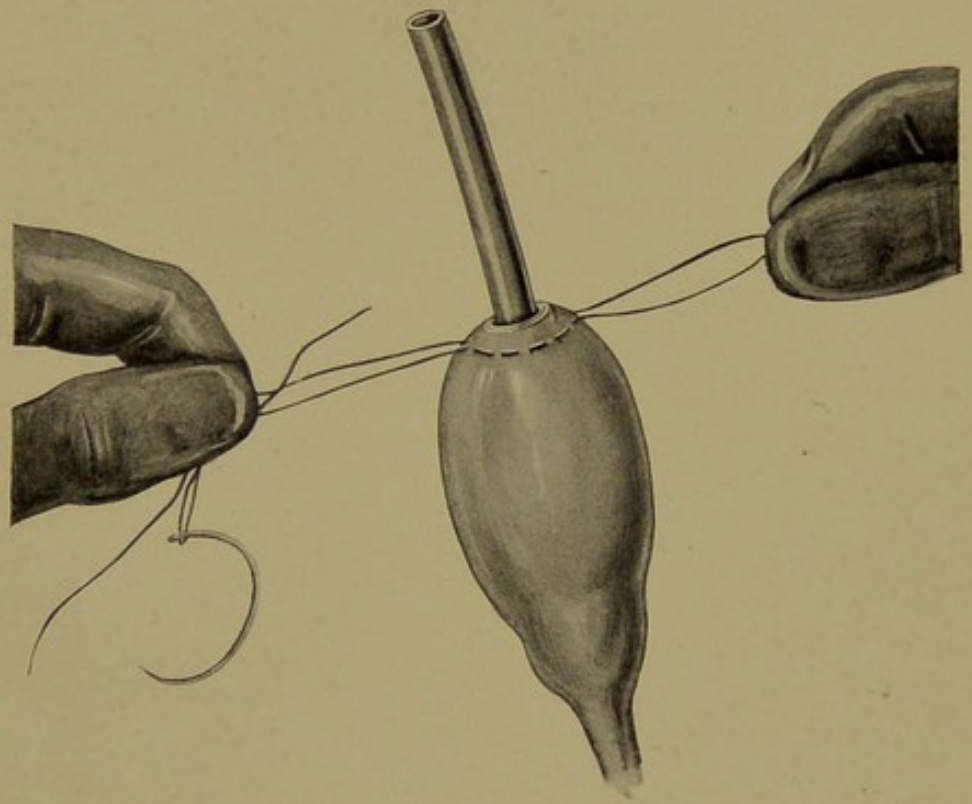

Fig. 308.—Application of purse-string suture round the tube in cholecystostomy (Summer's method).

pelvis of the gall-bladder before withdrawal. A glove-finger worn over the operating glove enables a digital examination of the gall-bladder to be made. This manœuvre renders more accurate information with regard to the presence or absence of small stones than does the scoop. When all the stones are, so far as can be seen, entirely cleared away, a final examination of the duct is again made, and if it is found to be clear, the swabs may be removed from the kidney pouch and from above

the stomach, one swab only being left beneath the centre of the wound. A thick-walled rubber tube is now introduced into the gall-bladder. The size most often used is about one-third of an inch in diameter. About two to three inches are laid within the gall-bladder, so that the end of the tube reaches approximately to the pelvis. The tube is now fixed by a single catgut stitch, which passes, on the one hand, through all the coats of the gall-bladder except the mucosa just beyond the edge of the opening, and, on the other, through the tube. This is tied, and the tube thereby is fixed firmly. The incision and this stitch are now buried in one of three ways: either by taking a purse-string suture around the wound and tightening this, as the tube is pushed deeper into the gall-bladder, as is done in Senn's method of gastrostomy, or a continuous stitch is taken from side to side of the incision, taking all the coats except the mucosa, so that on drawing this tight the edges are infolded as in Kader's method of gastrostomy, or interrupted sutures are passed from side to side, taking all the coats except the mucosa; this is the method now adopted. The stitches in either case are made to embrace the tube closely, so that no leakage can occur by its side. The following method of passing a purse-string stitch, devised by Summers, is the best:

A purse-string suture of No. 00 or No. 1 catgut is passed through all the coats of the gall-bladder about a quarter of an inch below the opening for the tube. A loop is left long when the suture has been passed half-way round the circumference of the gall-bladder, and the suture is then completed. The loop is then held on one side, and the two ends of the suture on the other, by the operator, whilst the assistant presses in the tube and so inverts the cut margins of the gall-bladder; the catgut is pulled tight, bringing the peritoneal surfaces closely into contact with the rubber tube; another purse-string suture is then passed, and a similar manœuvre gone through (Summers: "Jour. Amer. Med. Assoc.," March, 1900). The swab within the abdomen is now removed, and the abdominal wound closed in the

usual manner. The gall-bladder is allowed to fall back within the abdomen and is not fixed to the parietal peritoneum.

The disadvantage of fixing the gall-bladder to the abdominal wound is that, in some instances, a kink may be produced in the common duct by the dragging of the gall-bladder, and an external biliary fistula result. I invariably allow the gall-bladder to drop back into the abdomen in the manner first suggested by Summers.

THE OPERATIVE TREATMENT OF STONE IN THE CYSTIC DUCT.

When a stone is present in the cystic duct, it may be loosely fixed, being contained in a pouch or diverticulum, and interfering very little with the passage of bile and mucus, or it may be tightly wedged in the duct and in this way may cause a condition of hydrops or of empyema, or, in the latest stage, of cysto-intestinal fistula. A stone wedged in the pelvis of the gall-bladder is not to be distinguished from a stone in the cystic duct, for, when it has been long stationary, the gall-bladder may narrow behind it, forming an "hour-glass gall-bladder," the pouch in which the stone is lying then resembling a dilated cystic duct.

When the stone is found in the cystic duct, it may be dealt with, by incision of the duct, cysticotomy, followed by suture of the duct or drainage, or by cholecystectomy, the gall-bladder and cystic duct being removed *en masse*, or by cholecystotomy.

Of the operation of cholelithotrity, whether for stone in the cystic or for stone in the common duct, I have not had, and I do not anticipate that I shall have, any experience. The method seems to me to be one that was only fitted for, perhaps compulsory in, the earliest days of the operative treatment of gall-stones. But at the present time it is never necessary. The disadvantages of the method are that it is likely to damage the duct, and therefore, perhaps, to lead to rupture, ulceration, or stenosis; that it is uncertain,—other stones being overlooked and left untreated,—and that some fragments of the crushed stone may re-

main behind to form the nucleus of other stones. It is, in fact, a crude and imperfect method. The needling of a stone or stones through the duct-wall finds no place in the surgery of today.

Cysticotomy.—The removal of stones from the cystic duct through an incision which is subsequently sutured, or into which a drainage-tube is introduced, is an operation that is occasionally, though very rarely, necessary. The operation was first performed by Lindner in 1891 upon a patient from whom he also removed the gall-bladder. Kehr, in 1892, removed a stone from the duct and closed the opening by suture, draining the gall-bladder.

The neck of the gall-bladder and the cystic duct are exposed by the method of rotation of the liver already described. When the duct is exposed it is incised, the stone or stones removed, and a further exploration of the duct made at once. If the bile-passages are found to be clear, the wound may be closed by a continuous catgut suture which misses the mucosa. This will close the incision satisfactorily, but a second supporting layer of sutures, either of catgut or preferably of thin celluloid thread, should also be introduced. A drain is then placed in the gall-bladder and the abdominal wound is closed in the usual way.

When the stone is tightly wedged in the duct and hydrops or empyema has resulted, the operation to be practised will depend very much upon the general condition of the patient and upon the especial conditions found when the field of operation is exposed. As a rule, cholecystectomy should be performed. It is the operation I perform as the routine procedure, in the absence of special circumstances which would add an undue risk to its performance. I have removed the gall-bladder and the cystic duct upon several occasions for these conditions, and the results have been remarkably good.

If, however, the condition of the patient is poor and her power of bearing any operation is but small, or if the gall-bladder be adherent or the mechanical difficulties of the operation,

owing to thickness of the abdominal walls, be considerable, cholecystotomy should be performed.

It will be found helpful, then, to aspirate the contents of the distended gall-bladder very slowly. If the fluid is quickly withdrawn, the gall-bladder contracts rapidly on to the stone and forms a tight constriction on the distal side of it. If, however, the fluid be withdrawn slowly and the operator keeps his fingers on the stone, he may be able to squeeze the stone backwards into the gall-bladder, which is still moderately distended with fluid. The gall-bladder should never be emptied until a very thorough attempt at displacing the stone has been made. This little manœuvre is one the use of which I have experienced. The reason for its success is easy to understand. The fact that the stone has been displaced, and that, therefore, the cystic duct is clear, will be appreciated when bile is seen to flow from the gall-bladder. After dislodging the stone the gall-bladder may be drained as in the ordinary method of cholecystotomy or it may be removed.

If it is found impossible, after persistent efforts, to dislodge the stone the operation of cysticotomy is performed, or preferably cholecystectomy. If the wall of the cystic duct has been damaged by the pressure of a fixed stone, or fretted by the movements of one loosely held, a stricture at the point of injury is very likely to develope. Such a stricture causes symptoms closely resembling those produced by a stone. In such case removal of the gall-bladder and the cystic duct is essential.

Treatment of Biliary Fistulæ.—If, in operating upon a patient for gall-stone disease, a fistula be found between any part of the intestinal canal, on the one hand, and the gall-bladder and cystic duct, on the other, the adherent and communicating viscera should be separated. This must be done with great gentleness, so that no unnecessary damage is done to the stomach or intestine. When a complete separation has been made, the opening into the intestine must be trimmed and its closure securely effected by suture. As a rule, a continuous suture of cat-

gut, embracing all the coats of the gut, and outside this a continuous suture of fine Pagenstecher thread, will prove the most satisfactory method of closure. The opening in the gall-bladder or in the cystic duct may be closed by suture; it may be drained or, preferably, the gall-bladder and the cystic duct together may be removed, as in the cases under my own care to which reference has already been made.

CHOLECYSTECTOMY.

Indications for the Performance of Cholecystectomy.—In 1902 I read a paper, entitled "A Series of Cases of Cholecystectomy," before the Yorkshire Branch of the British Medical Association. I gave then the following indications for the performance of this operation:

1. In injuries of the gall-bladder, rupture, stab or bullet wounds.
2. In gangrene of the gall-bladder.
3. In phlegmonous cholecystitis.
4. In membranous cholecystitis.
5. In chronic cholecystitis with dense thickening of the walls of the gall-bladder and cystic duct, with or without stenosis of the cystic duct, and in chronic cholecystitis, when the gall-bladder is shrivelled and puckered and universally adherent. In such cases it is no longer a receptacle for the bile.
6. In distension of the gall-bladder, hydrops or empyema, due to blockage of the cystic duct by calculus, stricture, growth, or external inflammatory deposits; or in cases of mucous fistula following operations for these conditions.
7. In cases of fistula between the gall-bladder or the cystic duct, on the one hand, and the stomach, duodenum, or colon, on the other.
8. In multiple ulcerations of the gall-bladder or the cystic duct, when gall-stones have eroded their way through the walls into the liver, the duodenum, or other protective adherent masses.
9. In primary carcinoma of the gall-bladder.
10. In the condition known as "strawberry gall-bladder" (see "Annals of Surgery," 1909, ii, 1265).

Speaking broadly, it may be said that, in cases of an inflammatory character, if the cystic duct is blocked or is so damaged by a stone as to be likely to have a stricture developed therein, the gall-bladder should be removed; if bile can pass through the duct into the gall-bladder, cholecystotomy may be safely performed.

The result of my early cases was so satisfactory that I was led to put the operation to a more extended proof, and, as my experience increases, I am tempted to ask whether it would not be the better treatment in many gall-stone operations to remove the gall-bladder entirely.

The experience of every surgeon who has worked extensively in this field of surgery is that the chief purpose and the main indication in any operation for gall-stones is the drainage of the gall-bladder and bile-ducts. Of the validity of this experience there can be no question. We know that gall-stones are rendered troublesome by the cholecystitis or the cholangitis which they are the means of arousing. In many cases it is because of the inflammatory consequences that an operation is demanded. The essential part of any operation would, therefore, seem to be the drainage of the gall-bladder, prolonged for such a time as to allow a complete subsidence of the inflammatory process. But in the very great majority of cases the secondary inflammation has its origin, and runs its course, entirely within the gall-bladder; an infection of the hepatic or common ducts does not occur. In many cases, therefore, in removing the gall-bladder, we are doing away with the necessity for drainage by removing that structure the drainage of which seemed imperative.

It is within the gall-bladder that the great majority of stones are formed; it is within the gall-bladder that the secondary inflammatory troubles break out, and are, in the majority of cases, altogether limited. The removal of the gall-bladder, therefore, does away with the need for drainage. It renders less likely the inflammatory consequences of their

presence. If, however, the need for drainage is absolute, it is possible—in fact, quite easy—to drain the ducts after the gall-bladder has been removed. After the division of the cystic duct the stump of the duct may be slit up until the hepatic duct is reached, or the cystic duct may be cut off flush with the common duct. It is then quite a simple matter to explore upwards and downwards with a gall-stone scoop or with the finger to make certain that the ducts are clear of calculi, and then to stitch in, by a single catgut suture, a rubber drainage-tube. The presence of stones in the common duct does not debar one from removing the gall-bladder. The plea, therefore, that the need for drainage is opposed to the routine removal of the gall-bladder is answered by the facts that when the gall-bladder is removed, the need for drainage does not often exist, as that need was due to the presence of the gall-bladder, and that, if desirable or necessary, it can be carried out without the smallest difficulty.

An examination into the recorded cases of carcinoma of the gall-bladder and of the adjacent portions of the liver shews that in approximately 95 per cent. the malignant change is due to the chronic irritation of gall-stones. If the gall-bladder is removed there will, of course, be no chance of this malignant growth occurring. This is not, however, a point of much importance, for the cases of carcinoma are, as a rule, those in which no operation has been done; by the time the surgeon sees the cases the growth is already there. To make the argument for cholecystectomy a strong one, from this point of view, it would be necessary to shew that malignant disease occurred after cholecystotomy, and, so far as I know, this had not been done at the time my paper, already referred to, was written. Since then, however, my colleague, Mr. Lawford Knaggs, has recorded an exemplary instance of this. The case is given at length in the chapter dealing with the General Pathology of Gall-stone Disease in my book on "Gall-Stones and Their Surgical Treatment." A similar instance is recorded by Mr. Mayo

Robson. The patient was a lady, aged fifty-seven, upon whom cholecystotomy was performed in February, 1902. A good recovery followed, and the patient remained well up to August, 1903, except for pain in the gall-bladder. On examination a tender lump could be felt in the gall-bladder region. On opening the abdomen a second time, in October, 1903, the gall-bladder was found the size of a small hen's egg, full of solid material. On incising it the swelling was found to be new-growth which was infiltrating contiguous parts of the liver. The gall-bladder and adjoining part of the liver were removed successfully. Cases such as these strengthen materially the plea for cholecystectomy. In several recent cases of my own, gall-bladders which were supposed to be affected only with chronic inflammation have proved, on microscopic examination, to be the seat of early malignant changes. In two cases upon which I performed cholecystostomy malignant disease of the gall-bladder developed four and seven and one-half years subsequently, without recurrence of stones.

For a further discussion on the relationship of gall-stones to cancer of the gall-bladder see the "Lancet," 1905, vol. i, pp. 1059 and 1227.

In the very great majority of operations for gall-stones there is ample evidence of long-standing inflammation in and about the gall-bladder. Often normal smoothness of the gall-bladder is gone, its deep blue colour is lost, its once supple walls have become thickened and tough, owing either to the presence of stones or of a chronic inflammation aroused previously by them. On the other hand, it must not be assumed that because a gall-bladder is blue it is healthy. Such a gall-bladder, although appearing normal to the eye, may contain stones which have not been present a sufficient length of time to give the usual opaque, grey, or yellow colour of the chronically inflamed gall-bladder.

In some cases, therefore, it will be conceded that cholecystectomy is the more desirable operation, but before its routine adoption is advocated it is necessary to shew that the gall-bladder

is useless, and that its removal does not add any risk as compared with cholecystotomy. In the abstract one might be inclined to think that the loss of a bile reservoir capable of emptying on demand would be a serious matter to the individual, or, at the least, a disability. The perfection of the mechanism of digestion, so graphically told by Pawlow, would seem to require that bile should be ejected in spurts, as it were, into the duodenum during digestion. But there is clinical experience in abundance to shew that when all the bile is discharged from the body through an external biliary fistula, without a drop entering the intestine, the individual suffers no sign of disability of any kind. The increased secretion of bile still occurs during duodenal digestion, even though there is no outpouring of bile from the gall-bladder. There is abundant evidence, also, furnished by my own cases and by many others, to shew that the removal of the gall-bladder does not interfere with digestion; that the individual eats well, gains in weight, and to all appearance has the same duodenal digestion as an ordinary healthy individual.

The removal of the gall-bladder in cases judiciously selected does certainly not involve a greater risk than the operation of cholecystotomy. I have, in fact, in several cases, been convinced that the removal of the gall-bladder made the operation simpler and shorter than it would have been if a multitude of small stones had been removed. By carrying out the operation in the manner described below it will be found a safe, speedy, and simple procedure. During the last eight years I have inclined more and more to the performance of cholecystectomy, and after some hesitation and some trepidation, which experience has removed, I am strongly disposed to advocate the frequent, though certainly not the invariable, adoption of this operation in preference to cholecystotomy in view of the character of the cases that submit themselves to surgical treatment. Its advantages are that the operation removes the chief source of the disease; that it thereby prevents, in great measure, a recurrence either of stones or of the inflammation which betokens their

presence; and that growths in the gall-bladder or adhesions around it are subsequently impossible. The gall-bladder is devoid of any strikingly useful purpose, and its removal does not add appreciably to the danger of the operation. If drainage of the ducts is necessary, it can be carried out quite satisfactorily. The presence of a stone in the common duct does not prohibit the operation, but drainage of the duct, after removal of the stone in the duct or in the ampulla, is necessary.

The one disadvantage that may justly be urged against cholecystectomy is this: that if a late operation should become necessary,—for stones can, and do, form in the hepatic and common ducts,—such an operation would be more difficult and almost certainly more dangerous. The possibility of a further operation being necessary cannot be denied, but the likelihood of it is negligible.

I am bound to say that from time to time I have wavered in my views as to whether cholecystostomy or cholecystectomy is the better procedure. Probably surgeons who differ in their ideals are supplied with different material upon which to work. If cases of cholelithiasis were handed over to the surgeon, the only person who can do them any real good, at an early stage of their disease, before the walls of the gall-bladder were seriously damaged, then the removal of the stones and drainage of the gall-bladder would give a perfect restoration of function to the parts. But unhappily, in a very large proportion of the cases, the disease has made great strides, the gall-bladder walls are thickened, opaque, white, and often sclerosed, and the patency of the cystic duct is impaired. In such cases cholecystotomy may give relief for a time, but troubles are apt to recur and result in the disappointment of the patient and of his surgeon, who is compelled to advise a further operation.

The crusade of the surgeon should be directed to the insistence upon a recognition of those early symptoms and signs which his investigations have shewn to be characteristic of gall-stone disease, so that early operation with speedy recovery and perma-

nent restoration of the normal health may be carried through with safety ("Brit. Med. Jour.," 1913, i, 8).

Briefly, we may say that if the functions of the gall-bladder as a receptacle for bile which it is capable of expressing through a patent cystic duct can be restored, the gall-bladder should be allowed to remain. If, however, the walls of the gall-bladder are so much altered by a thick inflammatory deposit that its capacity is much reduced, and if the musculature is so grossly impaired that rhythmical expulsion of the contents is no longer possible, and if, finally and chiefly, the lumen of the duct is narrowed so that obstruction is offered to the onward passage of the contents, then the gall-bladder is no longer of use,—is, indeed, probably a menace to the health and life of the patients, and should be removed.

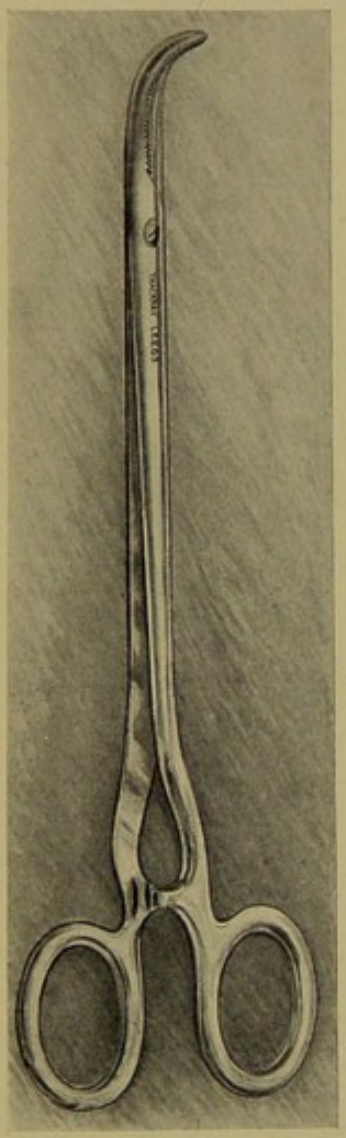

Fig. 309.—Cholecystectomy forceps. Author's pattern.

Surgeons of the largest experience will from time to time make mistakes—will remove a gall-bladder that would perhaps have been better left; or will leave a gall-bladder that should have been excised. If a mistake is to be made, it is better to leave a gall-bladder that some one may later take away, than to remove one which no one can replace.

The Operation.—Cholecystectomy was first performed by Langenbuch on July 15, 1882.

The operation is performed in the following manner: Mayo Robson's incision is made, the abdomen opened, the adhesions separated, and the liver rotated in the manner already described. The gall-bladder may be removed from before backwards or

from behind forwards; that is to say, the cystic artery and duct may be first cut across and the gall-bladder stripped up towards the fundus, or the peritoneum around the fundus may

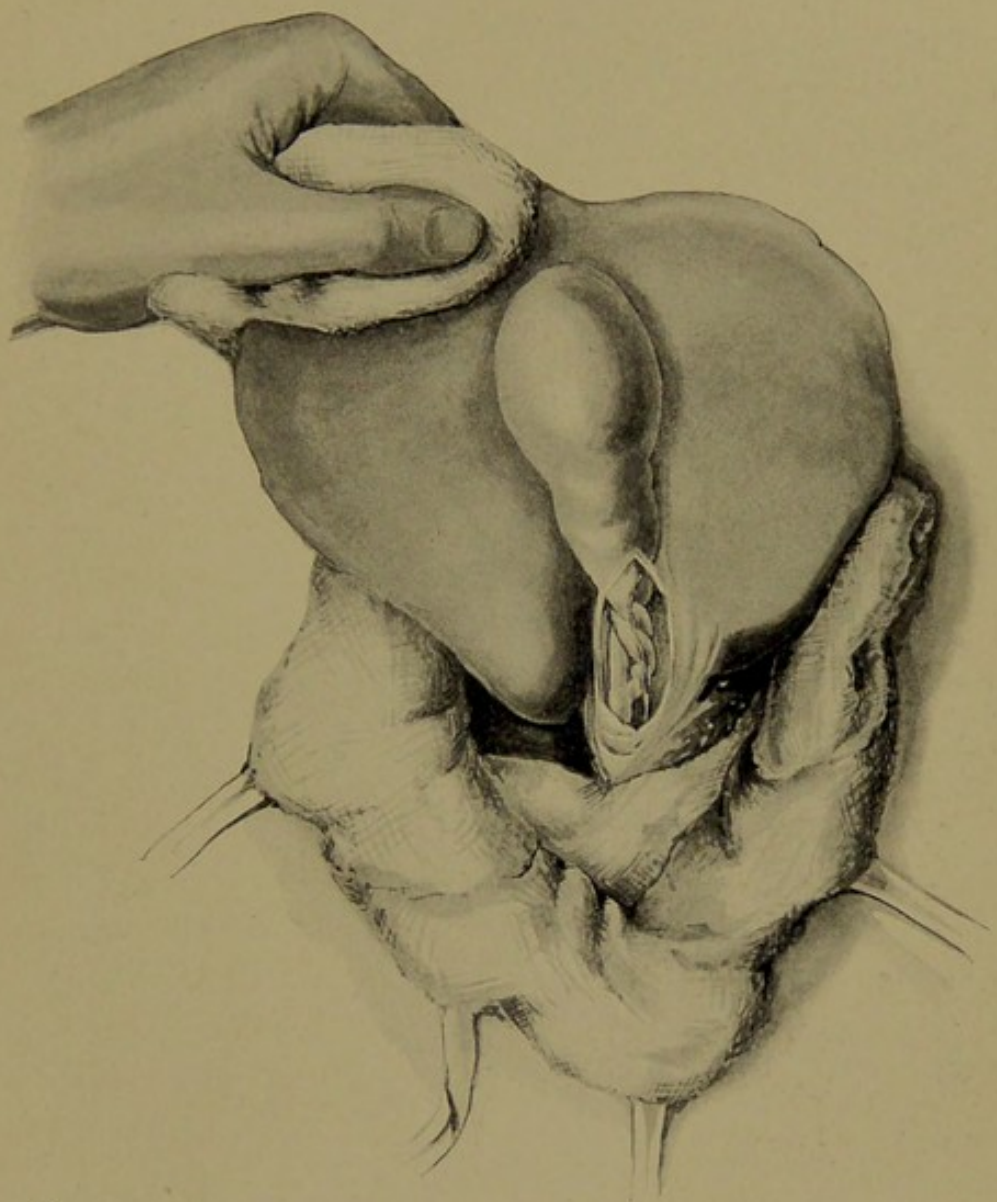

Fig. 310.—Cholecystectomy. The liver is rotated so that the gall-bladder lies outside the abdominal wound. The cystic duct and artery are seen. The wound is packed off with swabs; these are not shewn in the subsequent drawings.

be first divided and the gall-bladder stripped up towards the cystic duct. I have adopted both methods, but prefer the former, as the only difficult part of the operation—the ligation of the pedicle—is accomplished first; in the latter the blood

trickling down from the denuded area of the liver may obscure the view.

The liver being held upwards, the cystic duct and its termination in the common duct are defined. A circular peritoneal incision is now made around the cystic duct, about half an inch from its termination, and a peritoneal cuff is stripped up towards the common duct. In this way the cystic duct is

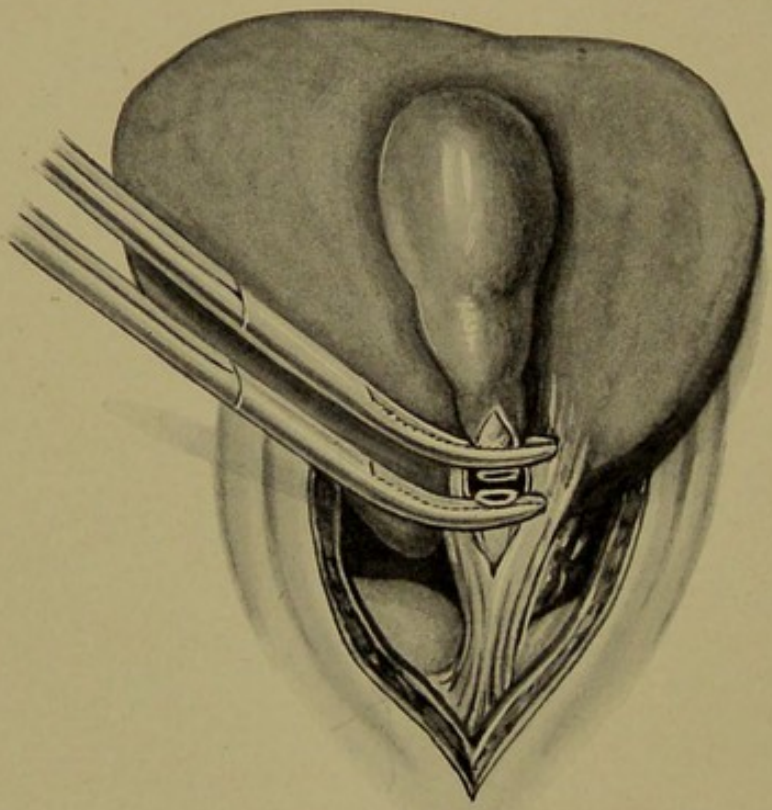

Fig. 311.—Cholecystectomy. The cystic duct is clamped between two pairs of Moynihan's forceps and divided; each mucous surface is touched with pure carbolic acid.

cleared to the view. Two clips with curved beaks are now placed on the cystic duct, and the duct is divided between them. The clip on the gall-bladder side prevents any leakage during the further steps of the operation. The stump of the cystic duct is ligated with catgut, and the clip on its divided end is removed. The frayed end of the duct is trimmed away with scissors and either touched with the cautery or treated with a

drop of pure carbolic acid. The cystic artery and vein are now defined. They lie above and to the inner side of the divided duct, and may be readily seen by gently stripping with gauze that part of the pedicle which remains. Two clips are applied and the vessels are divided between them. The proximal ends of the vessels are now ligated with catgut, and the clip which secures them is removed. Occasionally, another vessel than the

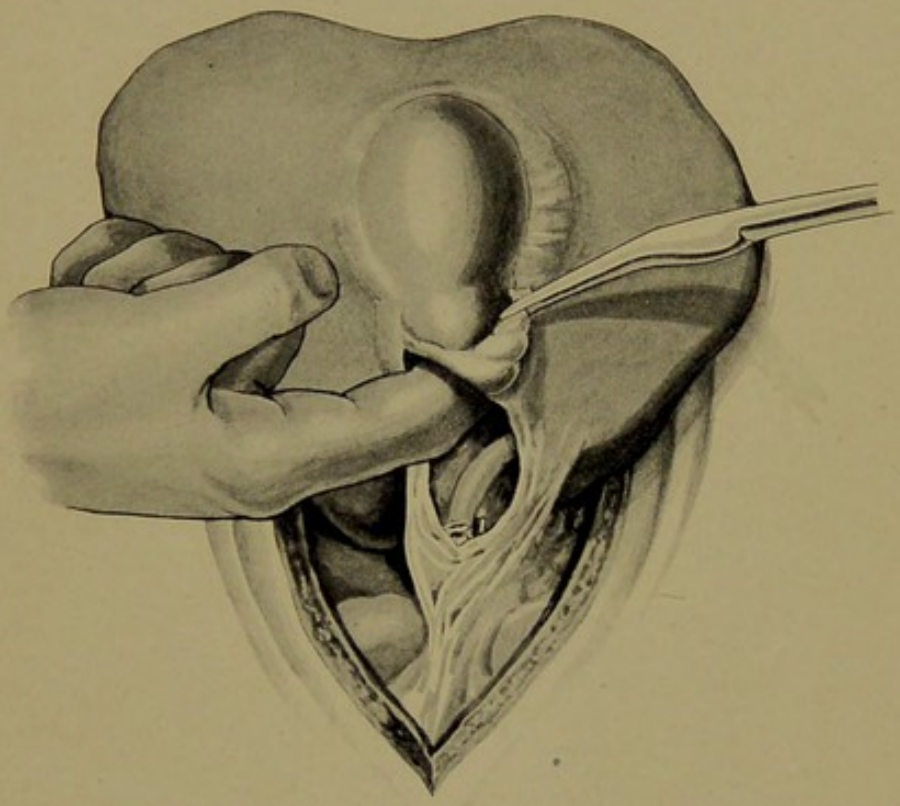

Fig. 312.—Cholecystectomy. The cystic duct and artery are tied, the former as close as possible to its termination. The gall-bladder is being stripped up from the liver. The cut end of the cystic duct is closed by forceps.

cystic artery, an "accessory cystic artery," may need to be clipped and ligated; it is a separate branch of the hepatic which passes to the common and cystic ducts. If there is no inflammation of the common duct, and if, therefore, there is no need for drainage, the stump of the cystic duct may be covered completely by its peritoneal cuff, which is fixed over it by one or two sutures of fine Pagenstecher thread. Always, however, I make it my prac-

tice to pass a split-rubber drainage-tube down to the site of the cystic duct, fixing it in position in the following way. When the ligature has been tied on the duct, the ends are left long and are passed through the rubber drainage-tube by means of a needle threaded first on one end of the ligature then on the other; by this method the tube can be fixed in position after the gall-bladder has been removed. Before the insertion of the drainage-tube

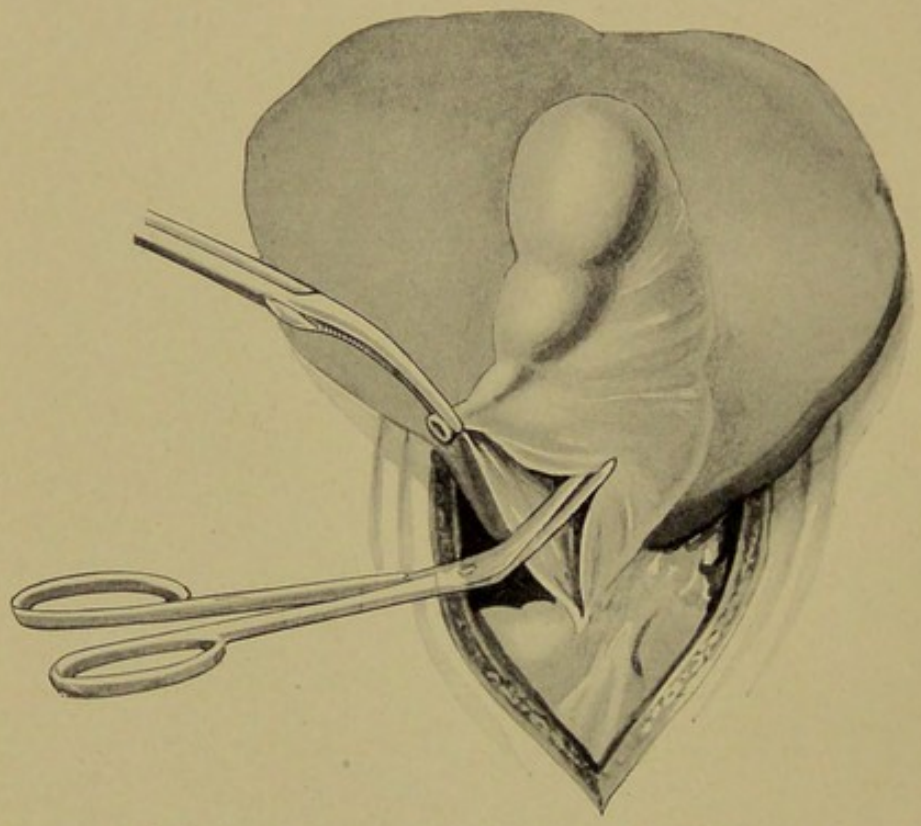

Fig. 313.—Cholecystectomy. The peritoneum is being divided between the gall-bladder, which is partly stripped, and the liver.

a small flat swab is placed over the common duct, and the separation of the gall-bladder from its fossa is begun. This is most easily and expeditiously effected by working upwards towards the fundus with the index-finger, which is insinuated at first between the pelvis of the gall-bladder and the liver. The finger may be covered with gauze, so as to make the separation easier. A little patience will soon secure that the gall-bladder is stripped cleanly away and is left attached only by a peritoneal fold around

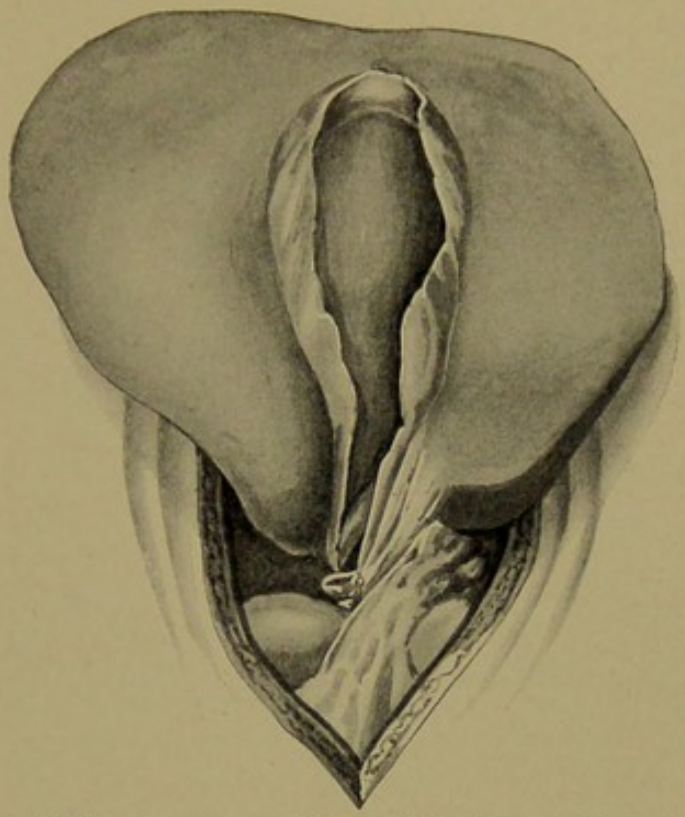

Fig. 314.—Cholecystectomy. The gall-bladder and cystic duct have been removed. The peritoneum, stripped from the sides of the gall-bladder, remains.

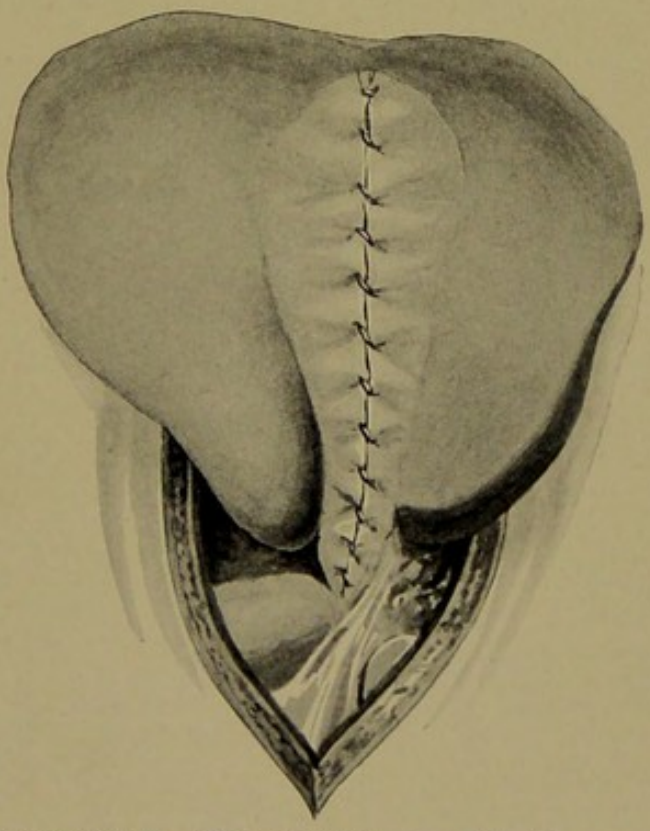

Fig. 315.—Cholecystectomy. The operation completed by suture of the peritoneum over the bared surface of the liver.

it. This fold is then divided about one-half to three-fourths of an inch away from the liver, and the gall-bladder then comes away. A raw surface fringed by a collar of loosely hanging peritoneum is now left. From this raw surface there may be some oozing. This is checked by the pressure of a swab wrung out of hot sterile salt solution. Rarely a suture may be necessary if any vessel bleeds. This is passed with a curved intes-

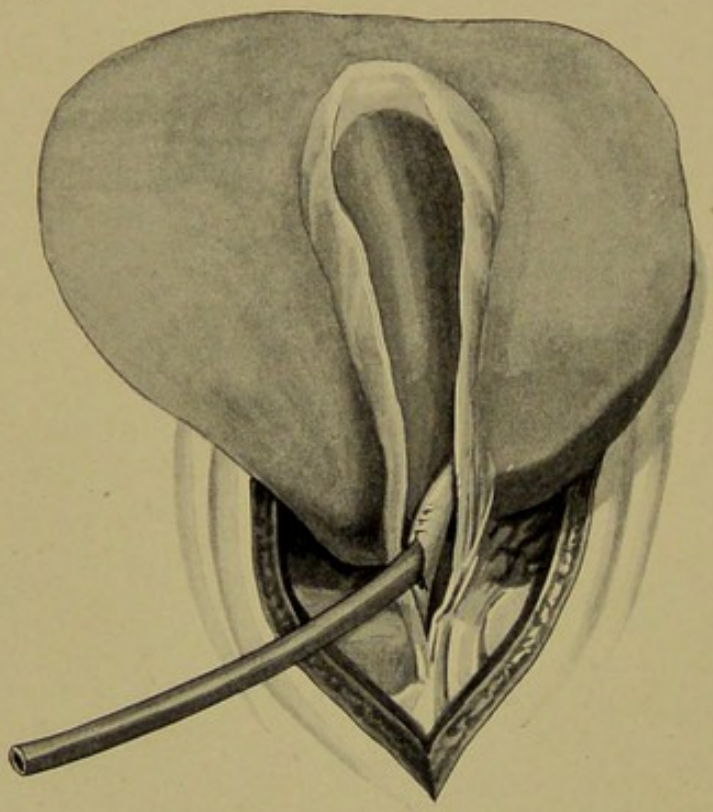

Fig. 316.—Cholecystectomy. Drainage of the hepatic duct, which, for purposes of illustration, is shewn pulled forward from its normal position.

tinal needle and tied gently. When all the oozing has stopped, the peritoneum around the denuded surface is closed over it by a continuous suture of catgut which passes from the liver-edge to the cystic duct. A final cleansing of the operative area is carried out, the drainage-tube is passed, in the manner indicated, down to the stump of the cystic duct and the abdomen may then be closed.

If, however, drainage of the common duct is necessary, the

cystic duct is not ligated in the manner described. When that stage in the operation is reached, the clip is removed from the stump of the cystic duct, and the cut edges are seized with fine French vulsella. The duct is reached, and an opening is made into this, at its junction with the hepatic duct, of sufficient size to permit of the introduction of a rubber tube. This is fixed in the duct by a suture of catgut which picks up the wall of the common duct a little distance away from the cut edge. To the outer side of this tube a second one is placed, being split and having a gauze wick into the kidney pouch. This second tube may come through the abdominal wound or be made to project from a stab wound in the loin—preferably the former.

During the operation of cholecystectomy great care must be exercised to see that the duct is divided close to its junction with the common bile-duct. In some cases where there is a broad sessile attachment of the gall-bladder to the common duct the latter, or the common hepatic duct, may be wounded unless the parts are thoroughly cleared and exposed to view before the duct is clamped or divided. I have wounded the common duct or the hepatic duct in three cases; the following are the notes.

CASE 1.—*Wounding of the Right Hepatic Duct.*—Operation. Kocher's incision. On opening the abdomen the gall-bladder, which was small, was seen to have an hour-glass narrowing in its middle, there being one stone in the distal compartment and several smaller ones in the proximal. The fundus was somewhat inflamed, and had an adhesion fixing it to the omentum. After division and ligation of this adhesion and digital examination of the common duct the cystic duct was defined, clamped, and divided, the stump being then cauterised and ligatured. In the subsequent dissection to isolate the cystic artery, a structure was exposed at the base of the gall-bladder, which was thought to be a vein. This structure was clamped and divided. Whilst tying, the ligature broke and the clip had to be reapplied; the whole mass originally held in the clip was not picked up, however. The cystic artery was then defined and ligatured. In stripping back the neck of the gall-bladder the large right branch of the

portal vein was exposed as it lay in the portal sulcus; it was somewhat distorted owing to an adhesion to the neck of the gall-bladder. After cholecystectomy was completed a slight escape of bile was observed coming from the region of the cystic artery stump. This escape was not from the cystic stump, which was securely ligatured, but flowed from a duct which had been wounded obliquely near the cystic artery. Some time was spent in endeavouring to secure the opening, but the attempt was abandoned eventually as the amount of bile was inconsiderable, and the opening in the duct was slit-like. The duct wounded was the

Fig. 317.—Wound of the right hepatic and common hepatic duct during the operation of cholecystectomy.

Fig. 318.—Wound of the hepatic duct during the operation of cholecystectomy.

right hepatic, which had been distorted in a similar fashion to the right branch of the portal vein. This duct was probably partially included in the ligature which broke.

A split-rubber drainage-tube was stitched down to the stump of the cystic duct, and surrounding this a larger tube was passed so as to drain the right kidney pouch. The wound was then closed.

CASE 2.—*Wounding of the Common Hepatic Duct.*—Operation. Mayo Robson's oblique incision. On opening the abdomen the

gall-bladder was found to contain many large stones. It was fixed by numerous adhesions to the duodenum and omentum. These adhesions were ligated and divided. Several large stones of a similar size to those felt in the gall-bladder were present in the common duct, and one was in the ampulla of Vater, which latter was displaced by digital manipulation up to the common duct. Cholecystectomy was now performed; the gall-bladder being first freed from the liver and stuffed downwards. The cystic artery was clamped, divided, and ligated. In making the division of the cystic duct, a piece of the anterior wall of the common hepatic duct was taken away, it having been adherent to the posterior aspect of the cystic duct. Six large stones were removed from the common duct, and the wound in the hepatic duct was closed with some difficulty by interrupted catgut sutures. A drainage-tube was passed into the common duct through the cystic duct stump and below the line of suture. A large split-rubber drain was passed down to the kidney pouch, whilst a piece of rubber tissue was tucked round the two tubes so as to shut off the operation area as completely as possible.

Fig. 319.—Wound of the common duct and of the common hepatic duct.

CASE 3.—*Wounding of the Common Hepatic Duct and of the Common Duct.*—Operation. Mayo Robson's incision. On opening the abdomen the gall-bladder was found to be buried beneath a mass of adhesions, which were separated with difficulty, many bleeding points having to be ligated. The gall-bladder was atrophic and contained many stones; a large stone lay in the cystic duct, which was markedly dilated. The junction of the cystic duct with the common hepatic duct was exposed, and the cystic duct clipped, cut across, and cauterised. The gall-bladder was then dissected upwards from the liver and removed.

On examining the region of the cystic duct it was found that there were three openings—the true cystic stump, which was held in the clip; above this, the common hepatic duct was cut into near its termination; whilst below, the commencement of the

common duct was wounded. Examination of the specimen shewed a portion of the common duct and of the common hepatic duct adherent to the gall-bladder.

The common hepatic duct was sutured and a tube tied into the common duct below the line of suture. A drainage-tube was placed down to the kidney pouch and the abdomen closed.

All three cases recovered.

LUMBAR CHOLECYSTOTOMY OR CHOLECYSTECTOMY.

In a certain small proportion of cases the opening or the removal of the gall-bladder in the loin may be deemed necessary, as, for example, when a mistaken diagnosis of renal tumour has been made and the gall-bladder has been exposed. W. P. Manton ("Amer. Med.," Oct. 4, 1902) describes a case of extirpation of the gall-bladder through a lumbar incision. The diagnosis in this case was nephroptosis with probable cystic metamorphosis of the kidney. When the kidney was brought out of the lumbar wound, the gall-bladder containing a number of stones could be easily palpated, and was so thoroughly shut off from the general peritoneal cavity, either by adhesions or because of its anomalous situation, that the operator was able to remove it, with the cystic duct, without much difficulty. The gall-bladder and the cystic duct contained nineteen stones.

Cholecystotomy Performed upon the Left Side.—Carl Beck ("Annals of Surgery," vol. xxix, p. 593) records a case of cholecystotomy in which, owing to transposition of the viscera, the liver lay in the left side of the abdomen, and the incision had, therefore, to be made through the left rectus muscle.

THE SURGERY OF THE HEPATIC DUCT.

When calculi are arrested in the hepatic duct, they may be removed through incisions made into the gall-bladder, into the common duct, or, rarely, into the hepatic duct itself. In the very great majority of instances stones which are felt in the hepatic ducts can be milked downwards and removed during cholecystotomy or during choledochotomy. In very exceptional

instances, however, the performance of hepaticotomy—that is, incision of the hepatic duct—may be necessary.

Hepaticotomy.—The operation was first performed by Kocher on November 8, 1889, unintentionally and unknowingly. In the hepatic duct, which was closely adherent to the gall-bladder, a stone was tightly wedged. The duct was opened and the stone was removed. Shortly afterwards the abdomen was re-opened, as symptoms of peritonitis were present. Bile was found in the general peritoneal cavity. The patient died.

Other operations were performed by Cabot (1892), Elliot (1894), Czerny (two cases), Kehr, and recently Delagénière and Rogers. Cabot's case was one in which many calculi were removed from the gall-bladder. A large stone was then felt in the hepatic duct, deep under the liver. The duct was opened with very great difficulty and the stone extracted. The duct and the gall-bladder were drained, and the patient recovered.

Elliot ("Annals of Surgery," vol. xxii, p. 86) gives the following account of his case:

"On September 4 I opened the abdomen by an incision in the upper right linea semilunaris. The gall-bladder was found empty and flaccid; the ducts were palpated, and a stone was felt deep under the liver in the hepatic duct. The stone could not be pushed along the duct nor crushed with the fingers. No other stone was felt in the common or cystic duct. After separating numerous adhesions the stone was seized between the thumb and forefinger of the left hand and pulled up from its deep position. Adhesions and duodenum were pushed aside until the stone appeared between the fingers with only the peritoneum and the wall of the duct covering it. The field of operation was packed with gauze to prevent contamination with bile; the duct was incised, and a stone the size of a robin's egg extracted. The duct was closed at once with catgut sutures, a second row of silk sutures, including the peritoneum, being placed outside. The duct was held with the fingers, and very little bile escaped. A drainage-tube and gauze were packed down to the sutured duct. A rapid and complete recovery followed. The duct did not leak, and on the second day the gauze drain

was removed. On the fourth day the abdominal wound was completely closed by provisional sutures. The jaundice had partially disappeared, and the stools were natural in colour. The patient was well in three weeks. Eight months after operation he was known to be in perfect health."

In Czerny's case and in one of Kehr's the duct was ruptured during the manipulations attendant upon the removal of stones, and the wound was closed by sutures. An interesting case of hepaticotomy is related by Leonard Rogers.

The following are two cases amongst many hepaticotomies which I have performed:

CASE 1.—*Cholecystotomy; hepaticotomy; recovery.*—E. F., female, aged forty-six. The patient was admitted complaining of attacks of pain in the right side and jaundice. She has had many attacks of pain, attended by nausea, retching, vomiting, and sometimes by collapse and profuse sweating, followed always by jaundice. The first attack was four years ago, and then attacks came about every six months up to the last few weeks, when there have been several. During the last month she has had several rigors, with high temperature, vomiting, and diarrhœa. Pain in the right side has been acute, and tenderness is exquisite. The liver is enlarged. A diagnosis of stone in the common bile-duct was made.

Operation June 17, 1905. Mayo Robson's incision. Gall-bladder found full of stones; 32 were removed. The ducts were then explored, a great many adhesions having first to be separated. The common bile-duct was clear, but in the hepatic duct a large stone was felt. A persistent effort to dislodge this failed, and an incision was then made directly over the stone, which was removed. It was about the size of a Barcelona-nut. A scoop was passed upwards in the hepatic duct, and 5 more smaller stones were removed. The finger was then readily introduced into the duct and passed both upwards and downwards but no calculi were felt. A tube was stitched in the hepatic duct, and a second tube in the gall-bladder. The patient went on well for about ten days. Then the jaundice which had lessened began again to increase; a rigor followed, and on the next day a small stone was expelled through the wound. From this time the

progress was rapid and satisfactory and the patient returned home on July 18th with the wound healed.

CASE 2.—*Cholecystotomy; hepaticotomy.*—M. T., female, aged sixty. Fourteen years ago she had a severe illness, lasting some weeks, which she believes was typhoid. During this illness she had a tender swelling in the right hypochondrium and she also became jaundiced. The jaundice subsequently disappeared and, with this exception, she has never suffered from any abdominal complaint until four months ago. At that time she had an attack of severe abdominal pain of a colicky nature, most intense to the right of the epigastrium. The onset was accompanied by shivering; then there occurred vomiting, and she became jaundiced. A similar attack occurred at the beginning of this year (two months ago), another three weeks ago, and a third attack came on soon after her arrival at the Nursing Home. The attacks are preceded by a feeling of tightness and stiffness over the lower ribs on the right side. The jaundice lessens in degree between the attacks only to deepen again after the onset of pain. On examination, a markedly jaundiced woman, presenting an indefinite tender swelling projecting from the right costal margin. There is some rigidity of the upper segment of the right rectus; stools pale-coloured; urine contains a small amount of albumen and a trace of bile pigment; the temperature chart was of the characteristic "steeple" form. Two days after admission the temperature and pulse had fallen to normal, and on the fourth day the swelling and rigidity in the hypochondrium had almost gone, while the jaundice was less, and the motions were coloured with bile.

Operation February 21st. Robson's incision. The gall-bladder was found to be thickened and packed with stones which also extended along the cystic duct. The gall-bladder was opened and numerous stones removed, the majority being facetted, about half an inch in diameter, but 2 of the calculi—one situated in the fundus, the other fitting the pelvis—were of the size of nutmegs. Further examination revealed the presence of stones in the hepatic duct. Attempts to milk them downwards into the common duct having failed, the hepatic duct was incised and several stones and some debris extracted. A probe, followed by the finger, was then passed through the gall-bladder and cystic duct into the common duct, which was found

to be quite clear. Another probe inserted into the hepatic duct also met with no obstruction. The incision in the hepatic duct was sewn up with fine catgut, a drainage tube inserted in the gall-bladder, and the abdomen closed, leaving a split drainage tube passing down to the neighbourhood of the suture line in the hepatic duct. Recovery was quite uneventful.

The operation of **hepaticostomy,** or the opening of the hepatic duct, and the suture of the duct in the abdominal wound, was first performed by Knowsley Thornton in 1888. He removed 412 stones from a dilated hepatic duct which formed a swelling closely resembling the gall-bladder. The duct was stitched to the abdominal wall and drained. The fistula closed in fourteen days.

A remarkable case is recorded by H. V. Chapman. An abdominal tumour, about the shape and size of a large kidney, was felt in the abdomen; it was connected with the liver. The abdomen was opened over the tumour by an incision 13 cm. in length, between the umbilicus and the anterior superior spine. There were numerous adhesions which were readily freed. The tumour was seen to consist of a portion of the liver near its anterior margin; at the lower part the wall was thin and seemed likely to burst. A trocar was plunged in, and 480 c.c. of lightly bile-stained fluid were withdrawn. Then, with a round needle, the tumour was stitched to the abdominal wall, and a few days later was opened and 127 calculi were removed therefrom. The case is described by Pantaloni as "transhepatic hepaticostomy." An example of "subhepatic hepaticostomy" is recorded by Nicolaysen, of Christiania. The patient was a little girl, aged eight, in whose abdomen a cyst 17 cm. long and 15 cm. broad was felt. The swelling descended about three finger-breadths below the umbilicus. A year before there had been jaundice for three months; from this the patient recovered, and attended school to within three days of her admission to hospital. At the operation the cyst was fixed to the abdominal wall, and six days later was aspirated. Death occurred one day later.

The cyst was found to be formed by a dilatation of the whole of the hepatic and of a part of the common duct. The hepatic duct had been stitched to the abdominal wound. There was no tumour, and no stone could be found. Nicolaysen considered that the deformity was congenital in origin.

Leonard Rogers ("Brit. Med. Jour.," vol. ii, 1903, p. 706) records a case in which the hepatic duct was opened under the impression that it was the gall-bladder; it was brought to the surface and drained. The patient died the next day; it was then found that the hepatic duct, and not the gall-bladder, had been opened. The duct was immensely dilated behind an impacted stone.

Access to the duct may be readily obtained, as was first shewn by Elliot, by placing a sand-bag under the patient's back at the level of the liver. The manœuvre of rotation of the liver already described makes it a simple matter to expose the duct to view and to easy handling.

The operation of **hepaticolithotripsy** or the crushing of a stone in the hepatic duct is at times the safest and the speediest method of dealing with such an obstruction. It was first suggested by Kocher in 1890, and has been performed by Mayo Robson, Delagénière, and Marcel Baillet ("Bull. et Mém. Soc. de Chir.," vol. xxix, p. 1194). The last case was one in which choledochotomy and suture of the common duct had been performed. The symptoms were not relieved, and nine days later the abdomen was reopened and a stone, found in the hepatic duct, was crushed. The result was good.

In a case of obstruction of the lower end of the hepatic duct Quénu ("Bull. et Mém. de la Soc. de Chir.," vol. xxxi, p. 218, March 7, 1905) united the enormously distended hepatic duct to the stomach, performing the operation of *hepaticogastrostomy*. The case proved fatal.

The *after-treatment* of gall-bladder cases hardly calls for special mention. The patients are allowed to sit up in bed from the first, the tube or tubes draining into a little glass bottle fixed to the dressings. The bile, which at first is thick and tarry, becomes

thin and light about the fourth to sixth day. The sooner the tube is then removed the better. After removal of the tube the wounds close rapidly. They may be filled, as suggested by Mayo, with sterilised oil or vaseline.

Very occasionally I have noticed, after the operation of cholecystotomy, on about the tenth or twelfth day, that the pulse suddenly mounts up to 120 or more, and the patient complains of a little respiratory distress. It may be that a small embolism has occurred. Happily, I have never known any serious trouble to follow.

In patients who are ill, from long suffering or infection or any other cause, the continuous administration of saline fluids by the rectum by Murphy's method is a great help. This is especially the case in the wasted and enfeebled patients who have long carried a stone in the common bile-duct.

L. L. McArthur ("Jour. Amer. Med. Assoc.," 1910, i, 1), in a paper on the therapeutic possibilities of temporary biliary fistulæ, either of the gall-bladder or the common duct, advocates daily lavage of the gall-bladder with an alkaline mildly antiseptic solution.

The technique is very simple, the drainage-tube coming either from the gall-bladder or from the common duct through which bile has been flowing, is connected with the tube of an irrigator containing the solution which it is proposed to inject. The rate of flow is regulated so as not to exceed more than five or six drops per second, and the pressure not to be more than twenty inches' elevation. If these requirements be fulfilled, a continuous flow into the duodenum can be established and maintained without discomfort to the patient; too rapid flow or too high pressure will quickly produce mild biliary colic.

McArthur commences this lavage, if he considers it necessary, immediately in cases where cystostomy has been performed, or on the third day in cases where the common duct has been opened. As an adjuvant to drainage, lavage would appear useful to relieve cholæmia, cholecystitis, cholangitis.

McArthur writes:

"I have repeatedly injected in such cases, by continuous irrigation of a warm sterile normal salt solution, 500, 1000, or 3000 c.c. of fluid, first, as an experimental observation, than as a means of flushing out the kidneys or clearing up a jaundice, or filling up the blood-vessels, and in one case even added dextrose as supplying the food calories most easily assimilable."

The advantage of this method is that it minimises the risk of urinary suppression, hastens the disappearance of a chronic jaundice, and diminishes post-operative biliary vomiting by clearing the duodenum as well as cleansing the biliary tract itself.

The method is well spoken of by Ransohoff and other competent authorities. I have used it only once, in a patient greatly emaciated and gravely ill. After removing a stone from the common bile-duct, I left two drainage-tubes in, one lying in the hepatic duct, the other directed towards the duodenum. Through the latter I injected several pints daily of fluid, about one-half of which contained glucose. The result was excellent.

CHAPTER XLI.

OPERATIONS FOR OBSTRUCTION OF THE COMMON DUCT.

CHOLEDOCHOTOMY.

A STONE may be impacted in the common duct in any point of its course. The stone may be solitary, or there may be, and commonly are, more stones than one. A stone may be fixed in the ampulla, and a second stone, or several, may be wedged in the upper part of the duct, or even in the hepatic duct.

Access to the duct may be obtained in three directions:

1. Above the duodenum by supraduodenal choledochotomy.
2. Behind the duodenum by retroduodenal choledochotomy.
3. Through the duodenum by duodeno-choledochotomy.

First, **Choledochotomy Performed upon the First Portion of the Common Duct.**—The operation was first suggested by Langenbuch in 1884, first performed by Kümmell in the same year, and first performed successfully by Knowsley Thornton in 1889. This is the simplest operation, and in my experience has been that which I have been most frequently called upon to perform.

The position of the patient during the operation is a matter of great importance. All the steps of the operation up to the suture of the abdominal wound are simplified by placing a large sand-bag or air-cushion under the patient's back behind the liver, as already described. The table may be slightly tilted, so that the feet of the patient are lowered four or five inches and the head correspondingly raised. Mayo Robson's incision is made—that is, a vertical incision, about five inches in length, near the outer border of the rectus, and an oblique upward and inward prolongation from this, about one-half of an inch from the costal margin, for about two inches or more, if necessary. The abdomen is opened, the kidney and stomach swabs carefully placed

in position the intestines protected by a mackintosh and the wound edges covered in their deeper portions by mackintoshes, all adhesions carefully separated by gauze stripping or divided and ligated, the bleeding points being carefully sought and at once ligated in this as in all stages of the operation.

The gall-bladder and the edge of the liver are now grasped in the hand, being first covered by gauze, so that a firm grip may be obtained. They are dragged gently but firmly downwards from under the costal margin, and the liver is then rotated so that the posterior surface of the gall-bladder now looks forwards and upwards, and the common duct is stretched and brought much nearer to the abdominal wall. In thin patients the common duct is brought quite on a level with the skin-wound; in fat patients this is not possible, but in all, the duct is made easy of access. It is possible to explore it thoroughly, to incise, and, if need be, to stitch it without, as a rule, any difficulty.

The common duct now being exposed is surrounded very carefully with swabs and the position of the stone defined. It will often be found to slip about in the dilated duct and to be very elusive. This is, from some points of view, a disadvantage, but it often enables the surgeon to move a stone impacted low down in the duct into the upper and more accessible portion. The stone is now grasped between the index-finger and thumb of the left hand, and the duct incised over the stone, the cut being of such size as to permit the easy removal of the stone. The cut edges of the duct are taken in fine vulsella, and with a pair of forceps or with a gall-stone scoop the stone is now dislodged. Immediately after it bile will flow, and this the assistant wipes away at once, before there is time for it to soil the parts around. Such bile is always, or almost always, infected by the *Bacillus coli communis*, if not by other organisms. The escape of bile may be controlled by the left index-finger, which has passed through the foramen of Winslow. This position of the finger makes the whole operation much easier, and is the key to many difficulties. Any other visible stones are removed, and the scoop

is passed upwards and downwards along the ducts to explore. It will always be found that the duct is of large size, partly as the result of an old-standing cholangitis, partly perhaps because of the increased tension of the bile therein. The duct will, therefore, be large enough in most cases to admit the finger, and in this way alone can a perfectly satisfactory exploration of the duct be made. A stone that will evade detection by the scoop is at once perceived by the finger. The finger, therefore, should always be passed both upwards and downwards along the duct and a free exploration made. A stone even in the ampulla may, by the conjoined manipulation of the fingers on the duodenum and a finger within the duct, be coaxed upwards into the duct and removed.

This digital exploration should always be resorted to in cases of common duct stone, but it must be remembered that the duct is a septic tract. A glove-finger must, therefore, be put on before the exploration, or the glove on that hand must be changed. It is often advisable to push into the duct, both upwards and downwards, a wick of sterile gauze. This, when withdrawn, will often be found to have little calculi and particles of sand or grit adhering to it. After the duct is cleared of stones two courses are open to the surgeon. He may either close the duct by suture or he may drain the duct by a rubber tube. Each case must be decided as seems best, but, on the whole, it will be found both desirable and necessary to drain.

Drainage of the common duct may be direct or indirect—direct, when a tube is introduced into the opening in the duct made for the extraction of the stone; indirect, when the duct is sutured and a drain is left in the gall-bladder or in the stump of the cystic duct left after removal of the gall-bladder. In some instances one method, in other instances the other, may seem the best. But in nearly all cases drainage by one or other of these methods is imperative. If the common duct is closed by suture and the gall-bladder drained, it is prudent, though

not always necessary, to leave in the wound a piece of dental rubber tissue whose end lies against the suture line.

If drainage is employed, a rubber tube is passed upwards towards the hepatic duct for about an inch. If the opening in the duct is very wide, it may be narrowed by a stitch or two of catgut, introduced by Lembert's method. The tube is stitched in by a single catgut suture, which picks up the wall of the common duct a little outside the edge and passes through the tube. So long as this stitch holds—and it holds about seven to ten days—the tube will remain in place. In addition to this tube another drain is necessary on the outer side of the duct. For this I prefer a rubber tube, split longitudinally. The tube lies to the outer side of the duct in the kidney (Morison's) pouch; it may be brought out of the abdominal incision or made to present in a stab wound in the loin—preferably the former. A third tube to lie to the inner side of the duct is occasionally necessary. These tubes are left in for from three to ten days, as seems necessary. There is no advantage in removing them early.

There does not seem to be any general agreement even yet among surgeons as to the propriety or advisability of adopting drainage after the removal of a stone from the common duct. For my own part I never consider it safe to attempt the complete closure of a wound in the duct; I drain the duct invariably. A discussion was held at the Société de Chir. de Paris ("Bull. et Mém. de la Soc. de Chir. de Paris," vol. xxix, p. 1194) in which several surgeons gave their experience. Michaux, in twelve choledochotomies, had sutured the duct in all, and the results were "very satisfactory." A drain was left in contact with the suture-line, and in "three or four" there was a slight escape of bile. Quénu had abandoned suture entirely, as second operations, owing to blockage of the duct by the infolded mucosa or blood-clot, were sometimes called for. Schwartz considered that suture of the duct might be responsible for certain disasters, and he advised drainage in all cases. Hartmann considered that suture of the common duct was "always unnecessary and

sometimes harmful." In my own early cases I not infrequently stitched the wound in the duct, but it is now my invariable practice to drain the duct by a rubber catheter, closing the wound in the duct snugly round the tube. It is most important to see that the tube which is introduced passes *upwards*. I have several times passed the catheter into the opening of the duct, and have believed that the tube has reached the hepatic duct; yet on examining closely I have found that the catheter has passed downwards to the duodenum. The mistake seems a very unlikely one to make, but I am not sure that it does not often occur. If there is much dust or grit in the duct, this may be wiped away with strands of gauze passed upward or downward or washed out by means of a fine rubber tube. The patency of the lower end of the duct may be shewn by the filling of the duodenum through a catheter in the lower end of the common duct. The whole operation area is now gently wiped with sterile swabs wrung out of salt solution, the liver is replaced and the abdominal wound closed around the tubes.

ROTATION OF THE DUCT.

There are cases occasionally met with in which, when a stone is impacted in the common duct, the condition of the patient is such that only the minimum of interference is permissible. If, in such circumstances, the gall-bladder be small, shrunken, and buried in adhesions which also surround the cystic duct, the mere separation of these adhesions may be a tedious and time-consuming process. It is more than probable that such a gall-bladder is entirely useless, and it may be cut off entirely from communication with the common duct. It is generally considered that it is impossible to reach the common duct until all these adhesions, which may involve the duodenum or the colon, are divided or separated. But by the method I have often used, for which I suggest the term *rotation of the duct*, the adhesions are ignored and the stone is yet easily removed. As soon as the condition of things is seen, the left hand of the surgeon is

passed transversely inwards in front of the pylorus and above the stomach, along the gastrohepatic omentum. When the hand is well placed, the fingers are flexed and the hand and wrist bent over to the patient's left, with the result that the common duct is twisted up into the wound and can be readily incised.

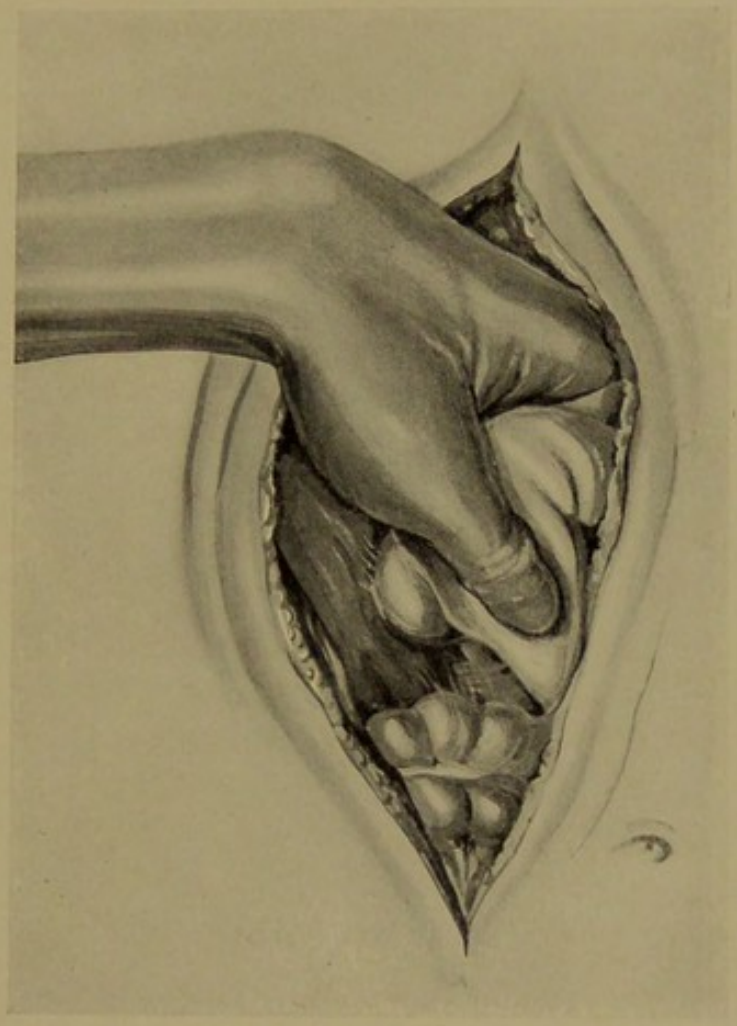

Fig. 320.—Rotation of the common duct. The stone is made to project on the outer side by the pressure of the fingers. No gall-bladder adhesions need be separated to allow of this being done.

The surgeon's left thumb is then placed upon the duodenum in the position indicated in the figure. As soon as the duct has been brought well forward, a stitch is taken in the longtudinal axis of the duct, and well towards the posterior part of it. The needle penetrates the whole thickness of the duct wall at two or three points. The ends of this suture are then seized in a clip,

traction upon which fixes the duct and aids the subsequent suturing. Behind the ducts two or three small swabs are packed to catch the bile which escapes, often in profuse quantity.

When the surgeon's left hand is well fixed he can feel the stone or stones between his left fingers and thumb. The stone is

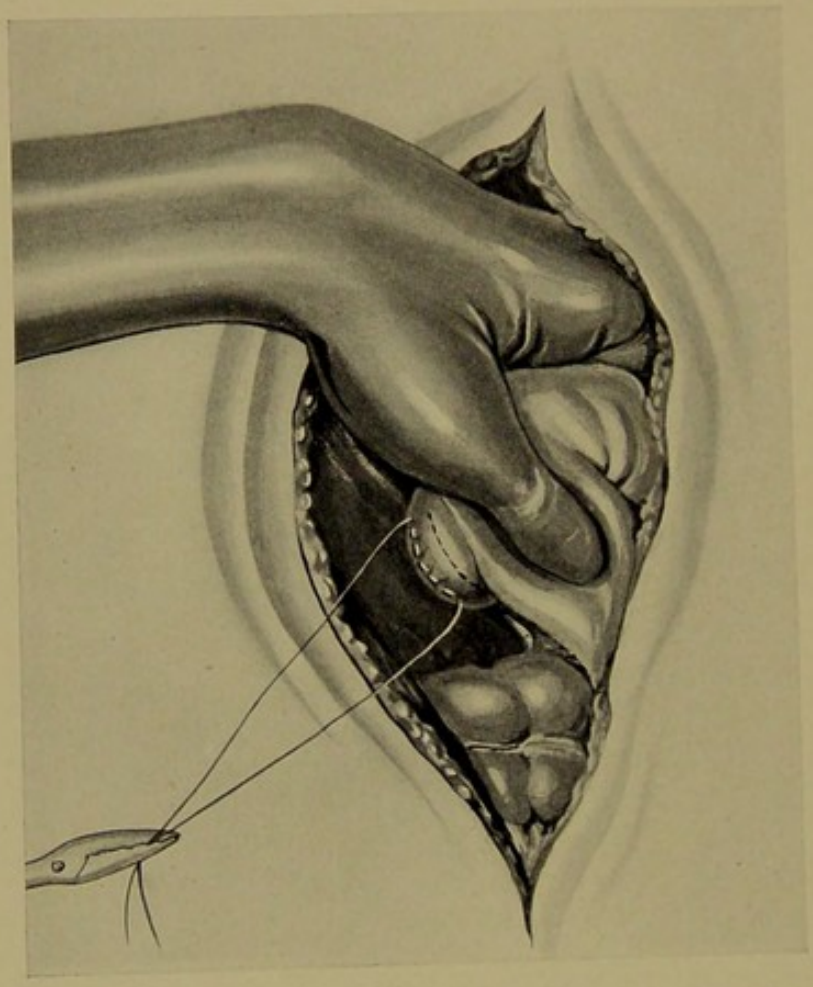

Fig. 321.—Rotation of the common duct. A stitch is introduced in the manner indicated to fix the duct; an incision is then made in front of it, and the stone extracted. Two stitches may be introduced, one on each side of the incision; then upper and lower ends when tied across bring the edges of the opening together.

forced prominently against the wall of the duct, and a free incision made over it. The edges of the duct are at once seized in fine vulsella and the stones removed. Digital exploration of the duct is necessary here also; indeed, all the details of the operation in this respect are those already described.

As soon as the ducts are cleared, a drainage tube is passed upwards into the hepatic duct, fixed by a catgut stitch, and the opening in the common duct closed, by continuous or interrupted sutures, snugly around the tube.

I believe that this method of rotation of the duct is of the greatest possible service in not a few cases. It has been my fortune to see seven cases in succession in which the gall-bladder was shrunken and buried in adhesions implicating the duodenum, colon, or omentum, and in all the method above described has been carried out successfully. If the adhesions, however dense, do not produce any interference with the proper action of the duodenum or pyloric end of the stomach, they need certainly not be interfered with; for if they are separated they are certain to re-form. Their separation then is time-consuming, a little hazardous, and futile. The futility is shewn by the fact that at secondary operations performed after gastrolysis alone has been thought necessary, the adhesions are always found as dense and as numerous as ever, although the immediate result of the first operation may have been striking. In expressing this opinion I find that I am not in agreement with Mr. Mayo Robson who writes: "If adhesions have been thoroughly separated, as they always should be, the surgeon has immediately under his eye the whole length of the ducts with the head of the pancreas and the duodenum."

The after-results of my cases shew beyond disproof that separation of these adhesions is not necessary.

In all these remarks I refer of course only to cases in which the gall-bladder is shrivelled, contracted, and empty; when, in fact, it is a mere cicatrix. If it contains stones, or mud, or pus, it should be dealt with separately, and such stripping of adhesions done as is necessary.

I do not suggest this manœuvre as a routine procedure, but in the exceptional circumstances which have been mentioned it may be of paramount service.

Second, **Retroduodenal Choledochotomy (Haasler's Operation).**

—The retroduodenal portion of the duct may be reached from behind by a procedure similar to that employed by Kocher in the "mobilising of the duodenum" as a preliminary to the performance of gastroduodenostomy. This method was suggested at the German Surgical Congress in 1898 by Haasler. It had been found necessary three times in eighteen operations for stone in the common duct. Oscar Bloch, of Copen-

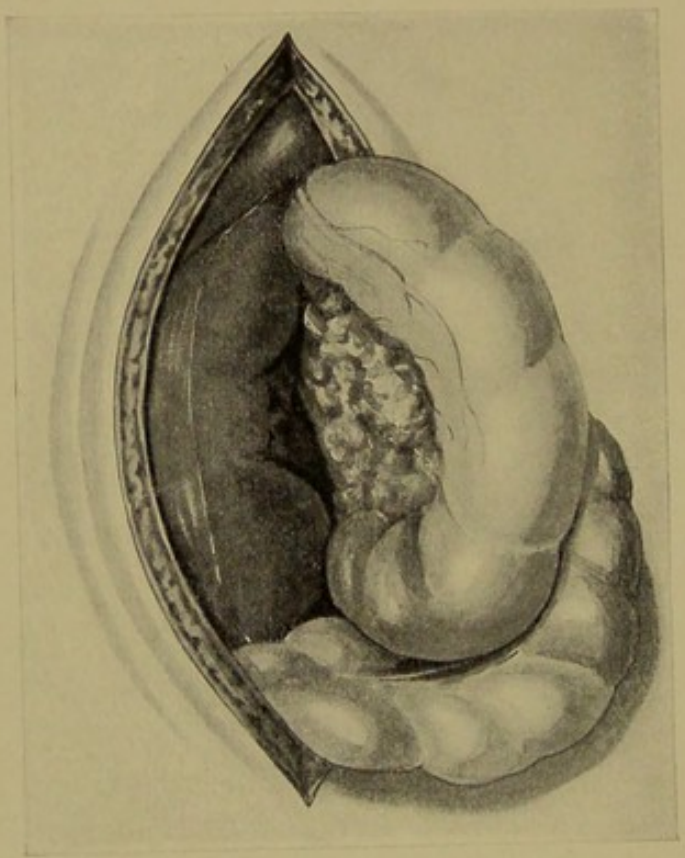

Fig. 322.—Choledochotomy. Access to the common duct in its retroduodenal portion is obtained by this "mobilising" of the duodenum after the method of Kocher.

hagen, and Berg, have described a similar operation to this. In the very great majority of cases a stone which appears to be fixed in this portion of the duct can be moved upwards into the first portion. The operation to be now described is, therefore, very rarely necessary.

The common duct is exposed in the manner already described. The parietal peritoneum of the posterior abdominal wall is now

incised vertically, over the right kidney about one and one-half inches to the right of the duodenum. The fingers are introduced into this incision, and the peritoneum stripped up until the duodenum is reached. By dragging gently on the second part of the duodenum it can be turned over to the left, so that its posterior surface is visible. Wiart suggests making the peritoneal incision to the outer side of the hepatic flexure and stripping the colon with the duodenum towards the duodenum. I cannot see any advantage in this. A stone seated in the second portion of the duct can now be felt, and the duct over it incised. This part of the duct is either covered by or lies in a groove within the pancreas. The gland must, therefore, be cut, or be separated by blunt dissection. In Haasler's three cases the former procedure was once necessary, the latter twice. Vautrin has suggested the division of the pancreas by means of the thermocautery. The pancreas surrounding the stone is probably atrophied or sclerosed by reason of the constant pressure of the gradually enlarging stone, and is therefore only recognisable as thick and tough fibrous tissue. After removal of the stone the duct is explored and sutured, and a drain left in the posterior peritoneal wound. A sound healing of the duct without leakage is not likely to occur, the duct being here devoid of any peritoneal investment.

Third, **Duodeno-choledochotomy.**—Of this operation there are two varieties. In the first the duct itself in its second or third portions is opened; in the second the ampullary opening is enlarged by incision of its edges. If the duct itself is incised the operation is known as *transduodenal choledochostomy*, or *Kocher's operation;* if the ampulla is opened the operation is known as *duodeno-choledochotomy*, or *McBurney's operation.* The former will be described first.

A. *Transduodenal choledochostomy*, or *Kocher's operation.*—In order to get at a stone impacted in the second part of the duct from the front, it is necessary to divide both the anterior and posterior walls of the second part of the duodenum, and then to incise the pancreas which lies around the duct. This operation

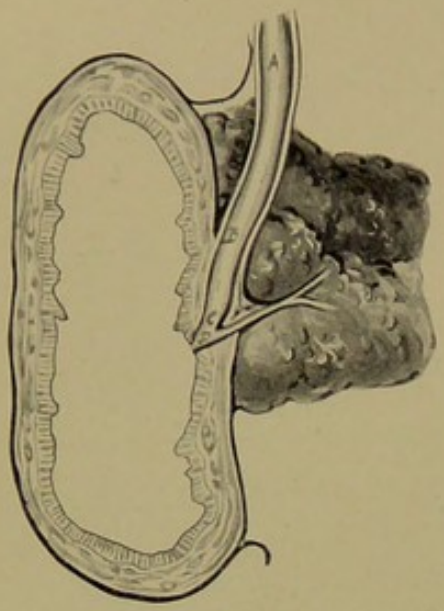

Fig. 323. — Section through the duodenum and the head of the pancreas to show the lower end of the common bile-duct. A to B in the second portion of the duct; B to C, the third portion; D, the ampulla.

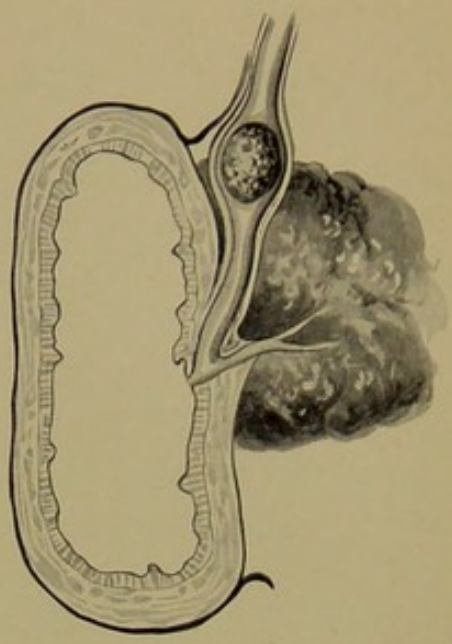

Fig. 324.—Shewing a stone impacted in the second portion of the duct. Note the compression of the pancreas between the duct and the duodenum. A stone such as this might be pushed upwards into the first part, removed by retroduodenal or by transduodenal choledochotomy.

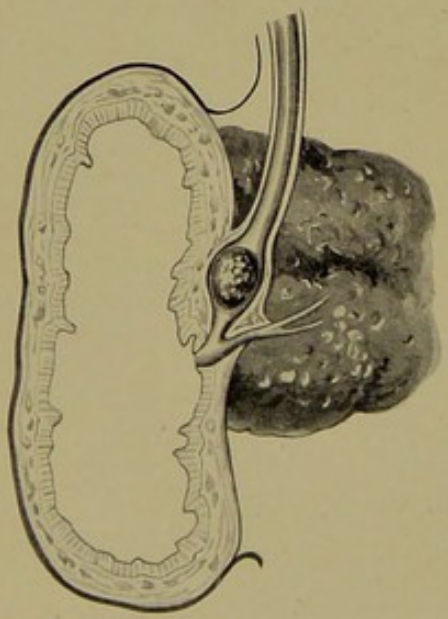

Fig. 325.—Stone impacted in the third portion of the common bile-duct. Such a stone would be removed by Kocher's operation.

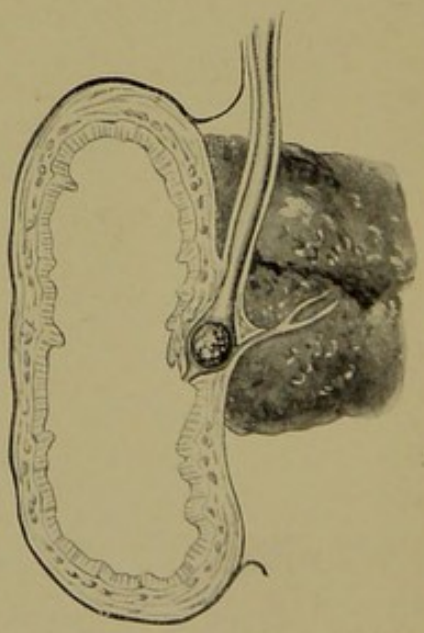

Fig. 326.—Stone impacted in the ampulla of Vater. This stone would be removed by McBurney's operation.

was first performed on June 4, 1894, by Kocher, and was described by him as "internal choledocho-duodenostomy."

When the calculus has been impacted in the duct at this part for any length of time, the pancreas which lies between the duct and the inner and posterior part of the duodenum has probably become somewhat atrophied by pressure, and sclerosed as a re-

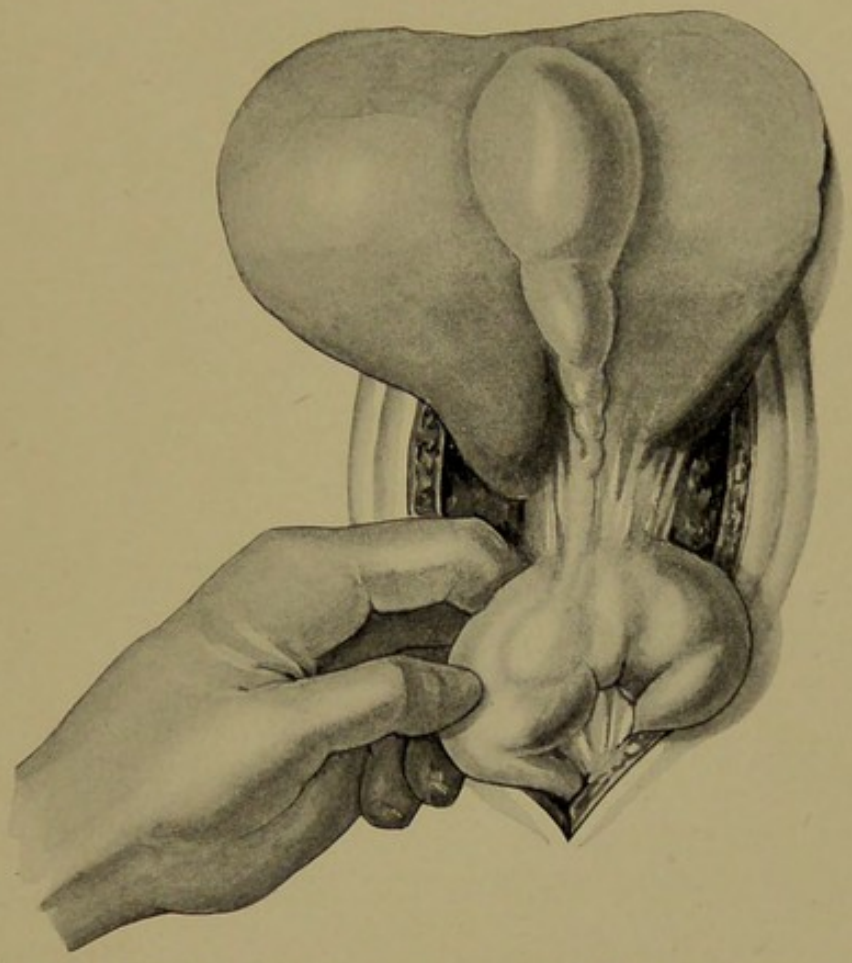

Fig. 327.—Duodenocholedochotomy. Stone in the common duct low down. The duodenum has been freed and brought to the surface preparatory to being opened.

sult of chronic inflammation. In my own cases it has been so altered as to be barely recognisable as pancreatic tissue, though it was evident that the gland had been divided, because after incision of the posterior wall of the duodenum a very dense and thick fibrous layer was encountered before the duct was opened. The incision in the gland causes no ill effects.

The preliminary steps of the operation are those necessary in all common duct cases.

As soon as the abdomen is opened a general examination of the parts is made and the procedure determined. Cholecystotomy or cholecystectomy may be necessary in addition to the removal of the stone by the method now to be described.

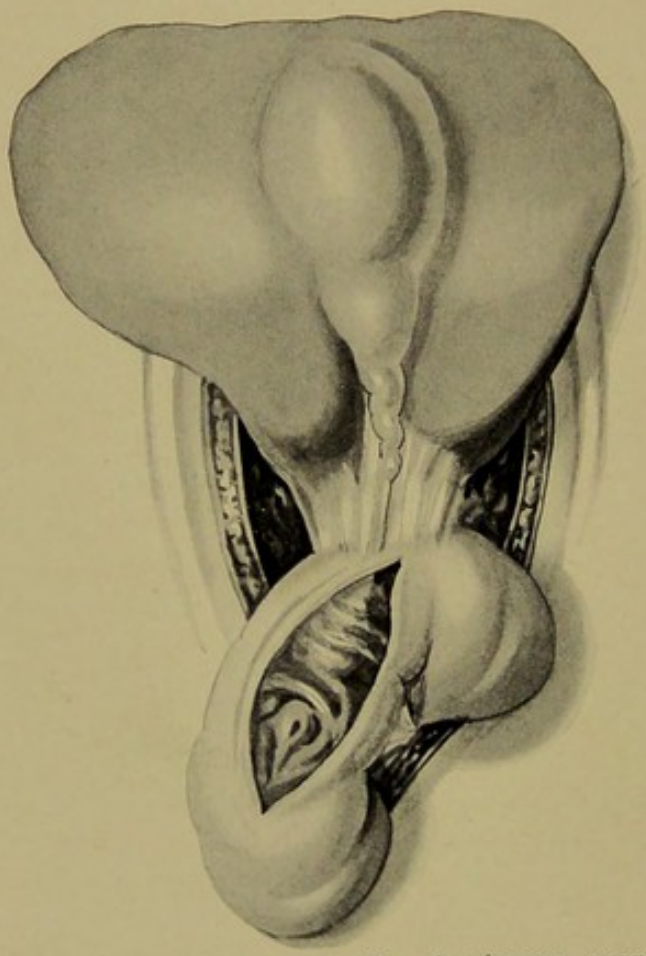

Fig. 328.—Duodenocholedochotomy. The duodenum opened to shew the stone in the common duct above the ampulla.

If the patient is thin, and if the liver lies low, the lifting and rotation of the liver will generally leave a clear way to the duodenum, but in stout patients, with many adhesions, it may be a matter of no little difficulty to reach the bowel. The duodenum must then be rendered mobile by the procedure described by Kocher. A vertical incision is made about 1½ inches to the outer side of the duodenum, and the peritoneum stripped in-

wards to the duodenum from this point. When the intestine is reached the stripping is continued, the duodenum and the head of the pancreas being raised up towards the middle line. In this way it can be so secured that with a couple of fingers behind the duodenum, or in the foramen of Winslow, the bowel can be raised up to the abdominal wound. The fingers which so sup-

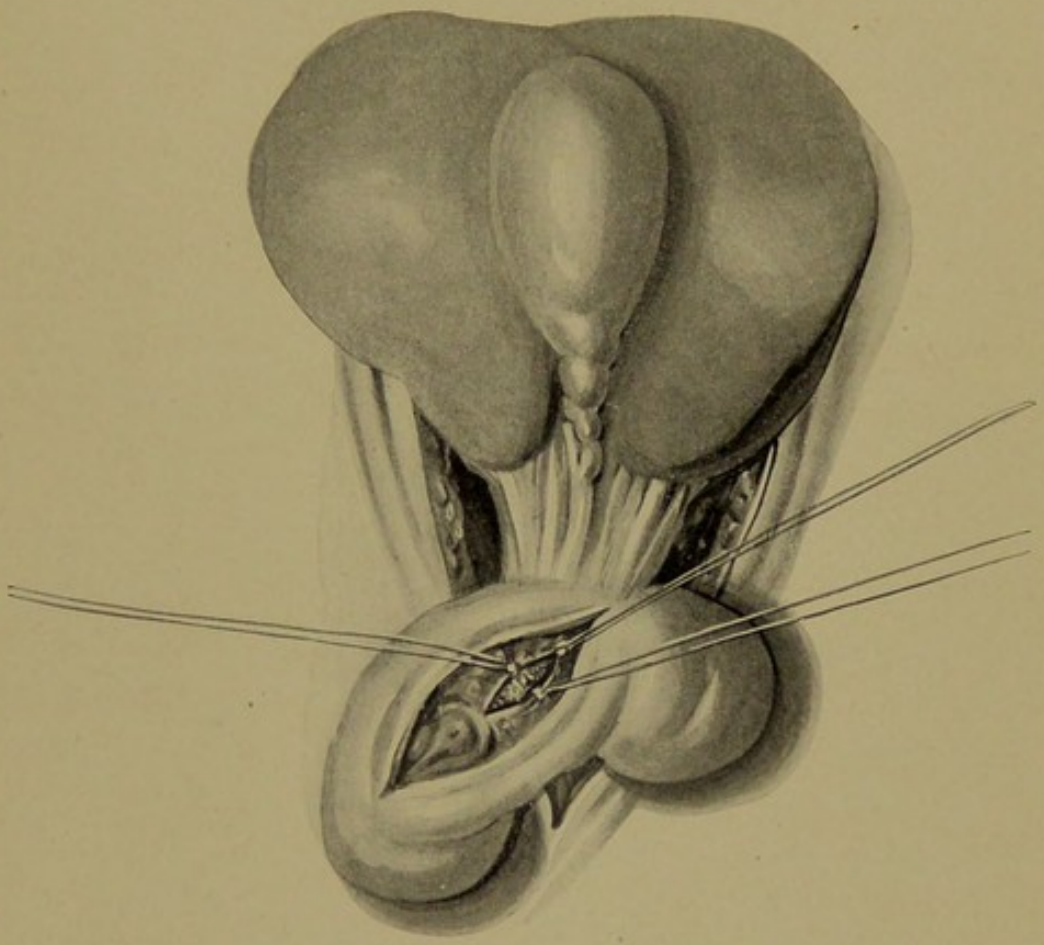

Fig. 329.—Transduodenal choledochostomy (Kocher's operation). Sutures in position; they are left long to act as retractors.

port the bowel must remain steady throughout the duodenal manipulations, and must be protected from soiling by being covered by a flat gauze swab or mackintosh. When the duodenum is held secure, and the stone is localised, the anterior wall of the duodenum is incised and a small vulsellum placed on each edge of the wound. The fluids escaping from the duodenum are mopped up, and the posterior and inner wall of the bowel exam-

ined. The bulging over the stone will then be readily discernible, and at a little distance below it the ampulla is seen. If the stone can be pushed downwards and extracted through the ampulla this should be done; but if not (and I have never been able so to do), then the duodenum is incised directly over the stone. The incision is carried at once down to the stone over a part of its

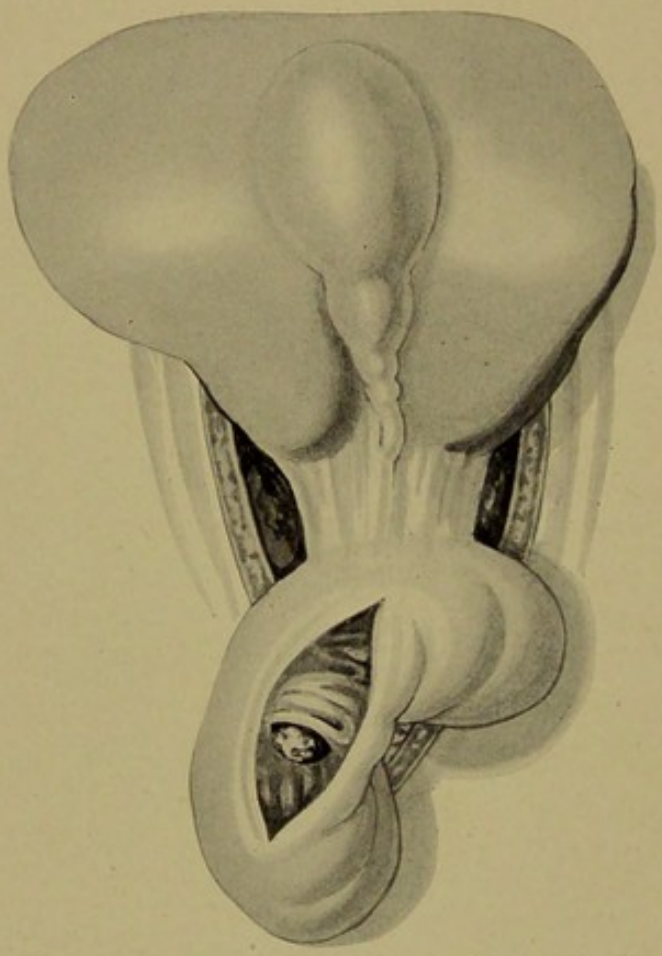

Fig. 330.—Duodenocholedochotomy (McBurney's operation). Stone in the ampulla. The edge of the ampulla is incised and the stone extracted.

projecting surface. Then a stitch is taken, on each side, through all the tissues between the stone and the duodenal wall. These sutures are of catgut, and they are useful to steady the walls of the duct in the subsequent explorations. As soon as the sutures are tied (the ends are left long) the incision over the stone is lengthened to a degree sufficient to allow of the easy removal of the calculus. When the stone is taken away, a third stitch is

taken at the extreme upper end of the incision. This also embraces the duct, the pancreas, and the duodenal wall. As soon as the stone is removed, bile begins to flow into the intestine, but other stones, may, nevertheless, be present in the ducts above. A scoop is therefore passed upwards as far as it will go (generally about $4\frac{1}{2}$ inches, and the duct emptied. An examination with the finger, however, is a far more certain method of detecting stones. A stone which is not felt when the scoop is passed is instantly recognised by the finger. When it is certain that no other stones remain the sutures (which have been useful as retractors) are cut short. It is not necessary always to introduce any other stitches, though Kocher advises that this should be done. If the second portion of the duct has been opened, leakage of bile through the wound is possible, though it is not likely on account of the fact that, owing to the large size of the stone, the duct has probably been brought into close contact with the wall of the intestine. If the opening is well above the papilla, sutures should therefore be introduced; if the opening implicates only the interstitial (third) portion of the duct, they are not needed. If they are considered necessary, they should be through-and-through sutures of catgut.

At this stage there remains only the anterior incision in the duodenum to be closed. This is done in the usual manner, by two layers of stitches, the inner embracing all the coats of the gut, the outer only the serous and muscular coats. An omental flap may well be sutured over the duodenal incision also. It is of the greatest importance that the closure of the duodenum should be done with care. Eighty per cent. of the deaths after this operation are due to leakage from the suture line. The inner catgut suture should be of the Connell type. ("Loop on the mucosa.")

The fingers are now removed from behind the duodenum, and the bowel allowed to fall back into its natural position. If neither cholecystotomy nor cholecystectomy have to be performed, the abdomen may be closed without drainage. The

advice is, I find, constantly given that a drainage-tube should be passed down to the duodenum, but I have not found this necessary. The wound in the gut involves a surface clad with peritoneum, and healing therefore occurs quite securely.

If the third portion of the duct is involved the duodenum is of course not divided *completely through* on its inner and posterior part. This portion of the duct lies actually in the duodenal wall, and therefore, in order to open the lumen of the duct, the duodenum is cut *into*, and not *through*.

The following description of this operation is given by Kocher (Stiles' translation of fourth edition "Operative Surgery," p. 231). The operation is as follows:

The stone situated behind the duodenum is fixed with the finger, and after the duodenum has been opened, as above described, at a point opposite to the stone, an incision is made down on to the stone. Whether the incision should be transverse or longitudinal will be determined by the position and shape of the stone. The distended common bile-duct is more likely to be found applied to the duodenum in the whole length of the necessary incision, if the latter be made in the long axis of the stone. In this case also we advise, as does Elliot, for choledochotomy in general, that the wall of the duodenum and bile-duct right down to the stone should be seized with artery forceps as soon as incised, and, if necessary, a stitch may be passed through the middle of the entire thickness of both edges of the wound, so as to keep up the apposition of the two walls and facilitate a choledocho-duodenostomy, as we have termed the operation, if this be required. After the stone has been extracted the canal should be probed (with the finger if possible) so that other stones may not be overlooked. Whether the opening is now closed in the ideal way (by a suture through the whole thickness of the wound, with a secondary suture to approximate the mucous edges) or not must depend upon whether the opening in the papilla is stenosed or not. As a general rule, it will be found advantageous to make sure of a considerable opening where there is a danger of the formation of new stones. If the opening is not required, it will contract of its own accord. A suture should, therefore, be put in all round the opening through

the whole thickness of both canals. In Kocher's and Kehr's case, in which this method was adopted, no bad consequences resulted from chance regurgitation of intestinal contents.

I have performed this operation in three cases, all successfully. The following are the notes:

Case 1.—Mr. N., aged fifty-six, sent by Dr. Bastow Cooper, Lincoln. The patient had had occasional attacks of severe pain in the right hypochondrium for four years; the attacks were accompanied by sickness. In February, 1905, a similar attack was followed by jaundice, which, at first very deep, gradually lessened until another attack of pain in April, 1905, after which it became very much deeper. Between April and September attacks of pain, followed by deepening jaundice, occurred about once a fortnight. In between these attacks the jaundice never lessened and no bile ever passed into the intestine. He was more deeply jaundiced than any patient I have ever seen. In the attacks he had shivering and nausea; each attack lasted from half an hour to two days. A diagnosis of stone in the common duct was made and operation was performed on September 28, 1905. The abdomen was opened through Mayo Robson's incision. The gall-bladder was found shrunken and empty and adherent to the duodenum. A stone was felt in the second portion of the common duct just below the upper margin of the duodenum. A prolonged attempt to push the stone upwards into the supraduodenal portion of the duct was unsuccessful. The duodenum was therefore held secure in the fingers of the left hand, and its anterior wall opened by a longitudinal incision. The duodenal edges were seized in small vulsella, and an inspection of the duodenum made from within. A bulging of the inner and posterior wall of the gut was seen, and behind this lay the stone, fully an inch and a half above the ampulla of Vater. Incision was made over the stone. The stone even when well exposed was extracted with some difficulty; it seemed to have grown into the wall of the duct, and its outer surface was roughy and "spiky." After the stone was removed the duct was explored with the finger and with a scoop, but no other calculi were felt. No stitches were introduced into the posterior duodenal wound. The anterior wound was sutured and the abdomen closed. The patient recovered rapidly. By January, 1906, he had gained 1½ st. in weight, and was perfectly well.

Case 2.—Mr. J. V., aged fifty-two, sent by Dr. Lambert, Farsley. The patient had noticed a dull aching pain in the gall-bladder region five months ago; this lasted ten days and was followed by jaundice, which has never cleared off since. He has had attacks of pain, shivering, nausea, followed by deepening jaundice ever since. The jaundice almost disappears between the attacks. A stone in the common duct was diagnosed and operation performed on November 3, 1905. The abdomen was opened through Mayo Robson's incision. The gall-bladder was shrivelled and buried in a mass of dense fibrous tissue. A stone was felt in the retroduodenal part of the duct; it was fixed. The duodenum was therefore opened, and about one inch above the papilla the bulging of the stone on the posterior and inner wall was seen. An incision was made down to the stone, which was readily extracted. No sutures were introduced in this incision. The duodenum was closed, and as there had been some soiling of the parts a drainage tube with a gauze wick was left in for five days. The

wound was slow to heal, but in five weeks was perfectly sound. The patient was seen on February 28, 1905. He had gained 2 st. 2 pounds and reported himself as "quite right."

Case 3.—Mrs. B., aged fifty-six, sent by Dr. Hutton. The patient has suffered for many years from indigestion, "spasms," flatulent distension of stomach, but has never been jaundiced. The present illness dates back three months, when she was taken ill with shivering, vomiting, and dull abdominal pain, followed by jaundice. Since then similar attacks have occurred at intervals of about a fortnight. The jaundice becomes slightly less in the intervals, but by no means disappears. The pain, which is not severe, is felt down the right side of the abdomen and up to the scapula. The stools are light coloured. On examination, February 24, 1905, a stout woman with marked jaundice. Liver edge felt in the gall-bladder region which is tender. Operation February 25th. Mayo Robson's incision. Duodenum firmly adherent to gall-bladder, which was almost hidden among dense adhesions. By invaginating the duodenum with the finger the crateriform hollow of a deep ulcer could be felt where the gut was welded to the gall-bladder. A calculus was felt in the hepatic duct and pushed down into the common duct. A stone was also felt impacted and immovable in the common duct, just above the ampulla. The duodenum was opened and its posterior wall incised over the stone, which was extracted. Three more stones were then taken from the common duct and finally a probe passed up for 5 inches into the hepatic duct. The anterior wall of the duodenum was closed with a continuous suture, in two layers. A covering of omentum was fixed over the suture line by two interrupted sutures. Abdomen closed without drainage.

B. *Duodeno-choledochotomy—McBurney's operation* (ampullary choledochotomy).—In cases where this operation is performed the stone is arrested in the diverticulum of Vater, having passed down the whole length of the common duct. The stone is usually small, about the size of a split pea. The operation in all its details is similar to that which has just been described except that the incision in the anterior wall of the duodenum is made a little lower down. As soon as the duodenum is opened the stone may be seen protruding through the ampulla, and a little frothy bile-stained fluid may escape past it. In McBurney's first case an attempt was made to extract the stone by dilating the orifice of the ampulla, but this was not successful. The edges of the opening were therefore incised and the stone extracted.

As soon as the stone has been removed, small vulsella should be placed on the lateral edges of the opening, and a gall-stone

scoop passed upwards into the common duct. The duct is always dilated, and some fine stones or sand may be removed. In some cases an opening may have already been made in the supraduodenal part of the duct for the purpose of extracting a stone impacted there, the later opening of the duodenum being necessary because of the impossibility of displacing the ampullary stone upwards. If this has been the case, it is well to pass in through the supraduodenal opening a wick of gauze which is brought out at the ampulla. On pulling a long strand of this through the duct, some fine sand, or grit, or small stones may be removed.

In both this operation and in Kocher's operation a longitudinal incision is made into the duodenum through the serous-covered anterior surface. Such a wound, when carefully sutured, heals well. Several operators record cases of duodenal fistulæ following these operations, and I think it not improbable that this has been due to drainage of the wound. The drainage material has adhered to the suture line, and has, when removed, torn open the wound. I have never drained down to the duodenum in any of my cases, but have always sutured carefully, and have made assurance doubly sure by laying over the line of stitches a flap of omentum.

The following are brief notes of some of the cases upon which I have operated. In all I have now done this operation 39 times with three deaths.

Case 1.—Mrs. T. B., aged thirty-nine, seen with Dr. Sproulle, Mirfield. Three years ago she had an attack of epigastric pain and vomiting, followed by slight jaundice,—a typical attack of biliary colic. Since then she has had nine similar but progressively more severe attacks; nine weeks ago an extremely severe attack. Pain has continued all the time, and jaundice, though varying slightly, has always been pronounced. The motions during this period have been light coloured, the urine thick and scanty. Pain is constant, but at times an acute paroxysm occurs. Has lost flesh rapidly during the last two months, and has been eating little, owing to pain and heaviness after even light diet, and vomiting. Operation December 7, 1900. Eighty-seven gall-stones were removed, mostly from the hepatic and common ducts. A few lay in the gall-bladder, but both hepatic ducts and the whole length of the common duct were filled with tightly packed stones. These were removed through an incision in the common duct, which was afterwards sewn up. A stone was

found tightly impacted in the ampulla of Vater, and the duodenum had to be opened in order to remove it. The patient had severe hæmatemesis after the operation and died on the third day.

Case 2.—Mrs. M. A. R., aged forty-one. Calculus in the ampulla of Vater; chronic pancreatitis; duodeno-choledochotomy. The patient was admitted on March 23, 1901. The history was that attacks of pain in the right hypochondriac region had been intermittently present for eight or nine years. Sixteen months before admission jaundice was noticed for the first time. Similar attacks of pain, followed by jaundice, had been noticed several times since that date. On admission she was jaundiced and the colour had been present, though varying in tinge, for four months. A stone in the common duct was diagnosed. The abdomen was opened and a stone was found impacted in the ampulla of Vater. The head of the pancreas was densely hard,—as hard as stone. I remarked at the time that the gland felt more like a plaster cast of a large pancreas than like a normal organ. The duodenum was incised and the stone was removed. The gall-bladder was drained for eleven days. The patient made a good recovery and is now quite well (March, 1906).

Case 3.—Mr. J. A. E., September 24, 1902. For the last four and a half years has suffered from acute pains in the right hypochondrium. After an attack of the normal kind he became jaundiced nine weeks ago, and since then has remained jaundiced more or less. For the first month the jaundice steadily deepened; then a rigor occurred and the jaundice became still more intense, but quickly got less. Now jaundice is not more than sallowness. Has had three rigors recently with slight increase in jaundice after each attack. At the operation, a small stone in the ampulla of Vater, and a few gritty particles in the gall-bladder. The duodenum was opened and the stone removed from the gall-bladder. Cholecystotomy was performed. The patient recovered; in March, 1906, reported as having been quite well since the operation.

Case 4.—Mrs. A. D., aged thirty-nine, sent by Dr. Handcock, Scarborough, July 11, 1903. Seven months ago patient began to suffer from pain in the right hypochondrium; collapse, faintness and vomiting. The first attack was followed at once by jaundice. Between this and five weeks ago, after a similar attack, a stone was passed and was recovered from the fæces; but since then jaundice has been continuously present, though variable in depth of tinge. Every few days, lately, has had attacks of shivering and slight pain. Operation was performed after a diagnosis of stone in the common duct had been made. A stone the size of a split pea was removed from the ampulla through the duodenum. The gall-bladder contained stones (forty-eight were subsequently counted); it was therefore aspirated, and clear mucous fluid removed. A few small stones were immovably fixed in the cystic duct. The gall-bladder was removed and a drainage tube introduced into the junction of the hepatic and common ducts. Recovery was uneventful; quite well in March, 1906.

Case 5.—Mr. G. K., aged fifty-three, sent by Dr. La Touche, Ossett, July 25, 1903. Cholecystectomy; duodeno-choledochotomy. The patient had suffered for a "great many" years from pain after food,—nausea, belching, distension of stomach. Four months ago, after a severe attack of pain, became jaundiced and has remained so since then. There have been many attacks of

pain, nausea, and shivering, followed by deepening jaundice. There has been a loss of over two stones in weight. Stone in the common duct was diagnosed. At the operation a hard, shrivelled gall-bladder, with a few stones in its contracted cavity, was felt, and a single pea-like stone in the ampulla. The duodenum was opened, the ampulla exposed, and a small stone seen to be projecting through its orifice. The opening was enlarged slightly and the stone removed. A scoop passed up the duct discovered no other stone. The gall-bladder was then removed, as the cystic duct was found blocked, and a drainage tube passed into the hepatic duct. The patient recovered, and remains well to-day, having gained over two stones in weight (March, 1906).

Case 6.—Mr. T. H., aged forty-two, April 25, 1904. Cholecystotomy; duodeno-choledochotomy. The patient has suffered for years from "chronic dyspepsia." Three years ago he had an attack of very severe pain, followed by jaundice. Five months ago a similar attack, and since then has never been free from jaundice. Has had attacks of very slight pain, and slight deepening of the jaundice, but his colour has never been more than "sallow." At the operation a gall-bladder with thickened walls was found to be full of stones. The common duct was very much dilated, and a stone the size of a small Barcelona-nut was felt in the lower part of the duct. The duodenum was opened to remove this, and the stone was seen through the orifice of the duct (I doubt if the ordinary form of "ampulla" was present). The opening was enlarged and the stone removed. The gall-bladder was then opened, many stones removed, and a drainage tube placed in it. Quite well in February, 1906.

Case 7.—Mrs. M. N., aged thirty-six, January 26, 1906, sent by Dr. Cass, Ravenglass. For two years the patient had suffered from gall-stones; there were attacks of pain in the right hypochondrium, followed by jaundice. In August last, a very severe attack with a rigor and jaundice. Since then has been continuously jaundiced, though at times, if free from pain, the jaundice has almost gone, and the urine and fæces have been normal. Her last attack was on December 26, 1905. When seen on January 26, 1906, was very slightly sallow. Operation January 31st. The abdomen was opened through the right linea semilunaris. A stone was felt at once in the ampulla. The duodenum was opened by a longitudinal incision and the calculus extracted. The gall-bladder was contracted and thickened; it contained four stones. Cholecystectomy was performed.

The following description of his first case is given by McBurney ("Annals of Surgery," vol. xxviii, p. 483):

"On opening the abdomen I found a much enlarged and engorged liver; an atrophied gall-bladder containing no calculi; moderate adhesions covering the cystic and common duct, which were, however, easily broken down, allowing of complete palpation of the entire bile track. With one finger behind the duodenum and another depressing its anterior surface a large, hard mass was readily discovered lying behind the centre of the

descending portion of the duodenum. This was clearly a calculus. I at first made a somewhat prolonged effort to so raise the duodenum and bring the lower end of the common duct into view as to enable me to open the latter and extract the stone. I found that this was quite impossible, for I could neither bring the lower end of the common duct into view, nor, if I opened it, could I expect to be able to suture it. It occurred to me that if I entered the duodenum through the anterior wall of its descending portion I should come at once to the point where the duct joined the intestine. I therefore made a vertical incision, about 1½ inches long, at the point referred to, and found the papilla which marked the entrance of the common duct, directly opposite the incision. A probe was introduced without difficulty, which, after passing about half an inch upward through the duct, came in contact with a firmly impacted stone. The orifice of the duct was first slightly incised, then with the aid of forceps largely stretched, until it was possible without difficulty to dislodge the calculus and draw it down into the intestine. Large quantities of bile immediately flowed into the gut. The wound in the intestine was then sutured with three rows of silk. The parts that had been exposed were carefully cleansed and the abdominal wound sutured with catgut, leaving only a small orifice for drainage by means of a piece of iodoform gauze. The drainage material was removed at the end of two days, and, although the superficial wound was somewhat slow in healing, the patient made a complete recovery without fever or other abnormal sign of any kind. Her weight, which had been reduced to 90 pounds within six months, has returned to her normal standard of 180. Since that time I have frequently seen this patient, and she has remained in robust health up to the present date."

Difficulties Experienced During the Performance of Choledochotomy.—During the performance of operations for gall-stones it may be difficult—it is, indeed, at times impossible—to say whether a stone is present in the common duct. An enlarged lymphatic gland lying in the free edge of the gastrohepatic omentum may be absolutely indistinguishable, by touch alone, from a calculus in the first portion of the common duct. It causes a hard, rounded, slightly mobile swelling, in all respects similar to a stone.

When, however, the method of rotation of the liver is employed and the duct is brought to the surface, the distinction between the two is readily made.

It is not so much in this first part of the duct that difficulties are likely to occur: it is in the second and third portions of the duct; when a stone is present, it may be, indeed often is, surrounded by a dense thickening in the head of the pancreas, so that in the midst of this tough mass no definite stone can be felt. Or, on the other hand, so dense and resistant a swelling may there be felt that the surgeon has no doubt that a stone will be found. Yet, on cutting into the swelling, or on introducing a finger into the duct, no calculus may be felt. In some instances a small chronic abscess in the head of the pancreas may be opened. Legueu, Schwartz, and others have recorded cases of localised induration of the head of the pancreas, incised in the belief that a stone was present, and until I became familiar with the conditions of chronic pancreatitis I made several such mistakes.

When a stone is impacted in the ampulla of Vater, it may be so small as to be felt with difficulty, or, being felt, it may be mistaken for a hard, inflammatory, or perhaps malignant nodule in the pancreas. A growth in the ampulla cannot be discriminated from stone until the duodenum is opened. In one case of carcinoma of the ampulla that I saw it was thought that the small, hard, rounded lump was calculous, and it was only after exposing the ampulla that a growth therein was disclosed. Difficulties, therefore, in the recognition and discrimination of stone in the lower end of the duct may arise from—(*a*) Stones being overlooked, a thickening felt upon the duct, and its surroundings being looked upon as due to inflammatory deposit; (*b*) no abnormality being recognised when a postmortem examination or a later operation discloses the presence of a stone; (*c*) a condition supposedly due to calculus being recognised and the duct being directly incised, or the ampulla laid open and the duct probed, with the result that no obstruction is found.

LUMBAR CHOLEDOCHOTOMY.

Access to the common duct may also be obtained by the lumbar route, as was shewn by Braun in 1876. On one occasion Tuffier has performed lumbar choledochotomy successfully. The method, however, as a deliberate procedure, possesses no conceivable advantages, and may usefully be relegated to oblivion.

Though these operations are described separately for convenience, it must not be considered that they are performed in the academic method here portrayed. In several instances I have simultaneously performed choledochotomy and cholecystotomy, choledochotomy and cholecystectomy, and duodenocholedochotomy and cholecystotomy or cholecystectomy. One point cannot be too frequently nor too strenuously emphasised —that is, that drainage is the secret of success in gall-bladder surgery; it is always an advantage, often imperative. In cases of cholangitis, as made manifest by fever or jaundice or both, and of pancreatitis, drainage must be practised, and should be maintained for a considerable time.

OPERATIONS FOR IMPERMEABLE OR IRREMOVABLE OBSTRUCTION OF THE COMMON DUCT.

When the common duct is occluded by stricture or growth, or rarely by inaccessible or irremovable calculus (if, indeed, such a thing exists), or by pressure from without, due to pancreatic enlargement, it may be necessary to divert the stream of bile by forming a communication between the gall-bladder or the duct above the obstruction and some part of the alimentary canal. Anastomoses have been made between the gall-bladder and the stomach—cholecystgastrostomy; with the duodenum or any part of the small intestine—cholecystenterostomy; or with the colon—cholecystcolostomy. The common duct has been united to the duodenum or other accessible part of the small intestine—choledocho-enterostomy. The duodenum is the portion of the bowel selected whenever possible, but where adhesions are binding and inseparable, any accessible portion of the stomach or

small or large intestine may be chosen. These operations are rarely practised at the present time, except in some cases of carcinoma of the head of the pancreas, or in chronic pancreatitis, where cholecystenterostomy gives marked relief. Since the longer incisions have been made, and the method of rotation of the liver already described has been practised, the common duct has been more readily accessible, and any obstruction has been more easily overcome. There are very few indications for the operations.

CHOLECYSTENTEROSTOMY.

The operation of cholecystenterostomy was suggested by Nussbaum and first performed by von Winiwarter in an operation which was completed in six stages on dates from July 20, 1880, to November 14, 1881.

It used to be generally agreed that for the purpose of effecting the anastomosis a Murphy button should be employed. The button is never used now. In one case, Mayo Robson found the anastomotic opening made in this way narrowed almost to obliteration. I have performed the operation on many occasions in cases of chronic pancreatitis. I adopt the method of simple suture, the stitches being passed in exactly the same manner as in the operation of gastro-enterostomy. The advantage of simple suture is that the opening may be made of ample size, so that subsequent narrowing or closure need not be feared. If possible, enough of the gall-bladder and of the duodenum should be drawn up into the wound to allow of the application of Smith's small curved intestinal clamps. These will facilitate the operation considerably by keeping the viscera to be sutured close together without difficulty, and by preventing any leakage from the openings. The two portions to be anastomosed lying side by side, a continuous suture of fine Pagenstecher thread is now introduced along a line at least one inch in length. This suture picks up only the peritoneal and subperitoneal coats. In front of this line of stitches an incision is now made into the gall-bladder and

into the intestine, the length being about three-fourths of an inch. The edges of these incisions are now united by a continuous suture of catgut which begins at the one end of the incision, unites the posterior edges of the wounds until the opposite end is reached, and then returns along the anterior edges until the starting-point is reached. The suture is a continuous one, and unites the edges by a through-and-through stitch. The

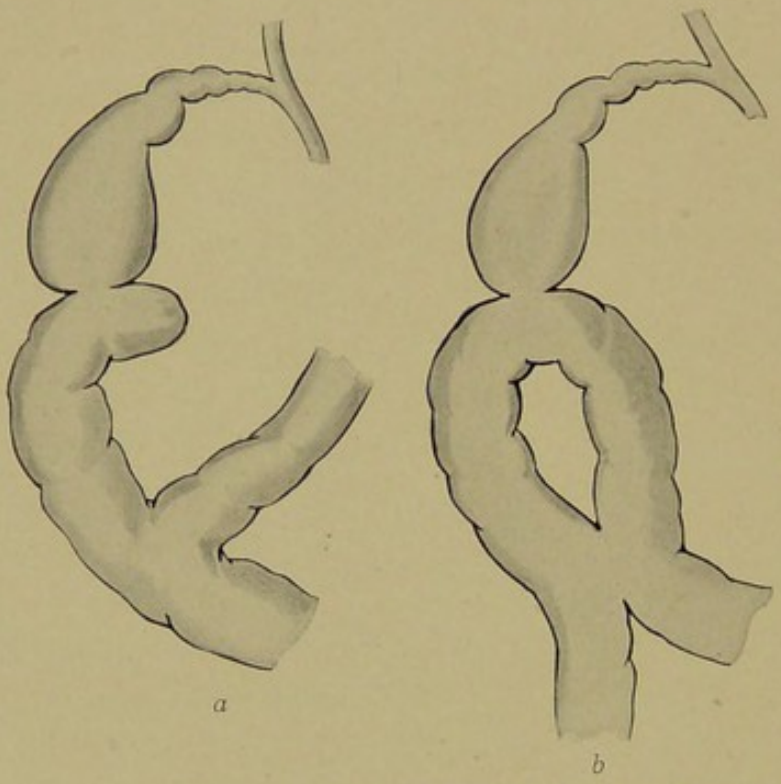

Fig. 331.—*a*, Cholecystenterostomy combined with exclusion of the intestine and end-to-end anastomosis: a method I have adopted once; *b*, cholecystenterostomy combined with entero-anastomosis as suggested by von Mikulicz and Maragliano.

returning half of the suture is introduced by Connell's method ("loop on the mucosa"), with the effect of turning in the peritoneal coat, and so producing a serous apposition. The edges of this suture are cut short, and the first needle which has been temporarily laid aside is now resumed and the serous coat united along the anterior margin of the wound, to the point whence it started. Thus there are two continuous sutures which completely surround the opening: an inner one of catgut, which

picks up all the coats of each viscus, and an outer one of Pagenstecher thread, which unites only the serous and subserous coats.

If the duodenum is not accessible, the stomach may be chosen. The records of seven cases of cholecystgastrostomy were collected by Perier in 1902. Of these, six proved successful. The fact that bile is not injurious to the stomach and does not in any way interfere with digestion has been shewn by a case of my own recorded in the "British Medical Journal," vol. i, 1901, p. 1136, and by the experiments of Stendel upon dogs. I have anastomosed the gall-bladder to the stomach in twenty-one cases; twenty patients recovered from the operation and lived for several months or years without suffering any disability which could be attributed to the entrance of bile into the stomach.

If the small intestine is selected for the anastomosis, some difficulty may result from the passage of the intestinal contents into the gall-bladder. To overcome this difficulty the operation may be performed after the method suggested by Mikulicz. A loop of the intestine is isolated. The apex of the loop is united to the gall-bladder; the sides of the loop, about four inches away, are united to each other by a lateral anastomosis. The intestinal contents are in this way short-circuited, and there is no risk of infection of the gall-bladder from the intestine.

It would, doubtless, be an advantage in cases such as this to perform intestinal exclusion as well as cholecystenterostomy. The small intestine at the point selected would then be divided completely; the proximal end would be united to the side of the distal end, about five inches from the point of division, and the distal end would be closed, and a lateral anastomosis made with the fundus of the gall-bladder. After the union of the gall-bladder to any part of the alimentary canal, a wisp of omentum is brought up and fastened round the line of suture, as an additional security. The abdomen is not drained.

CHOLEDOCHOSTOMY.

The operation of choledochostomy, the opening of the common duct and the suture of the margins of the openings to the abdominal wound, is said to have been first performed by Parkes. This, however, is incorrect. It was drainage of the duct that Parkes adopted—the performance of choledochotomy without sutures. The operation of choledochostomy was first performed by Helferich in 1887, subsequently by Ahlfeld, von Winiwarter, and others. The nature of the operation in the cases of Helferich and Ahlfeld was recognised only at autopsy; it was believed in both that the distended gall-bladder was being opened. To von Winiwarter belongs the credit of first deliberately performing the operation, knowing what he did. In all the cases recorded the common duct has been greatly, often enormously, dilated behind an obstructing calculus. That the dilatation must be considerable is recognised when we know that in two cases mentioned, and in several others, the duct has been mistaken for the gall-bladder, or even for a pancreatic cyst. Several remarkable examples of extreme dilatation of the common duct have already been mentioned. The duct may be opened, emptied, and forthwith stitched to the parietal peritoneum and the aponeurosis, or the operation may be done in two stages, the opening of the cyst being deferred until union between the duct and the peritoneum is complete.

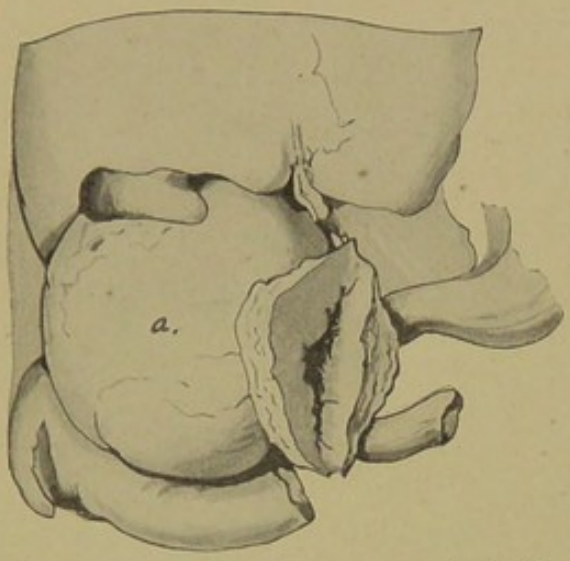

Fig. 332.—Ahlfeld's case of choledochostomy: *a*, The dilated duct stitched to the skin.

In Helferich's case the biliary fistula bled and suppurated,

and the patient died about one month after the operation. Ahlfeld's patient died on the eighth day, of collapse. Von Winiwarter's patient died six weeks after the operation, of gradual exhaustion due to the generalisation of a malignant growth. The following case is worthy of record as shewing the conditions likely to be met with during operation. It is recorded by Hamilton Russell ("Annals of Surgery," vol. xxvi, 1897, p. 692):

"George S., aged eight, was admitted to the Melbourne Hospital for Sick Children March 23, 1897. On the eighteenth, five days previously, he became feverish and ill, and on the next day, the nineteenth, the mother noticed a swelling of the right side of the abdomen. There was constipation, and the one motion passed during the five days prior to admission was putty-like and offensive; the urine was deeply coloured with bile.

"On admission the patient was a well-nourished child, with the history of having enjoyed excellent health up to the onset of the present illness. Jaundice was general and marked; temperature, 102° F.; pulse, 128. The right flank was occupied by a large, tense, elastic tumour, dull on percussion, being continuous with the liver-dulness above; extending downwards an inch below the iliac crest, reaching inwards nearly to the mid-line, and posteriorly occupying the entire lumbar region. There appeared to be distinct tenderness on palpation of the tumour; there was a slight increase of the liver-dulness upwards. A second, smaller tumour projected visibly immediately beneath the rib-cartilage about the right linea semilunaris; this tumour was rather larger than a pigeon's egg, round, soft, elastic, and painless. Both heart and lung sounds were normal.

"The view taken as to the nature of the case was as follows: The larger tumour was believed to be an echinococcus cyst, which had escaped notice until the onset of the present illness; the smaller tumour was either a second cyst or possibly a distended gall-bladder.

"Operation on April 8. The abdomen was opened by a four-inch incision in the right linea semilunaris, extending downwards from near the costal margin. The smaller tumour at once presented, and was found to be the gall-bladder distended with colourless contents; there were no adhesions, so that its entire con-

tour could be readily felt. Turning now to the larger cyst, this was found to be retroperitoneal, and the colon was bound to the face of it, being nearer the inner than the outer side of the cyst. An exploring syringe was now used, and perfectly clear, limpid fluid obtained, having all the physical appearance of hydatid fluid. The cyst was next emptied in great part by aspiration and then incised, when three surprising discoveries were made: (1) in the fluid, as it flowed, there came several blackish masses looking like cinders; (2) there was no echinococcus cyst; (3) at the end of the flow the fluid was observed to suddenly change in character, and in place of the clear, limpid fluid there came one or two ounces of less clear and distinctly mucinous fluid. It was now ascertained that this mucinous fluid had come from the gall-bladder, which was collapsed, having emptied into the larger cyst. Thus it was evident that this large retroperitoneal cyst had a communication with the common bile-duct, and the only conclusion I was able to arrive at as the result of much speculation, with which I need not weary the reader, ascribed to the cyst a pancreatic origin; the possibility did not occur to me that in a child of eight, who had never suffered a day's illness until three weeks previously, this enormous cyst could itself be the dilated common bile-duct.

"The operation was completed by stitching the opening in the cyst to the musculature of the abdominal wall, and closing the abdominal wound. After the operation the whole of the bile commenced to flow from the opening; with the view of ascertaining whether there was any admixture of pancreatic fluid with the bile, its digestive properties were investigated by my colleague, Dr. Stawell, with a negative result, nor was any excess of fat discovered in the stools. The child died four days after operation from hæmorrhage, the result of uncontrollable oozing from the stitches and into the cyst.

"*Autopsy.*—The body was universally jaundiced, and had the waxen appearance characteristic of death from hæmorrhage; the cyst was filled by a mass of normally clotted blood, with some bile. On opening the body the intestines appeared to be lightly smeared with blood, and the points of contact of neighbouring coils were marked by lines of blood; all the organs were healthy with the exception of those concerned in the operation. The liver, with the system of biliary vessels, including the cyst, the duo-

denum, pancreas, and spleen, were removed in one piece. The cyst is seen to communicate anteriorly with the gall-bladder, the cystic duct being dilated so as easily to admit an ordinary pen-holder. At the transverse fissure the dilated hepatic ducts are seen opening into the cyst. The duodenum and the head of the pancreas are spread over the outside of the cyst. A careful search for the terminal portion of the common bile-duct reveals a small valvular opening on the interior of the cyst, through which a probe can be passed into the duodenum, on the surface of which it appears through the usual papilla; that this is the normal termination of the common bile-duct is proved by passing a second probe through the same duodenal orifice into the pancreatic duct; this can be easily done. Russell adds: 'We may safely conclude that the condition was congenital.' "

Additional cases are recorded by Edgeworth and others.

CHOLEDOCHO-ENTEROSTOMY (RIEDEL'S OPERATION).

If the nature of the cyst formed by the dilatation of the common duct can be recognised, it is certainly better to perform an anastomosis between the overdilated duct and the intestine. This operation, choledocho-enterostomy, was first performed by Riedel in 1888. It was Riedel's intention at first to cut across the duct completely and to implant the severed end in the duodenum, but, abandoning this idea, he united, by lateral anastomosis, the dilated duct to the bowel. The patient died as a result of the leakage of infected bile into the general peritoneal cavity. Kocher, in 1890, operated upon a patient in whose common duct two stones were impacted. The duct behind the block was greatly dilated, and it was his intention to unite the duct to the duodenum lying in contact with it, and sutures were introduced for the purpose. The obstruction of the duct, however, was relieved by the breaking-up of the stones, and the opening, therefore, was not made. Sprengel, in 1891, reported the first recovery after this operation, the patient being a woman upon whom he had previously performed cholecystectomy. During the first operation the greatly dilated duct was mistaken

for the duodenum, and a calculus felt therein was pushed onwards.

Several operations have been done under the impression that a cholecystenterostomy was being performed—the exact conditions being made clear only at an autopsy.

The anastomosis has been effected either by simple suture or by the aid of mechanical appliances, such as Murphy's button, as in Czerny's case, or Boari's button. The method of lateral approximation has been always adopted.

The following case is related by Swain ("Lancet," vol. i, 1895, p. 743):

"On October 12, 1904, I was asked by Dr. Clay to see a girl, aged seventeen years, who had been brought to him for the first time on the preceding day. She had been ailing more or less for two years. In January, 1894, she became jaundiced, and a swelling formed under the liver. She had been treated by two medical men with mercury and other drugs, but in spite of their treatment the jaundice deepened and the swelling under the liver increased in size. They appear then to have told the parents that nothing more could be done, whereupon Dr. Clay was consulted. The condition of the patient when I saw her was briefly as follows: She was very deeply jaundiced; the urine was the colour of porter. The stools were white. She suffered no particular pain, had not been sick, and throughout her illness neither of these symptoms had been present. She was much emaciated. There was a large abdominal tumour reaching from below the liver to the brim of the pelvis and across the abdomen obliquely about 3 inches to the left of the umbilicus. The whole swelling was absolutely dull on percussion, and the merest tap on any part of it produced a thrill of fluctuation. Taking the sum of her symptoms we had little doubt that it was distended gall-bladder, although the possibility of a hydatid cyst was suggested. I aspirated the tumour with a full-sized aspirating needle, and we immediately perceived the characteristic fluid of distended gall-bladder. As if to make assurance doubly sure, towards the latter end of the aspiration a gall-stone struck the cannula repeatedly, and the click of impact was heard by Dr. Clay, the father, and myself. The quantity of fluid with-

drawn was six pints and one ounce. No evil results followed the aspiration, and I did not see the patient again until October 17, when I found that the swelling was as large as ever. We then advised that an operation should be performed, and for this purpose she was removed to the private home for patients, and on the following day I operated on her. An incision about four inches long was made a little to the outer side of the right linea semilunaris. The integuments were very thinly spread over the tumour, and the peritoneum was rapidly reached and opened. The cyst, being exposed, and packed well round with small sponges, was tapped with an aspirating needle. Fluid of the same character as before was withdrawn, but to the amount of seven pints and twelve ounces. On passing the hand into the abdominal cavity the cyst was found to be firmly adherent to the intestine in all directions, the transverse colon being spread out over it. A small opening was now made, sufficiently large to admit the forefinger. The cyst-wall was very thin, but tough. Externally, it was of a dark chocolate colour; the cut edge was rather white, and the interior bile-stained. On introducing the forefinger after a prolonged search no gall-stone could be found, although, as previously stated, the presence of one could not be doubted. The finger passed upwards and inwards towards the liver into a passage with a crescentic opening, which I believed to be the common bile-duct; but a probe passed down far beyond the finger impinged on no stone. Up to this time I had no doubt but that I was dealing with a huge, dilated gall-bladder, but my astonishment may be appreciated when I found, in the course of further investigation as to the relations of the parts outside the cyst, the gall-bladder in its normal position, somewhat pale in colour, undistended by bile, and containing no gall-stones. The question now arose as to what course was the best to pursue. To remove the cyst was impossible. To stitch it to the parietes seemed to condemn the patient to a perpetual fistula, or, at any rate, to very prolonged drainage. I decided, therefore, to accept the other alternative and to attach the cyst to the intestine. Without much trouble I succeeded in drawing up a good coil of jejunum close to the duodenum. My great difficulty was to get a good surface on the cyst. In order to do this I had to tear through the two layers of the mesocolon, and even then the surface obtained was limited. The cyst was then rapidly attached

to the bowel by Murphy's button in the manner described by him. The small original opening made to explore the cyst was closed with Lembert's sutures. The peritoneal cavity, which had been thoroughly well packed with sponges, was now cleansed, and the pouch to the outer side and beneath the liver drained with a Keith's tube. The wound was closed with silkworm-gut sutures."

A case is recorded by Terrier in which, after the anastomosis of a dilated duct to the upper part of the duodenum, the bile flowed backwards into the stomach and was vomited in large quantities.

A case of choledocho-enterostomy is also recorded by Brenner ("Virchow's Archiv," November, 1899, vol. clviii, part ii).

In certain cases there may be an actual loss of substance as a result of operations on the common duct. An anastomosis then between the common hepatic duct or the upper end of the common bile-duct, on the one hand, and the duodenum on the other, may be necessary.

Dr. W. J. Mayo reports ("Annals of Surgery," August, 1905, p. 90) a case of choledochotomy and cholecystectomy followed by stricture of the common duct. A secondary anastomosis was effected twelve months later between the hepatic duct and the duodenum. The following is his description of the operation and the annexed figures are copied from his:

"A five-inch incision was made just internal to and parallel with the cicatrix of the former wound. A dense tangle of adhesions was encountered, involving transverse colon, duodenum, and stomach, on the one side, and the liver and ducts on the other. By following the remains of the fistulous tract carefully and keeping close to the liver the original drainage opening at the site of the cystic duct was discovered. The hepatic duct was dilated and easily admitted the tip of the index-finger to the primary division. The common duct was reduced by cicatricial contraction to a fibrous cord, along which could be traced a little stain of bile. During the separation of adhesions it was noted that the duodenum overlapped the remains of the common duct

and formed one wall of the fistulous tract in its deeper portion. The external incision was continued to the sternal notch and the overlying liver held upwards. The duodenum was still further mobilised. The hepatic duct was freed from its attachment to the fistulous tract and from the remains of the common duct; the adhesions posteriorly were not otherwise disturbed, and served a very useful purpose. About three inches from the pylorus the duodenum was caught with three catgut sutures and fastened firmly to the adhesions and scar tissue about the hepatic duct, so

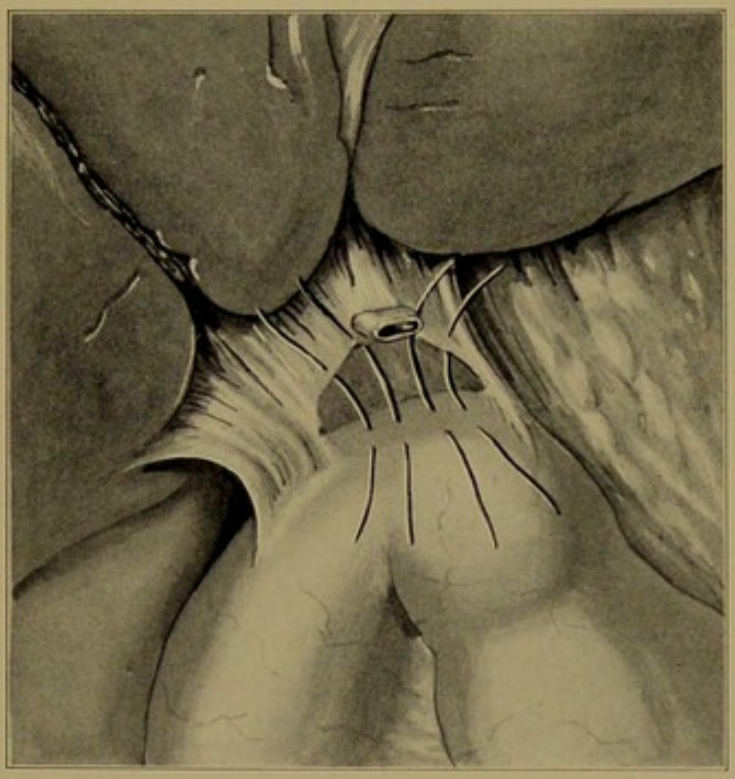

Fig. 333.—Hepatico-duodenostomy (Mayo's method).

that it was brought into contact with the end of the piece of all the coats of the hepatic duct. At the point of easy contact, an elliptical piece of all the coats of the duodenum was excised of about the same diameter as the open end of the hepatic duct, and four or five catgut sutures were introduced from the mucous side through all the coats of both duct and intestinal wall. In this way the posterior line of the anastomosis was completed. By alternately placing a suture externally and internally the sides were built up in a similar manner to a two-row intestinal anastomosis, excepting that only the inner row penetrated the duct-

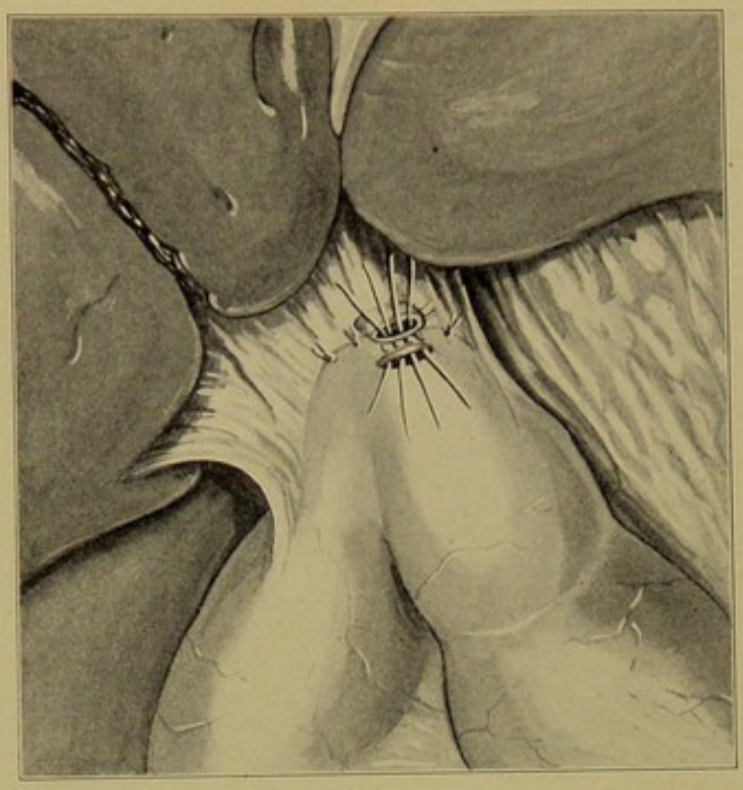

Fig. 334.—Hepatico-duodenostomy (Mayo's method).

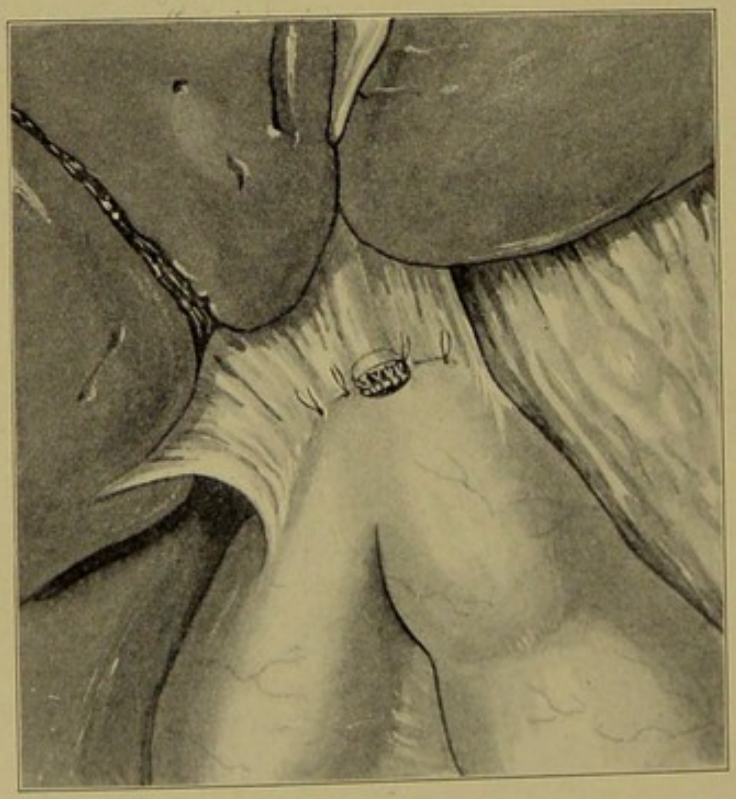

Fig. 335.—Hepatico-duodenostomy (Mayo's method).

wall. At the upper part the few remaining sutures were all placed before they were tied. The duodenum was still further attached laterally and anteriorly to the scar tissue, covering the liver and ducts by catgut sutures, making a broad area of attachment. A drain of rolled gutta-percha tissue was placed at the upper angle of the abdominal incision and another at the lower, but each at a considerable distance from the anastomotic suture line. The abdominal incision was then closed. Time of operation, fifty minutes. Patient made an uninterrupted recovery. There was no leakage of any kind; drains were removed on the sixth day; patient discharged on the sixteenth day. Patient reëxamined ten months after the operation (March 22, 1905): had gained 31 pounds in weight and was in excellent health."

CHOLEDOCHECTOMY.

Removal of a portion of the common duct with subsequent complete suture has, so far as I am aware, been performed only on one occasion, by E. Doyen. The case was one of stone impacted in the upper part of the common duct; in extracting the stone the duct was torn through. The frayed ends were trimmed and the ends sutured over a rubber tube. The figures explain the various steps of the operation.

When a part of the common duct is excised various reparative measures may be employed. The ends of the duct may be brought together with or without drainage; the distal end may be closed by a ligature while the proximal is implanted into the intestine; or both ends of the duct may be closed and cholecystenterostomy performed.

Kehr records a case in which a stricture of the common duct was excised. The posterior part of the duct alone was united; through the anterior part a drainage-tube was passed upwards to the hepatic duct. The patient recovered, though the hepatic cells were so damaged that no bile flowed through the tube at first; for several weeks a very small quantity only was passed. The fistula eventually closed.

In one case I excised a malignant stricture from the upper

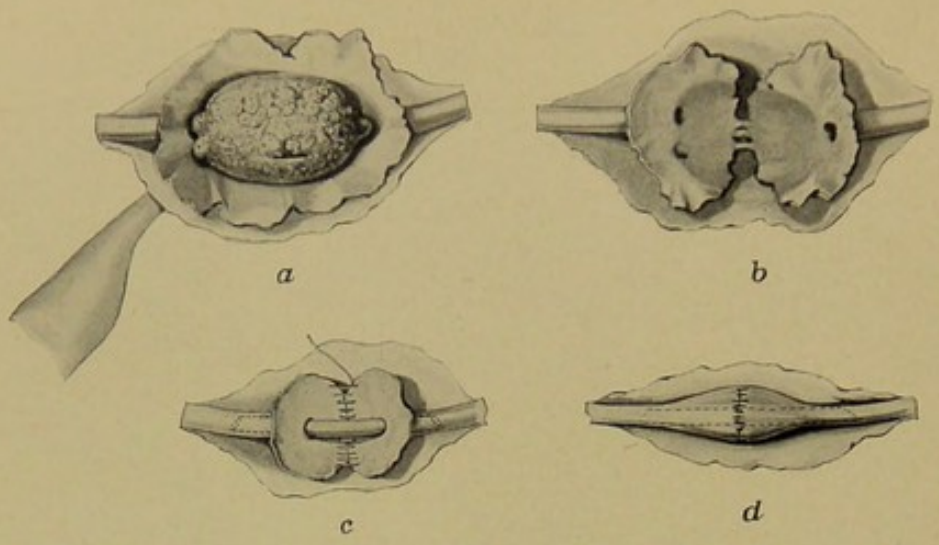

Fig. 336.—Doyen's case of choledochectomy: *a*, Shews the stone in the common duct, just beyond the junction of the hepatic and cystic ducts; *b*, shews the duct ruptured after extraction of the stone; *c* and *d*, the duct sutured after removal of the frayed edges seen in *b*.

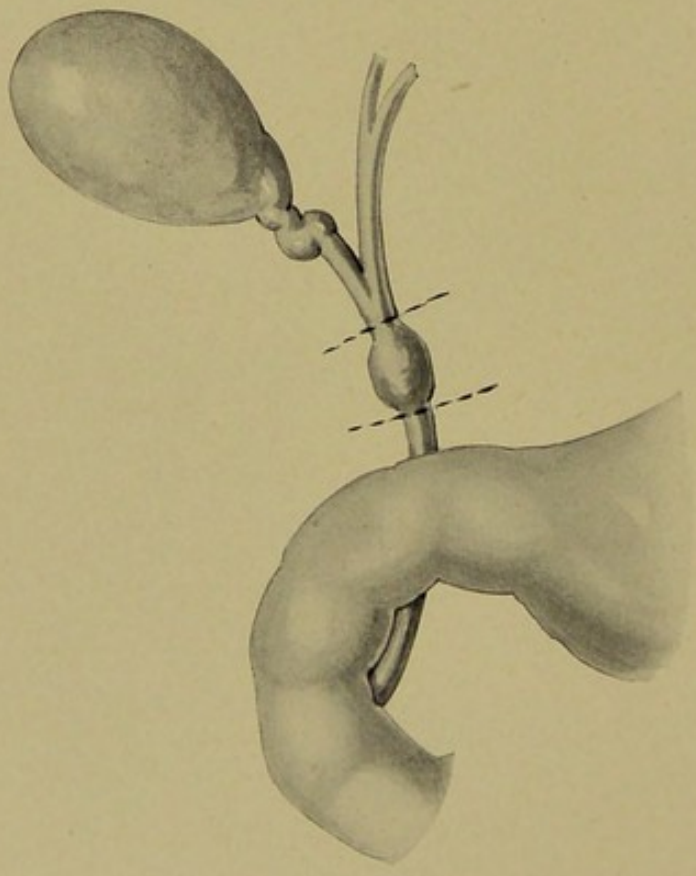

Fig 337.—Excision of growth in common duct.

part of the common duct. The ends of the duct came into easy apposition. About two-thirds of their circumference was united; the remaining third was left open, and a drainage-tube was left therein. The patient recovered from the operation,

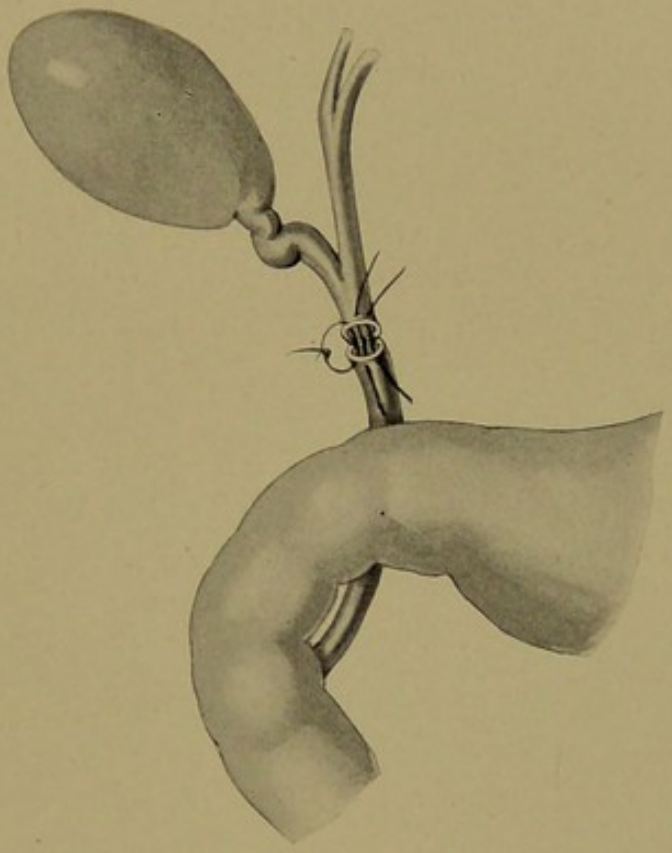

Fig. 338.—Resection of the common duct. End-to-end approximation after resection of a portion of the common duct.

but died in three months from recurrence in the glands in the portal fissure.

Waring and Reynier have successfully performed the operation of excision of a part and of the whole of the common duct in dogs. The operation deserves to be remembered, as in certain exceptional instances it may be necessary.

PLASTIC OPERATIONS UPON THE COMMON DUCT.

In certain cases of removal of a stone from the common duct so much damage may be done to the softened, easily lacer-

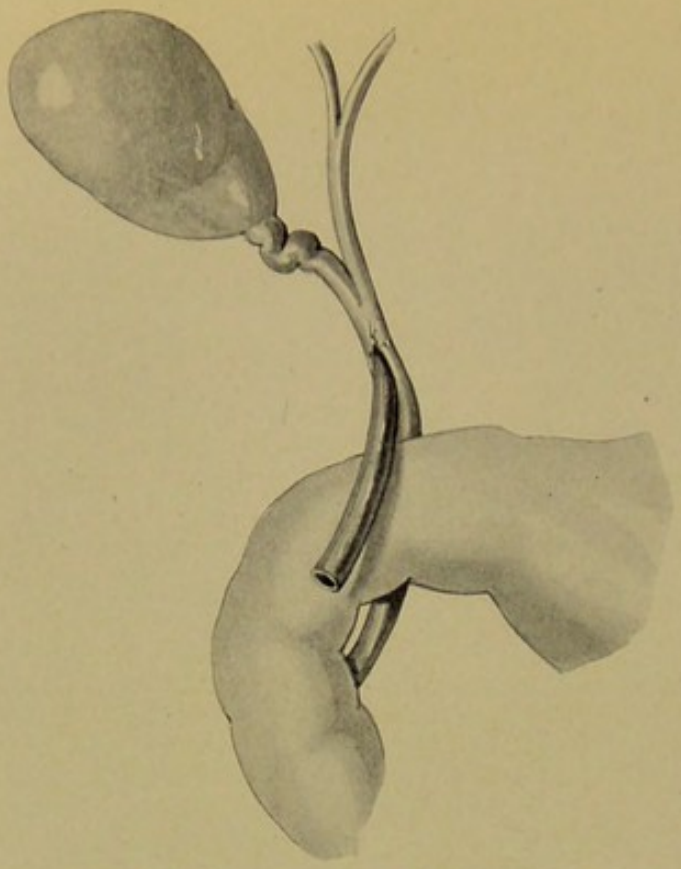

Fig. 339.—Resection of the common duct. Drainage tube introduced into common duct at the suture line of an end-to-end anastomosis.

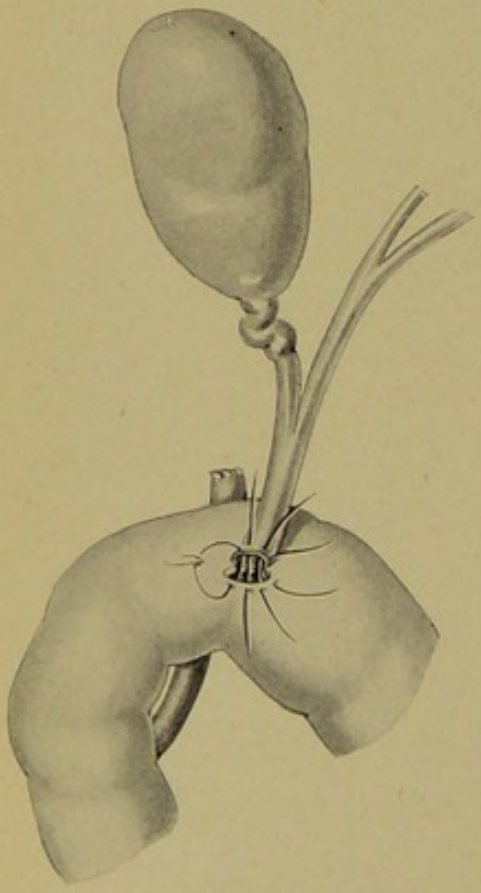

Fig. 340.—Resection of the common duct: closure of the distal opening and performance of choledocho-duodenostomy.

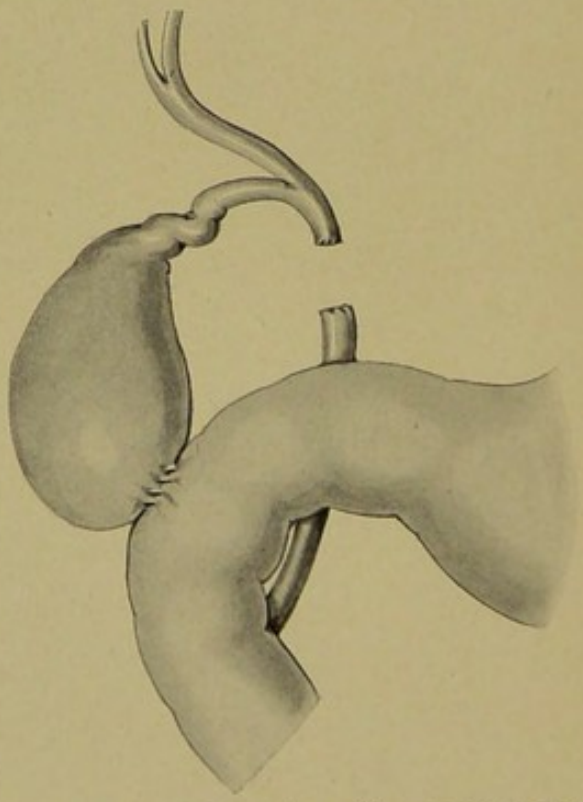

Fig. 341.—Resection of the common duct; closure of both ends and performance of cholecystenostomy.

able walls that a satisfactory healing without stricture may be impossible. In these circumstances choledochectomy may be performed as practised by Doyen; or the upper end of the duct may be closed by ligature, and cholecystenterostomy be performed; or the upper end of the duct may be united to the duodenum or stomach or finally a plastic operation may be performed as suggested and carried out in one case by Kehr. This surgeon, in order to repair a rent in the common duct, turned up over the

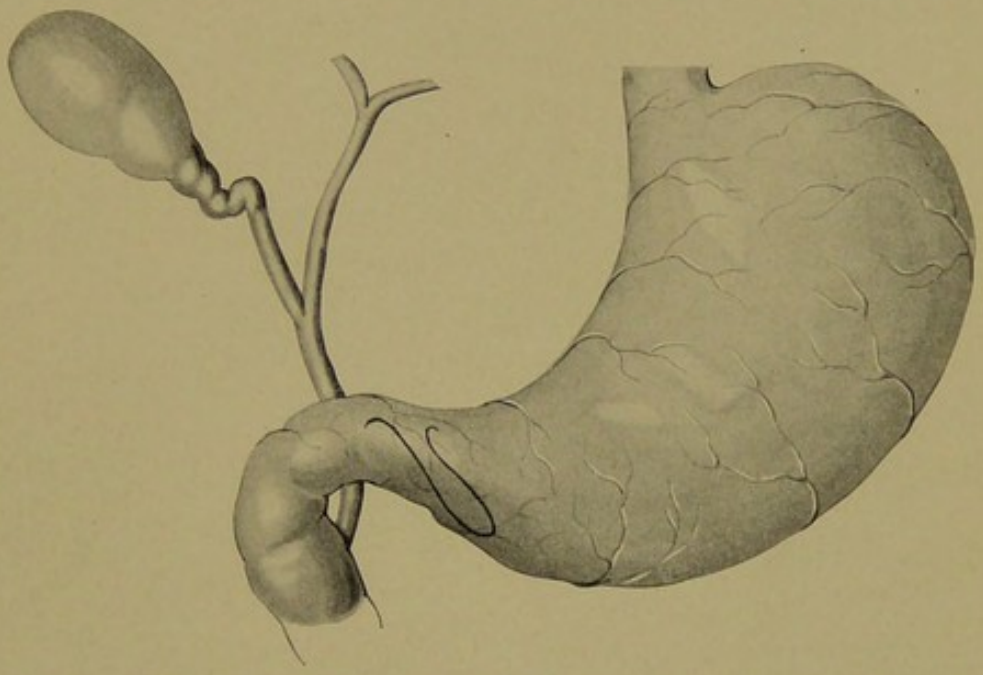

Fig. 342.—Plastic operation upon the common duct. A seromuscular flap is turned upwards from the stomach and sutured along the common and cystic ducts to repair a gap in the former (Kehr's operation).

duct a seromuscular flap from the stomach. A reference to the annexed pictures will make it easy to understand the details of the operation.

In one case I have performed a plastic operation upon the common bile-duct. The following are the notes:

M. S. B., aged sixty-three, had suffered for ten to twelve years from the following symptoms: Pain across the epigastrium, rather more on the right side, of the nature of cramp, radiating at times all over the abdomen, and especially to the left costal margin, and to the back of the right shoulder-blade; vomiting, which came on soon after the pain and very often gave relief to it, and jaundice, which was first noticed only eight years ago. There have been "dozens" of

attacks of pain followed by vomiting and jaundice. In the end of 1902 and the early part of 1903 the jaundice did not disappear for four months; during this time there were still attacks of pain followed by a deepening of the jaundice, and occasionally slight rigors were experienced. In April, 1903, a gall-stone weighing ½ ounce was passed; it measured 1¼ inch in length, and was ovoid in shape, "like a plover's egg." After this stone passed he was quite well up to December, 1903, when there was an attack of colic followed by jaundice. Until August, 1904, he remained free from attacks; then had a very severe attack

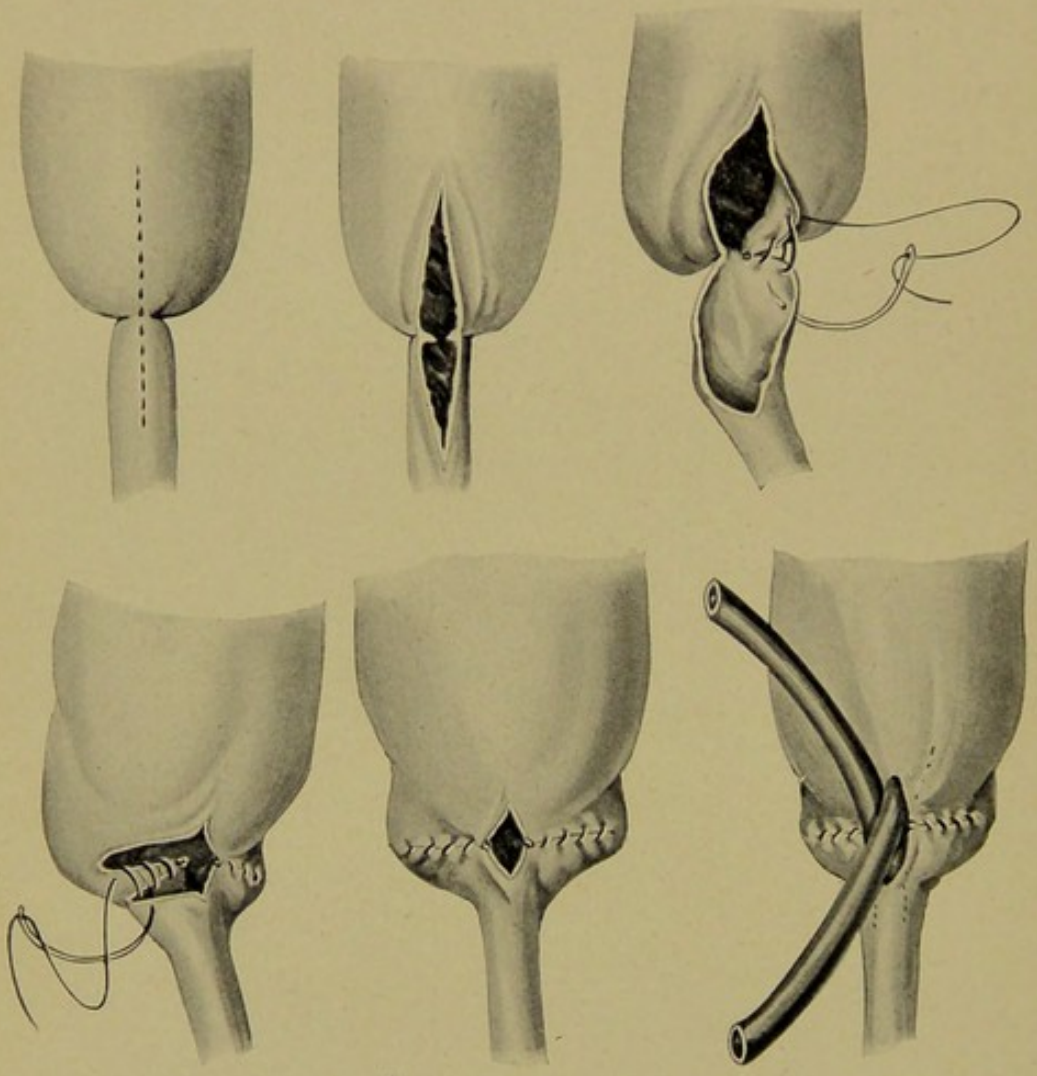

Fig. 343.—Stricture of the common duct treated by a plastic operation.

of pain followed by jaundice and vomiting. He remained jaundiced up to the time of operation. The jaundice had varied a little, being deeper after attacks of pain, but, on the whole, has become steadily deeper, and for the last six to eight weeks, during which he had several rigors, it has not lessened at all, but the colour has become progressively darker. He has lost 3 stones in weight, 1 stone in the last eight weeks.

A diagnosis of stone in the common duct was made, and operation advised. The operation was performed December 10, 1904. The abdomen was opened

through a vertical incision over the right rectus muscle, the upper end of the cut being prolonged inwards along the costal margin to the middle line. The gall-bladder was slightly adherent, its walls a little thickened, and there were many stones in its cavity. These were removed, but the gall-bladder was not extirpated, in view of the conditions found in the ducts. The common duct was found dilated, forming a cyst-like swelling. It was aspirated, and 11 ounces of bile were withdrawn. The needle being removed, an incision was made into the duct, and a stone the size of a nutmeg withdrawn at once; six other stones were found in the duct. After the dilated duct had been cleared of all easily discoverable stones by a scoop, the finger was passed in the duct upwards to the bifurcation of the hepatic duct, which was also dilated. The finger was then passed downwards, but no orifice could be felt; the inside of the duct seemed smooth everywhere, and no evidence of a passage from the cyst could be discovered. The outside of the cyst was then cleaned by gauze stripping, and the common duct below was defined. It was dilated also; an incision was made into it, and after a little difficulty a probe could be passed upwards into the dilated cyst-like duct. It was clear, then, that there was a narrow stricture of the duct, and that the dilation of the upper part had resulted from the obstruction. Between the two openings now made in the duct, one above and one below the stricture, an incision was made, dividing the stricture completely. Its nature was then seen. It was cicatricial, hard, indurated, and clearly the result of an old ulcer. An attempt was made to perform a plastic operation upon the duct, but it became evident that, despite the distension of the duct, it would be necessary to free the second portion of the duodenum, to "mobilize" it after the manner of Kocher. This was done, and the plastic operation was then readily performed. The stricture, which had been freely divided by a vertical incision, was now abolished by the approximation of the edges of this incision in a transverse direction. A reference to the diagrams will shew how this was done. A through-and-through suture of catgut was used, threaded upon an intestinal needle. The transverse wound was not completely closed, sufficient room being left for the introduction of two rubber tubes, one of which passed upwards into the dilated common duct and the other downwards towards the ampulla. Each tube was fixed with a single catgut stitch. The tubes were removed on the eleventh day. For four weeks bile in large quantities, in fact all the bile, passed through the wound. Some pancreatic juice also escaped in this way, as was shown by the digestion of the skin around the wound. In the fifth week, bile began to pass into the intestine, and in the ninth week the wound was entirely closed. The patient was sitting up in bed from the first, and was allowed to get up in the first week.

Since the operation he has been perfectly well, and a report received in January, 1908, says that he has gained 3½ stones in weight, has returned to work, and is in all respects quite well.

There are cases of stenosis and obliteration of the common bile-duct, or cases of trauma inflicted chiefly at the time of operation in which some method for the reconstruction of the bile tract would be a great advantage. A very ingenious method has been worked out, by experiment upon dogs, by A. G. Sullivan ("Jour. Amer. Med. Assoc.," 1909, ii, 774). The duct is replaced by a

rubber tube, one end of which is inserted through the duodenal wall, and the other is sutured into the upper end of the hepatic or common duct. Over the lower part of the tube the wall of the duodenum is folded and stitched as in Witzel's method of gastrostomy. The tube, if possible, is buried in the duodenal wall, as far upwards as the cut end of the duct into which its upper end is fixed. The tube and the duodenum are covered over with omentum. A small sponge was attached to the duodenal end of the tube, so that it might be grasped by the duodenum and excite a peristaltic action which would drag the tube down into the intestine by degrees. The results in eight dogs were functionally quite satisfactory. In only one case in man has a similar method been tried.

Brewer ("Annals of Surgery," 1910, i, 830) reports a case of obstinate biliary fistula treated in this way. The patient, aged thirty-five, was admitted to hospital suffering from acute cholecystitis. Operation was delayed two days after admission in the hope of the acute process subsiding. On the third day the abdomen was opened, the stomach, duodenum, colon, and gall-bladder were matted together, and the gall-bladder was gangrenous. Cholecystectomy was performed, the cystic duct being ligatured with No. 2 chronic catgut. Considerable reaction with infection of the wound followed this operation, and on the third day after operation a profuse flow of bile set in. The general condition improved, although there was considerable loss of tissue from sloughing, both in the surface and in the deeper portions of the wound. At the end of the third week the temperature was normal and the wound was closing rapidly. The biliary flow, however, still persisted, and there was no trace of bile in the stool. In eight weeks the fistula closed, but immediately following this pain and jaundice, with a sharp rise of temperature, set in. Two days later the fistula reopened and the fever, pain, and jaundice subsided.

It was thought that the sloughing following the operation had extended to the cystic duct, and had in all probability de-

stroyed at least a part of the common duct. A second operation was decided upon for the purpose of reconstructing the duct by the method of Sullivan. Brewer writes:

"On the seventy-fifth day after the primary operation the abdomen was reopened, and an attempt made to follow the fistulous tract downwards to its junction with the main biliary passage. In this we were unsuccessful, owing to the extreme friability of the tissues. After a tedious dissection, however, the opened end of the hepaticus was found, but no sign of the distal extremity of the choledochus could be discovered. The peritoneum along the outer border of the duodenum was next divided, the bowel turned towards the median line, and the head of the pancreas exposed. No trace of a duct was found in the retroduodenal region, but as the head of the pancreas was densely indurated, the lower segment of the choledochus was supposed to lie within this indurated pancreatic tissue. A careful but limited dissection was made of the superior extremity of the pancreatic head, but no lumen of the duct was encountered. The duodenum was then replaced, and the open end of the hepaticus freely explored. A small rubber tube was inserted into hepatic duct and secured by a purse-string suture of chromic gut. The other extremity of the rubber tube was then passed into the duodenum through a stab wound made on its upper surface. An attempt was next made to draw the duodenum upwards and hold it in contact with the open extremity of the hepatic duct, but this was unsuccessful, owing to too great tension and the fact that the sutures would not hold in the friable tissues surrounding the duct. The duodenum was then allowed to recede until all tension was removed, and the exposed median portion of the rubber tube wrapped in a mass of omentum which was secured by sutures in such a manner that it extended well above the opening of the hepatic duct, and downward for a considerable distance below the entrance of the tube into the duodenum. The abdominal wound was then closed, a cigarette drain being inserted to the omental graft."

On the third day after the operation bile appeared in the stools; later, the fistula closed completely, but the patient had a chill, high temperature, and slight jaundice on the thirty-first. From this he recovered, and was discharged on the twentieth day after

the second operation, or one hundred and fifteen days after the original cholecystectomy. Ten days later the patient returned to hospital on account of another chill and transitory rise in temperature and distinct return of the jaundice. There was no bile in the stools. A day or two later bile again appeared, the appetite returned, and the patient was discharged well. The rubber tube was not found in the stools at the time this paper was written (May, 1910), five months after the original operation.

OPERATIONS UPON BILIARY FISTULÆ.

External Biliary Fistula.—The treatment of external biliary fistulæ will depend entirely upon the conditions which produce and maintain the patency of the external opening. As a rule, with few exceptions, it will be found that the passage of bile through an external fistula is due to the fact that this is the direction of least resistance. If the bile-ducts are clear and free from narrowing, the bile finds its easiest course along them. After a cholecystotomy it is sometimes, as in cases of chronic pancreatitis, advisable to keep the opening patent for several weeks, and to accomplish this is not seldom a matter of the greatest difficulty. If, therefore, the bile-passages are free, an external biliary fistula will close spontaneously.

One form of external biliary fistula mentioned by both Riedel and Langenbuch is that in which a greatly dilated gall-bladder has been drained after cholecystotomy. The dragging of the gall-bladder fixed in the abdominal wound produces a kink in the common duct, and the passage of bile to the intestine is, therefore, prevented. In such circumstances the gall-bladder may, as Riedel advises, be freed, and the opening into its fundus sutured. A better plan would be to remove the gall-bladder entirely.

If the fistula persist after the operation of cholecystotomy, it probably indicates that a stone is wedged in the common duct. In this and in all cases it is advisable to make bacteriological examination of the bile, and to delay any operative intervention until the fluid discharged is almost sterile.

The treatment, therefore, of an external biliary fistula necessitates, at the first, a very thorough examination of all the bile-tract, and the discovery of the condition which is responsible for the prevention of the normal flow of the bile into the intestine. If a stone be found in the common duct, it will be removed; if there be a stricture of the duct, it also may be removed or cholecystenterostomy may be performed. If there be a growth or an inflammatory tumour causing obstruction of the duct by pressure from without, or by blockage from within, the fistula may be left as a permanent drain, or a cholecystenterostomy may be performed. If, after the removal of a stone in the duct, it is quite certain that the duct is clear, the gall-bladder may be removed. Kleiber, in 1892 ("Dissert.," Greifswald), had collected the records of thirty cases of fistula in which cholecystectomy was performed.

Internal Biliary Fistula.—The discovery of a fistula between the bile-passages and the intestine will generally be made only during the course of an operation. If the fistula connect the gall-bladder or the cystic duct, on the one hand, with the stomach, duodenum, or colon, on the other, the two united viscera must be separated with the utmost gentleness. The opening into the intestine is then closed by suture, and the gall-bladder is, by preference, removed, or a drain is introduced through the opening. It is of the highest importance in all such cases to make sure that the passage is clear for the bile. If there is a block in the common duct, it must be removed. As a rule, a stone will be found in the cystic duct, in the common duct near the cystic duct, or in the common duct low down. If choledochotomy is performed, it is wiser to afford, through the incision, a direct drainage for some days.

Cases of fistula between the bile-passages and the urinary tract or the lungs may also be dealt with successfully, by operation, the stones which are blocking the hepatic or common duct being removed and free drainage established. Instances are recorded in the chapter dealing with Biliary Fistulæ in my work on "Gall-stones and Their Surgical Treatment."

CHAPTER XLII.

THE SURGICAL TREATMENT OF CIRRHOSIS OF THE LIVER.

THE treatment by operation of those cases of ascites due to cirrhosis of the liver in which repeated tappings were necessary, though suggested and carried out in 1889 by Talma and Van der Meulen, owes its established position in the surgical procedures of to-day chiefly to the successful advocacy of Rutherford Morison. The patient under the care of Van der Meulen died almost at once of shock. In 1892 Lens, a pupil of Talma, recorded a case in which the edge of the omentum was sutured into the parietal wound, but the patient was unrelieved by the operation and died six months later, after being tapped on four occasions.

Rutherford Morison's first case, operated upon in 1895, was unsuccessful, but his second case was an unquestioned success. The patient was a woman who lived for two years after the operation, and died after a second operation undertaken for the relief of a ventral hernia which had developed at the site of the wound. Before the first operation tapping of the abdomen was frequently necessary; after the operation it was never needed. It was the success of this case which first attracted prominent attention to the operation.

The principle of the operation consists in the formation of additional venous communications between the systemic and portal circulations for the purpose of relieving the obstruction of the latter. The principle is carried into effect by suturing the omentum to the anterior abdominal wall, where it becomes firmly adherent, and by roughening, by gauze friction the outer surface of the liver and spleen (or even, as suggested by Ito, the mesentery and intestines), so that they too may adhere firmly to the parietal peritoneum.

In all the adhesions so formed vascular channels are soon established. In the postmortem report of Mr. Rutherford Morison's second case, alluded to above, the omentum, the liver, and the spleen were all firmly adherent to the parietal peritoneum by strong bands. In the case operated upon by Lens venous channels were easily formed in the new adhesions which had formed between the omentum and the parietal peritoneum.

The normal communications between the portal and systemic circulations are few; the coronary veins anastomose along the œsophagus with the azygos veins; the veins of the cæcum and colon, with the internal mammary; the superior hæmorrhoidal with the middle and inferior hæmorrhoidal in the rectum; these are the chief. Though they are capable of great dilatation, they do not afford much relief to the portal system in the oppressive congestion due to cirrhosis of the liver. When, however, a multitude of fresh communications are established, a considerable relief may be afforded.

Rolleston and Turner argue against the view that the new adhesions divert a part of the portal blood-stream; that ascites does not occur when the blood-pressure is presumably highest in the portal vein; that is, in the earlier course of the disease, when hæmatemesis is most often met with; that experimental ligation of the portal vein does not necessarily produce ascites; and that ascites is a late manifestation and appears to be rather a result of the toxæmic condition of the blood than a mere mechanical result of increased portal blood-pressure. They explain the results of Rutherford Morison's operation as being due to the formation of adhesions around the liver, which may be beneficial in two ways: (1) By diminishing somewhat the flow of blood through the liver and so enabling the organ to deal more satisfactorily with the blood passing through it, and so reduce the toxæmic condition of the blood, which is probably the important factor in inducing ascites. (2) By the presence of vascular adhesions allowing a freer supply of arterial blood

to the liver. The nutrition of the liver-cells is thus improved, and they are placed under better conditions for undergoing compensatory hyperplasia.

The conditions in which the operation is indicated are, according to Bunge:

1. Atrophic cirrhosis of the liver.
2. Cardiac cirrhosis: cirrhosis the result of cardiac disease.
3. Pseudo-cirrhosis, with chronic pericarditis.
4. Chronic hyperplastic perihepatitis.
5. Portal stenosis due to thrombosis (rarely).

THE OPERATION OF EPIPLORRHAPHY OR EPIPLOPEXY (TALMA-DRUMMOND OPERATION; DRUMMOND-MORISON OPERATION; TALMA-MORISON OPERATION).

The operation is performed in the following manner: As a rule, local anæsthesia amply suffices; it is in rare cases only that a general anæsthetic need be administered.

The abdomen is opened by an incision in or near the middle line, between the ensiform cartilage and the umbilicus. As soon as the peritoneum is opened the ascitic fluid will escape; it is encouraged to do so, and the pools of fluid in the renal pouches and in the pelvis are mopped with swabs until they are dry. Pains should be taken to see that no fluid is allowed to remain anywhere in the abdomen. The liver is then inspected, and a note of its condition is made. The whole of the upper surface of the liver—all that lies in contact with the diaphragm—is then brought as far into view as possible, and a gauze swab is rubbed with fair vigour over all the surface that is accessible. The spleen is then exposed (it will always be found enlarged) and is similarly treated. The omentum is now brought into the wound, and is sutured to the parietal peritoneum of the anterior abdominal wall. In the now relaxed condition of the abdomen, owing to the escape of fluid which had distended its cavity, the wall can be well everted and that part of it as far from the middle line as is accessible is first united to the

lateral margin of the omentum. The same procedure is adopted on both sides, and a series of sutures uniting the omentum at many points to the parietal peritoneum are passed. The peritoneum may first be roughened somewhat by gauze friction. The more points of adhesion which are ensured between the

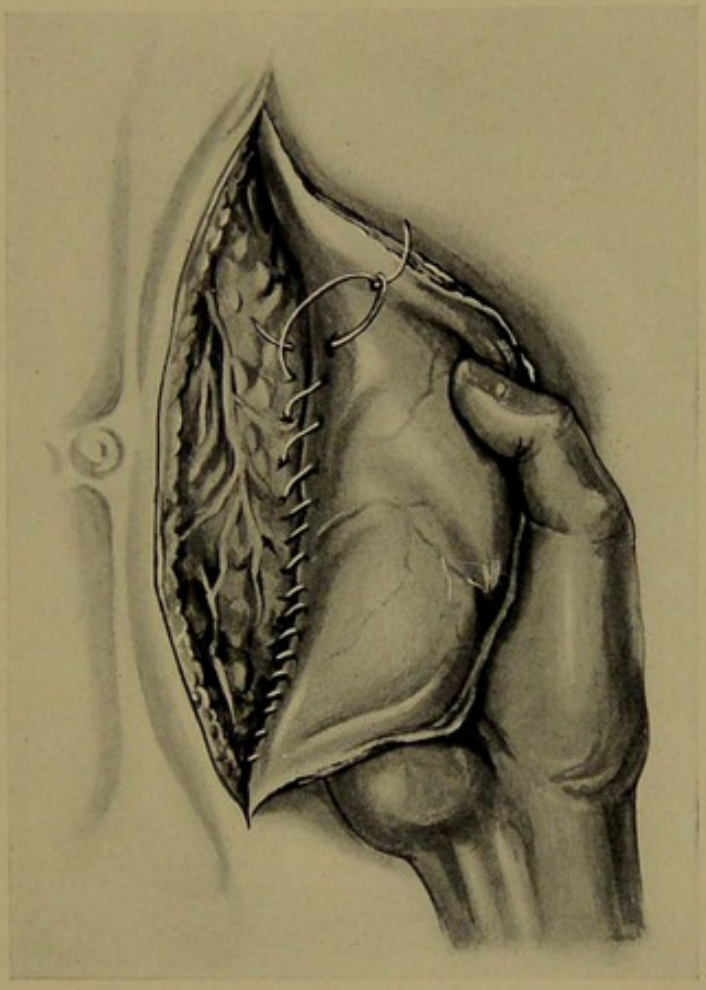

Fig. 344.—Epiplopexy (Talma-Morison operation). The omentum may be fixed by a continuous suture or by interrupted sutures. The abdominal wall, which is lax after the fluid has been emptied away, is everted as much as possible.

omentum and the peritoneum the better. In some cases the omentum has been sutured between the layers of the abdominal wall, with good result (the method of Schiassi). The abdomen is closed in the usual manner. In the earlier cases a second opening was always made above the pubes, into which a drainage-tube was inserted, but this has been proved to be both

unnecessary and undesirable, in that it has been a source of septic infection.

Results.—The results of this operation on the whole have been satisfactory. The mortality in a series of 105 cases collected by Greenough, however, was high, being, within thirty days of the operation, no less than 29.5 per cent. If this were the death-rate to be expected, it is so high as to be almost prohibitive of the operation. In the recent cases it is probably little more than a quarter of this, owing to the better selection of cases for operation, the necessity for which Dr. Greenough had emphasised. The most favourable cases for operation are those in which the liver is enlarged, rather than atrophied, and those in which perihepatitis is present. The operation is contra-indicated in patients who are in bad condition, in whom the functional activity of the liver-cells is greatly reduced, and in whom advanced renal or cardiac disease is present.

It should be performed, if a reasonable prospect of success is to be assured, as early as possible in the disease, in order that the compensatory hypertrophy of the liver-cells, which is probably one of the causes of the improvement in the patient's condition, may have time to develop.

Monprofit, of Angers, in an extremely good summary of the subject ("Traitement Chirurgical de la cirrhose du foie," Paris, 1904), has collected the notes of 224 cases. In 213 the result of the operation was known. He gives the following table:

Fatal cases	As a result of operation		42 cases.
	Shock		9 "
	Infection		7 "
	Other accidents		26 "
	Subsequent to operation	Cachexia	30 "
		Other concomitant disease	12 "
Cases recovering from operation	Recurrence of effusion		25 "
	Improvement		26 "
	Recoveries		70 "
	Patient's history not obtainable		8 "

The mortality of the operation was, therefore, 42 cases in 224, approximately 20 per cent. The post-operative mortality is also 20 per cent.

Monprofit points out that complete recovery has followed oftenest in the cases operated upon early, when the cirrhosis was not too advanced.

The procedure of Schiassi, the "intramural operation" of the Americans, was adopted in 35 cases, with 13 deaths and 22 recoveries. Of these 22, 4 cases recurred, 3 were not followed, 6 were improved, and 9 cured.

The method of Schiassi, therefore, offers no advantages over the original operation of Talma.

The following description of Schiassi's method is taken from O'Malley, "Amer. Jour. Med. Sci.," 1906, cxxxi, 878:

The skin incision is made on the left side, perpendicularly to the middle of the clavicle, and extending downward six to eight inches from the costal arch. At right angles to this cut, from its upper end, an incision passes to the right to a point a little beyond the median line. These two incisions are carried into the peritoneum, which is left intact at this stage of the operation.

Near the median line, and in the transverse incision, the peritoneum is picked up between two forceps, and a small opening is made to let out the ascitic fluid. Then a triangular flap, composed of the skin and the muscles, is dissected up, bluntly, or with some use of the blade, from the peritoneum. The apex of the flap is the angle of the incisions, and the base is a line out about the region of the navel. The flap is held folded over towards the right side of the patient by hæmostats. Then the small incision made in the peritoneum to let out the ascitic fluid is enlarged horizontally, parallel to the horizontal skin incision, until two fingers may be introduced to serve as directors, while the peritoneum opening is further enlarged. The omentum is to be brought out through this opening, but only about half of the peritoneal opening is made at first.

The omentum is drawn out through this opening so far that its border touches the base of the everted musculocutaneous flap.

The omentum is sutured to the peritoneum at the lips of the wound, serosa to serosa, the upper surface of the omentum to the

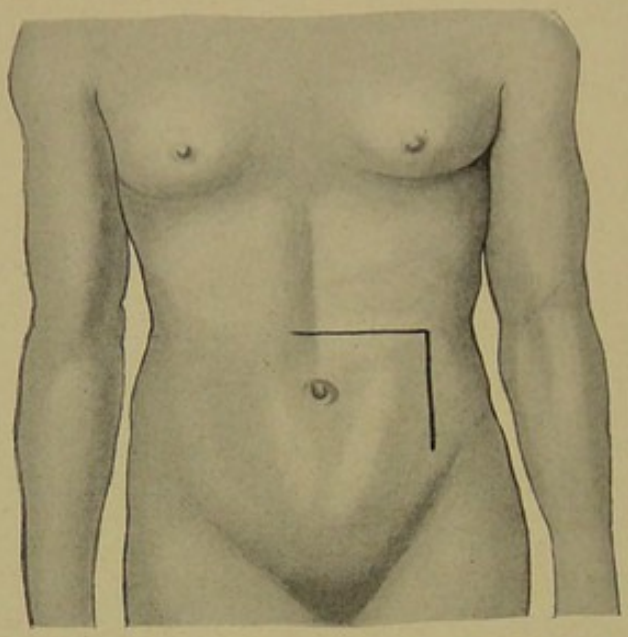

Fig. 345.—Schiassi's operation (from the original figures reproduced by O'Malley).

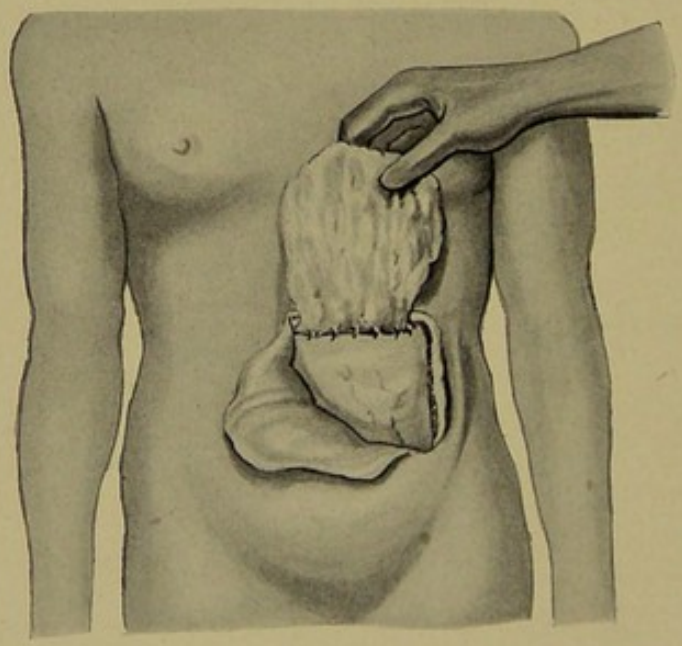

Fig. 346.—Schiassi's operation (from the original figures reproduced by O'Malley).

upper lip and the lower surface to the lower lip, avoiding all wounding of vessels by the stitches. The incision in the peritoneum is next prolonged to the left over to a point under the

apex of the costal arch and the omentum is further stitched to the lips of the peritoneal wound as before.

The exposed omentum is next rubbed, to excite adhesion, with gauze which has been dipped into 1 : 1000 bichloride, spread along the bared peritoneum, and fixed along its free border to the peritoneum by a few stitches.

If splenopexy is to be done, the next step is to open the peritoneum, so as to expose the spleen, by a slit parallel to the perpendicular musculocutaneous incision, and down the entire length of this cut. The exposed surface of the spleen is rubbed as widely as possible with sublimate gauze to excite adhesion, as

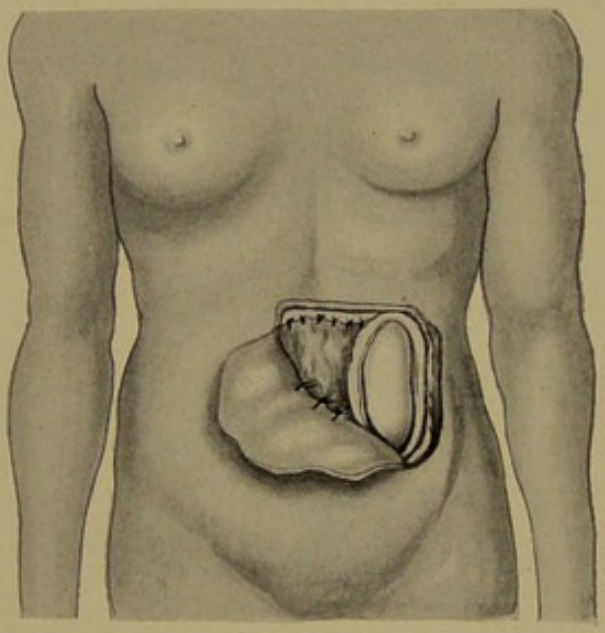

Fig. 347.—Schiassi's operation (from the original figures reproduced by O'Malley).

the omentum had been. Then a large piece of iodoform gauze is pushed into the space between the spleen and the diaphragm above, taking care to spread it out over the upper surface of the spleen toward the front, and this gauze is left projecting from the wound. A second large piece of gauze is inserted at the lower end of the wound so as to envelop the lower pole of the spleen, and the end of this gauze is pushed back to the bottom of the hypochondriac space. An end of the gauze is here also left projecting from the wound. The gauze is intended to aid in forming the juncture of the spleen with the belly wall, and to drain any seepage from the needle punctures.

The musculocutaneous flap is now brought up over the fast-

ened omentum. Then a semicircular needle is used, which has a diameter of from 6 to 8 centimetres and one millimetre thickness,

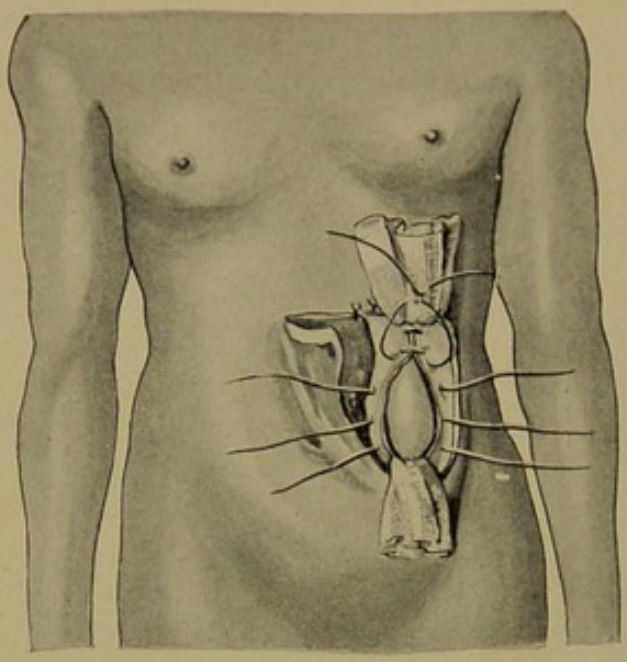

Fig. 348.—Schiassi's operation (from the original figures reproduced by O'Malley).

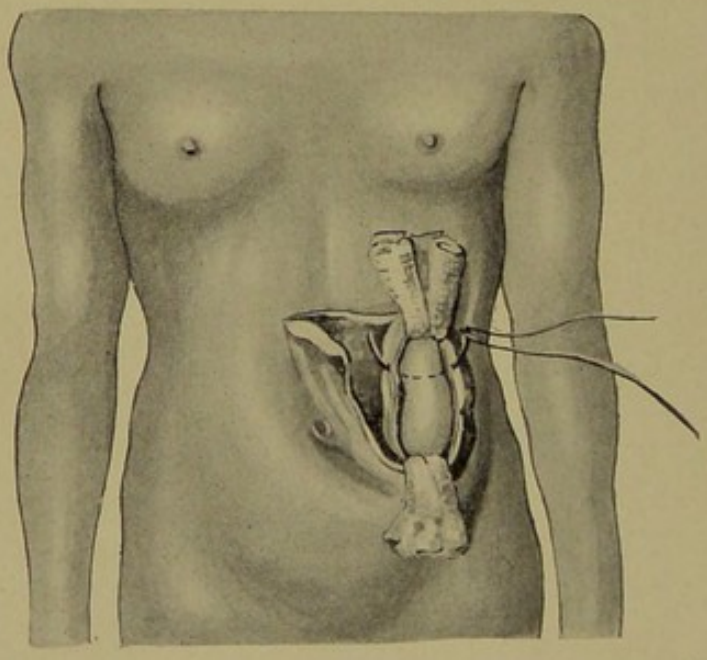

Fig. 349.—Schiassi's operation (from the original figures reproduced by O'Malley).

and heavy catgut, to fix the spleen to the belly wall. The skin is pushed aside and the needle is inserted about four centimetres to the left of the vertical musculocutaneous incision, passed

through muscles and peritoneum, then into the substance of the spleen and brought out through the peritoneum near the fixed omentum, into and through the muscles (not the skin) of the original triangular flap, so that finally the muscles along the left border of the vertical wound will join the muscles of the flap and cover the spleen. Similar interrupted sutures are inserted at two fingers' breadth distance down the vertical incision. There will be three, four, or six of these sutures according to the size of the spleen. These sutures are not tied at once, but left held by suspended hæmostats.

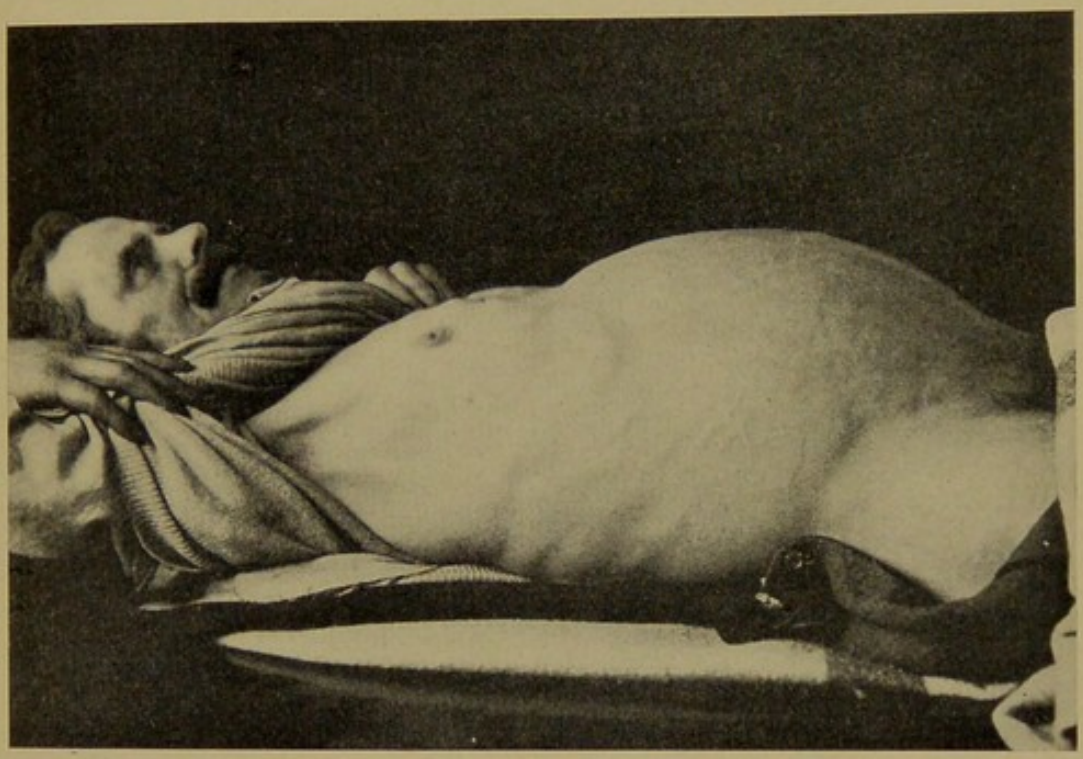

Fig. 350.—R. P., before operation. Shews the distension of the abdomen, with some venous trunks coursing up towards the axilla (Morison).

Next the incisions in the belly wall are closed, as in any cœliotomy. The sutures begin at the angle of the wound near the gauze, and silk or heavy catgut is used. The sutures are tied as they are inserted, except near the gauze at the top and bottom of the spleen. The sutures near the gauze are left untied for a few days until after the gauze has been drawn out. As the surgeon goes down the wound he meets and draws together and ties separately the sutures that are in the spleen itself and are fastened to the suspended hæmostat. The transverse musculocutaneous wound is afterward closed as in any cœliotomy case.

By the courtesy of my friend, Mr. Rutherford Morison, I am enabled to give two photographs of a patient upon whom he operated. The following are the notes of this case:

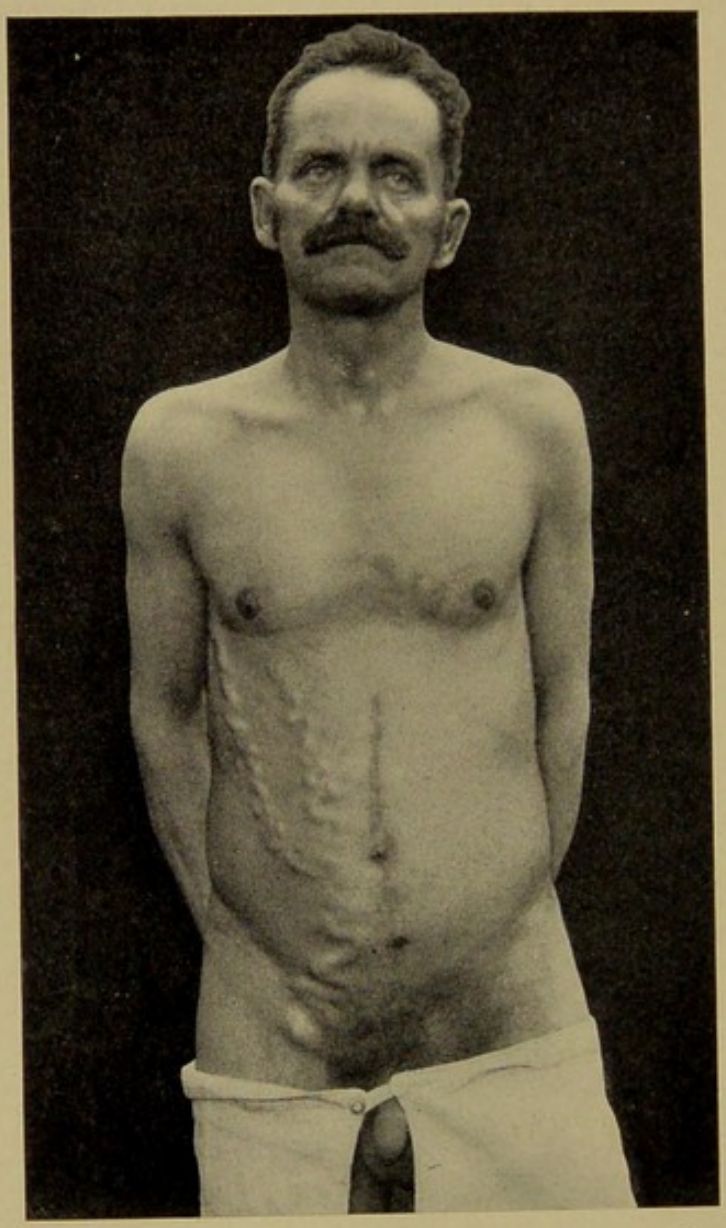

Fig. 351.—R. P., three and one-half years after operation. Shews the enlargement of the epigastric vein on the right side. The line of the incision above the umbilicus and the site of the drainage-tube below it are also seen (Morison).

"R. P., aged fifty-two years, was admitted to the Royal Infirmary, Newcastle-upon-Tyne, on February 27, 1899. Six months before he had begun to have occasional swelling of the abdomen, attended by a dull aching pain and swelling of the

legs and feet. Three and a half months later the abdominal swelling and pain became permanent and the swelling steadily increased. He had felt sick at times, but had never vomited. His urine had been scanty, high coloured, and thick on cooling. The bowels were constipated, but no blood had been noticed in the motions.

"*Previous History.*—He had had a rupture in the left groin for many years, which had grown more troublesome lately. Two and a half years ago he was treated in the Newcastle-on-Tyne Infirmary for delirium tremens. Previous to the attack he had been a heavy drinker; since then he had abstained entirely from alcoholic drinks. He had never had syphilis or other serious illness.

"From the time of his admission until the operation in August he was under the care of Dr. George Murray, to whom I am indebted for the following note: 'The main line of treatment has been as follows: Limitation of fluids taken; regular administration of mist. purg. alb., and tapping of the abdomen on left side by means of Southey's trocar. Girth at umbilicus before tapping, 36 inches.

Date of Tapping.	Quantity Removed, Fluid Ounces	Girth of Umbilicus after Tapping, Inches.
March 11	285	31
March 25	197	34
April 1	122	34½
April 8	317	32
April 20	114	35
April 30	97	34½
May 10	169	
May 20	176	
May 30	186	
June 11	167	
June 21	204	
July 2	212	
July 22	330	
August 9	354	
Total	2930	fluid ounces—18 gallons, 2½ pints.

"The case was discharged from the medical wards on August 17, 1899.

"On admission to the surgical ward his condition was described as follows: He was a thin man, with sallow complexion, sunken cheeks, and yellow-tinted conjunctivæ. His

tongue was clean and moist, appetite fairly good, arteries slightly atheromatous; pulse 92 and temperature normal. No jaundice or other disease discovered beyond what follows. His abdomen was much distended, and the physical signs were those of a large collection of free fluid. The left side of the scrotum was swollen from fluid distending a hernial sac.

"Dilated subcutaneous veins were visible, starting from the neighbourhood of the umbilicus and terminating in one large trunk on either side, which ran up over the chest into the axilla. The direction of the blood-current in them was ascertained to be from below upwards. Percussion shewed an increased splenic and diminished liver-dulness. There was some œdema of the feet and legs, extending as far as the middle of the calf.

"On August 29, 1899, the patient was operated upon, under chloroform. An incision about four inches long opened the abdomen between the ensiform cartilage and the umbilicus. The cut subperitoneal fat was vascular and bled freely. A large amount of clear, straw-coloured fluid escaped as soon as the peritoneum was divided. A second opening was next made, between the umbilicus and pubis, large enough to admit a half-inch diameter glass drainage-tube, which passed through it into the pelvis. Some adhesion was present between the liver and the omentum and between the omentum and the abdominal wall. The liver was firm, finely granular on the surface, and of about normal size. The spleen was hard and enlarged to at least double its normal size. The abdominal cavity was dried with sponges, special care being taken to rub the surface of the visceral peritoneum opposed to them. The omentum was fixed across the anterior abdominal wall by catgut sutures.

"The upper incision was entirely closed by catgut sutures. The lower was kept open for a drainage-tube, through which the fluid was pumped out of the pelvis. Over the dressings, broad, long strips of adhesive plaster were applied transversely from the chest above to the drainage-tube opening below. This was for the purpose of keeping the upper part of the abdominal cavity empty of fluid and the parietal closely applied to the visceral peritoneum.

"Two nurses with a reliable knowledge of antiseptic wound treatment were told off to look after the tube and keep any fluid from collecting in the pelvis or from escaping on to the dressings.

"The operation was well borne and his recovery straightforward. The following shews the amount of fluid removed daily from the tube:

1899.		1899.	
August	29, ℥xxiii.	September	16, ℥xvi, ℥v.
"	30, ℥xii.	"	17, ℥xxi, ℥vi.
"	31, ℥xix.	"	18, ℥xiv, ℥vi.
September	1, ℥xvii.	"	19, ℥xvi, ℥i.
"	2, ℥xix.	"	20, ℥xiv, ℥i.
"	3, ℥xiii.	"	21, ℥xiv, ℥iv.
"	4, ℥viii.	"	22, ℥xvi, ℥iii.
"	5, ℥xvi.	"	23, ℥xiv, ℥iii.
"	6, ℥xiv.	"	24, ℥xvii, ℥x.
"	7, ℥xi.	"	25, ℥xvi, ℥vi.
"	8, ℥xiii.	"	26, ℥xv, ℥vi.
"	9, ℥xiv.	"	27, ℥xiii, ℥vi.
"	10, ℥xiii.	"	28, ℥xi, ℥v.
"	11, ℥xiii.	"	29, ℥xix, ℥iv.
"	12, ℥xi.	"	30, ℥xvi, ℥iii.
"	13, ℥xiv.	October	1, ℥xix, ℥v.
"	14, ℥xvi.	"	2, ℥x, ℥i.
"	15, ℥xv.	"	3, ℥xii, ℥vii.
		"	4, ℥xii.

"October 9.—For the last few days very little fluid had escaped from the tube. There was some œdema of the scrotum and subcutaneous tissues of the back.

"October 10.—The tube was removed. There was no fluid escaping from it.

"October 16.—Patient very well; appetite good; quantity of urine, 63 ounces; the abdomen was a little distended; it measured 24 inches around the umbilicus. There was dulness on percussion in left flank, reaching as far forward as the anterior axillary line. This disappeared on turning over. The veins of the abdominal wall were not so prominent, and there was much less œdema of the scrotum and back.

"Three weeks after the patient left the Infirmary (December 17, 1899) he returned with signs of a large fluid collection in the abdomen; 230 ounces were removed by tapping. He had passed only about 18 ounces of concentrated urine daily.

"January 3, 1900.—Better; signs of very little fluid in belly.

"From this date there was no further accumulation of fluid, and at the present time (February, 1903) 'he is very well; never looked better; is fat and strong, and has a good appetite. There are no signs of fluid in the abdomen. The veins in the abdominal wall are very large. He complains of some dragging pain in the abdomen; the liver can be felt adherent to the abdominal wall.' (Note by Mr. G. Grey Turner, Surgical Registrar.)"

This subject is fully dealt with in a recent monograph by Bunge, "Die Talma-Drummondsche Operation," Jena, 1905. A brief summary of 255 recorded cases is given.

Sinclair White, in his paper read before the British Medical Association in 1906 ("British Journal," November, 1906), gave a valuable résumé of the surgical treatment of ascites secondary to vascular cirrhosis of the liver. He lays stress on the value of drainage as an adjunct to epiplopexy. He writes:

"Apart from the usefulness in keeping the upper abdomen dry and thereby favouring incision between the viscera and the abdominal walls, its beneficent influence is similar to that exerted by the pumps of a water-logged ship. In progressive cirrhosis there is an ever-increasing condition of unstable equilibrium between peritoneal effusion and peritoneal absorption, and a little thing suffices to destroy the equilibrium. So soon as this occurs and the ascitic fluid begins to accumulate, the movements of the diaphragm are impeded and one of the most important mechanisms concerned in peritoneal absorption becomes seriously handicapped."

White thinks that in all cases tapping should be resorted to once or oftener before proceeding to operation. A minority of cases will be cured permanently by this proceeding. He mentions the following procedure as additional to omental fixation: Removing the peritoneal surface of the liver and spleen, together with the peritoneal surface of the diaphragm and anterior abdominal wall. Subperitoneal displacement of the spleen after

leaving the splenic peritoneal covering. Formation of adhesions between the intestines and the abdominal wall.

Sinclair White's method of operating is as follows: The abdomen is opened by a vertical median incision along the umbilicus, the peritoneum being divided slightly to the left of the middle line, so as to obviate injury to the falciform ligament and its anastomotic veins. Through this incision the fluid is siphoned off and then a median suprapubic opening is made into which a glass drain is fitted tightly, the tube reaching to the floor of the pelvis.

The under surface of the diaphragm and the upper surface of the liver are vigorously rubbed with dry gauze and the anterior border of the liver is sutured to the diaphragm with silk.

The peritoneum is then detached, together with the rectus sheaths above, below, and to the left of the abdominal wound, and then turned outwards and stitched in its new position. The omentum is then sutured to the raw peritoneal surface left. The omentum should be so sutured as not to puncture its vessels.

After operation the abdomen is firmly bandaged and the patient placed in bed with the head of the bed raised, until the amount of fluid aspirated through the tube amounts to less than three ounces daily; the pelvis is pumped dry every six hours.

White adds: "Although the new anastomotic vessels develop with great rapidity, a short interval must necessarily elapse after the operation before its full effects on the portal circulation are manifested. In cases when drainage is not employed the fluid may reaccumulate during this time and require removal by tapping."

White has analysed Monprofit's and Bunge's series of cases and gives the following figures:

Total number of cases	227	
Deaths	75,	33 per cent.
Failures	34,	15 per cent.
Improved	29,	13 per cent.
Cured	84,	37.3 per cent.

The causes of deaths were:

Peritonitis	14
Uræmia	12
Shock and cachexia	10
Heart failure	5
Hæmatemesis	3
Intestinal obstruction	2
Pleurisy, meningitis, apoplexy, and bronchopneumonia, each	1

The cause of death in 15 cases was not ascertained. White concludes the report with the history of 5 cases of his own, with 4 recoveries.

W. Sampson Handley ("Brit. Med. Jour.," 1910, i, 853) in a case of ascites in a woman of forty-one due to atrophic cirrhosis first attempted internal drainage by silk threads. A stout needle threaded double with silk for lymphangioplasty, *i. e.*, No. 12, tubular woven silk was passed in and out in a series of loops through the peritoneum and subperitoneal tissues of the right iliac fossa to the outer side of the mesocolon, thus leaving portions of silk in the peritoneal cavity whence they might be expected to absorb fluid by capillary attraction; in all four series of stitches were employed.

These stitches ended in the region of the anterior superior iliac spine, they were then threaded in turn on to the special probe and thrust beneath Poupart's ligament near its outer attachment so as to pass well down into the subcutaneous tissues of the thigh.

This operation was only a partial success. The outcome being complicated by syphilitic lesions.

Stoney and Moorhead ("Lancet," 1911, i, 1069) report a successful case of treatment of ascites by lymphangioplasty.

H. E. Castle ("Jour. Amer. Med. Assoc.," 1911, ii, 2123) describes an operation for draining the peritoneal cavity into the femoral vein in cases of ascites. A vertical incision is made, and the saphenous vein is dissected out for some eight inches, ligatured distally, and then divided. All its tributaries are ligatured as close to the vein as possible to avoid clots. The vein is then

lifted from its bed, and its lumen washed clear of blood with normal saline. It is then covered with paraffin. A silk ligature is tied very close to the proximal cut end, to be utilized when the abdomen is opened. The vein is now laid back in its original situation, while the internal saphenous of the opposite side is treated similarly. A second incision about two inches in length is made upwards and outwards nearly to Poupart's ligament from the proximal end of the original vertical incisions. This second incision describes a quarter circle. Its object is to prevent kinking of the saphenous vein. When the latter is turned upwards to be joined to the peritoneum, a median hypogastric incision is now made and the abdomen opened. The next step in the operation consists in piercing the abdominal wall from the peritoneal surface outwards, passing through the peritoneum, transversalis, and internal oblique muscles and the aponeurosis of the external oblique. This opening extends to the superficial fascia, and is made external to the deep epigastric artery and internal abdominal ring. Through this opening a uterine sound is passed, and when the instrument reaches the superficial fascia, it is wormed through the fat by a rotary movement until it reaches the upper end of the curved incision in the leg. When it protrudes, the silk which was previously tied to the free end of the vein is tied to the sound. The sound is then withdrawn, resulting in the vein being drawn into the peritoneal cavity. The vein is now seized with fine vulsellæ, taking only the adventitia, and the fragment damaged by the silk ligature is cut off. The vein is then slit with scissors so as to make three equal leaf flaps through all its coats. These flaps, which are about ½ inch long, are stitched to the peritoneum by mattress sutures. Castle calls attention to the necessity of stitching the great omentum in several places so as to prevent it from becoming adherent to the venoperitoneal anastomosis and thus causing blockage.

For the subcutaneous drainage of ascites Tavel ("Jour. Amer. Med. Assoc.," 1911, ii, 1169) uses a glass spool with broad ends, the hole through the centre 1 cm. in diameter. One end of the

spool is worked through into the peritoneal cavity, and an ample hole to hold the other end of the spool is made for it in the subcutaneous tissue. Not even local anæsthesia is required for the insignificant operation of introducing the spool; the only point is to manage so that omentum will not get into the lumen and obstruct it. He has used the spool in five cases which he reports in detail, the outcome being excellent in all, the ascites draining effectually and harmlessly into the subcutaneous tissue.

The "physiological justification" for the operative treatment of cirrhosis of the liver is contained in the case records published by Chauffard and others. The following is an example related by Siredey, Lemairi, and Deroye ("Bull. Soc. Med. des Hôpitaux," 1908, i, 128):

"Man aged forty-one was admitted to hospital on April 13, 1908, suffering from right pleural effusion. Paracentesis yielded a litre of pus containing numerous streptococci. The abdominal wall and thorax were covered with large veins running longitudinally and communicating with the epigastric veins below and the axillary and subclavicular veins above. At the level of attachment of the diaphragm were numerous little red vessels like those seen on a varicose leg. The abdomen was a little flaccid and there were no signs of ascites. The liver was large and hard and the spleen was slightly enlarged. The medical attendant first saw the patient in July, 1906, when he found considerable ascites and a slightly developed collateral circulation. The patient admitted that he took 2 or 3 litres of wine daily. Paracentesis yielded 12 litres of citrine fluid. A milk diet and iodide of sodium were ordered, but the ascites recurred and required repeated paracentesis. Up to January, 1907, this was performed 9 times; the quantity of fluid obtained varied from 13 to 18 litres. Then the fluid was more slowly reproduced, paracentesis was performed at longer intervals, and the quantity of fluid obtained diminished. At the same time the subcutaneous abdominal veins gradually enlarged. When the ascites was great an umbilical hernia appeared; when the ascites diminished the hernia nevertheless continued to increase. In May strangulation occurred and herniotomy was performed. Health was recovered.

When the patient was next seen in November, 1907, the liver was large and the subcutaneous abdominal veins were still more developed, but there was no trace of ascites. He returned to work, but resumed his intemperate habits. In March, 1908, he had acute bronchitis, which was followed by the pleural effusion mentioned above. The operation for empyema was performed, but the patient was in an exhausted and infected condition and succumbed on April eighteenth.

Necropsy.—The veins forming the collateral circulation in the abdominal wall were for the most part larger than the radial artery. Almost all converged to two large varicose trunks which originated in the epigastric region and ran obliquely upwards to terminate in the first part of the axillary veins. In the sheaths of the recti muscles were numerous orifices from which large veins emerged. A huge vein ran from the suspensory ligament of the liver and emptied into the left side of the subcutaneous plexus. The posterior wall of the sheaths of the recti also showed numerous orifices for the passage of veins which traversed the muscles to the subcutaneous plexus. The omentum was extensively adherent to the abdominal wall, intimately in the umbilical region above and below the cicatrix of the herniotomy, for a surface 15 cm. broad and 12 cm. long. The omentum contained numerous varicose veins, which were found to be those which traversed the recti muscles. There was a much developed subphrenic venous plexus which received veins from the phrenico-colic and phrenico-splenic ligaments and œsophagus, and which terminated in two large trunks opening into the vena cava.

SECTION V.

OPERATIONS UPON THE PANCREAS AND SPLEEN.

CHAPTER XLIII.

OPERATIONS UPON THE PANCREAS.

The pancreas, for the purposes of operation, may be approached from the front or from behind. In the great majority of cases the former route is preferable.

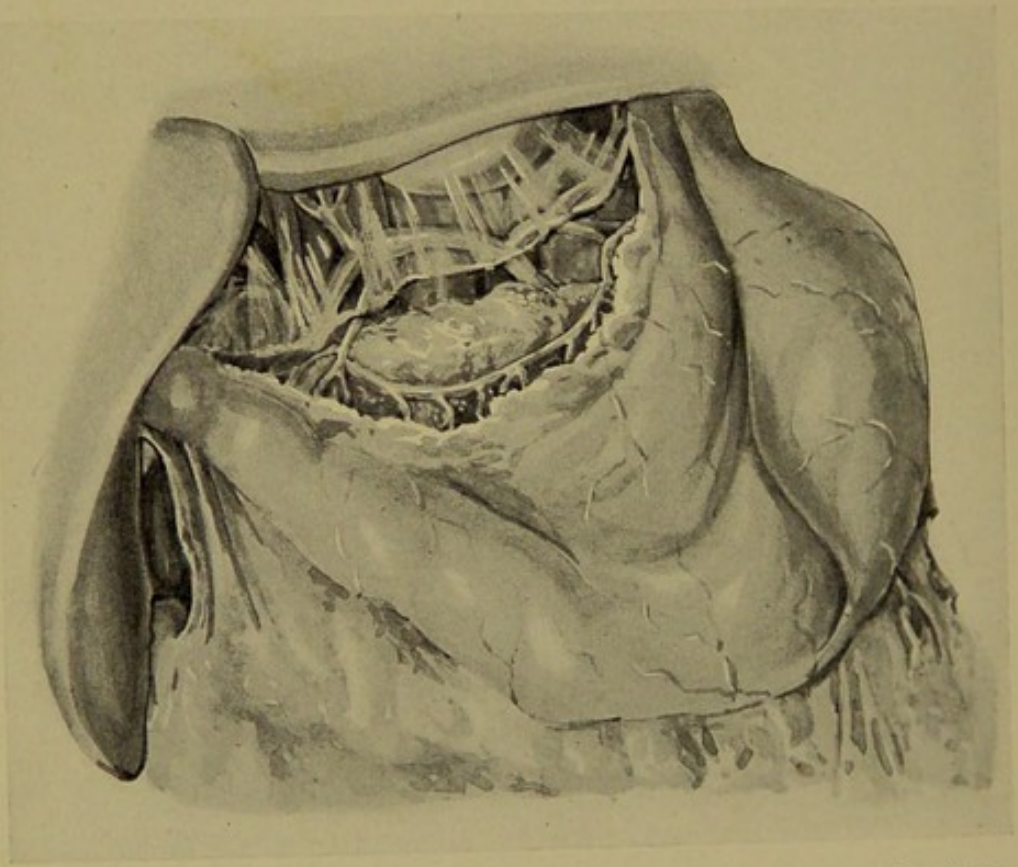

Fig. 352.—Exposure of the pancreas. The position of the pancreas in relation to the stomach when the gastrohepatic omentum is incised is shewn.

APPROACH FROM THE FRONT.

A sand-bag or air-cushion having been placed behind the lower part of the chest, the abdomen is opened by an incision be-

tween the ensiform cartilage and the umbilicus, in the middle line, or to one or other side of it, as seems necessary for speedy access to the part to be treated. When the peritoneal cavity is opened, the pancreas may be reached in five ways: (*a*) Above the stomach, through the gastrohepatic omentum; (*b*) through the stomach, both walls being incised; (*c*) below the stomach,

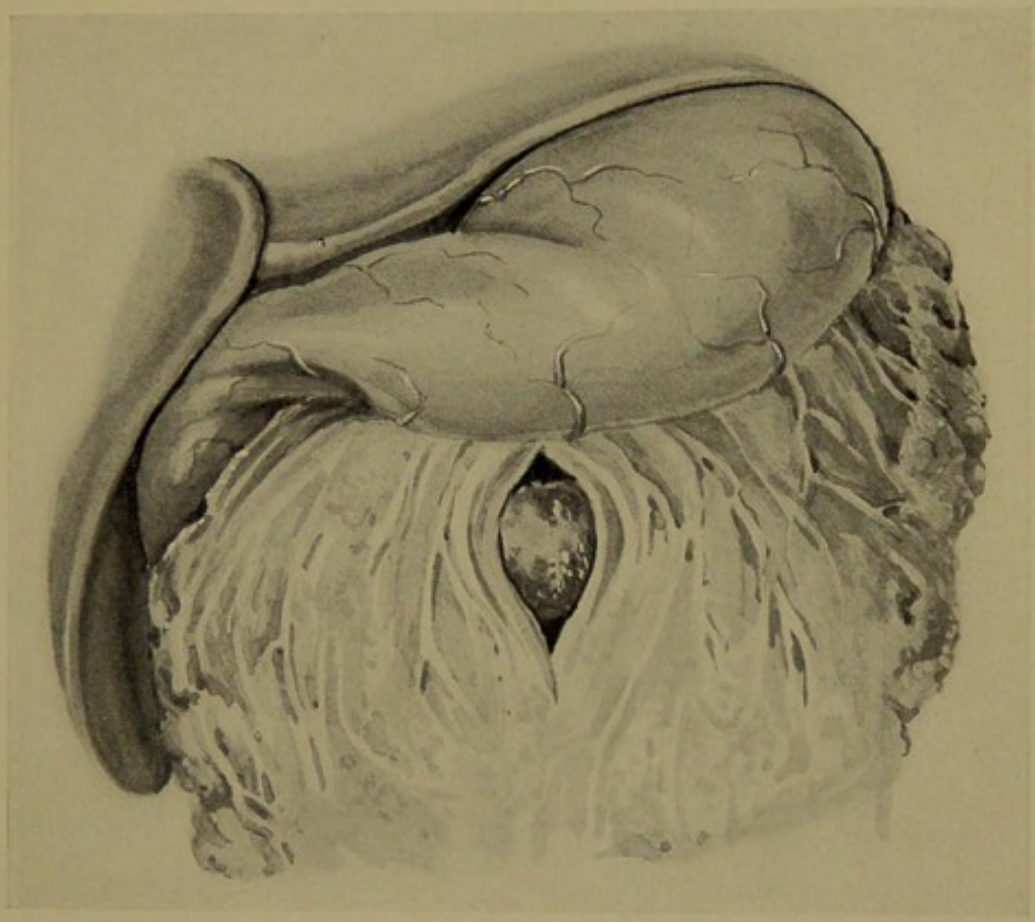

Fig. 353.—Exposure of the pancreas; the lesser sac is opened by an incision in the great omentum immediately below the greater curvature of the stomach. The stomach is pushed upwards.

through the gastrocolic omentum; (*d*) through the transverse mesocolon; (*e*) in addition access to the posterior part of the head of the gland may be obtained by Kocher's method of "mobilising the duodenum."

(*a*) **Above the Stomach.**—In thin people in whom visceral prolapse is present the pancreas may often be recognised on palpation as a mass lying transversely a little above the um-

bilicus. Indeed, a mistaken diagnosis of tumour in the stomach has not seldom been made in these circumstances. If the abdomen of such a patient be opened, the pancreas can be seen quite clearly through the thin, diaphanous gastrohepatic omentum. A small incision through this omentum rapidly enlarged will then give easy access to the gland.

(*b*) **Through the Stomach.**—This method is one which, so far as I am aware, has been deliberately undertaken only on

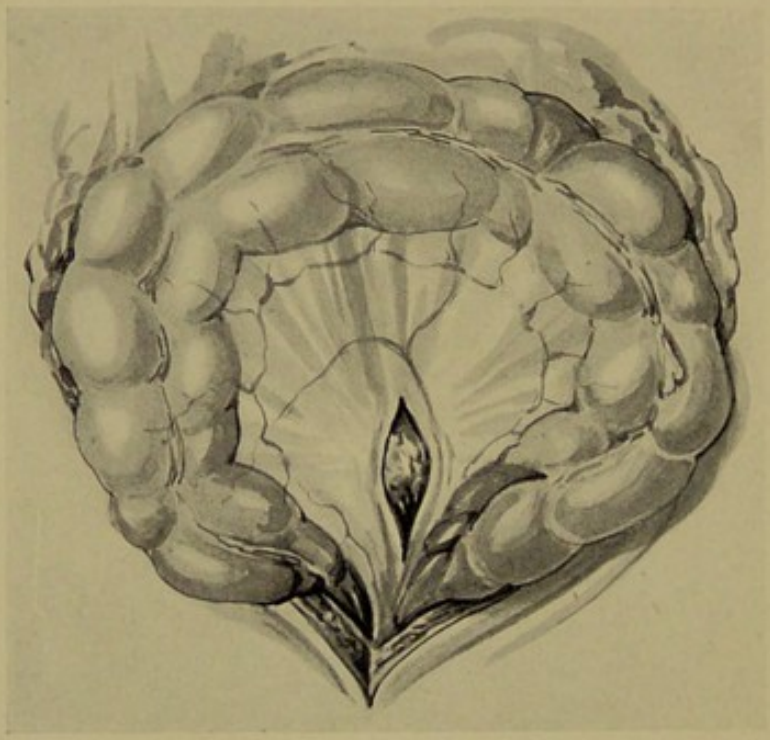

Fig. 354.—Exposure of the pancreas. The transverse mesocolon is incised, as in posterior gastro-enterostomy.

one occasion. The operator was Hagen, and the case concerned a boy aged thirteen, in whose abdomen a cyst the size of a child's head was discovered. It lay behind the stomach and was surrounded by such strong adhesions that it was impossible to bring it to the abdominal wall. The anterior wall of the stomach was, therefore, incised, and subsequently the posterior wall, and the cyst contents were then readily evacuated. The flaccid wall of the cyst was then, with great difficulty and after displacement of the stomach and resection of the

costal margin, brought into contact with the parietal peritoneum.

(*c*) **Below the Stomach.**—This is the route which has been chosen by the majority of operators. A bloodless spot in the omentum immediately below the greater curvature of the stomach is selected, and a small tear therein is made and slowly enlarged. The lesser sac of the peritoneum is thus opened,

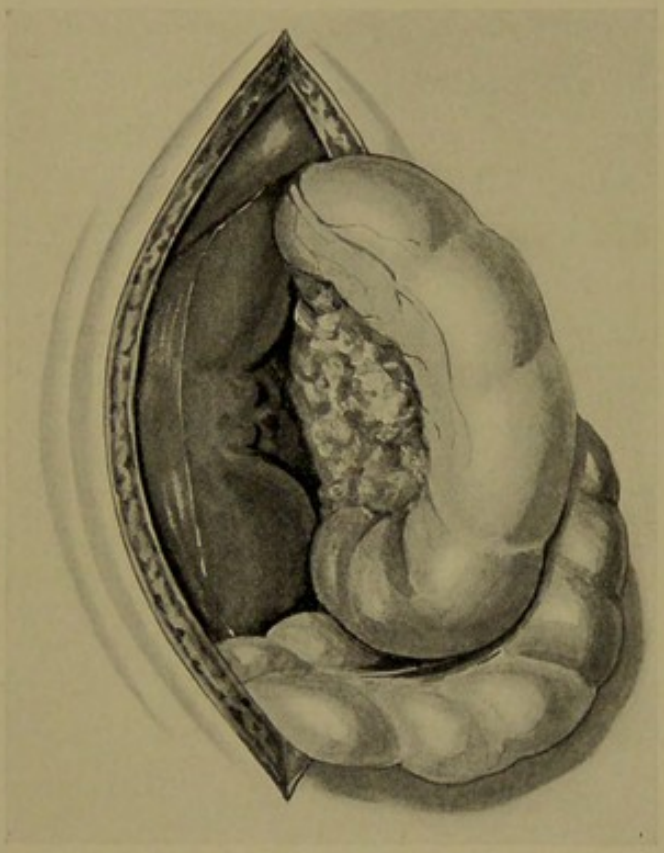

Fig. 355.—Exposure of the pancreas. The peritoneum to the outer side of the second portion of the duodenum is incised and the duodenum is raised up towards the middle line. The posterior part of the head of the pancreas is exposed.

and through the posterior wall of this sac the pancreas can be reached. If a cyst of the pancreas be present, it will often be found to bulge forwards below the stomach and to be reached very readily by an opening made in the position described.

(*d*) **Through the Transverse Mesocolon.**—The omentum and the transverse colon are turned upwards as in the performance of the operation of gastro-enterostomy. The transverse meso-

colon is then incised in a spot devoid of blood-vessels; a finger is passed through into the lesser sac, and the opening gradually enlarged by gentle tearing. This route is that to which the preference is given by Krönlein, but it is obvious that if drainage is necessary, it is unsatisfactory.

(*e*) The posterior part of the head of the gland may be exposed by incising the peritoneum to the right of the duodenum and stripping the second part of the duodenum upwards towards the middle line.

Approach from Behind.—The pancreas may be reached by an incision in the left loin, commencing at the tip of the twelfth rib, and extending obliquely forwards to the umbilicus. Peters has operated in this way upon a hydatid cyst of the tail of the pancreas, and in several cases of acute or subacute pancreatitis, supplementary drainage has been established through this incision.

THE SPECIAL CIRCUMSTANCES IN OPERATIONS UPON THE PANCREAS.

There are two circumstances of the highest importance in connexion with operations upon the pancreas.

The first refers to **hæmorrhage.** The pancreas has a blood-supply in proportion to its requirements as the gland by which the most important of the digestive juices are secreted. It is extremely vascular, and its blood-vessels are both large and numerous. Any injury of the gland, therefore, causes free bleeding, bleeding which is, moreover, very difficult to control. When, as the result of direct incision, bruising by external force, or tearing during the removal of growths involving the stomach or the pancreas itself, hæmorrhage occurs, it is not possible, in the majority of cases, to arrest it by ligature. The simple tying of a mass of the exceedingly fragile tissue of the pancreas often results in the ligature cutting through, and consequently in a further onset of bleeding. The individual vessels in the gland cannot be secured. The only means of arrest of the hæmorrhage is, therefore, the use of deep sutures of material—silk or catgut—(preferably the latter) sufficiently thick to prevent its cutting through the gland when the stitch is drawn

tight. And this method in itself is unsatisfactory, for it causes, necessarily, such damage by compression and strangling of the soft gland substance that sloughing is not unlikely to occur.

The second refers to **the escape of the pancreatic juice.** It has been shewn, both by experimental work and by observations made upon cases submitted to operation, that after the pancreas has been incised, bruised, or torn, its special secretion is poured out from the wound-surfaces. The experimental work of Simon Flexner, Biondi, Katz and Winkler has shewn that when the pancreas is so damaged, by injury however produced, that its vitality is lowered, there is an escape of the gland secretion into the parts around. The observations of Ruggi and Biondi and other operators who have removed parts of the gland for simple or malignant growths shew that a free outpouring of secretion occurs from the cut surfaces. The result of this is that fat-necrosis occurs, as well as an active digestion of the tissues with which the juice comes into contact. An acute inflammation of the pancreas, with or without hæmorrhage or subacute or chronic pancreatitis, may thus result. In one case, recorded by Koester, an injury to the pancreas during the course of an operation was followed by fat-necrosis. The digestion, by the pancreatic juice so freely poured out, results in the provision of an admirable culture-material for any organisms that may chance to be present. Infection of the wound area is almost inevitable to some extent in operations, necessarily difficult and prolonged, upon the pancreas. An infection that the healthy peritoneum could certainly deal with becomes of the utmost virulence when an abundant food-supply for the organisms is present. As Professor von Mikulicz says, the secretion of the pancreas does not flood the peritoneal cavity in such quantities that it proves fatal by mere absorption; "it acts indirectly by reason of the local irritation of the peritoneum, in that it prepares a nutrient medium for bacterial invasion and makes infection extremely easy." It is almost certain that in all abdominal operations some germs enter the peritoneal cavity. When their numbers are few, the

unharmed peritoneum can resist them without difficulty, but if the natural powers of resistance of the peritoneum are greatly reduced, they may be competent to produce an acute inflammation.

A further source of danger lies in the digestive action of the pancreatic juice upon the adhesions which the peritoneum produces. The outpouring of lymph is the chief means possessed by the peritoneum of protecting itself from harm; when the thick flakes of lymph are speedily digested by the pancreatic secretion, the avenue for a further extension of septic trouble is at once opened.

The secretion from the injured or inflamed pancreas is able, according to Mikulicz, to cause, in itself, a variety of aseptic peritonitis, which is followed by intestinal paralysis and obstruction.

The lesson to be drawn from these facts is that in all cases of operation upon the pancreas, where there is any likelihood of the escape of the secretion, free drainage should be provided. The escape of secretion from a wound of the pancreas can be prevented by accurate suture and by the careful closure of the peritoneum over the wound in the gland. Successful cases where this has been performed are recorded by Ninni and Mayo Robson. If this sealing-off cannot be secured, the need for drainage is imperative. Its value is well shewn by the statistics given by Mikulicz. In 12 cases of injury to the pancreas, the result of blunt force, or stab or gunshot wounds, 8 were drained, and of these, 6 recovered; 4 were not drained, and the only one that recovered was that recorded by Ninni, in which the peritoneum was securely closed over the wound.

The peculiar difficulties and dangers attaching to operations upon the pancreas will, therefore, be readily understood. Bleeding is apt to occur and is difficult to arrest. Escape of pancreatic juice is almost constant; it can produce an aseptic peritonitis, or digest adhesions poured out by the peritoneum for its own protection, or, finally, by acting upon the blood so constantly present, on the pancreas itself, and on all the parts around, a culture-medium is provided which is eminently suited to ensure the very rapid growth of organisms.

CHAPTER XLIV.

INJURIES OF THE PANCREAS.

The pancreas is rarely injured. This is owing in part to the deep position it occupies in the abdomen, and in part to the shelter afforded to it by the ribs and by those viscera which lie over it. The number of cases in which the pancreas has been injured is, however, probably assessed too low, for a wound of the gland is quite likely to be overlooked.

In the majority of cases an injury to the pancreas is not the only damage which is inflicted; the liver, the stomach, the kidneys, and the intestine are, one or all, likely to suffer at the same time. The blow which causes the injury generally impinges upon the epigastrium and is directed from before backwards.

There are no special signs or symptoms indicative of injury to the pancreas. In deciding upon an exploratory operation in a doubtful case the surgeon has, therefore, to rely upon the symptoms of shock, hæmorrhage, and, in the later stages, peritonitis. Reliance must especially be placed on the steady increase in severity of these symptoms. There will almost certainly be a sufficient warrant for operation in the conditions of other organs than the pancreas; and the danger is that, as in several recorded cases, the surgeon may be content in dealing with these other injuries, and overlook the wound which has been inflicted upon the pancreas. An emphatic rule should be laid down that in all cases of injury to the upper part of the abdomen, in those cases especially where the injury has fallen upon the epigastrium, no operation is to be considered complete until an examination of the condition of the pancreas has been made.

OPERATION.

The abdomen is opened, as a rule, through the middle line, or close to it, by a vertical incision between the ensiform cartilage and the umbilicus. As soon as the peritoneum is opened a general inspection of the parts likely to have suffered injury is made. No pains must be spared to make this inspection as thorough as possible, for an oversight will perhaps prove fatal. If a wound of the liver, stomach, or intestine be met with, it is dealt with in the manner which has already been described.

The pancreas is then examined. As a rule, the route above the stomach will be selected. The gastrohepatic omentum

Fig. 356.—Method of suture of a wound in the pancreas. Two or three deep sutures of stout catgut are passed, and the wound-surfaces drawn together. The wound-edges are then sutured with fine catgut sutures.

is torn through and the lesser sac is opened. Extravasated blood and pancreatic juice will often be found in the lesser sac, and a general mopping-up of these fluids will be necessary. Especial care is taken to see that this fluid, for reasons that have already been mentioned, is not allowed to escape into the general peritoneal cavity.

When the parts are thoroughly dried and the general peritoneal cavity has been protected in the usual manner by a layer of large flat swabs, the hæmorrhage from the gland must be arrested, and an attempt made to suture the wounds. The hæmorrhage is best arrested by deep sutures of stout catgut, or, in certain cases, by the ligation, *en masse*, of an area which is oozing freely. As a rule, the placing of deep sutures checks

the hæmorrhage and draws together the margins of the wounds in the gland.

It is then necessary to adopt measures to prevent the escape of the pancreatic secretion into the peritoneal cavity or into the subperitoneal tissues. This has been done in two cases by the accurate suture, over the gland, of the peritoneum which covers it, the layer, that is, which forms the posterior part of the lesser sac. In the majority of cases, however, this sealing-off is neither prudent nor possible, for a secretion from the gland is very likely to be poured out, and if it is, a free escape should be provided for it. Drainage is consequently almost always necessary, and is certainly always desirable. Drainage may be established through the anterior wound, or a posterior incision may be made, a large rubber tube introduced, and the anterior wound may be closed.

Professor von Mikulicz ("Annals of Surgery," July, 1903) has collected the records of 45 cases of pancreatic injury. There were 21 cases of penetrating wounds and 24 of subcutaneous wounds from blunt force. Of the 21 cases of penetrating wounds, 12 were due to gunshot and 9 to stab wounds. Five of the 12 gunshot wounds were operated and 3 recovered; 7 were not operated upon and all died. The 3 successful cases were recorded by Otis, Hahn, and Ninni. Ninni's case was one of revolver wound of the abdomen in a man aged twenty-seven. The patient had run more than 500 yards after the wound had been inflicted, but was brought to hospital, collapsed, almost unconscious, with thready pulse, and the abdomen painful and tympanitic. The bullet had entered close to the second lumbar vertebra, and, after passing through the pancreas, had made six wounds in the small intestine and one in the colon at the hepatic flexure, and had finally come out in the right epigastric region. An incision was made from the ensiform cartilage to half-way between the umbilicus and the pubes, giving vent to blood and gas. The seven intestinal wounds were sutured, and then, as blood was seen to ooze from between the

stomach and transverse colon on the right side, a transverse incision was made, the gastrocolic omentum opened, and a wound of the pancreas at the junction of the head and the body disclosed. Two deep sutures were passed which arrested the bleeding. Drainage was established. The patient left the hospital in thirty-five days. In 7 of the 9 stab wounds the pancreas was prolapsed in part; in 2 it was replaced; in 5 it was sutured or ligated and replaced; all these patients recovered. In only 2 of the 9 stab wounds was there intra-abdominal injury of the pancreas; in these 2 only, therefore, was there the risk of contamination of the general peritoneal cavity. These two cases were recorded by Küttner and Hildebrand. In Küttner's case there was a deep wound of the body of the pancreas which almost divided it into two portions. The wound-edges were drawn together by two sutures and a superficial stitch of catgut. Hæmorrhage was in this way completely and at once arrested. In this case there was also a wound in the stomach, which, being found at once on opening the abdomen, was temporarily closed by a Doyen's clamp until the suture of the pancreas was completed. Drainage was provided by a large packing of gauze. A subphrenic abscess formed, and was opened on the twelfth day. On the eighteenth day the patient was up, and at the end of four weeks was sent home quite well.

In Hildebrand's case there was also a perforation of the stomach as well as an injury to the pancreas. The bleeding points in the pancreas were secured by individual ligatures; the stomach wound was closed; no drainage was provided. Death occurred on the fourth day.

Of the 24 subcutaneous injuries, 13 were not operated upon and all died; 11 were operated upon and 7 recovered; the operation consisted in exposure of the pancreas and drainage.

In some of the late operations little more was done than to evacuate some old disintegrating blood-clot and to provide drainage.

Cowen ("Brit. Med. Jour.," May 4, 1907) reports a case of subcutaneous injury to the pancreas. The patient, a man, was admitted to hospital with a history of a fall on the abdomen four days previously. During these four days he had endured great pain in the upper abdomen and back, continuous in character and with paroxysmal exacerbations. On admission the symptoms and signs were those of a commencing peritonitis. Small pulse, rate 100; temperature, 98.8° F.; abdomen slightly distended, rigid, tympanitic, tender, great pain, much thirst.

"The abdomen was opened a little to the left of the middle line, between the umbilicus and pubes, by an incision about three inches in length. Liquid blood began to flow out from all directions as soon as the peritoneum was opened. The incision was enlarged upwards and downwards, and the lower viscera explored, no injury or disease being detected; there was much clot in the pelvis. The hand, passed upwards, came across a bulging semi-fluid swelling above the navel; an incision was therefore made above the umbilicus about four inches in length, when blood was seen coming through a hole in the omentum between the stomach and transverse colon. The two cuts were then joined and it became apparent that the swelling was the lesser sac filled with clot and fluid blood. The opening in the omentum was enlarged by tearing and the clot removed by handfuls.

"Dark fluid blood continually welled up from the region of the pancreas obscuring everything so that a view of the source of the flow was impossible. It was obvious that the only thing to be done was to trust to gauze pressure, and accordingly gauze was packed firmly against the pancreas and the back of the lesser sac, quite twelve yards being used. The end of the gauze was brought out of the wound on a level with the hole in the gastro-colic omentum."

Three days later a portion of the gauze plug loosened and was removed. Five days after operation "the rest of the gauze packing was removed. There was a copious discharge of blood stained fluid."

The wound healed up fairly well, except for the sinus where

the plug had been, and from this was discharged daily 6 to 8 ounces of clear fluid. This fluid was most irritating to the skin, causing a very painful dermatitis whenever it came in contact with it. The skin condition was relieved by a catheter conveying the fluid from the sinus to a bottle. The patient was left with a permanent sinus when last seen—at the time of Cowen's paper, March, 1907—he was doing his work, but the sinus still discharged 3 or 4 ounces of fluid a day.

The principles which should be observed, therefore, in all operations upon the pancreas for injury are these:

1. Bleeding must be carefully arrested by ligature *en masse* or by suture; preferably the latter.
2. If the tail of the gland is very badly crushed, a resection must be performed.
3. If the duct of the gland is exposed, care must be taken to see that the sutures do not penetrate the duct.
4. Free drainage, through the anterior wound, through a special posterior wound, or through both, must be provided.

Professor Garré ("Beiträge zur klinischen Chirurgie," June, 1905, Bd. 46, Heft 1) reports from his clinic in Königsberg a case of total transverse subcutaneous tear of the pancreas only, in which a successful operation was performed. The patient, a man of twenty-four, had been crushed in the upper abdominal region between two buffers of a train. There was some little pain after the accident, no vomiting or nausea, no shock, and pulse and temperature were normal. The abdomen was tense and there was some tenderness in the epigastrium. Three hours after the injury, vomiting of coffee-grounds material and later of some blood set in, with severe pain. The diagnosis of rupture of an intestine was made, and an immediate laparotomy followed. A considerable amount of blood was found in the abdomen, and after an examination of the other organs in the peritoneal cavity had shown them to be intact, the blood was discovered coming from behind the stomach, which was somewhat low in the abdomen, but uninjured. Tearing through the lesser omentum, above the stomach, a complete tear in the pancreas was found, the edges of which were about the thickness of a thumb apart. The edges were

sharp, as if cut with a knife. The splenic vein was intact. The severed tail of the pancreas was about 10 cm. long.

The torn edges of the organ were brought together into exact apposition, and with three posterior and three anterior fine silk sutures through capsule and parenchyma the defect was repaired and the hæmorrhage stopped. The sutured portion was isolated

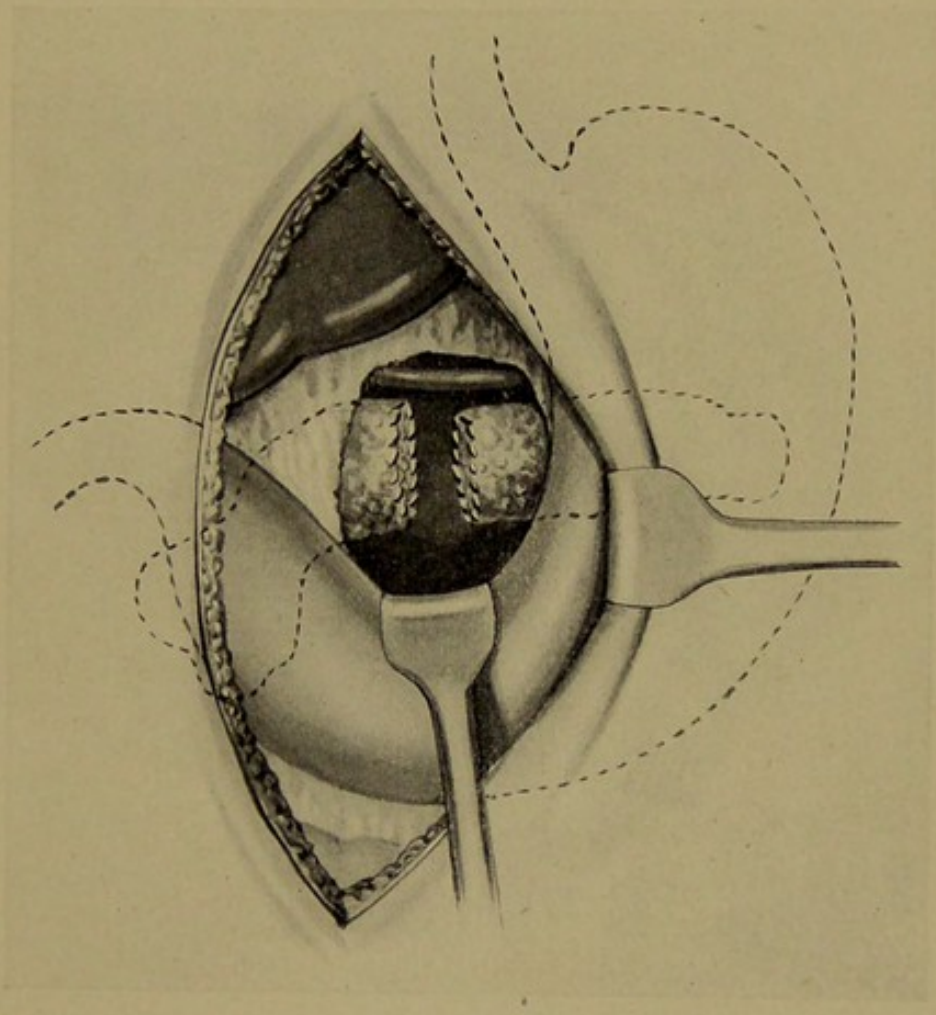

Fig. 357.—Complete transverse rupture of the pancreas, treated by suture (Garré).

by tampons, gauze was put around the pancreas wound and up under the liver, and was brought out of the original incision. There were no areas of fat necrosis (Fig. 357).

The progress of the case was most pleasing. The pains ceased at once. For two days there was vomiting of blood-stained fluid. On the third day the tampons were saturated with pancreas

secretion, and in the subcutaneous fat layer there were three areas of fat necrosis. The secretion was examined, and shewed all the pancreatic enzymes. The first tampon was removed after eight days and a new loose one inserted. In two weeks a drain was put in. The secretion became less and less, and in two weeks more the drain was omitted. In about six weeks the fistula was closed.

CHAPTER XLV.

INFLAMMATORY CONDITIONS OF THE PANCREAS.

ACUTE PANCREATITIS.

Acute pancreatitis is one of the most serious diseases which the surgeon is ever called upon to treat.

There has been much confusion from a want of clearness in the terms which have been used to describe the various forms or stages of the disease.

Acute inflammation, in the majority of cases, is attended by hæmorrhage, which may be localised to one part of the gland, affect the whole gland, or involve also the parts around. There is even yet a want of agreement among those whose experience in the matter is considerable, as to whether, as a rule, the hæmorrhage precedes the inflammation and causes it, or whether the inflammation occurs first and results in the hæmorrhage. There can be no doubt, however, that inflammation may occur without hæmorrhage, and that hæmorrhage, even fatal in character, may occur without inflammation. In the majority of instances, however, the two conditions are found together. Mayo Robson is inclined to believe that a differentiation of cases is sometimes possible, the ultra-acute cases having a violent and sudden onset, accompanied by collapse, ending fatally with extreme rapidity, being, for the most part, those where the hæmorrhage precedes the inflammation; whereas the cases which are still acute, though somewhat less so, where the onset is more gradual, where the symptoms are not ushered in by collapse, and where resolution and relapse are likely to occur, are those in which inflammation precedes the hæmorrhage. There is no doubt that the three forms of pancreatitis described by Fitz—the hæmorrhagic, the gangrenous, and the suppurative

—are merely different stages of the same disease and are alike in their etiology.

Mikulicz considers that pancreatic apoplexy is distinguished from acute hæmorrhagic pancreatitis only by the bacterial conditions: the former is an aseptic process; the latter, a septic process.

The influence of the pancreatic ferments in cases of injury to the gland is considerable. As Mikulicz points out, the following vicious circle is established: "Small hæmorrhages or disturbances in circulation (from arteriosclerosis, embolus, thrombosis); from this, necrosis of a small area of the gland; infiltration around this focus of the ferments set free by the destruction of the parenchyma cells; digestive changes in the surrounding tissue and its vessels, which were until this time unchanged; enlargement of the hæmorrhagic focus, partly as a direct result of the erosion of the vessels and partly as the result of the undermining of the tissues and the increased pressure from the hæmatoma; necrosis and destruction of the surrounding parenchyma of the gland; further escape of the ferments," etc.

The escape of the ferments of the pancreatic juice from the damaged portion of the gland is responsible for causing the characteristic signs of acute pancreatitis, fat-necrosis, localised peritonitis, and, in the later stages, when infection is added, pancreatic abscess.

J. D. C. White ("Archiv. Path. Inst. Lond. Hosp.," vol. i) reviews the hypotheses as to the etiology of acute hæmorrhagic pancreatitis. His report is based upon 7 cases occurring at the London Hospital between December, 1902, and February, 1905, and an examination of the reports of 7 cases of comparatively recent date. In the 7 cases jaundice was present in 2; in 1 patient there were gall-stones; glycosuria was found in 1 case. As regards the pathology, White writes:

"The picture presented under the microscope is simply that

of hæmorrhage, each hæmorrhage being, as it were, encapsulated by a thin layer of leukocytes. The existence of perfectly normal tissue in every specimen (except one which was completely destroyed by hæmorrhage) makes it difficult to believe that the disease was the result of infective inflammation spreading upwards from the duct."

Fatty degeneration was seen in every specimen, *but* only "where the hæmorrhage had wholly or partially destroyed the cells." With regard to the state of the pancreatic ducts of the 7 cases—the duct was opened at the autopsy in 4, and in no case were any obvious signs of inflammation discovered; of the 44 extraneous cases, in 7 there was a special note as to the absence of inflammation; in only 4 reports is there any reason given for the assumption that there was inflammation of the ducts. White calls attention to the absence of general peritonitis in acute hæmorrhagic pancreatitis. In one of the London Hospital cases there was no sign of peritonitis; in the other 6 it was early and localised. He offers the following evidence against the theory of an ascending infective inflammation of the duct:

"1. The pancreatic ducts almost invariably present a normal appearance.

"2. The pancreatic tissues outside the hæmorrhagic zone do not show any microscopic signs of inflammation, whereas if infection had spread up the ducts, we should expect a tolerably uniform inflammation of the organ.

"3. Where fibrosis is present, it is in all our cases not only explicable by organisation of previous hæmorrhage, but in each case its appearance cries out for this explanation.

"4. General peritonitis is conspicuously absent—a most surprising fact if the disease is due to acute infection of the pancreas."

Pancreatic hæmorrhage is found in heart lesion cases, in cases of emphysema, and in these cases lipolysis is found too. If a hæmorrhage does occur in the pancreas, secretory tissue is destroyed and trypsinogen liberated with the lipase; now this trypsinogen is inactive until altered by a kinase; the only possible sources of a kinase are (1) enterokinase regurgitated up the

pancreatic duct from the duodenum. (2) Kinase formed in cases of hæmorrhage from the leukocytes themselves (cf. Delezeune "C. R. de la Société de Biologie 1902, 1903, 1904). (3). Opie experimented with bile causing acute pancreatitis by injecting bile into the pancreatic duct. Bile cannot activate trypsinogen, so it must be surmised that bile acts as an irritant in the pancreatic duct. Here again hæmorrhage sets in and the leukocytes give up a kinase which would turn the inactive trysinogen into active trypsin. White's conclusion is as follows:—

"Of the explanations here suggested the least common is no doubt the entrance of enterokinase into the duct of Wirsung. In one-seventh of the cases gall-stones cause the disease by driving bile into the same duct; in a large majority a small extravasation of blood, elsewhere of no importance, in the pancreas becomes the spark which kindles the fatal conflagration."

Villar (French Surgical Congress, 1905) reported 130 cases with 67 recoveries.

Korte ("Annals of Surgery," 1912, i) has collected 103 cases since Villars statistics; in these there were 41 recoveries and 62 deaths, or a 60 per cent. mortality.

Korte's own series of cases numbered 44, 34 of which were his personal cases and 10 from the department of Brentaus at the Krankenhaus am Urban Berlin. Of the 44 cases 38 were operated upon; of these in 34 the diseased pancreas was subjected to operative treatment, whilst in four cases the gall-bladder or ducts only received attention; these 4 cases all died. Of the other 34 cases—16 died and 18 recovered. Thus giving 60 per cent. mortality in the total series. This high mortality may possibly be accounted for by the fact that of Korte's 34 personal cases only 12 were operated upon within the first week of illness. With regard to the connection between acute pancreatitis and diseases of the gall passages Korte writes:

"The appended table covers the concomitant pathological conditions in the 44 operated cases including those on which a post-mortem examination was made.

Infective cholecystitis without stone, 1 case. Cholelithiasis, 22 cases. Diagnosis of stone or inflammation in the gall passage obtained subsequently (*i. e.*, post-mortem), 16 cases. No absolute evidence, 6 cases."

Quénu reports 21 operations for acute pancreatitis with 13 deaths. Mayo Robson 59 operations with 36 deaths. Ebner 36 operations with 19 deaths. Dreesman 118 operations with 61 deaths. Nove 43 operations with 21 deaths. Osler found 105 cases of pancreatitis with cholelithiasis in 45 cases. (Quénu found 128 cases, complicated by gall-bladder involvement in 47.)

The occurrence of acute inflammation in the pancreas attended by hæmorrhage is clearly a condition which calls for early operation, for unless the tension is relieved and free vent given to the pent-up exudates, the local and general manifestations are hardly likely to do other than continue.

The **symptoms** which are present in acute pancreatitis are those of an acute epigastric peritonitis. No more succinct description has been given than that which Fitz embodied in his first article upon the subject, "Acute pancreatitis is to be suspected when a previously healthy person or sufferer from occasional attacks of indigestion is suddenly seized with violent pain in the epigastrium, followed by vomiting and collapse, and, in the course of twenty-four hours, by a circumscribed epigastric swelling, tympanitic or resistant, with slight rise of temperature." In two out of three cases upon which I have operated the most striking feature has been the general lividity of the skin; the face has looked suffused, the lips blue, and the body surface has been damp, cold, and leaden-hued.

The onset of pain in acute pancreatitis is usually sudden; a moment before the patient may have been going about in comfort, conducting the ordinary affairs of the day. The absolutely instantaneous onset of the very severe pain is constant, but some of the patients will say that they have been conscious for a few hours, or it may be for a few days of a sense of discomfort or milder pain in the upper part of the abdomen. About one-third

of the total number of observed cases have occurred in patients who were the subject of recurring flatulent dyspepsia. The patients are generally stout; women are affected slightly more than men, and pregnancy would seem to be a factor of some importance in the causation. The intense pain, then, is sudden in onset, is confined within the abdomen to the upper portion, but passes almost always through to the back; it is agonizing beyond endurance, and is not seldom the cause of fainting or a profound collapse. The face is drawn and white, though the lips are often blue. In many of the cases I have seen there has been a curious leaden colour of the whole face, a slight but unmistakable and I think characteristic cyanosis. Halsted, an early and shrewd investigator, pointed out that lividity of the face and abdominal wall was often a striking feature of these cases. The whole appearance and attitude of the patient suggest that death may be imminent, for the extremities are cold, the heart beats with great rapidity, and the quality of the pulse is poor. Vomiting is an early symptom, is frequently repeated, and may last for days or weeks if the patient should survive so long. The food that has last been taken is the first to be rejected; afterwards all the vomited matters are deeply stained with bile, and pure bile, to all appearance, may be brought up in large quantities. This has suggested in several cases a diagnosis of high obstruction in the jejunum. The patient, as will be grasped from this description, presents the aspect and the symptoms of profound poisoning; and the researches of Gulecke, Egdahl, and others make it appear probable that the toxic substances are produced as a result of the digestion of the pancreas by its own escaped secretions. The abdomen, when examined early, presents the most indomitable rigidity and some fullness in the upper part; the remaining parts may be quite soft and flaccid, yielding readily to the hand, or they may be held with some degree of firmness. The upper portion of the abdomen, the epigastric region especially, never ceases to offer the most incoercible resistance, and, however gentle the examination may be, it is grievously resented and is

repelled at the earliest occasion. When the records of published cases of acute pancreatitis are studied, it is seen that the number that have been correctly diagnosed before the operation is extremely small; yet I am confident that the symptoms are of such a character as to make a recognition of their cause a matter of very little difficulty. Briefly to recapitulate, there is, perhaps, in a patient inclined to stoutness a history of antecedent dyspepsia which presents nothing of the characteristic features of duodenal, or indeed of gastric ulceration, but which suggests rather the presence of stones in the gall-bladder, and jaundice may have been noticed on one or many occasions. The severe pain comes quite suddenly, is beyond the limits of human fortitude to withstand, is associated with collapse of a profound character, and may cause the patient to swoon. The limbs are cold, the pulse extremely poor, rapid, and thin, or even hardly to be felt and not to be counted. The face may be cyanosed. The upper part of the abdomen is exquisitely tender, and all the muscles there offer the most resolute resistance to any examination. Vomiting is an early and often a conspicuous feature. I do not think a group of symptoms at all similar is to be found in any other form of abdominal calamity. There can be no doubt that, as in the case of perforations of the stomach or duodenum, recovery may follow an attack of acute pancreatitis. Every now and again I find the evidence of this in the abdomen. Very extensive fat necrosis in or upon the pancreas, and in its immediate vicinity, is to be seen, and the pancreas itself may show the remnants of old hæmorrhages or contain a cyst, an abscess, or a slough. But these occasional survivals cannot impugn the fact that the safest course here also lies in early operation upon the lines first followed by Dr. Ramsay of Bournemouth.

Operation.—In some cases operation will be undertaken without a positive diagnosis having been made. The surgeon will feel that some acute catastrophe has occurred in the abdomen, and that in operation alone lies the hope of relief. In all I have operated upon 15 cases. In the last 8 a correct diagnosis was made in 7, and all 7 patients recovered.

The incision will, therefore, owing to the localisation of the signs, be made in or near the middle line above the umbilicus. As soon as the abdomen is opened, a deeply blood-stained fluid will escape. The omentum, which will probably present in the wound, shews almost always the small round white or pale-yellow patches which indicate the presence of fat-necrosis. The discovery of these patches is quite enough to enable the surgeon instantly to recognise the nature of the disease and to make the operation purposeful, which, until this point, had been exploratory. An inspection of the gastrohepatic omentum, the stomach, duodenum, gall-bladder, and bile-ducts is then made. The pancreas will be found engorged with blood, soft, swollen, and purplish in colour. The surgical indication is then at once to afford relief to the pancreas, which is in a condition of phlegmon. The same measures are necessary as in phlegmonous inflammation elsewhere. The gland must be exposed freely by tearing through the gastrohepatic omentum; multiple punctures or small incisions must be made into the gland, and free drainage must be secured.

The need for the relief of tension and for free drainage are, indeed, the circumstances of chief importance. A large gauze packing may be introduced through the anterior abdominal wound, or a second posterior incision may be made in the left costovertebral angle, and the pancreas exposed from behind, punctured freely, and large drainage-tubes introduced. In some cases both anterior and posterior drainage may be profitably established.

In a certain number of the cases gall-stones will be discovered when the gall-bladder is examined. These should be removed and the gall-bladder should be drained, if time permits. It should not be forgotten that in many cases, as Opie was the first to shew, the onset of the acute inflammation in the pancreas is due to the blocking of the ampulla of Vater by a small stone, and the conversion, thereby, of the common bile-duct and the duct of the pancreas into a common channel; as

a result of this, bile, which is infective, escapes into the duct of Wirsung, and sets up the acute inflammation of the pancreas. The removal of the offending stone can hardly be carried out in any case of this kind, owing to the bad condition of the patient, but if cholecystotomy is performed, the bile will be drained away from the hepatic duct, and the removal of the stone, if the stone does not escape into the duodenum, may be carried out later.

This method of treatment—the free exposure of the pancreas, its puncture, and the provision of free drainage, followed or not, as may be deemed necessary, by cholecystotomy—is that which should always be followed. There were on record, according to Mikulicz, up to May, 1903, 75 cases of operation for acute pancreatitis. Of 37 cases in which the pancreas was involved in the operative interference, 25 recovered; in 41 where the pancreas was not touched, 4 cases recovered, and in all of these free peritoneal drainage was established. In one of these cases the intestine was drained by the performance of typhlotomy. If intestinal paralysis is a prominent feature in the case, this should certainly be done.

It is to Dr. Muspratt and Dr. Ramsay, of Bournemouth, that acknowledgment is due for their putting into practice for the first time, fortunately with success, the principles of the operation which have just been laid down. In the "British Medical Journal" (February 6, 1904, p. 304) the brief record is given of a case operated upon on December 2, 1902. The patient was a woman, aged forty, who, after a long period of abdominal suffering, was suddenly seized with severe pain, collapse, and incessant vomiting. The abdomen was opened within twenty-four hours. The omentum and the intestines in the neighbourhood of the pancreas were found deeply blood-stained, and there were numerous areas of fat-necrosis. The pancreas was swollen, tense, and purple in colour. It was decided "to try the result of relieving tension" in such a case, and a free incision into the head of the pancreas, which was more

especially affected, was made. Free bleeding followed, which was checked with some difficulty. A gauze drain was introduced and the patient made a speedy recovery. The case recorded in Professor Mikulicz's paper in the "Annals of Surgery" of May, 1903, operated upon by Dr. Porter, of Boston, though recorded first, was, in point of time of performance, second to this.

SUBACUTE PANCREATITIS.

Gangrenous and suppurative pancreatitis are the conditions which result from an infective process which is rather less acute than that just described. There is a difference in the intensity, rather than in the character, of the infection.

The plea has been urged that in cases of acute pancreatitis operation should be deferred, because if the condition is left to itself and gangrene or abscess of the pancreas result, operative treatment then is far less serious and attended by a greatly reduced mortality. This argument is grossly misleading, for it takes no account of the number of cases of acute pancreatitis in which the processes are so rapid, and the course of the disease so acute, that the patient dies before either suppuration or gangrene—leisurely processes both of them—has developed. The symptoms and the mode of onset in abscess of the pancreas are similar to those in acute pancreatitis, though there is less of acuteness in both. The term *subacute* applies more accurately to gangrenous and suppurative conditions than the word *acute*. But it will readily be understood that between the most virulent and the most lethargic cases there is an unbroken series. The onset in the subacute cases is not so abrupt, and the progress of the symptoms by no means so rapid. There is, indeed, the same kind of difference as exists between the acute and the subacute forms of perforating ulcer of the stomach.

Treatment.—An incision is made between the umbilicus and the ensiform cartilage. As a general rule, there will be a marked bulging of the epigastrium, or palpation will reveal the presence of a deep-seated tumour. The pancreas will be exposed, in the majority of cases, by tearing gently through the

gastrohepatic omentum. It will then be obvious if one part rather than another of the pancreas is involved, and if a well-defined abscess cavity is located, it may be opened after adequate protection of the peritoneal cavity has been assured; or the abdomen may be closed, and a posterior incision in the left (or occasionally in the right) costovertebral angle may be made, so that an adequate escape is afforded to the pus, without risk of contamination of the peritoneum. In the majority of cases, however, drainage from the front will be necessary. Before the abscess cavity is opened, the peritoneum is walled off with gauze. The contents of the abscess are not fetid, and the pus on examination may be sterile. Very often little lumps of necrosed fat or portions of disintegrating pancreas may be found in it, and in some instances large, greyish-black sloughs of the pancreas may be removed. The loss of even a large portion of the pancreas does not seem to lessen, at any rate perceptibly, the chances of recovery of the patient. I know of two patients who are living and in perfectly good health, whose metabolism seems perfectly satisfactory, in whom at least one-third of the pancreas was removed as a slough.

The sloughs that I have seen are always deeply stained with altered blood-pigment; they are grey or greyish-black in colour, and are clearly the result of a process exactly similar to that seen in acute hæmorrhagic pancreatitis. The formation of the slough is the end condition of which hæmorrhagic infiltration is the earliest recognisable manifestation.

CHRONIC PANCREATITIS.

Though Riedel was the first to point out that a condition of chronic induration of the head of the pancreas was at times associated with cholelithiasis, especially with stone in the common duct, it is to Mayo Robson that we are indebted for a clear description of the clinical symptoms of the disease and for the first recognition of the fact that surgical treatment is capable of affording complete relief in the great majority of cases.

Chronic pancreatitis is generally due to gall-stone irritation, especially to the presence of a stone impacted in the ampulla of Vater or in the lower end of the common duct. Other causes are pancreatic calculi, obstructions of the duct by pressure from without, typhoid fever (as first described by me in the "Lancet"), alcohol, syphilis, gastric or duodenal ulcer, etc. The description which Opie has given of the two forms of chronic pancreatitis, interlobular and interacinar, has been generally accepted. In the former the interstitial deposit of fibrous tissue occurs in wide bands separating the lobules of the glands; in the latter there is newly formed fibrous tissue within the lobules. In the former the contraction of the newly formed fibrous tissue causes an atrophy of the secretory portion of the gland, and the processes of digestion are, therefore, affected; in the latter the islands of Langerhans are also affected, are sometimes all the part that suffers, and consequently it is not only the digestive, but also, and chiefly, the metabolic, processes that are affected.

The **symptoms** of chronic pancreatitis are very similar to those found in cases of malignant disease of the head of the gland; indeed, there have been many cases—doubtless there are still many—in which an erroneous diagnosis of cancer has been made. It is to Mr. Mayo Robson that credit is chiefly due for the differentiation of the two diseases, a clinical advance of the first magnitude. Of chronic pancreatitis in its clinical aspects he writes:

"The symptoms of pancreatic catarrh passing on to interstitial pancreatitis present great varieties according to the cause; for instance, if it be due to gall-stones, there will be a history of painful attacks in the right hypochondrium, associated with jaundice and possibly accompanied by fever of an intermittent type. Tenderness at the epigastrium with some fulness above the umbilicus will usually be noticed; loss of flesh soon becomes marked, and if the pancreatic symptoms predominate, the pain will pass from the epigastrium around the left side or even to the renal and scapular regions. Fat and muscle-fibres may be

noticed in the motions as soon as the obstruction to Wirsung's duct is complete, and the pancreatic reaction will be found in the urine. If gall-stones be not the cause, there may be merely an aching or painful attacks not at all pronounced, or the symptoms may come on painlessly, associated with dyspepsia and with slight jaundice, soon becoming more marked; in such cases the gall-bladder may dilate and give rise to a suspicion of cancer of the pancreas which the rapid loss of flesh will tend to confirm. In the later stages pale or white and bulky motions may be passed, and a hæmorrhagic tendency will be noticed. The liver is usually enlarged when the common bile-duct is tightly gripped, and in several cases I have found cirrhosis of the liver, doubtless due to long-continued stagnation of septic bile in the ducts. I have seen well-marked enlargement of the spleen on four occasions. In one patient the fever and the enlarged spleen gave rise to a symptom of ague, the organisms of which were said to have been found in the blood."

The importance of the early recognition and treatment of chronic pancreatitis cannot be exaggerated, for the disease if left unchecked may produce such a sclerosis of the gland that the whole of the secretory substance and all the islands of Langerhans may be destroyed. The result is diabetes which proves fatal. Even when operative treatment is adopted, the condition may have progressed so far that nothing more can be done than to remove the cause of the disease and to prevent its increase, the damage already done to the gland being irreparable. In one case of my own where chronic inflammation of the whole of the gland was found, due almost certainly to a stone, long impacted in the ampulla of Vater, which had escaped by the formation of a fistula between the lower end of the common duct and the duodenum, there was relief from cholecystotomy followed by prolonged drainage, but the patient died after three and one-half years from diabetes.

Treatment.—The treatment of the disease will necessarily vary according to its cause. If a stone be found in the common duct or in the duct of the pancreas, it must be removed. If a gastric or duodenal ulcer be found, it must be treated by ex-

cision or gastro-enterostomy, as seems best. But the main indication to be fulfilled is drainage of the bile to the surface for such a length of time as will allow the ducts to free themselves from infection.

Drainage of the gall-bladder may be instituted either by the operation of *cholecystotomy* or by the operation of *cholecystenterostomy;* the former, for some reasons, is to be preferred. By it the bile is drained to the surface and the common duct is, therefore, empty. After the operation of cholecystenterostomy bile may flow into the intestine through the new opening, but intestinal contents may also pass into the gall-bladder and increase the infection which it was the purpose of the operation to relieve. When cholecystenterostomy is performed in the manner already described, with a simultaneous lateral anastomosis or exclusion of the intestine, the risk of this infection is lessened considerably but is not abolished.

The disadvantage of cholecystotomy is that it does not afford a sufficiently prolonged drainage; the operation of cholecystenterostomy is therefore from this point of view decidedly to be preferred.

The operation of choice in chronic pancreatitis consists, therefore, in the removal of the cause and in the institution of drainage for the bile, by the performance of cholecystotomy, cholecystenterostomy or by direct drainage of the hepatic duct by choledochotomy. The results of these operations are most satisfactory if treatment is not too long delayed. A perfect recovery may be expected in the very great majority of cases. But if long-standing infection is discovered, the damage already inflicted upon the liver, the ducts, and the pancreas may be irreparable, and cirrhosis of the liver or sclerosing pancreatitis may remain, and may, in the end, prove fatal.

The mortality of the operation, judging by all recorded cases, is about 10 to 12 per cent.; but many of the patients were desperately, almost hopelessly, ill. A mortality not exceeding about 5 per cent. is what may be reasonably expected in the future.

CHAPTER XLVI.

PANCREATIC CYSTS.

The term "pancreatic cyst" has been used to describe any fluid tumour in, or associated with, the pancreas, though such tumours differ widely in causation, position, and clinical features.

The following classification is as precise as our present knowledge permits:

1. Retention cysts.
2. Proliferation cysts { Cystic adenoma. / Cystic carcinoma.
3. Hydatid cysts.
4. Congenital cystic disease.
5. Hæmorrhagic cysts.
6. Pseudocysts.

From the pathological standpoint the inclusion of the last form is not permissible. As, however, the clinical features tally precisely with those of true pancreatic cysts, the academic objection must give way to considerations of convenience.

1. **Retention Cysts.**—Virchow ("Die krankhaften Geschwülste," 1863, vol. i, p. 276) described two forms of retention cyst of the pancreas. In the one the whole duct is widened, and a "rosary-like" dilatation occurs. In the other the duct is blocked at its outlet and becomes distended into a cyst, which may reach the size of a fist and may contain mucoid, hæmorrhagic, or calculous matter. With the smaller cysts there can generally be little or no difficulty in determining their origin; with the larger cysts,—with such as the surgeon is destined to meet,—the differentiation may be difficult or impossible. Virchow himself has expressed his inability to determine the origin of

a large cyst attached, on the one side, to the pancreas, and, on the other, to the stomach.

The causes of retention cysts are:

(*a*) The impaction of a calculus or calculi.

(*b*) Cicatricial stenosis.

(*c*) Pressure upon the duct from without.

(*d*) Dislocation of a part of the gland.

Retention cysts have been recognised as such during the course of the operation by several observers. In Ludolph's case ("Inaug. Dissert.," Bonn, 1890) the cyst was excised and the opening of the duct clearly seen. Hagenbach found two dilated radicles of the main canal opening into the cyst. Dixon ("Medical Record," March, 1884) found the duct opening into the larger of two cysts. Richardson's case was considered by him to be a cystic dilatation of the duct. As it is rarely possible to make an exhaustive inspection of the parts during an operation, it is perhaps remarkable that so many observations have been recorded.

On the postmortem table specimens have been recognised by Virchow, Klebs, Gould, and many others. Virchow applied the term "ranula pancreatica" to a general distension of the whole duct. When numerous small engorgements of the minute ducts are present, Klebs suggested the name "acne pancreatica."

2. **Proliferation Cysts.**—Proliferation cysts may be either simple or malignant. The exact differentiation is not infrequently difficult, and is at times impossible, from the pathological standpoint. One has, in some cases, to await the course of events after the removal of a cystic tumour before deciding as to the class in which to include it. Thus Fitz, of Boston, in relating his case ("Amer. Jour. of Med. Sci.," August, 1900), says: "The tumour, from its histological appearances, is to be regarded as essentially a multilocular cystoma, but on the border-line between a proliferating cystoma or cystadenoma and a cystomatous carcinoma, a distinction which the subsequent history of the patient may be expected to make clear."

3. **Hydatid Cysts.**—Hydatid cysts of the pancreas are extremely rare. Massèron ("Thèse de Paris," 1881) was able to collect the records of only five cases, and these were first recognised on the postmortem table. Graham, of Sydney ("Hydatid Disease in its Clinical Aspects," 1891), writes: "The hydatid is sometimes found in the pancreas. I have observed it as a cyst about three inches in diameter, replacing the head of the organ." Tricomi states, without giving references, that seven cases have been recorded.

4. **Congenital cystic disease,** similar to the congenital cystic disease of the liver and kidneys, has been observed on rare occasions. Dr. Pye-Smith recorded ("Path. Soc. Trans.," 1885, p. 17) a case of cyst of the cerebellum with numerous small cysts in the pancreas and kidneys. The patient was a man aged twenty-seven.

Richardson has recorded a cyst of the pancreas occurring in a child fourteen months old; and in one case, related by Shattuck, a tumour had been noticed since birth.

5. **Hæmorrhagic Cysts.**—That bleeding may occur into the substance of the pancreas as the outcome of acute or chronic inflammation is well proved.

Of the influence of these or other hæmorrhages, traumatic or spontaneous, upon the building up of a cyst, no positive opinion can be expressed. Hagenbach distinguishes between hæmatoma, in which bleeding occurs into pre-existing cysts, and apoplectic cysts, resulting from hæmorrhage into softened, degenerate gland substance. In favour of the hæmorrhagic origin of cysts are the writings of Kühnast, Schröder, and Friedreich.

Gussenbauer conjectured that the origin of the cyst in the case operated upon by him was due to a central hæmatoma of the pancreas. In discussing the case Senn remarks: "This assumption lacks demonstration, and it is just as logical to assume that the cyst originated in the usual way from an obstruction, and that the blood in the cyst contents was an accidental product," a comment with which Körte seems in accord.

6. **Pseudocysts.**—Körte has proposed the term "pseudocysts" for those fluid tumours found in more or less close proximity to the pancreas, but not originating in the substance of the gland. The accurate distinction of a true pancreatic cyst from a pseudocyst is not always possible during life, for a cyst primarily peripancreatic may originate in a trauma which implicates the gland at the same time, so that the pancreatic juice may in small quantity escape into the pseudocyst and make its mimicry of a true cyst so complete that a distinction is impossible. I am, indeed, strongly inclined to believe that many cases of so-called pancreatic cysts, especially those of traumatic origin, are in reality peripancreatic or pseudocysts, effusions into the lesser cavity of the peritoneum, localised extravasations of blood, and so forth. In some recorded examples the origin of a cyst in the pancreas is purely hypothetical, and in these the tumour may be a "pseudocyst" of the pancreas or a true cyst of a neighbouring organ, such as the suprarenal or the kidney.

The most frequently occurring form of "pseudocyst" is that first described by Mr. Jordan Lloyd ("Brit. Med. Jour.," November, 1892). In this very important paper attention is drawn to effusions into the lesser peritoneal cavity, as the result of injury to the pancreas, and two cases are fully reported.

Mr. Jordan Lloyd writes: "The diagnosis of pancreatic cyst appears to me often to have been made upon insufficient evidence. The fact that a cavity within the abdomen contains pancreatic secretion is no proof whatever that the cavity is within the pancreas; it tells us nothing more than that the cavity is connected with this organ. Neither is the fact that the pancreas can be felt by an examining finger from within an intra-abdominal sac, for if the lesser peritoneal cavity is opened from below by an incision in the transverse mesocolon, a finger passed through this opening enters a large space, at the back of which the pancreas is found; similarly, too, if the lesser peritoneal cavity is opened by an incision in the great

omentum below the stomach. Through either opening the deepest part of this space is found to the left, and cannot be reached by the examining finger."

Mr. Jordan Lloyd summarises his conclusions as follows:

"1. That contusions of the upper part of the abdomen may be followed by the development of a tumour in the epigastric, umbilical, and left hypochondriac regions.

"2. That such tumours may be due to fluid accumulations in the lesser peritoneal cavity.

"3. That when the contents of such tumours are found to have the property of rapidly converting starch into sugar, we may assume that the pancreas has been injured.

"4. That many such tumours have been regarded as true retention 'cysts of the pancreas,' and that this opinion has been formed upon insufficient evidence.

"5. That the diagnosis of distension of the lesser peritoneal cavity before operation can usually be made by the characteristic shape of the swelling.

"6. That early median abdominal incision and drainage is the safe and proper treatment."

The following most interesting case is recorded by McPhedran ("Brit. Med. Jour.," 1897, vol. i, p. 1400):

G. A. B., male, fifty-three. In 1891 had an attack of biliary colic, with well-marked jaundice and pale motions. Had two or three similar attacks every year. Condition became gradually worse; there was almost constantly some epigastric discomfort, indigestion, flatulence. One severe attack of pain lasted three days; the epigastrium was tender, and pain radiated in several directions. Was losing flesh. On examination on a certain date there was an increase in the thickening in the deep part of the epigastrium; three days later a large, smooth, cyst-like tumour was found in the epigastrium, extending from the right parasternal line to the left mammary line and down to the umbilicus. The upper boundary was ill defined; the stomach resonance was above and to the left. A cystic collection in the bursa omentalis was diagnosed, and the abdomen was opened. The cyst was emptied; at the bottom lay the

pancreas, irregularly enlarged and firm, but somewhat elastic. The peritoneum over it was smooth and healthy looking. There was no sign of hæmorrhage anywhere. Five months after a tumour was again found in the epigastrium; this tumour extended down to the level of the anterior superior spinous processes and laterally to the mammary line on the right and the anterior axillary line on the left. It forced the diaphragm upwards, so that the cardiac impulse was in the fourth intercostal space. The abdomen was again opened, and a cyst exposed lying behind the stomach; the cyst-wall was about 2 mm. thick; the fluid was opaque, whitish, and contained many flocculi and fibrin masses. The fluid was alkaline, contained albumin and no digestive ferment. The cavity contracted rapidly, but a fistula persisted. The discharge from this irritated the skin. On examination it was found to possess marked action on albuminoids, fats, and starches, leaving no doubt as to the presence of pancreatic secretion. The condition causing the repeated attacks of colic lay in the pancreas, and may have been a calculus or a localised inflammatory deposit causing mechanical obstruction. In the most acute attack the symptoms were those of acute pancreatitis.

This case is especially interesting from the fact that it is, so far as I know, the only one recorded in which a pseudocyst and a true cyst have been observed in the same individual.

PATHOLOGICAL ANATOMY.

Cysts of the pancreas are rather more frequent in men than in women. Of 121 cases collected by Körte, 60 were males, 56 females; in the remaining 5 no mention of sex is made.

The youngest patient affected was a child thirteen months old, whose case is recorded by Shattuck. Richardson has operated upon a child fourteen months old. Stiéda's patient was a man of seventy-six.

The cystic tumour may be situated at any part of the gland from the duodenal margin of the head to the tip of the tail. The body is more commonly affected than the head, and the

tendency to implication seems, roughly, to increase as the tail is approached.

In 22 cases collected by Hagenbach the cyst arose in the tail 10 times, 4 times in the head, once in the body, and in 7 the site is not indicated. Nimier gives the following: 21 times in the tail, 6 times on the body, 4 times in the head, once in the head and the body, and in 1 the whole organ was implicated.

Cysts may be single or multiple, unilocular or multilocular. Two cysts may be simultaneously observed of almost equal size; or, after the healing of one cyst, a second may develop in a distant portion of the gland and necessitate further operation. One small cyst may be found with a large number of smaller ones packed in its walls.

The cysts are generally smooth and rounded; they are elastic and rather tense. The inner surface of the cyst-wall is commonly smooth, and lined throughout by cylindrical epithelium; trabeculæ or incomplete septa may at times be present, and a thimbling of the surface may be seen. Intracystic polypoid masses are found in cases of proliferation cyst. In the great majority of recorded cases blood in greater or less quantity has been observed.

SYMPTOMS AND SIGNS OF PANCREATIC CYSTS.

The symptoms produced by a pancreatic cyst are chiefly referable to the pressure exerted by the tumour upon surrounding viscera. In the earlier stages, while yet the tumour is small, the symptoms are absent, or so trivial as to attract but little attention. Almost imperceptibly the feelings of discomfort, weight, and fulness in the epigastrium increase. Pain is noticed towards the end of, and for some time after, a meal, and vomiting becomes gradually established as a distressing symptom. To these earlier, less pronounced, symptoms Friedreich has given the name "cœliac neuralgia." The pain is generally confined to the upper half of the abdomen, but it may radiate to the back, especially on the left side, and has been said

to strike downwards into the testes. The intensity of the pain is liable to wide variation: it may resemble that of "indigestion," or may be acute and almost intolerable, and suggest intestinal obstruction. Vomiting is inconstant and variable, but generally in close relationship to the amount of pain suffered. In one case related by Kocher pain and vomiting occurred in paroxysmal outbursts every two or three months. Salivation is rarely noticed; the vomiting of clear, colourless fluid, "salivatio-pancreatica," is recorded by Zielstorff.

The functions of the bowels are generally sluggish; obstipation is the rule, but may give place to diarrhœa at times; a blood-stained liquid motion has been occasionally remarked. In one case, recorded by Indemans, a bloody diarrhœa constantly recurred.

Jaundice is noticed in a small proportion of cases. It depends upon a pressure exerted by the tumour upon the common duct, and is therefore associated almost always with a tumour in the head or neck of the pancreas. Körte finds the occurrence of jaundice noted in 9 out of 121 cases.

In these few recorded examples of giant cyst the usual concomitant disabilities of a largely distended abdomen are noticed. Dyspnœa is mentioned by Zielstorff, Filipoff, Stapper, and Shattuck.

In almost every case the general health of the patient suffers seriously. Wasting is rapid and continuous. In one of my cases the patient lost three stones of weight in seven weeks. Weakness is very pronounced, and in appearance the patient ages quickly, looking sallow, pinched, shrunken, and profoundly ill. According to Friedreich, wasting is more serious when affections of the bile-passages are associated with disease of the pancreas.

The cystic tumour developing in the pancreas lies behind the posterior layer of peritoneum, forming the lesser sac. As the swelling increases it bulges into the lesser sac and is covered, whatever direction it may take, by this layer of the serous

membrane. The tumour is at first placed behind the stomach, but in its gradual enlargement it displaces the viscus. It may pass in one of three directions:

(*a*) In the great majority of cases the stomach is pushed upwards and to the right, and the transverse colon is pushed downwards, the cyst coming to the surface below the greater

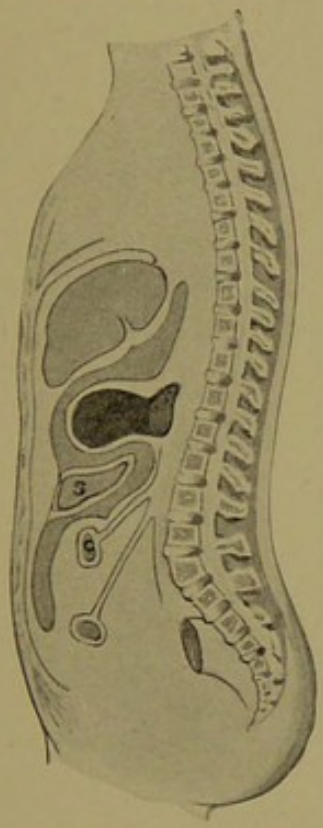

Fig. 358.—Cyst of the pancreas: the cyst presents above the stomach.

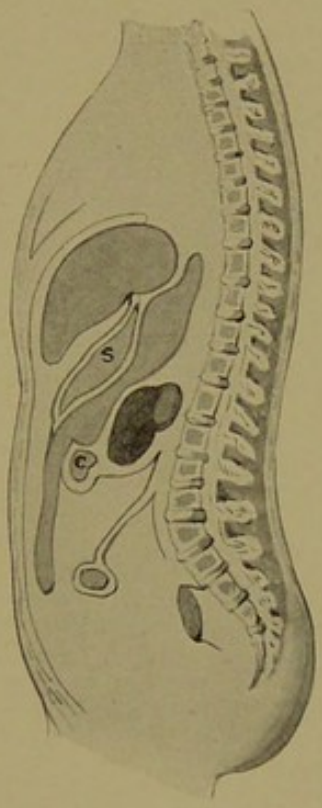

Fig. 359.—Cyst of the pancreas. The stomach and the transverse colon lie in front of the cyst.

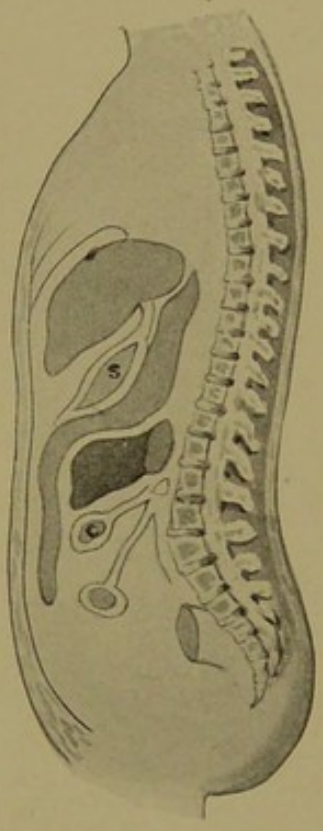

Fig. 360.—Cyst of the pancreas. The cyst presents between the stomach and the colon.

curvature of the stomach. In order to reach the cyst through the abdominal wall the parietal peritoneum, the two layers of peritoneum forming the great omentum, and the posterior layer of peritoneum of the lesser sac, have all to be divided. The amount of pressure and displacement to which the stomach and the transverse colon are subject depends entirely upon the bulk of the cyst. The stomach may be jammed tightly under

the liver, and the transverse colon may, as recorded by von Riedel, Salzer, Heinricius, and others, be pushed down as low as the symphysis pubis.'

(*b*) In certain cases the enlarging tumour may push its way forwards above the upper border of the stomach and there present. In order to reach the cyst in this position the following layers of peritoneum must be divided: parietal, two layers of

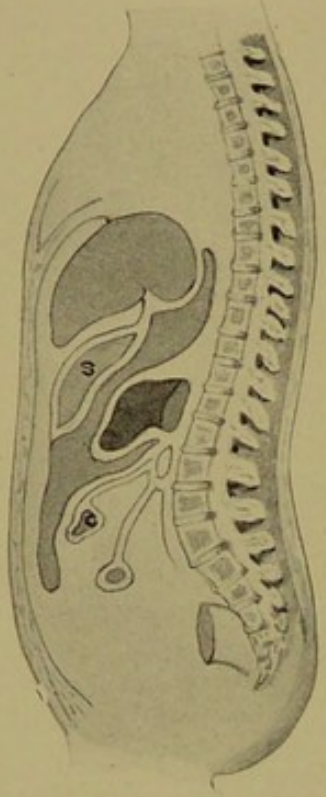

Fig. 361.—Cyst of the pancreas. The stomach lies in front of the cyst: the transverse colon is below it.

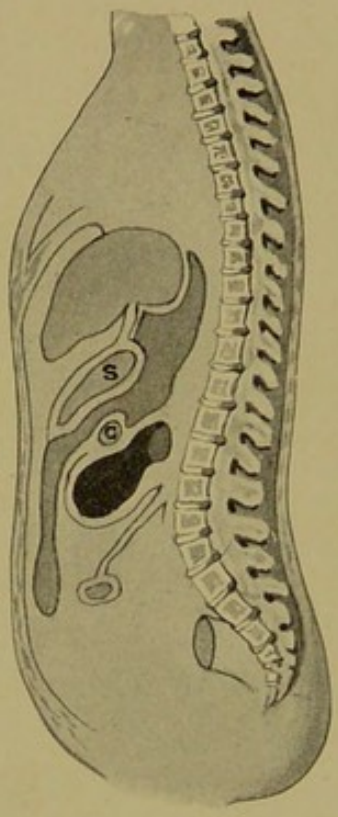

Fig. 362.—Cyst of the pancreas. The cyst lies below both the stomach and the transverse colon.

the gastrohepatic omentum, posterior layer of the peritoneum of the lesser sac. The stomach is pushed downwards, and the liver forced upwards and to the right. The most prominent part of the cyst presses against the anterior abdominal wall. In one case Albert saw a bulging of the cyst through the foramen of Winslow into the greater cavity of the peritoneum. The presenting of the cyst above the lesser curvature of the

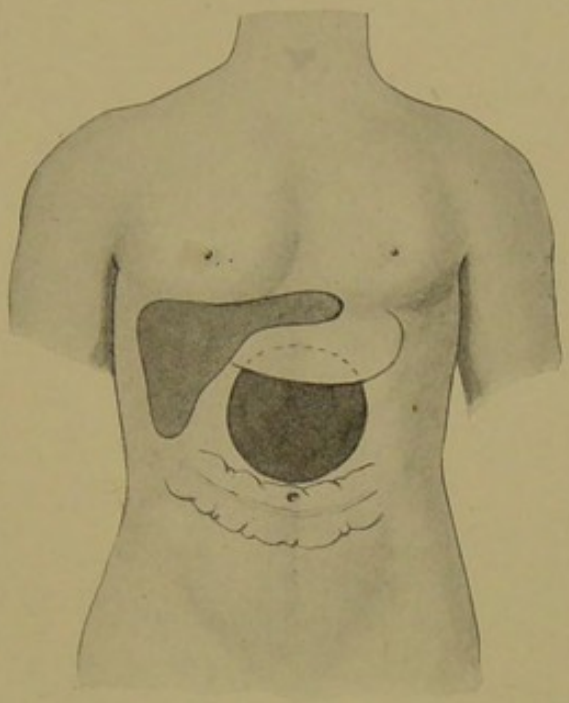

Fig. 363.—Cyst (or tumour) of the pancreas. The cyst presents between the stomach and the transverse colon.

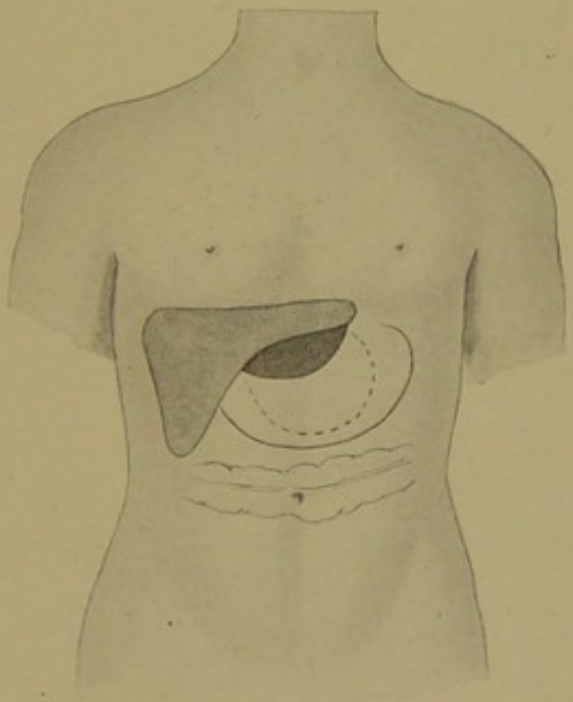

Fig. 364.—Cyst of the pancreas. The cyst projects forwards between the liver and the stomach.

stomach has been observed in eleven cases (Albert, Indemans, Zielstorff, Riegner, Swain, Hahn, Karewski, Doran, Herman, Finotti). Riegner and Finotti diagnosed the position before operation.

(*c*) If the cyst spring from the lower portion of the head of the pancreas or from the inferior border of the body or tail, it will be at the lower limit of the lesser sac. As it then increases in size it will push its way between the layers of the transverse mesocolon, or bulge downwards the inferior layer. If

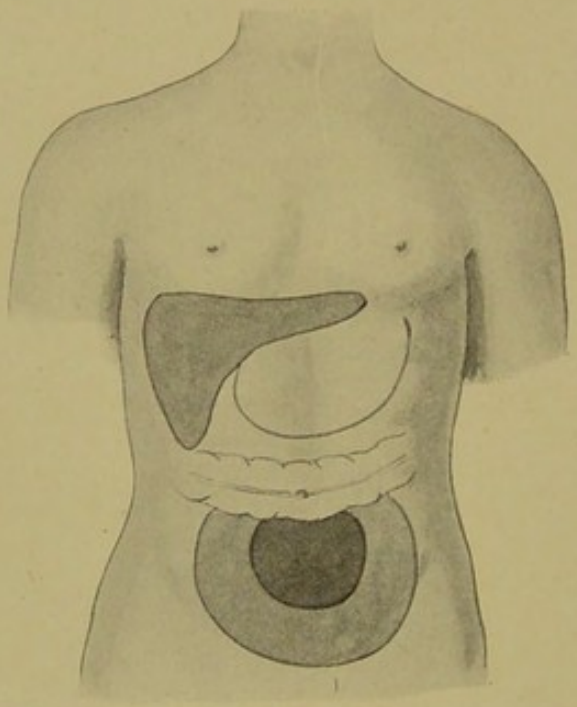

Fig. 365.—Cyst of the pancreas. The cyst presents below the transverse colon. The darker area is the area of absolute dulness. The surrounding area represents the region of partial dulness.

the former, the transverse colon will run directly across the front of the cyst; if the latter, the transverse colon and the stomach will both be pressed upwards.

Cases in which the transverse mesocolon was invaded are recorded by Zukowski, von Petrykowski, Lardy, Salzer, Riegel, Treves. The tumour then presents as a smooth, rounded mass, crossed at or near its middle by the stretched colon.

The bulging of the lower layer of the transverse mesocolon

is recorded by Hersche, Lindh, and Heinricius. The great omentum may be stretched over the cyst, and thinned by its enlargement, or it may be pushed aside. If the former, the parietal peritoneum, the great omentum, and the inferior layer of the transverse mesocolon have to be cut to reach the cyst, and in the latter the parietal peritoneum and the inferior layer of the transverse mesocolon only. In one instance, recorded by Bernard Pitts and Shattock, the enteric mesentery invested the front of the cyst. Martin found the descending colon in front of the cyst in his case, and Schwartz, the cæcum; in both the tumour was of large size and occupied the larger part of the abdomen.

DIAGNOSIS.

The signs and symptoms warranting a diagnosis of pancreatic cyst are as follows: A patient ill, with indefinite symptoms of epigastric uneasiness, weight, pain, and occasional vomiting, begins to lose weight, and, on examination, a swelling of the upper part of the abdomen is discovered; or, a patient suffers an injury of some severity to the upper part of the abdomen,—the kick of a horse, a heavy blow, or while lying on the ground the abdomen is trampled upon,—within a brief period of days or weeks a tumour forms, with or without symptoms, in the epigastric region. As the tumour enlarges the symptoms become more acute, or, less commonly, remain stationary. Jaundice, intestinal hæmorrhages, or diarrhœa may be observed.

The tumour which forms lies generally in the epigastric region, with its most prominent aspect at or near the middle line or between the midline and the left costal margin. The tumour is rounded, generally smooth, elastic, or fluctuating. It may vary in size from time to time. It is dull on percussion in the centre, but above percussion demonstrates the stomach resonance, and below, that due to the transverse colon. Inflation of these viscera, as first suggested by Gussenbauer, increases the area of their tympany and lessens the central dull

area of the tumour. The tumour is fixed; the skin over it, smooth and unwrinkled.

In the urine sugar may be found; in the fæces, an excess of fat and of undigested muscle-fibre.

TREATMENT.

The operative treatment of pancreatic cysts is limited to three methods:

1. Aspiration.

2. Evacuation and drainage, the cyst being stitched to the abdominal wall (Gussenbauer's method).

3. Extirpation, partial or complete.

1. Aspiration.—This method may be dismissed in a few words. It is unscientific, unsatisfactory, and redolent of mediævalism. The risks and drawbacks of this old-time procedure need no emphasis to-day. All surgeons feel that it is not the simple procedure that was at one time supposed. In the days before antiseptic surgery was introduced almost any risk was run rather than that the certainty of disaster which followed an open incision should be encountered. With modern methods, however, there can be no hesitation in saying that the open operation does not possess a tithe of the risk of this blind procedure. The method of aspiration is not only dangerous: it is futile. It has never been attended with success. In Lynn's case ("Lancet," 1894) it is practically certain that the tumour was due to a fluid effusion into the lesser sac, with perhaps a rupture of the pancreas as well. In fact, all our knowledge of pancreatic cyst disproves the possibility of cure by aspiration, however often repeated.

If the cyst be emptied, it will refill. The risks during refilling are leakage from the point of puncture and laceration of the cyst starting from the small opening, both of which have been recorded.

If the patient is seriously ill from diabetes or suffering acutely from pressure symptoms, and unable to withstand the shock

of an abdominal operation, an aspiration may be resorted to in the hope of tiding the patient over an acute crisis, so that the subsequent operation may safely be borne. Under no other conditions can it be considered desirable.

2. Evacuation and Drainage.—The method which has been the most frequently adopted is that of stitching the cyst to the abdominal wall, and opening and draining its cavity. The operation may be done in one or two stages, the opening of the cyst being delayed until adhesions have formed which protect the peritoneal cavity. The operation at two sittings has rarely been adopted in recent years. Of seventeen cases collected by Takayasu, death occurred in one.

The abdomen is opened by a median or slightly lateral incision. As a rule, the cyst will be found to bulge forwards below the greater curvature of the stomach and above the transverse colon. The cyst is exposed by tearing gently through the omentum just below the greater curvature of the stomach. A careful exploration and examination are made in order to determine the source of the cyst, the condition of the pancreas, the presence of adhesions, and so forth. The most prominent part of the cyst being exposed, a few swabs are packed around, to prevent any leakage into the peritoneal cavity or any soiling of the abdominal wall. An aspirator needle is then thrust into the cyst and the contents are evacuated. As the needle is withdrawn a clip is placed over the puncture. By gentle traction on the clip the cyst can be lifted well up into the wound. With a curved intestinal needle threaded with strong catgut, fine silk, or Pagenstecher thread, a continuous suture unites the peritoneum, covering the cyst to the parietal peritoneum. When the stitching is secure, the clip may be removed, the puncture which it guarded enlarged into an opening, and a large rubber drain introduced.

Drainage may be secured by an opening through the loin, as advised by Cotterell and Pearce Gould. This should be done after the exposure of the cyst and its evacuation through an

abdominal incision. In cases where the diagnosis is difficult this method permits of a certain diagnosis. After the emptying of the cyst a finger is passed to the back of the cavity, and by pressure is made to present below the last rib, where an incision is made down on to it and a drainage-tube is introduced. The anterior wound in such a case must also be drained, the cyst-wall being stitched to the parietal peritoneum. The anterior wound gives vent to very little fluid and heals rapidly.

In some cases, deliberately or after a mistaken diagnosis, an incision has been made posteriorly and the cyst contents have been at once evacuated.

Peters, in a case of hydatid cyst of the tail of the pancreas, made no abdominal incision, but cut directly down from the loin through an incision three inches in length, made from the margin of the erector spinæ forward, about parallel to the last rib, and curving slightly upwards around its end in the direction of the margin of the costal cartilages. The lumbar fascia was divided, the colon reached by pressing the finger upwards, forwards, and inwards.

The exposure of the cyst from the front is not seldom a matter of difficulty; adhesions may be numerous and dense, and the vessels in the omentum may be greatly enlarged, swollen, and easily lacerable. As bloodless a spot as possible must be found in the great omentum, and as few vessels interfered with as is consistent with adequate exposure of the cyst-wall. Any vessels needing division should be doubly ligated before being severed.

Hagen ("Archiv f. klin. Chir.," Bd. lxii, H. 1) reports a case of abdominal tumour in a boy thirteen years of age. Laparotomy was performed, and after opening the abdomen a cyst, about the size of a child's head, was found, posterior to the stomach, firmly surrounded by adhesions, so that it was impossible to bring the cyst-wall in contact with the abdominal wall, and equally impossible to remove the cyst as a whole. The only hope of saving the child's life, however, was in the evacua-

tion of the cyst. Approach to the cyst was finally gained by first incising the anterior gastric wall, and then, through the cavity of the stomach, the posterior gastric wall was reached and the cyst opened. The contents of the cyst were easily removed. A finger passed in through the openings found the least external resistance on the left side of the cyst, and with difficulty the stomach was here displaced a little towards the right, so that, pushing firmly on the abdominal wall, the cyst could be brought in contact with the parietal peritoneum. The two wounds in the stomach were sutured—first that in the posterior wall and afterwards that in the anterior wall. In order to allow the abdominal wall to fall in to a sufficient extent to come in contact with the cyst it was found necessary to resect a part of the ninth and tenth rib cartilages. The cyst was then sutured to the abdominal wall and opened. Examination of the cyst shewed that it was evidently the result of a chronic interstitial inflammation of the pancreas. The patient stood the operation well, and two months afterwards the cyst had disappeared, the pancreatic fistula had closed, and the patient had gained twenty pounds in weight.

If the cyst is not of a large size, there may be some difficulty in dragging its wall up to the parietal peritoneum in order to suture it there. Under these circumstances a tube surrounded by gauze may be passed down to the cyst, the tube projecting beyond the gauze into the cavity; or a purse-string suture may be passed around the opening into the cyst and a tube introduced. On tying the suture the tube is held firmly in position, and will so remain until lymph has been thrown around it to wall off the general peritoneum; or, again, a fold of the great omentum may be brought round to form a barrier to the escape of fluid into the peritoneal cavity. If none of these devices seems desirable, then, after exposure of the cyst and its evacuation by means of an aspirator needle, gauze packing may be introduced and left for three days. On removing it, it will generally be found that a water-tight channel from the abdominal

wound to the cyst has been formed, and that the cyst may then be safely opened without the risk of peritoneal contamination. When the cyst is very tense and cannot be made to reach the abdominal wall, the contents should be removed by aspiration. The flaccid walls can then be drawn well forwards, and suture to the parietal peritoneum is quite easy.

The mortality of this method has been carefully computed from the records of published cases by Körte.

From Gussenbauer's case, the first one so treated, there have been 84 patients submitted to operation. Of these, 1 died of sepsis (Ogston), 2 died of peritonitis (Durante, P. Gould), and 1 died of shock and peritonitis (Mérigot de Treigny). Two patients who suffered from diabetes subsequently died (Churton and Pagenstecher); 2 patients who were operated upon for cystic epithelioma died soon after operation (Labbee and Hartmann); and 1 (Reeve) died of secondary infection from the fistula. This last case and the first four may be considered as deaths from the operation—5 deaths in 84 patients, a comparatively small mortality. Takayasu, in a tabular list of 64 cases, found 8 which proved fatal.

The sinus which remains after this operation may discharge fluid for many weeks or even months. The fluid is often very irritating, digesting the skin and making it red, intensely sore, and angry. It is, therefore, better to keep a fine tube in as long as possible, the outer end of the rubber tube leading into a test-tube or a little rubber bag fastened to the patient's clothing. The fluid is clear and watery, and gives all the reactions characteristic of pancreatic secretion.

3. Extirpation.—The extirpation of a pancreatic cyst is seldom necessary, and is rarely capable of successful accomplishment. The adhesions formed by the tumour are often of the densest character; blood-vessels of large size run in and around the cyst-wall, and the tissues are very readily lacerable. An attempt at extirpation under such conditions is very hazardous and may prove impossible. Mikulicz, than whom there

are few surgeons more dexterous, on two occasions has abandoned attempts at removal, finding the physical difficulties insuperable. In 2 cases (Billroth, Mikulicz) the splenic vessels have had to be tied in liberating the cyst from adhesions.

If, as may rarely be the case, the cyst is rather narrowly pedunculated and the adhesions are of no great density, then extirpation may properly be attempted. In all, 15 cases of complete excision have been recorded, with 13 recoveries. In 7 additional cases the extirpation has been only partial, some of the cyst-wall being irremovable; 4 of these patients died.

The pedicle has been ligated (Clutton and others), clamped with forceps (Poncet), or divided with the thermocautery (Kosinski). In almost all the cases the cyst presented between the stomach and omentum. The most favourable case for excision was that related by Sharkey and Clutton. The patient was a female, aged thirty-five, who had noticed an abdominal enlargement for sixteen or twenty years. The tumour was remarkably movable in all directions. At the operation the tumour "shot out of the wound with the greatest facility," with the tail of the pancreas attached to it. The splenic artery and vein had to be dissected off the tumour, which was removed entire, without being opened. The pedicle bled freely and was packed with gauze. The wound for some time after the operation discharged pancreatic juice. The contents of the cyst were fluid, canary yellow in colour, of specific gravity 1024; albumin was present in large quantity; the fluid was turbid and iridescent with cholesterin.

CHAPTER XLVII.

NEOPLASMS OF THE PANCREAS.

Carcinoma of the Pancreas.—The most common of the new-growths of the pancreas is carcinoma. The growth may be primary or secondary; far more commonly the latter. It is, of course, to be remembered that in the statistics of all hospitals the term "carcinoma" probably includes many cases of chronic simple induration of the head of the pancreas, for until the last few years there was no accurate discrimination, clinically, between the two diseases. The great frequency of secondary growths as compared with primary is due to the fact that the gland is not infrequently implicated in the extension from gastric carcinomata. The growth may involve any part of the pancreas, but is found most frequently in the head.

Oser, in 78 cases, found the distribution of the growth to be: in the head, 39 times; in the whole organ, 19 times; in the tail, 4 times; in the head and body, 3 times; in the body and tail, once; in the body, once; in the head and tail, once. The fact that the duodenal end of the duct is so commonly affected accounts for the character of the symptoms usually observed. For the growth then compresses the common bile-duct and the canal of Wirsung, and leads to a gradual dilatation of both. As a result of the retention of the secretion of the pancreas and a consecutive diminution in its quantity there are symptoms due to an insufficient digestion of food, such as marked and rapid progressive wasting, azotorrhœa, and steatorrhœa. Boldt has shewn that in one case in three of malignant disease affecting the head of the pancreas a dilatation of the duct of the gland is seen.

As a result of the compression of the common bile-duct there is jaundice, and in the majority of cases, in conformity with

Courvoisier's law, there is a distension of the gall-bladder with bile. The jaundice comes on slowly and imperceptibly at first. As a rule, the alteration in colour is commented upon by a relative or friend before the patient notices it. The jaundice, moreover, is progressive and not liable to variations. There is no fever, and pain is conspicuous by its absence. Before the appearance of jaundice the patient may feel weak, enfeebled, disinclined for exertion, and wasting is even then a matter of comment.

I have elsewhere ("Edin. Med. Jour.," May, 1906) pointed out that Courvoisier's law, like all other laws, is capable of infraction. The following may be stated as the chief circumstance in which the law may be violated:

1. Where there is a stone or stricture in the cystic duct causing hydrops or empyema, together with the acute impaction of a stone in the common duct.

2. Where there is a stone in the cystic duct pressing upon the common duct.

3. Where there is distension of the gall-bladder by an acute inflammatory process with obstruction of the common duct by stone.

4. Where there is chronic induration of the head of the pancreas with a stone in the common duct.

5. Where there is malignant disease of the common duct at any part of its course, or cancer of the head of the pancreas and a chronic sclerosing cholecystitis.

After making full allowance for all these conditions it cannot be denied that the validity of the law is established in at least 90 per cent. of the cases met with in practice. In the remaining 10 per cent. there is rarely a difficulty in diagnosis when the other symptoms are passed in review.

Sarcoma of the pancreas is very rare as a primary disease; secondary growths, especially in melanotic sarcoma, are not so rare. In some cases, as, for example, in those recorded by Michelsohn and Baudach, a combination of sarcoma with carcinoma—"sarcocarcinoma"—was found.

Adenoma of the pancreas has been noticed by Thierfelder, Biondi, and others. Thierfelder's specimen was found as a distinctly encapsulated tumour which could be easily enucleated. Biondi excised a "fibro-adenoma" from the head of the pancreas; the patient was alive and in good health two years later.

TREATMENT.

The treatment of malignant disease of the pancreas by the surgeon can hardly be said to exist. It is true that recently Franke ("Archiv f. klin. Chir.," Bd. lxiv, 1901) has related three cases in which malignant tumours of the gland were removed,

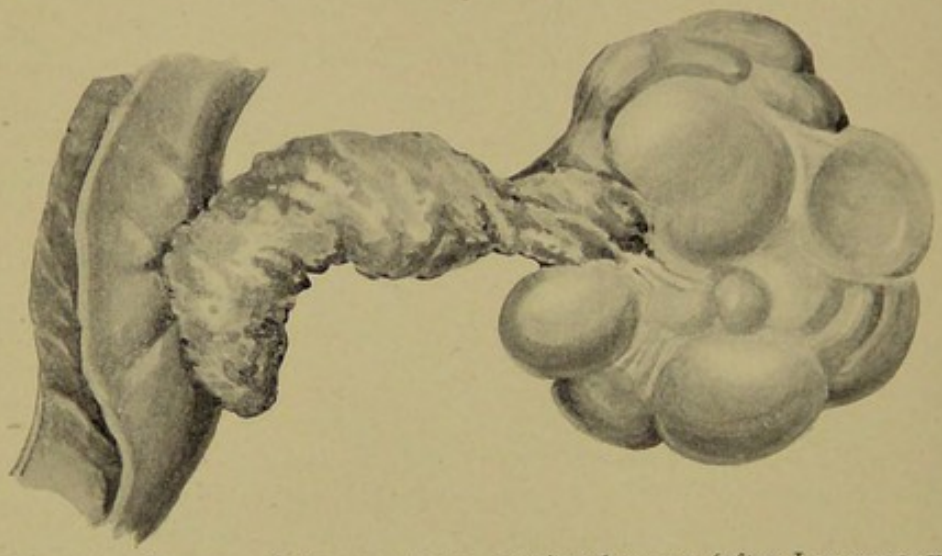

Fig. 366.—Tumour of the pancreas—cystic adenoma (after Lancereaux).

but two of the patients died as a result of the operation, and in the third case the patient lived only five months. In this last case it is said that the whole pancreas was removed, but a reading of the case-history does not convince one that this was done. I have elsewhere collected the records of all cases operated upon—thirteen in number. They all serve to shew that the mechanical difficulties of the operation are well-nigh insuperable, and that if boldness and good fortune are the operator's gifts, the result to the patient hardly justifies the means. Removal of the pancreas, in whole, or in part, for neoplasms has rarely been undertaken. Finney ("Trans. Amer. Surg. Associa-

tion," 1910, pp. 315–327) collected 16 cases from the literature and recorded one of his own. There were 9 recoveries and 8 deaths in the series; all the deaths occurred in malignant cases. In three cases a partial resection of the pancreas was followed by suture of the divided ends.

The following list is taken from Finney's paper.

Case I (Billroth, 1884).—Total removal of pancreas for malignant tumour of the pancreas. Recovery.

Fig. 367.—Outer surface of tumour (Malcolm's case, Royal College of Surgeons' Museum, 2836 a).

Case II (Ruggi, 1889).—Woman, aged fifty years, tumour size of head of an adult; adhesions separated and whole tumour removed. Recovery. Examination showed it to be adenosarcoma of the head and body of the pancreas.

Case III (Terrier, 1892).—Woman, aged fifty-five years; tumour in umbilical region, slightly movable and found to be attached posteriorly by pedicle, which was severed with cautery. Patient died of shock the same day. Autopsy showed that tu-

mour of pancreas had been removed, only small portion of the head in the angle of the duodenum being left—cystic epithelioma of pancreas.

Case IV (Krönlein, 1894).—Woman, aged sixty-three years; tumour in umbilical region size of a fist, movable, diagnosis, cancer of pylorus. Operation. Tumour behind the pylorus in the head of the pancreas. The pancreatoduodenal artery was ligated, also the middle colic artery. After this, the separation of the tumour from the head of the pancreas was easy. The common duct and the duct of Wirsung were not seen. Patient did well until third day, when abdomen began to distend, and she died on the seventh day. Death due to gangrene of transverse colon. Angiosarcoma of the head of the pancreas.

Case V (Biondi, 1894).—Woman aged forty-five years; tumour umbilical region size of egg, painful; glycosuria and stearrhea. Operation. Tumour occupied the inferior two-thirds of head and body of pancreas. It envelops the canal of Wirsung and partially that of Santorini. It is isolated from the tissue of the pancreas. Hæmorrhage controlled by pressure and ligatures en masse. The duodenum is reunited to the remainder of the gland; drainage; recovery; temporary pancreatic fistula; adenofibroma of head of pancreas.

Case VI (Cordivilla, 1898).—Tumour size of fist in region of umbilicus. Operation. Tumour impossible to separate from duodenum resection en bloc of head of pancreas, duodenum, and part of stomach; common duct tied; gastro-enterostomy, cholecystenterostomy; drainage. Did well at first, then became cachectic and died on the twenty-fourth day. Autopsy. Epithelioma head of pancreas, generalised glandular involvement.

Case VII (Tricomi, 1898).—Woman aged fifty-two years; tumour above umbilicus, size of orange, firm and hard, moves down with inspiration, painful, no jaundice, no sugar or albumen in urine, probably primary cancer of pancreas. Operation. Tumour above lesser curvature and behind stomach; isolated and excised; it involved the head of the pancreas; patient did well. Died four months after operation of cancer of liver. Small nodule of cancer in tail of pancreas. Lymph glands not involved. Adeno-epithelioma.

Case VIII (Franke, 1901).—Woman aged sixty-eight years; operated upon two years before for tumour of pylorus, probably

ulcer; pylorectomy and gastro-enterostomy by method of Kocher; pancreas at that time all right. Patient did well until recently, when she began to feel bad, lost her appetite and noticed a tumour in the region of the operation; no jaundice; tumour size of apple to right of median line; moves slightly. Diagnosis, recurrence in stomach. Operation. Tumour behind the stomach; head of pancreas invaded by cancer; tail is free; two isolated nodules; total pancreatectomy; finds small mass under head of pancreas which he thinks is a supernumerary pancreas and he leaves it; abdomen closed. Five and one-half months after operation died of recurrence; had glycosuria for a few days which finally disappeared entirely.

Case IX (Tuffier, reported by Sauvé).—Man aged seventy-two years; sick two months; icterus for two weeks with vomiting; no sugar in urine; sense of resistance in right hypochondrium, but no pain. Operation. Gall-bladder very much distended, tapped for 300 c.c., induration in head of pancreas; pancreas sectioned at junction of neck and body; ampulla of Vater, head of pancreas with tumour excised; common duct tied; cholecystenterostomy; duodenum closed; stump of pancreas left in wound; patient died second night. Autopsy not allowed.

Case X (Michaux, reported by Sauvé).—Woman, aged forty-five years; tumour in umbilical region for six months; not painful, tumour a little above and to the right of umbilicus not much motility. Resonance over tumour. By exclusion made diagnosis of malignant tumour of the pancreas. Operation. Tumour size of fist; tightly adherent to second and third portions of duodenum; resected major portion of these parts of duodenum, head of pancreas removed; common duct tied; gastro-enterostomy; wound closed. Death same day from shock. No autopsy; nature of growth not stated.

Case XI (Trendelenburg, 1882, reported by Korte).—Woman, aged forty-four years; diagnosis, retroperitoneal tumour. Operation showed sarcoma of the tail of the pancreas; extirpation of the growth; recovery. Death after some months. No autopsy.

Case XII (Malthe, 1894, reported by Korte).—Woman, aged forty-nine years; carcinoma of the tail of the pancreas; extirpation; recovery.

Case XIII (Malcolm, 1898).—Girl, aged four years, sarcoma

of the tail of the pancreas; extirpation; death from shock. Autopsy showed a fibrosarcoma of tail of pancreas; tumour involved the portal vein.

Case XIV (Franke, 1901).—Man, aged fifty-nine years, diagnosis, probable cancer of pancreas. Operation, partial resection of pancreas. Death fifteenth day from hæmorrhage from inferior vena cava. Scirrhous cancer of the pancreas.

Case XV (Franke, 1901).—Man, aged sixty-two years; diagnosis cancer of cardiac end of stomach or diverticulum of œsophagus. Operation. Tumour size of walnut in tail of pancreas; partial resection of the pancreas; death on seventeenth day from secondary infection; medullary carcinoma of pancreas.

Case XVI (Ehrhart, 1908).—Woman, aged thirty-two years, three months previously a gastro-enterostomy had been performed for cancer of the pylorus. Operation shewed cancer of pylorus and a separate tumour in head of pancreas. Stomach and upper portion of duodenum together with most of head and body of pancreas resected, including duct of Wirsung. The two extreme ends of pancreas were left. These were then brought together by sutures and drained with gauze strips. Pancreatic fistula resulted. After two weeks piece of necrotic pancreas discharged through wound, after which fistula closed. Return took place with death in five months.

Case XVII (Finney, "Trans. Amer. Surg. Assoc.," 1910, pp. 315–327).—Mrs. G. C., aged forty-three; white; housewife and mother of four children, was admitted to the Union Protestant Infirmary, of Baltimore, January 11, 1909. Complaint, "lump in stomach." Family history, negative. Past history, negative.

Present illness began three years ago with "sinking feelings" in the region of the stomach. About this time a mass, the size of a small orange, was discovered just above and to the left of the umbilicus. Mass not painful but slightly tender on manipulation, and freely movable. Has suffered during this period from frequent and severe headaches, accompanied by nausea and copious vomiting. Size or sensitiveness of tumour not influenced by this or any other known factor. Of late, digestion not so good as formerly. Appetite only fair. Has lost weight and strength. "Sinking spells" have increased in frequency and severity. Has greatest comfort after eating, and while at rest. Bowels constipated.

Examination shews well developed, fairly well nourished woman, color good. Heart and lungs normal. Abdomen rather full. Inspection shows a mass in right hypochondrium, which descends with each inspiration. Palpation reveals a firm rather nodular mass about the size of the fist, situated in the right hypochondrium. It is freely movable in every direction, and can be pushed over into the left hypochondrium or down almost into the right iliac fossa. Slight tenderness is complained of on manipulation of the tumour. The edge of the liver cannot be definitely felt, nor can either kidney or the spleen. Gastric tympany a hand's breadth lower than normal. Pelvic examination negative. Urine normal. Analysis of gastric contents not made. Stomach not inflated.

Diagnosis uncertain. Evidently a solid tumour, probably of omentum. On account of the extreme mobility, the pancreas was not seriously considered.

Operation. January 14, 1909. Abdomen opened through right rectus incision. The mass felt previous to operation was found located beneath the gastrohepatic omentum, above the lesser curvature of the stomach, which was displaced downwards. Upon dividing the gastrohepatic omentum the tumour was found to have its origin in the pancreas. It was about the size of a lemon and involved the whole middle portion of the gland. At the extreme ends, head and tail, there was left a little normal-appearing glandular structure, but approximately two-thirds of the gland was replaced by the tumour which had all the characteristic appearances of an adenoma or adenocarcinoma. It was decided to excise the tumour, which was done without special difficulty, care being taken to avoid wounding the splenic and middle colic vessels. The tumour, which was somewhat pedunculated, appeared to have a rather indefinite capsule, but would not shell out, and the whole middle portion of the gland was removed with it, leaving a small area each of the head and tail. Those two fragments were brought together and their raw surfaces as accurately as possible opposed and united with mattress sutures of catgut. After this had been accomplished and the continuity of the peritoneum restored as far as possible, the portion of pancreas remaining was about the size of a walnut. The line of suture of the pancreas was packed about carefully with

cigarette drain of iodoform gauze, the ends of which were brought out through the lower angle of the abdominal wound.

The patient bore the operation well, and made a slow but uninterrupted convalescence. A fistula developed at the site of the drain, which continued for about three months copiously to discharge pancreatic fluid, as shewn by the usual chemical reactions and the marked excoriation of the epidermis, which was controlled by the liberal application of lanoline to the surrounding skin. Since this time, the patient has been perfectly well, and is now enjoying excellent health.

The following case of resection of half the pancreas for tumour is recorded by W. J. Mayo ("Trans. Amer. Surg. Assoc.," 1913):

J. L., female, aged thirty-seven years. Date of operation, June 15, 1912. History of severe attacks of pain extending into the left abdomen and left lumbar region, so severe at times as to necessitate the use of morphine. At no time was the patient free from pain. Point of tenderness over the region of the body of the pancreas. Loss of weight, 17 pounds. Duration of illness, three months. Contents of stomach stools, blood and *x*-ray negative. Tentative diagnosis, cholelithiasis with pancreatic involvement. An exploratory incision was made two inches to the right of the median line in the upper rectus muscle. There were no gall-stones but a hard, irregular tumour the size of an egg was found in the body of the pancreas about its middle. A second working incision was made through the upper rectus muscle three inches to the left of the median line. The gastrocolic omentum was divided, the stomach drawn upward and the transverse colon downward. The body of the pancreas and the tumour were brought to the surface as well as possible. It seemed best to begin at the tail and remove the left half of the pancreas with the tumour. This proved to be a difficult procedure since the entire pancreas was deeply placed and fixed in position. One of the deep veins was injured and a free hæmorrhage occurred which was difficult to control without injury to the splenic vessels. Finally the tail and body of the pancreas with the tumour, about four and one-half inches in all, was separated, a strong clamp applied across the body, one inch to the right of the tumour and the left half of the pancreas with the tumour cut away.

Four clamps had previously been attached to vessels in the deep portions of the wound. An attempt was made to tie off one of these clamps with catgut on a needle, and a fresh point of bleeding which required another clamp was the result. The handles of the five clamps and the handles of the clamp previously placed across the body of the pancreas were brought to the surface and the cavity from which the pancreas had been removed was packed loosely with gauze. On the fourth day the clamps were loosened and on the fifth day they were removed. The gauze was removed on the tenth day. The patient made a good recovery, regained her normal weight, and remains well. The tumour, which had the external characteristics of a malignant growth, proved on section to be a benign thick-walled trabeculated cyst buried in sclerosed pancreatic tissue.

I cannot do better than quote here in full a case related by Mr. Malcolm in the "Lancet," March, 1902:

"The patient was a female child and was born on March 9, 1894. Her father and mother are both alive and well; they have one other child, a healthy girl, born in 1897. One of the patient's grandfathers was said to have died from an internal cancer at the age of sixty-five years. The patient had whooping-cough when she was three weeks old. It was not known that she had suffered from any lung trouble. The bowels were very constipated while she was under immediate observation. There was no albumin in the urine, which was scanty (sometimes only 12 ounces in twenty-four hours), and deposited urates, its specific gravity being usually about 1030. An abdominal swelling was first noticed in April, 1898, and Dr. R. L. Guthrie sent the patient to a well-known surgeon, who diagnosed a tumour of the left kidney, but advised that no operation should be performed. Dr. Guthrie asked me to see the patient in May of the same year. She had then an obvious swelling in the upper part of the left side of the abdomen. It was firmly held in the position of a renal tumour, but the attachments seemed sufficiently lax to allow of the growth being shelled out of its bed. The patient was, however, extremely emaciated and anæmic, having a cachectic appearance which seemed to contraindicate surgical interference, and I therefore agreed with the opinion and advice already given.

"Dr. Guthrie treated the child with iron and laxatives, and in October, 1898, he asked me to see her again. She then had improved very much in her general condition, had quite a good colour, and was not thinner. The tumour had increased in size, but not to any great extent. It distended the hollow of the left loin, pushing the lower ribs upwards and forwards, bulging the side outwards, extending across the abdomen as far as the outer edge of the right rectus muscle, and downwards to below the level of the anterior superior iliac spines. The greatest girth of the body was $23\frac{3}{4}$ inches a little above the level of the umbilicus. On palpation the mass was smooth and elastic. It could

Fig. 368.—Cut surface of tumour.

be grasped between a hand in front of the abdomen and the other hand behind the loin, and although it was firmly held, there was still a slight mobility of the tumour, sufficient to make me think that I could remove it. There were some easily felt glands in both axillæ and in both groins, but they were not enlarged. The veins over the upper part of the abdomen were distended. No disease of the heart or lungs was detected. In view of the greatly improved condition of the child's general health I told the parents that she had a tumour of the kidney and explained that an operation would involve extreme risks. I also told them that I knew of only three cases in which, after the successful removal of a tumour of this kind from a child, the patient had

survived more than a few months. On the other hand, I pointed out that death must occur soon if nothing were done. It was decided to accept the risks of an operation.

"On November 4, 1898, chloroform was administered and the tumour then seemed decidedly more mobile. I opened the abdomen through the upper part of the left linea semilunaris, and exposed the growth, with the splenic flexure and adjacent portions of the colon fixed in front of it. The most convenient

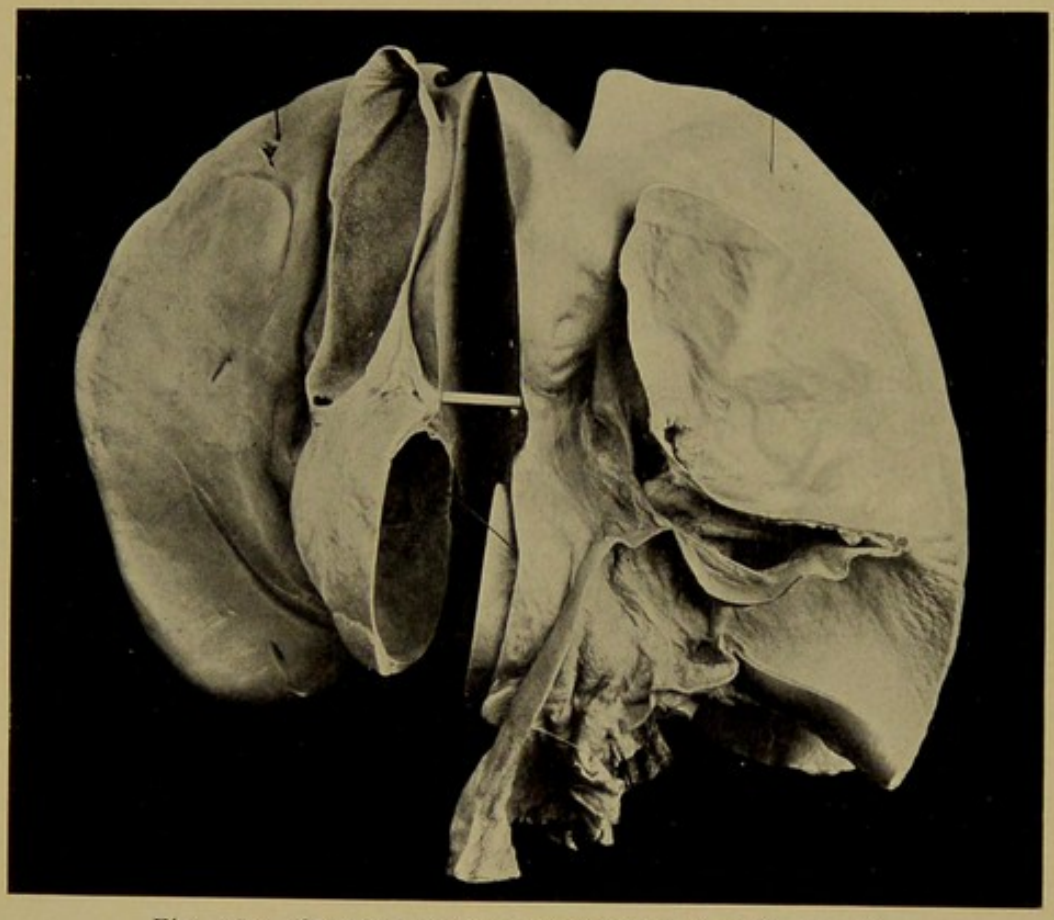

Fig. 369.—Shewing portal vein distended with growth.

place to open the retroperitoneal space, in which the tumour lay, was above the transverse colon, and when the peritoneum in that situation was divided, I had no difficulty in separating the tumour from the connective tissue in which it was loosely embedded. Some firm adhesions to the lower end of the spleen were separated, and the new-growth was then easily drawn out of the abdominal cavity, the tail of the pancreas being dragged out with it. The tumour was then only attached to the pan-

creas, and it was impossible to separate them without cutting through pancreatic tissue. In doing this large vessels were divided, but hæmorrhage from them was easily controlled by ligatures. No ureter was seen during the operation. There was a second new-growth, of about the size of a bantam's egg, to the right of the cavity from which the tumour had been removed. I thought that this was a collection of glands affected by malignant disease, but the patient was in such a serious state of collapse that it was out of the question to attempt an investigation of the nature and connexions of this second abnormal condition. I therefore ligated all bleeding points, having much trouble in securing those on the spleen. I washed out the abdominal cavity with warm sterilised salt and water, leaving as much as possible inside, when the wound was sewn up, with a view to counteracting the shock of the operation, which, however, was not survived by the patient.

"At the necropsy, which was conducted by Dr. Cuthbert H. J. Lockyer, caseating glands were found near the bifurcation of the bronchi and in the anterior mediastinum. There were extensive old pleuritic adhesions on the right side. There was no sign of peritonitis or of union of the lips of the wound. The peritoneal cavity was full of fluid (the salt and water introduced at the operation), which at first flowed away clear, but that from the loin pouches was deeply blood-stained. The kidneys were healthy and were normal in position. Part of the transverse colon was separated from its attachments, its mesocolon having been completely divided, and the omentum had been removed from all but the left one and a half inches of the stomach. The left pleurocolic fold was intact. The spleen had a wound on the lower end of its inner surface, one and a half inches long. The left half of the pancreas was absent, its cut surface presenting many ligated points. There was a smooth, encapsuled growth situated in the gastrohepatic omentum, with the bile-duct and some vessels in front of it. The neck of the gall-bladder and the transverse fissure of the liver were above it. The foramen of Winslow was behind and the new-growth seemed to be connected with the head of the pancreas below, the connexion between the two being much constricted.

"The parts were sent to the Royal College of Surgeons of England, and when they had been dissected, it was found that

the mass in the lesser omentum was a new-growth inside the portal vein and widely distending it. Mr. Shattuck has examined the tumours, and both are fibrosarcomatous in structure. The specimens are preserved in the museum of the college, and the accompanying illustrations (Figs. 367, 368, 369), which are reproduced from photographs taken by Mr. H. George, give a very faithful representation of their appearance."

The only circumstances in which the safe removal of solid tumours from the pancreas would seem to be feasible are these: (*a*) Where the tumour is pedunculated; (*b*) when it can be enucleated; (*c*) when it occupies the tail of the gland or the part of the body adjacent thereto; (*d*) when the vascular adhesions are not so numerous or so complex as to make the mechanical difficulties almost insuperable.

The question as to palliative operations in carcinoma of the head of the gland has still to be considered. It might be supposed that since many of the symptoms—jaundice and itching (sometimes absolutely maddening)—are due to the hindrance to the free outflow of bile, an operation destined to divert the current of bile would afford relief. Such operations as cholecystotomy and cholecystenterostomy have been practised on many occasions. The risk of the most trifling exploration in such cases was formerly said to be very great; so far as can be gauged from statistics of published cases it was at least 60 to 70 per cent. For many years therefore I was loth to operate upon patients in whom a progressive and finally complete obstructive jaundice had painlessly developed, when great emaciation had attended the onset and course of the disease, and when the gall-bladder was so distended as to be easily palpable.

With the history such as this, one could hardly fail to make a diagnosis of growth and predict a speedy ending to the case. But no one living is infallible in the differential diagnosis of obstructive jaundice. The diagnosis is always so difficult, and the chance of a life saved so important, that, however positive the evidence of malignancy may be, I now advise operation in all

cases. So far as immediate amendment is concerned there is little to choose between the malignant and the benign cases. In both the patient begins to improve, the jaundice falls away slowly, sometimes very slowly, and weight is soon gained. The operation performed consists in joining the gall-bladder to the intestine, to the duodenum if easily available (it may be quite inaccessible, lying high and remote, when the liver is enlarged and the gall-bladder overfull), or to the stomach. It may be feared that when all the bile passes directly into the stomach nausea, vomiting of bile, or loss of appetite result. Such fears are groundless. I have joined the gall-bladder to the stomach in more than twenty patients who have survived a year or more, and there is no suspicion of any special discomfort attaching to the operation. I have patients living still upon whom I operated four, six, and seven years ago, in the confident belief that they suffered from carcinoma and would shortly be dead. It is impossible for the most astute clinician or the most subtle pathologist to discover by physical signs, from the anamnesis or from the chemical examination of urine and fæces, whether a simple or a cancerous disease is present. He may shrewdly guess, but a guess is a poor peg on which to hang a man's life. All cases of obstructive jaundice should be operated upon; the mortality of cholecystenterostomy now is trifling if we take into account the severity of the disease and the outlook. Apart altogether from the prolongation or saving of life, almost every patient will declare that the relief from the maddening torture of itching is worth every sacrifice.

CHAPTER XLVIII.

PANCREATIC CALCULUS.

The occurrence of stone in the pancreas was first recorded by Graaf in 1667. Morgagni in 1765 and, in England, Cawley in 1788, refer to instances observed by themselves. In 1883 Johnston collected the notes of 35 recorded cases. The fullest account was given in 1886 by Giudiceandrea, and was based upon 48 recorded cases and two observed by the author.

The stones are generally white, greyish-white, or yellowish-white in colour, and rounded, ovoid, or elongated, like a date-stone. They are found in all parts of the duct of the pancreas, though much more frequently in the head; in the tail of the gland they are rarely seen.

The calculi may be branched, like coral, the trunk of the stone lying in the main duct and its offshoots in the secondary ducts. At times the canal of Wirsung is found packed with a coarse, mortar-like material, or with sand or fine, rounded pellets. The largest stone, measuring two and a half inches by half an inch, was seen by Schupmann. Calculi may be single or multiple; one of the most striking examples of the latter is in the Museum of the Royal College of Surgeons of England (specimen 2834, Curnow's case). As many as 300 stones have been found in one case. The stones are chiefly composed of phosphorus and carbon salts. One case of oxalate-of-lime stone is reported by Shattuck.

TREATMENT.

The following case, recorded by me in the "Lancet," August, 1902, is the first in which a diagnosis of calculus of the pancreas has been followed by a successful operation.

I saw the patient with Dr. H. M. Robertson, of Roundhay. She was a lady, aged fifty-seven, who had suffered for several

months from symptoms which briefly may be enumerated as follows:

There was steady loss of health, gradual wasting, irregular pigmentation of the skin in patches of the colour of café-au-lait (very closely resembling the pigmentation of molluscum fibrosum), persisting attacks of epigastric pain, and uneasiness of the type of hepatic colic, though less severe and unattended until very late in the history by jaundice, which was then always trivial, though unmistakable, and pain passing through from the front of the abdomen to the middle of the back. There was no rigor or any complaint of sensations of heat or cold. The stools were occasionally "frothy" and "greasy." On examination under chloroform some indefinite swelling could be felt above the umbilicus and a little to both sides of the median line, though chiefly to the right.

I considered that the evidence warranted a diagnosis of chronic pancreatitis. To explain the onset of this condition I suggested that a pancreatic calculus was present; that its transit down the canal of Wirsung had been attended by the attacks of epigastric colic; and that as it approached the ampulla an inflammatory condition had been started in the common duct, and a slight jaundice had thereby resulted. Upon this diagnosis I felt justified in basing my suggestion for operative treatment. If chronic pancreatitis were found and no cause was discoverable, the condition could be relieved by drainage of the gall-bladder; if a pancreatic calculus were found, it could be removed either from the pancreatic duct or from the ampulla of Vater, if it had travelled so far. I was bound to admit the difficulties of the case; and though I pressed the question of operation, I felt that I could give no definite undertaking as to its result.

Operation was performed on May 22, 1902. The abdomen was opened two inches to the right of the median line by an incision about seven inches in length, and the fibres of the rectus were split. On opening the abdomen the gall-bladder at once

presented; it was tense, well filled, and free from any adhesion; the cystic duct, hepatic ducts, and common duct were all thoroughly examined, the liver being rotated for that purpose. The ducts were all free from adhesion and nothing abnormal was felt. The head of the pancreas was very much enlarged and hard, the body less so, but still larger and denser than the normal. The chronic pancreatitis affected the whole gland, but chiefly the head, and in least degree the tail. The duodenum and the head of the pancreas were carefully examined, and a small lump was then felt, as it seemed, between the two. The swelling did not feel like a stone, and I expressed a suspicion that it might prove to be a growth deep in the ampulla of Vater. I therefore opened the duodenum and exposed the papilla Vateri; this was quite normal in appearance. The lump, however, was felt to be only a short distance beneath the mucous membrane. The papilla was, therefore, laid open, and the cut edges were seized with a small French vulsellum and held apart. At the bottom of the ampulla, lying in the end of the canal of Wirsung, a small object could be seen, and the knife touching it could be felt to be impinging upon soft stone. A small scoop was therefore passed into the dilated duct, pressure was made upon the head of the pancreas close to the duodenum, and the stone was lifted out.

The wound in the duodenum was stitched up with continuous sutures and the abdomen closed. The patient made a most satisfactory recovery, and was, when last heard of in March, 1905, quite restored to health, being heavier and in better general condition than she has been for years.

Since this case was reported, Mayo Robson has operated upon a case of pancreatic calculi (see "Lancet," vol. i, 1904, p. 913). The patient was a woman aged fifty-seven from whom four calculi were removed: one was removed from the duct of Santorini or one of its branches by direct incision into the pancreas close to the common duct; two were removed through an incision made in the duodenum to expose the papilla Vateri, which

was laid open; one was removed by incision of the body of the gland. The wounds in the pancreas were sutured by catgut.

Other cases of removal of pancreatic stones are recorded by Pearce Gould, Dalziel, and L. W. Allen.

There are, therefore, two routes by which a stone lying in the duct of the pancreas may be reached:

(*a*) By direct incision of the gland over the stone, followed by suture of the wound.

(*b*) By opening the duodenum, exposing the papilla of Vater, incising this, and passing a scoop or a pair of fine forceps along the duct.

It is important to remember that calculi in the pancreas are often multiple, and that, therefore, the surgeon must not rest content with the removal of the first stone encountered.

(*a*) The easiest method of access to the body of the gland is to incise the gastrohepatic omentum, to pull the stomach downwards and to the left, and so to bring the pancreas into view. The sand-bag beneath the back will project the gland forwards and bring it, therefore, much nearer to the surface. The gland being exposed and the stone located, the peritoneum is carefully protected by gauze swabs covered by mackintoshes in the usual manner. This is especially necessary in operations upon the pancreas on account of the character of its secretion and the known liability of serious changes in the parts around, such as digestion and infection, to occur. The peritoneum of the posterior wall of the lesser sac is divided carefully and the pancreas is then incised directly on to the stone, any bleeding points being at once seized, and the calculus is removed. The escape of blood or secretion is very carefully prevented by free mopping with dry swabs. The incision in the gland is then carefully sutured with catgut, and the overlying peritoneum drawn into careful apposition with a fine catgut or Pagenstecher suture. Drainage should be provided in all cases.

(*b*) The removal of the stone through the duodenum is carried out in precisely the same manner as in the operation of duodenocholedochotomy.

CHAPTER XLIX.

OPERATIONS UPON THE SPLEEN.—SPLENECTOMY.

INDICATIONS FOR THE OPERATION.

THE following are the conditions which may call for the removal of the spleen:

1. Injuries—
   (*a*) Prolapse.
   (*b*) Penetrating wounds.
   (*c*) Subcutaneous rupture.
2. Abscess.
3. Tubercular disease.
4. Cysts.
5. New-growths.
6. Malarial and other enlargements.
7. Wandering spleen.
8. Spontaneous rupture during typhoid fever.
9. Aneurysm of the splenic artery (Winckler, "Centralbl. für Chir.," 1905, xxxii, 257).

Leukæmia was formerly included among these conditions, but it is now universally conceded that splenectomy in this disease is unjustified. The patient's life is not prolonged, nor his comfort increased thereby; while in the majority of cases life is considerably shortened.

Injuries of the spleen are by no means infrequent. In a series of 292 cases of injuries, of varying degrees of severity, of the abdominal contents, Makins found 89 cases of rupture of the solid viscera. The largest number were those of the kidney —39 per cent.; next, those of the liver—23.5 per cent.; and third, those of the spleen. As a rule, a diagnosis of injuries of the spleen cannot be made. The symptoms and the signs are not sharply differentiated from those resulting from injury

to other abdominal organs. The chief signs are shock, collapse, symptoms of internal hæmorrhage, the presence of fluid within the abdominal cavity, as shewn by dulness in the flanks, a tendency to vomiting, and great rigidity of the abdominal muscles, often especially localised over the upper left quadrant of the abdomen.

1. **Injuries.**—(*a*) *Prolapse.*—Prolapse of the spleen through a wound in the abdominal wall is not often met with. Laspeyres, who made an exhaustive study of the literature of splenectomy ("Cent. f. d. Grenzgeb. d. Med. u. Chir.," 1904), found only three cases recorded in eight years. As a rule, reposition of the organ after due observance of aseptic precautions is possible and is attended by satisfactory results. Ledderhose has observed gangrene to follow the unreduced prolapse of the organ.

(*b*) *Penetrating Wounds.*—These are inflicted either as gunshot wounds or as stab wounds. Schäfer has gathered together the reports of 88 cases; of these, 71 were due to gunshot, 17 to stab, wounds.

Among the 71 cases of gunshot wounds there was only a single case in which the spleen alone suffered injury, a circumstance accounted for by the fact that the organ was grossly enlarged. The frequency with which other structures were involved is shewn in the following list:

Diaphragm	56
Left pleura	50
Stomach	32
Liver	28
Left lung	23
Left kidney	11
Pericardium	8
Heart	4
Small intestine	3
Large intestine	3
Pancreas	3
Spinal cord	3
Right pleura	2
Right kidney	2
Left adrenal	1
Aorta	1

Among the 17 cases of stab wounds, the pleura, diaphragm, and spleen were simultaneously injured in 14 cases; in 2 of these 14 cases the left lung and the left kidney were wounded, and in 1, the transverse colon. In 2 cases the spleen only was damaged, and in the remaining case the injuries were multiple.

A gunshot or stab wound of the spleen is almost invariably fatal within a short period of time. The existence of such an injury is, therefore, a distinct and direct indication for operative treatment at the earliest possible moment. The exact method to be adopted with the spleen can be decided upon only after the organ is exposed. In Schäfer's list closure of the wound by suture was undertaken 11 times, with success in 9 cases. Removal of the spleen was thought necessary in 10 cases, of which only 3 recovered. To these cases of splenectomy Laspeyres adds 7 cases, with 3 recoveries; so that in all, 17 cases of splenectomy are recorded, with 6 recoveries.

(*c*) *Subcutaneous Rupture.*—Lewerenz has collected the records of 135 cases of subcutaneous rupture of the spleen up to 1900. Among these were 82 cases in which the spleen shewed gross pathological changes, such as malarial enlargement; in 9 cases the enlarged spleen of late pregnancy was injured.

In 104 cases the result was fatal, and in almost all it occurred within the first twenty-four hours. In 5 cases death was delayed for periods varying between two and six weeks, and was caused by secondary inflammatory processes occurring in hæmatomata, suppuration, and peritonitis, for example.

Splenectomy was carried out in 25 cases, with 13 recoveries; tamponade, in 2 cases, of which 1 recovered; and suture in 1 case, which ended fatally. Laspeyres has found, in the statistics of the years 1896–1904, 58 cases of splenectomy or subcutaneous rupture recorded; of these, 39 recovered, equivalent to a percentage of 67.2.

As a general rule, removal of the spleen is the surest means of saving life, and should be practised, therefore, as the routine method of treatment. There are a few cases on record where

postmortem examination has shewn that this could not have been carried out, owing to the numerous and intricate peritoneal adhesions which surrounded the organ. In such circumstances packing with gauze, soaked, if need be, in adrenalin solution, is the only procedure that is feasible.

2. **Abscesses in connexion with the spleen** are rare, and are generally secondary, being due to the breaking-down in an infarct which was caused by an infected embolus. Suppuration may also occur in a hæmatoma due to a minute tear in the substance of the spleen.

Bessel Hagen found 7 cases of splenic abscess treated by operation recorded up to 1900; cases have since been recorded by Murphy, Karewski, and Ebehart and others. Suppuration in the spleen may lead to the formation of one abscess or of many abscesses. A primary infection within the abdomen may be recognised, as, for example, appendicitis (one case), pyosalpinx (one case). Typhoid fever is occasionally the cause; 12 cases observed during life or found postmortem are recorded by Esau. When pus is found around the spleen, a diagnosis of subphrenic abscess will probably have been made. When the abscess is opened, the entire spleen may be seen swimming in the abscess cavity, or detached portions of it may be evacuated as sloughs. In one very remarkable case recorded by Georgescu Mangiurea, the spleen was discharged as a slough through an opening at the umbilicus. The protrusion at first was small, but rapidly enlarged, and an acute inflammatory process set in.

Splenotomy may be practised in one or two stages, though it is rarely permissible or feasible. Splenectomy is the operation of choice.

3. **Tubercular Disease.**—Very few cases of tubercular disease of the spleen treated by operation have been recorded. Bessel Hagen found one unsuccessful case of splenectomy recorded before 1890, and two successful cases between 1891 and 1900. Since this last date three further cases have been recorded by Carle, Grillo, and Lannelongue. In Carle's case the patient

had borne two children after the operation and remained quite well. Grillo's patient remained well fifteen months after operation. In the Mayo Clinic between April, 1904, and October, 1912, there was one splenectomy performed for tuberculous disease. The patient died four months after the operation with evidences of disseminated tuberculosis.

In the great majority of cases tubercular deposits in the spleen are found only as a part of a widely spread infection. The peritoneum and other organs in the abdomen are also involved; and the affection of the spleen is clinically inconspicuous and pathologically unimportant. In the cases in which operation has been performed the tubercular deposits seem to have been of a markedly chronic character, and in some the spleen has been unduly mobile.

4. **Cysts.**—Following is the classification of splenic cysts:

(*a*) Unilocular and multilocular cysts not of parasitic origin; serous cysts; blood cysts; lymph cysts.

(*b*) Hydatid cysts.

(*c*) Dermoid cysts.

The first case of cyst of the spleen is recorded by Andral in 1829; the cyst was found postmortem. The first extirpation of the spleen on account of a cyst was performed, with a successful result, by Péan in 1867. In 1891 Terrier performed partial splenectomy successfully, and in 1896 Glück treated a blood cyst by incision and drainage.

(*a*) *Serous Cysts* (*Serosanguineous Cysts*; *Lymph Cysts*).—The contents of a serous cyst may be clear serous fluid, fluid stained with blood, the remains of a hæmatoma, or seropurulent. Bessel Hagen records 7 cases of cyst of the spleen treated up to the year 1900; all the patients recovered. Since 1900 there have been, according to Laspeyres, 4 cases recorded, making a total of 11 cases, all successful.

(*b*) *Hydatid cysts* are the most common of all forms of cyst of the spleen. As a general rule, hydatid disease is not confined to this organ, but affects also, and generally in wide-spread

manner, other parts within the abdomen, more especially the liver. According to Litten, hydatid cysts of the spleen are always unilocular and are prone to undergo calcification. The frequency of the affection is shewn in the statistics collected by Trinkler, who, in 2117 cases of hydatid disease, found echinococcus of the spleen in 68.

The methods of treatment which have been adopted are two—*incision and drainage*, the operation being performed in one or in two stages, and *splenectomy*. The latter is the operation of choice, and is to be performed in all cases when it is possible. In some of the recorded examples the adhesions of the spleen have been so numerous and so dense that removal of the organ has been utterly impossible. Snegireff, in attempting to separate a number of adhesions preparatory to the excision of a cyst of the spleen, tore the spleen deeply; free bleeding resulted and splenectomy had to be performed. The mortality for the operation of splenectomy, according to Bessel Hagen, is 10 per cent.; according to Tédénat, 14.2 per cent. Since 1894, 14 cases have been recorded, and all have been successful.

Resection of the spleen has been successfully performed by Terrier, Gussenbauer, and Bardenheuer.

5. **Neoplasms.**—The number of cases of new-growths in the spleen recorded in the literature is very small.

(*a*) *Sarcoma.*—An admirable paper by Jepson and Albert on "Primary Sarcoma of the Spleen" appears in the "Annals of Surgery," vol. xl, page 80.

The first cases recorded are two by Weichselbaum in 1881. The total number collected by Jepson and Albert is 32, but the exact nature of a certain number of these cases is open to question, the microscopic report not being of sufficient worth to satisfy modern requirements. Of these 32 cases, there were 12 submitted to operation, 11 to splenectomy, and 1, by Heinricius, to enucleation of the growth. Of the 11 splenectomies, 3 died as the result of the operation. Of the 8 who survived the operation, 3 patients have since died of recurrence, and of

1 patient the information is scanty. Two of the 4 remaining patients lived six and a half years and four years; and 2, including Jepson's case, were recorded too recently for any time-estimate to be of value.

A table of all the cases up to 1904 with the details available is given by Jepson and Albert.

Since the report of Jepson and Albert in 1904 Bush ("Jour. Amer. Med. Assoc.," vol., liv, No. 6) has reported a case of primary sarcoma of the spleen. Subcutaneous rupture occurred subsequent to a diagnosis of primary splenic tumour having been made, three days before the proposed date of operation. This happening necessitated a laparotomy at which bleeding from a sarcomatous spleen was found. The vent in the spleen was plugged with gauze and splenectomy was performed six days later. The patient lived for six months after operation. At the autopsy secondary growths were found throughout both lungs. A recurrence was found in the region of the wound and invading the left suprarenal body, the tail of the pancreas, and the wall of the stomach. Small secondary deposits were also found on the peritoneum of the bowel.

(*b*) *Cavernous Angioma.*—Three cases of cavernous angioma have been treated surgically; in 2 cases splenectomy was performed; in both cases the patients died; in 1 case a resection of the spleen was undertaken by Snegireff successfully.

(*c*) Other forms of splenic tumour, fibroma, for example, and endothelioma, myxoma, and lipoma, of which single examples are recorded, are so unusual that specific mention of them is not necessary.

6. **Malarial and Other Enlargements of the Spleen.**—The removal of the "ague-cake," the greatly enlarged spleen found in malarial fever, has been carried out in a large number of cases with fair success. The reasons which call for the removal of the spleen are its large size, its great mobility, and its consequent tendency to rupture. Spontaneous rupture is not infre-

quent in the tropics, and laceration from injury of the enlarged organ often occurs.

Bessel Hagen records 24 cases up to 1890 with 15 deaths; between 1891 and 1900 there were 64 cases with 15 deaths. In a review of the recorded cases Laspeyres, in 1904, assessed the mortality in 69 cases at 8.7 per cent. Removal of the spleen in cases of malarial enlargement, according to Schwarz, is needed only when there is undue mobility of the organ. Any beneficial effect upon the course of the malaria is not to be expected, though in some cases it has undoubtedly been observed. He records 10 cases in his own practice, with one death, on the fourteenth day, from peritonitis. In all the spleen was movable, and in 6 the pedicle was twisted.

Simple hypertrophy of the spleen, of unknown origin, has been operated upon 16 times, with 3 deaths. The nature and the causes of this condition of simple hypertrophy are not well understood, nor can it be said that the circumstances calling for operation are capable of being stated categorically. For the most part, the operation has been undertaken because the spleen was both bulky and mobile, and by its sheer weight or undue freedom of movement, or both, had become a source of the greatest inconvenience.

Banti's Disease.—Of the various conditions in which the spleen may be enlarged, especial mention of the disease which is known as "splenic anæmia," or Banti's disease, is necessary.

The disease occurs in young adults, as a rule; it begins insidiously, and at first progresses slowly. It may be that the patient first realises that things are not well with him by noticing the presence of a swelling on the left side of the abdomen. Soon after this hæmorrhages occur,—hæmatemesis, epistaxis, melæna,—slight or so severe as to be almost fatal. There is anæmia of a secondary type, though the blood-count is liable to variations in proportion to the amount and the frequency of the hæmorrhages. Senator states that the blood examination reveals a fairly uniform condition of things.

1. There is a diminution in the red blood-cells, the averages being about 3,500,000.

2. There is a low percentage of hæmoglobin.

3. There is a diminution in the number of white corpuscles.

There is sometimes a marked pigmentation of the skin, which has been observed, in one case at least, to disappear after the removal of the spleen.

In a later stage of the disease ascites appears, preceded or not by cirrhosis of the liver. It is this association of enlarged spleen, ascites, and cirrhosis of the liver to which Banti has drawn especial attention. He pointed out that in cases of this association the enlargement of the spleen, sometimes, at least, was the precursor of the other two conditions, and that it was very possibly the cause of their onset. The splenic enlargement he considered attributable to a toxæmia, the poison being derived from the intestinal canal. Banti described three stages in the disease. In the first stage anæmia and splenic enlargement are found, the former being secondary to the latter. In the second stage there is commencing cirrhosis of the liver with persistent diminution in the quantity of urine and an increase in the bile-pigment and urates. In the third and most characteristic stage there is ascites, which is insidious in origin and painless.

It is probable that more conditions than one are classed together under the term "Banti's disease." The whole subject of idiopathic splenic enlargements is in need of elucidation.

Osler's definition of splenic anæmia is as follows: "A chronic affection, probably an intoxication of unknown origin, characterised by a progressive enlargement of the spleen, which cannot be correlated with any known cause, such as malaria, leukæmia, syphilis, cirrhosis of the liver, etc. (primary splenomegaly); anæmia of a secondary type (leucopænia), a marked tendency to hæmorrhage, particularly from the stomach; and in many cases a terminal stage, with cirrhosis of the liver, jaundice, and ascites (Banti's disease).

The course of the disease in some cases is slow, in others rapid. The patient becomes steadily worse, especially after ascites and jaundice have set in, and death may come by gradual exhaustion or suddenly from hæmorrhage.

L. B. Wilson ("Surg. Gyn. and Obst.," March, 1913) in a paper dealing with the pathology of splenomegaly based on a study of the material afforded at the Mayo Clinic draws the following general conclusions on the subject of splenic anæmia.

"1. Pathological study of 18 spleens removed at operations in the Mayo Clinic from November, 1905, to November, 1912, from patients on whom positive diagnosis of splenic anæmia had been made, shows that in each spleen there was hyperplasia of one or more of the constituent elements. In two spleens the lymphoid tissue was so markedly overgrown as to suggest a diagnosis in one of lymphoma, and in the other of lymphosarcoma. In three spleens the proliferation of the endothelium of the venous sinuses was most predominant. In thirteen spleens the process was a chronic diffuse one involving all tissue elements.

2. While any cases of primary splenomegaly may begin as an overgrowth of the lymphoid tissue or of the endothelium in the ordinary course of events a secondary overgrowth of the stroma of the glands will appear later, accompanied by degeneration of the lymphoid or endothelial elements.

3. The largest spleens are those in which the lymphoid or endothelial hyperplasia is greatest. As the connective tissue overgrows the spleen may be reduced in size, owing to reduction in the amount of lymphoid and endothelial elements.

4. The roughness of the exterior of the spleen is in direct proportion to the development of connective tissue within it.

5. In primary splenomegaly a secondary cirrhosis of the liver is associated with great connective tissue overgrowth and degeneration of the pulp of the spleen.

6. From what we know of hyperplasia in other organs it would seem unnecessary to assume hypothetically the presence

of three different causes for the production of the three primary histological types of splenic anæmia.

7. The histological picture presented in all three types of spleens from cases of primary splenic anæmia seems to be in complete harmony with the hypothesis of the presence of a slowly acting local toxin."

The surgical interest in the subject centres around the possibility of giving the patient relief by splenectomy. If, as is highly probable, the splenic enlargement is the primary condition, the anæmia, cirrhosis, and ascites being secondary thereto, it is not unreasonable to hope that the removal of the offending organ may cut short the progress of the disease. The difficulty in arriving at an exact diagnosis is, however, not inconsiderable, and the first stage in which much benefit may result from splenectomy may unavoidably be allowed to slip by.

In operating upon a case in the late stage, when ascites was present, Tansini performed splenectomy and epiplopexy. Four weeks after the operation the abdomen had to be tapped on account of the reaccumulation of fluid; after this the patient was perfectly well several months later when the report was published. Rafferty ("Jour. Amer. Med. Assoc.," June 16, 1900) records a somewhat similar case. In the earlier published records of operations for Banti's disease it is perfectly clear that many other conditions have really been present, such as simple hypertrophy of the spleen, leukæmia, etc. An accurate estimate of the mortality has, therefore, been impossible till recently.

Klemperer and Mütsem ("Berliner Klinische Wochenschrift," May 27, 1912) report a case of Banti's disease cured by splenectomy.

Urbino ("Archives Internationales de Chirurgie," 1912, v. 3) reports nine splenectomies for anæmia from Nurci's clinic with three deaths.

W. J. Mayo ("Surg., Gyn. and Obst.," March, 1913) in an excellent paper on the surgery of the spleen records eighteen splenectomies for splenic anæmia. The operative results are as follows:

Operative deaths	2	
Well, twelve months to seven years	12	
Less than two and one-half years	6	Total, 12
Less than two and one-half years	1	
Less than three and one-half years	1	
Less than four years	2	
Less than five and one-half years	1	
Less than seven years	1	
Improved	2	Total, 4
Death in three years, improved until shortly before	1	
Death in two and one-half years after operation, cause unknown	1	
	18	

The pathological findings were:

Lymphoid hyperplasia (lymphoma(?) 1, lymphosarcoma 1)	2
Endothelial proliferation (Gaucher type)	3
Chronic diffuse splenitis	13
	18

7. **Wandering Spleen.**—Ectopy of the spleen, or a wandering spleen, in the majority of cases, is associated with, and is, indeed, a part of, that condition of general prolapse of all the viscera which is known as enteroptosis or Glénard's disease. In some few instances the mobility is solely due to an increased weight in the organ, the result of hypertrophy or new-growth. On the other hand, Steinbruck and Mainzer have both recorded cases in which it seems probable that the dislocation of the spleen, by causing persistent congestion of the organ, had been responsible for growth in one case and hypertrophy in the other. The condition is found far more frequently in women than in men.

Bessel Hagen records, between 1891 and 1900, 15 cases of wandering spleen with malarial enlargement treated by splenectomy, with 1 death; and 28 cases of idiopathic hypertrophy of the wandering spleen treated by splenectomy, with 2 deaths.

One of the chief dangers in wandering spleen is torsion of the pedicle. Schwarz records 10 cases of malarial enlargement of the spleen operated upon by himself; in 6 there was torsion of the pedicle. Subbotic, in 6 cases, found the pedicle twisted in 4. The pedicle may be of great length and tenuity, forming, as it were, merely a ribbon of attachment.

The twisting of the pedicle of the spleen may be a matter of long standing, causing only engorgement of the organ and a gradual increase in size; in some such cases there has been pressure upon the intestines, chiefly upon the colon, of sufficient severity to cause symptoms of intestinal obstruction. On the other hand, the symptoms which result from the rotation of the organ may be acute in character, simulating an attack of acute peritonitis or of acute obstruction. A tumour, taken to be a subphrenic abscess or a perigastric abscess, may be felt. There are several cases recorded in which operations have been undertaken for this acute condition, and in some, large infarcts have been found in the spleen or large thrombi in the vessels of the pedicle.

The extent to which the pedicle is twisted varies much; in Subbotic's 4 cases there was a twist of 180 degrees in 2 cases, of 360 degrees in 1 case, and of twice 360 degrees in 1 case.

In the great majority of cases splenectomy must be performed, especially when thrombosis of the vessels of the pedicle, infarcts in the spleen, gangrene of the organ, or peritonitis upon and around it, are present.

In some cases, however, splenopexy has been performed with complete success, the twisting of the pedicle being undone and the organ fixed in one of the recognised methods. Treves, in his work, "A Manual of Operative Surgery," records two cases of this kind upon which he had operated successfully; in one, infarcts were present.

When the organ is enlarged, it should in all cases be removed, for attempts to fix it will almost certainly be unsuccessful.

Rupture in the course of typhoid fever. R. C. Bryan ("Annals of Surgery," November, 1909) has collected thirty-eight cases of spontaneous rupture of the spleen during typhoid fever. In every instance the condition was undiagnosed.

Of the 25 cases which Bryan reports, rupture was found at the autopsy in 22 cases. In two cases (one of Bryan's) splenectomy was performed resulting in recovery. In one case laparotomy

was performed, but wound was closed owing to collapse of patient, the rupture being only discovered at the autopsy.

Ashby ("American Gynæcology," 1902, vol. i, p. 175) reports a splenectomy of a wandering malarial spleen during typhoid fever with recovery.

Splenectomy has been performed for other conditions than those included in the above list, such as amyloid disease and leukæmia. Operation in these circumstances is quite unjustifiable. The mortality is enormous and no benefit results from the removal of the organ.

If we place together Bessel Hagen's statistics and Bayer's we find that from 1891 to 1904 there were recorded 254 cases of splenectomy, with 200 recoveries and 54 deaths. The several percentage mortalities were as follows:

Leukæmic hypertrophy	8 cases	2	recoveries	6 deaths	
Splenic pseudoleukæmia	1 case	1	recovery		
Ruptures	43 cases	28	recoveries	15	"
Abscess	4 "	all	recovered		
Tuberculosis	3 "	all	"		
Blood cyst	4 "	all	"		
Hydatid cyst	13 "	12	"		
Sarcoma	5 "	4	"	1	died
Simple new-growths	2 "	1	"	1	"
Rotation of pedicle	15 "	10	"	5	"
Malarial enlargement	89 "	71	"	18	"
Hypertrophy of wandering spleen	29 "	27	"	2	"
Banti's disease	17 "	14	"	3	"
Idiopathic hypertrophy	21 "	19	"	2	"

J. H. Carsteus ("New York Med. Jour.," November 18, 1905) reports 122 ruptures of the spleen from hypertrophy or injury with 83 recoveries and 39 deaths. According to this author splenectomy had in January, 1905, been performed 739 times with 521 recoveries and 197 deaths. Splenectomy for myelogenous leucocythemia being now abandoned, it is probable that the operative mortality for splenectomy is considerably below 20 per cent.

Herczel (Wien. Klin. Wochschr., xx, 123, 1907) reports on the after history of five patients upon whom he performed splenectomy between 1904–1906. All were cured of their symptoms

by operation and had been in good health since. In two cases the enlargement was malarial, in one case there was a wandering spleen with enlargement and secondary anæmia, in one case there was an echinococcus cyst, and in the fifth case there was splenic enlargement accompanying hypertrophy of the liver.

Herczel believes that the febrile conditions sometimes seen after splenectomy are due to an aseptic necrosis of fat tissue in the stump when the pedicle was ligated en masse. He advocates ligation of each vessel in the hilus separately, and finds that if this course is followed there is no post-operative rise of temperature.

Between April, 1904, and October, 1912, twenty-seven splenectomies were performed at the Mayo Clinic. The operative mortality was two cases or 7.4 per cent.

Details	
Splenic anæmia (5 showing Banti's Syndrome)	18
Wandering spleen (recovered)	2
Tuberculosis (died in four months)	1
A typical anæmia unimproved two and one-half years	1
Cirrhosis of liver (death within six months, ascites)	1
Infections (?) splenomegaly	4
	27

J. B. Johnston ("Annals of Surgery," 1908, xlviii, 50) has collected 708 cases of splenectomy, including 6 cases of his own. The total mortality of the series is 27.4 per cent.

	Recoveries	Deaths
Idiopathic hypertrophy	53	21
Idiopathic hypertrophy, ectopic spleen	54	6
Idiopathic hypertrophy, twisted pedicle	19	8
Malarial hypertrophy	111	38
Malarial hypertrophy, ectopic spleen	39	1
Splenic anæmia	49	12
Hydatid cysts	19	4
Non parasitic cysts	19	0
Leukæmia	6	43
Tuberculosis of spleen	8	2
Sarcoma	9	3
Abscess	8	1
Miscellaneous affections	11	2
Wounds and injuries	99	51
	514	194
Total	708	

THE AFTER-RESULTS OF SPLENECTOMY.

The after-results of splenectomy, so far as the blood is concerned, are: a diminution in the amount of hæmoglobin; a reduction in the number of the red corpuscles; and an increase in the total number of white corpuscles. These changes attain their maximum in about a fortnight, and there is then a gradual return to the normal, which is reached in about four months. Pyrexia has been observed in some cases, but in them has perhaps been due to slight septic infection. Mental disturbance is occasionally noticed, and in many cases a general enlargement of the lymphatic glands. Lacrettic has remarked upon the fact that pain in the bones may be felt after operation, and attributes it to increased medullary activity. In animals it is frequently found that after splenectomy the bone-marrow becomes reddened and much denser. Other changes less frequently recorded are loss of weight, great weakness, thirst, polyuria, rapidity of pulse, enlargement of the thyroid gland, and abdominal pain and tenderness. Tizzoni has pointed out that all the effects which follow removal of the spleen are less noticeable in children, owing to the fact that their compensatory organs act more rapidly and more completely. The removal of a spleen disorganised by long-standing disease is also less likely to be followed by any symptoms, owing to the fact that the compensation has been progressing quietly for many weeks or months before operation. It has been suggested—and experimental work to some extent corroborates this—that an animal deprived of its spleen becomes more liable to infection by any septic organisms. In a case recorded by Harrison ("Brit. Med. Jour.," February 10, 1906) we found that digestion leukocytosis was absent after splenectomy even when a blood examination was made as long as six months after operation.

Von Stubenrauch ("Presse Medicale," May, 1912) has investigated the conditions governing regeneration and replacement of the spleen after splenectomy. He concludes that the

diminution in hæmoglobin, reduction in red blood corpuscles, and so forth, is only temporary. The functions of the spleen, in so far as they concern the blood, being taken up by—

1. Bone marrow and lymphatic glands, both of which are found to be increased.

2. By regeneration of the spleen itself in cases of incomplete splenectomy.

3. By hypertrophy of congenital accessory spleens.

4. By formation of new peritoneal organs or "splenoids," *i. e.*, bodies intermediate in structure between the lymphatic and blood glands.

SPLENECTOMY: DETAILS OF THE OPERATION.

The removal of the spleen may be an operation of the greatest simplicity or of insuperable difficulty. Everything depends upon the presence or absence of adhesions, which may bind the organ inseparably to the parts around. In several cases it is recorded that an attempt at the removal of the gland had to be abandoned because it was found impossible to dissever the adhesions, or because laceration of the spleen in an attempt to do so seemed unavoidable.

The incision will fall upon the abdominal wall at any part that seems most suitable. When the spleen is large and very mobile, a median incision is preferable. In the majority of the cases of all kinds it seems to have been the chosen incision for the reason that it gave easier access to the pedicle from the inner side. In cases of ruptured spleen the median incision will probably have been made, the operation having begun as an exploratory one; this is an advantage because it allows of a clear examination of other viscera within the abdomen. An incision through the outer border of the rectus is sometimes used, with or without lateral extensions subsequently made to give additional room. The incision, wherever placed, should be of adequate length to allow a perfectly clear view of the operation field, and to render it unnecessary to have any force applied

to the spleen or its adhesions to bring them into sight. Vanverts, and more recently Auvray, has suggested an oblique incision along the costal margin with resection of the costal cartilages of the eighth, ninth, and tenth ribs. They emphasise the facts that a better exposure is thus secured and that an easier and surer manipulation of the pedicle is possible. The incision is made on the left side, in the same manner as that on the right side is made, for the purpose of exposing the upper surface of the liver.

The first step in the operation is the isolation of the spleen, a step which is easy or difficult according as adhesions are few or many. In separating adhesions the utmost gentleness and patience must be exercised; undue haste or carelessness will court disaster. The thinness of the capsule of the spleen, and of the veins in its pedicle, and the softness and friability of the substance of the gland, must be remembered. The adhesions must be divided everywhere between ligatures. More than one case is recorded in which death has resulted from continued oozing from the raw surface left by the stripping of adhesions. When the exposed surface of the spleen is cleared, the hand is passed upwards between the organ and the diaphragm. In some cases, as Collins Warren remarks ("Annals of Surgery," vol. xxxiii, p. 524), the spleen can readily be pulled down by the hand thus introduced and be turned completely over. In this way the vessels of the hilum are immediately made superficial and can be readily seized and controlled.

The omentum is sometimes very adherent to a splenic tumour, and the vessels in it are then greatly engorged. A division of the omentum, a little distance away from the spleen, by a series of interlocking ligatures, is then necessary. Adhesions to the stomach must be dealt with respectfully, and wounding of the vasa brevia or stripping of the peritoneum from the stomach is to be expressly avoided.

The spleen, when freed from all adhesions, is brought slowly into the wound. In handling it a layer or two of gauze placed

beneath the fingers will give a surer hold. In delivering the spleen from the abdominal cavity any dragging upon its pedicle must be prevented. The vessels which, with their peritoneal investment, constitute the pedicle are numerous, and the veins are possessed of extremely thin walls. Laceration of the veins has occurred in two cases recorded as the result of forcible withdrawal of the spleen; and in one, death occurred from hæmorrhage within a few minutes.

The ligation and division of the pedicle are now performed, and this is the step of chiefest importance in the operation. The pedicle consists of the vessels going to the hilum of the spleen, together with their peritoneal investment. The two peritoneal folds concerned in the pedicle are the gastrosplenic omentum and the lieno-renal ligament. "The gastrosplenic omentum consists of two layers of peritoneum which pass from the front of the hilum of the spleen forwards and outwards to the posterior surface of the stomach, near its left border. If the outer of these layers be traced over the spleen, it will be found to cover the gastric surface to the left of the hilum, the phrenic surface, and the posterior part of the renal surface. It is then reflected on to the kidney, forming the posterior layer of the lieno-renal ligament. The inner layer of the gastrosplenic omentum is derived from the lesser sac, and is continued into the anterior layer of the lieno-renal ligament. Below, the two layers of the gastrosplenic omentum are continuous with the gastrocolic omentum. The splenic vessels pass to the spleen between the layers of the lieno-renal ligament (Quain)." Unless the spleen is very large, and the vessels therefore of unusual size, it is best to transfix the pedicle carefully between two vessels with a clip, then to draw through, in the bite of the clip, a long double ligature. The two halves of the ligature are made to interlock, and each half secures its own side of the pedicle. A separate ligature embracing the whole thickness of the pedicle is then made secure, and the pedicle divided distal to the ligatures and the spleen removed.

If the vessels are large, a separate ligature of each one in two places, with division of the vessel between, from below upwards, may be necessary. The vessels may be isolated by blunt separation carried out by the fingers covered with a layer of gauze.

A simple method of securing the vessels is the following: A large stomach-clamp is applied to the pedicle as close to the spleen as possible. Then, about 1½ inches away, a series of clips (the long clips of my own pattern are the best) is applied from below upwards. As each clip is applied the pedicle is cut through between it and the large clamp. When all the clips —three, four, five, or even more in number—are applied, a long ligature is taken, tied around the portion of the pedicle included in the uppermost clip, the clip is loosened slowly and removed, a double knot tied, then the next clip is raised, and the same ligature, without division, is passed around it, tied, the clip removed, and so on, as before. Every part of the pedicle is thus secured in one ligature, which is knotted in between each clip. For the ligature, stout catgut or Pagenstecher thread may be used. The ligature should always be thick, otherwise the flimsy vessel-wall may be cut through. In some cases the tail of the pancreas has accidentally or deliberately been included in the ligature surrounding the pedicle, in order to ensure a firmer hold. Esmarch advises that this should be done if there is any doubt as to the security of the ligature.

After the spleen has been removed, a careful examination of the cavity left is made, and any slightly oozing point is secured. The under surface of the diaphragm, especially, must be examined, and any bleeding point thereon secured by a stitch. When the surgeon is satisfied that all parts are dry, the abdominal incision is closed in the usual manner.

The operation is one which may call forth all the resources of the surgeon. The chief difficulties are those concerned with the adhesions and with the ligation of the pedicle. In a few cases, as in one recorded by Spanton, a dragging of the pedicle

may cause sudden symptoms of shock or collapse, owing to the irritation of the nerves of the solar plexus.

SPLENOTOMY.

Incision of the spleen may be called for in cases of abscess or cyst. Tédenat and Fontoynant recorded cases of abscess of the spleen which were successfully treated by incision and drainage. Giuliano, in reporting a case of hæmorrhagic cyst of the spleen, gives brief abstracts of 15 other cases treated by incision and drainage or aspiration.

The abdomen may be opened through the linea semilunaris in the case of cysts or of abscesses not pointing; or, through the linea semilunaris. In some cases a transpleural operation with resection of one or more ribs may be necessary. The details of the operation need not be particularised.

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CHAPTER L.

SPLENOPEXY.

THE operation of splenopexy, the fixing of a wandering spleen, is certainly preferable to splenectomy in a small number of cases. Where the spleen is enlarged or the pedicle so twisted that thrombosis of the vessels therein has resulted, or where any disease of the spleen exists, removal of the organ is necessary. In those cases alone where a perfectly healthy organ is unduly mobile is splenopexy to be performed.

The operation was first mentioned in surgical literature by Rydygier, in 1895, in a paper read at the German Surgical Congress ("Cent. f. Chir.," 1895); subsequent to this publication Tuffier reported, at the Surgical Congress in Paris in 1895, that he had in 1882 performed the operation. The case was one in which he was preparing to fix a movable left kidney by suture; a movable tumour in front of the kidney was found, the peritoneum opened, and a wandering spleen discovered. The organ was fixed by three sutures of catgut. Kouwer also reported, in 1895, that he had operated upon two cases successfully in 1891. Priority of publication belongs, however, as I have said, to Rydygier.

The following are the methods which have been adopted for fixing the spleen.

1. **Tuffier's Method.**—Suture of the spleen to the diaphragm or abdominal wall. The stitches may be of silk or catgut, and pass into the substance of the organ. Tuffier does not mention whether any hæmorrhage occurred from the spleen in his case. This operation has been performed by Greiffenhagen, who passed two stout silk sutures through the abdominal wall and through the parenchyma of the spleen. Alarming hæmorrhage followed, which was with difficulty controlled.

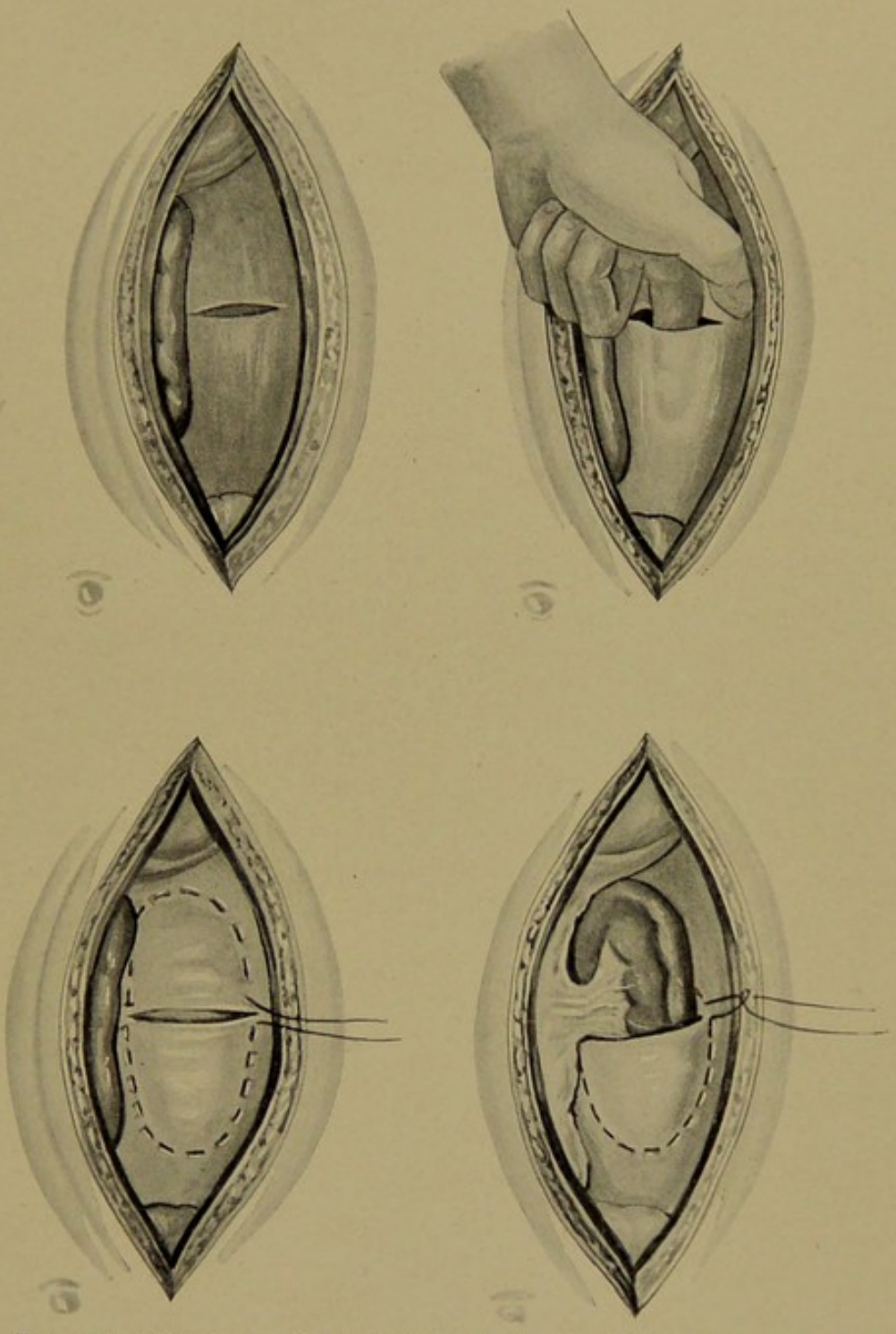

Fig. 370.—Splenopexy (Rydygier's method). Incision in the peritoneum on the under surface of the diaphragm, and the formation of pockets above and below by the stripping up of the peritoneum. The upper pocket is very difficult to fashion, owing to the strong adhesion of the peritoneum there to the diaphragm.

This method is not one to be commended. The risk of hæmorrhage is serious. Other and safer methods have now displaced it.

2. **Kouwer's Method.**—Kouwer, in both his cases, fixed the spleen by tamponade, thus causing the formation of a large number of adhesions. The consolidation of the adhesions secured the fixity of the spleen.

3. **Rydygier's Method.**—The abdomen is opened in the middle line or through the linea semilunaris. The diaphragm is exposed, and a transverse incision between the ninth and tenth ribs is made. The peritoneum above and below this incision is raised up by the finger until a pocket on each side is formed. To do this below is easy, but on the upper side the adhesion to the diaphragm is so close that the peritoneum tears away. A continuous suture (or a series of interrupted sutures) is now applied around the upper and lower margins of the pocket, so as to limit the cavity formed by the raising up of the peritoneum. The spleen is then placed in the pocket formed for it.

4. **Bardenheuer's Method.**—The patient lies on the right side, as for an operation upon the left kidney. A longitudinal incision is made in the axillary line, reaching from the tenth rib to the iliac crest. At the upper end of this a transverse incision is added to give additional room. The soft parts are divided down to the peritoneum, which is stripped up over an area rather larger than the area of the spleen. The peritoneum is then incised, the opening being made of as small a size as will allow the passage of the spleen through it. The spleen is sought and found and drawn through the opening in the peritoneum. The size of the opening is then lessened by a few points of suture, and the wound in the parietes closed. The spleen by this operation is brought to lie altogether outside the peritoneum.

5. **Basil Hall's Method.**—My friend, Mr. Basil Hall, records ("Annals of Surgery," April, 1903) a case of wandering spleen which he treated by a novel and ingenious method. He gives the following description:.

"On November 22, 1901, ether was administered, and the abdomen opened by an incision four inches long at the outer border of the left rectus abdominis. The lower pole of the spleen was exposed by this incision, and the whole organ was then delivered through it without much difficulty. It was seven and a half inches long and three and a half inches wide at its

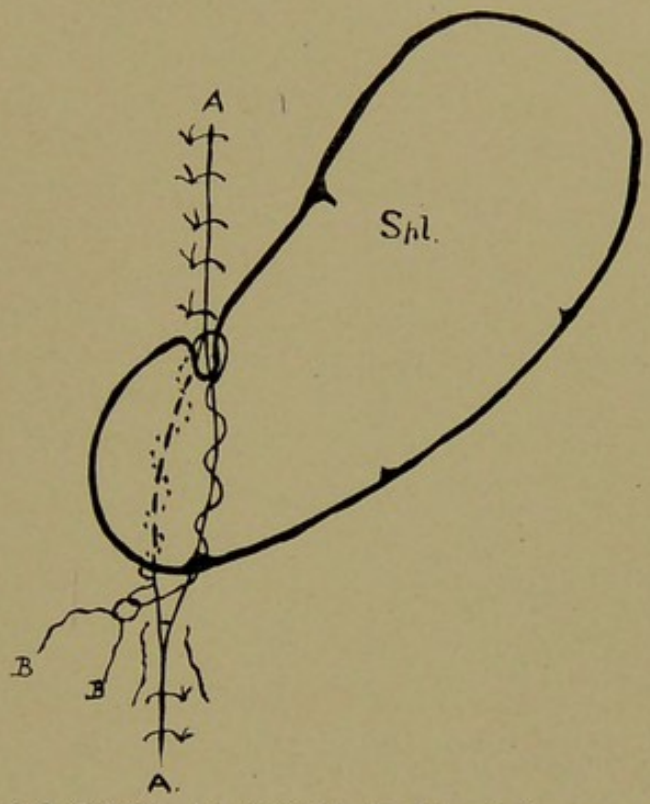

Fig. 371.—*Spl*, Spleen; *AA*, incision in abdominal aponeurosis closed by sutures, except in the center where the lower pole of the spleen projects through it; *BB*, purse-string suture carried around edges of unclosed portion of the incision. On tying this suture the aponeurotic edges close around the spleen like a waistband at the site of the splenic notch. Only one aponeurosis is here represented for the sake of simplicity. (From a drawing kindly supplied me by Mr. Basil Hall.)

centre. Except for its size, it was, to all appearances, a normal spleen. At this stage it was evident that splenectomy could be easily accomplished. The pedicle was so long that the delivery through the incision had scarcely tightened it, and the arrangement of the vessels was such as to allow of easy separate ligation. While considering the advisability of removal, however, it was noticed that the notch on the anterior border was only two to three inches from the lower extremity of the spleen,

and the depth of the notch was such that the lower pole of the spleen was only connected to the rest of the organ by a comparatively narrow isthmus. This arrangement at once suggested an easy means of fixing the organ. The main body of the spleen was, therefore, replaced in the abdomen, after rendering the parietal peritoneum raw in the splenic fossa in order to excite adhesions. Then, while the lower pole was held in the wound, the edges of the peritoneum were drawn tight by a purse-string suture until they closely gripped the narrow isthmus in the notch. The abdominal aponeurosis was next sutured in a similar manner until it grasped the isthmus in the notch sufficiently tightly to produce marked congestion of the now isolated lower pole. The left rectus muscle was next drawn outwards somewhat, so as to overlap the projecting pole of the spleen as much as possible, and the skin incision sutured. After closing the skin incision a prominent lump the size of half an orange remained."

Mr. Basil Hall tells me that the patient when last heard of (November, 1905) was quite well. Her medical attendant said that at that time "there was no sign of giving way, and the case was a surgical success."

RESULTS OF SPLENOPEXY.

The results of this operation in the cases recorded are good, though the after-history in some has not been given. Nothing is known of the after-history in Tuffier's case, in Plücker's, or in Geordano's. Kouwer's first case was well four years after operation; the spleen was in good position and securely fixed. In his second case the gauze packing had to be removed in forty-eight hours as symptoms of intestinal obstruction were appearing; in this the spleen had dropped a little, but its mobility was considerably lessened by the operation. Rydygier's patient was seen fourteen months after the operation and the conditions were perfectly satisfactory. Grieffenhagen's patient was seen seven months after operation; the spleen was in good position and was securely fixed. Hall's patient was entirely relieved of her symptoms and could undertake her house-

hold duties or any active exertion. The spleen had shrunk, but the diminution in size was not very great; it could not be displaced by palpation or any change of posture.

There does not seem to have been any mortality from the operation. In a limited number of cases, therefore, the operation is one to be preferred to splenectomy.

INDEX OF NAMES—VOLUME II

INDEX OF SUBJECTS—VOLUME II