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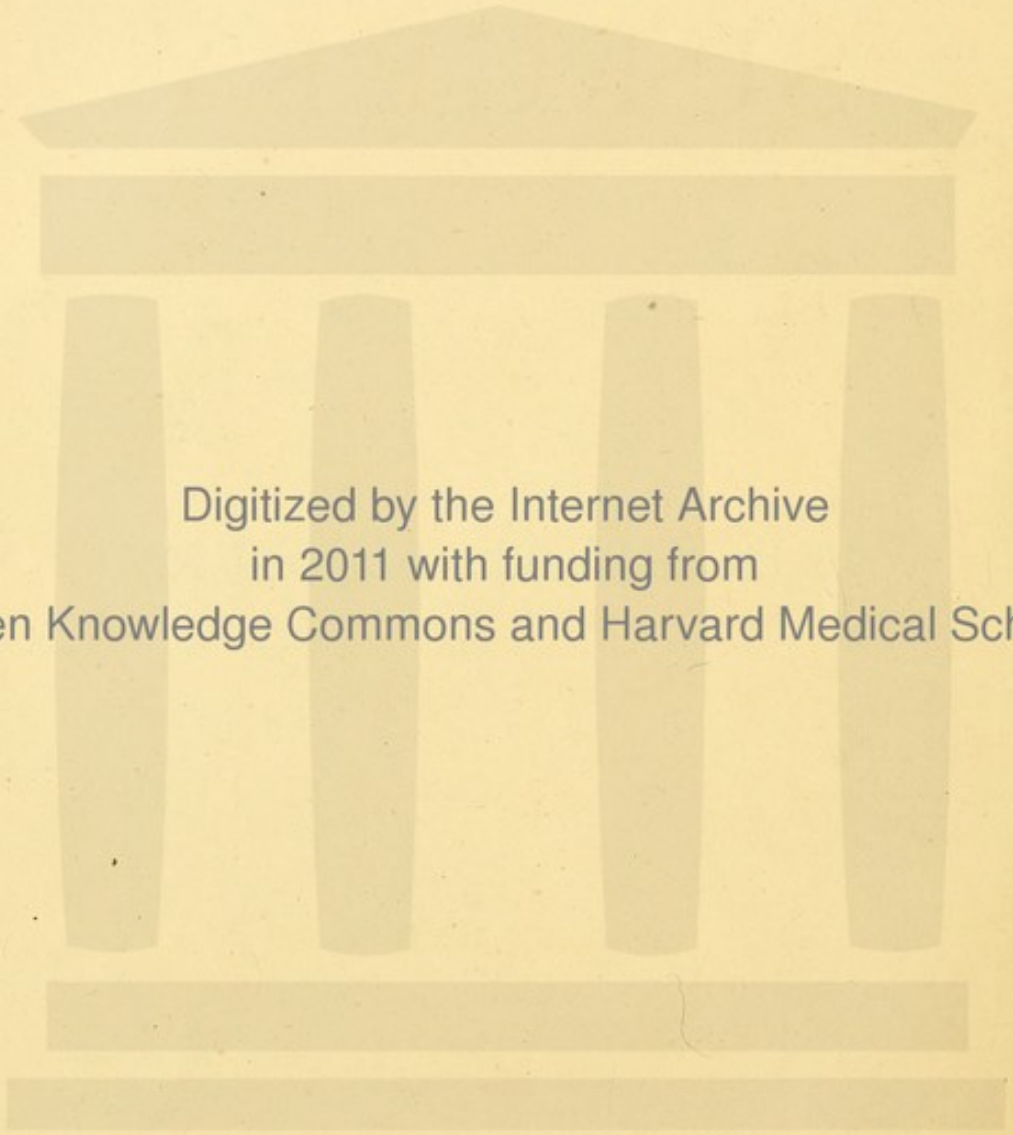

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ABDOMINAL SURGERY

BY

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Second Edition

LONDON
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1888

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TO

MY COLLEAGUES

ON THE STAFF OF

The Bristol Royal Infirmary,

TO WHOSE

GENEROSITY

I AM INDEBTED FOR FAR MORE THAN MY DUE SHARE OF

EXPERIENCE

IN

ABDOMINAL SURGERY,

I GRATEFULLY

DEDICATE

This Book.

PREFACE TO THE SECOND EDITION.

THE very rapid sale of the first edition took me unawares, and the work has been in consequence for six months out of print. Delay in the production of the second edition will be excused on the plea that time as well as labour were necessary to bring the work fully up to date, and to make certain desirable additions and improvements.

The advances made in the practical surgery of the abdomen in the few months which have elapsed since the work was written are truly astounding. For every operation some improvement has had to be chronicled, and several new operations have been added. The whole subject of the Reparative Surgery of the abdomen, being now placed on a basis which is comparatively permanent, has been elevated to the dignity of an independent section. This section is practically a new one. In deference to the opinion of certain reviewers, and, it must be confessed, in harmony with a personal feeling, a new section on Supra-pubic Cystotomy has been introduced. Among the minor additions may be mentioned Keith's mode of treating the pedicle in ovariotomy; Cervical Amputation of the uterus for cancer; the operations of Richardson and of Bull for removal of foreign bodies impacted in the lower œsophagus; Bernays's operation

for removal of growths in the stomach; and the modifications of Laparo-colotomy introduced by Allingham and by Ball.

About forty new wood-engravings have been included. The instruments have been mostly re-drawn to scale from photographs made on the blocks. Engravings copied from other works have their source uniformly acknowledged: engravings with no name attached are from drawings made by myself.

It only remains that I should gratefully acknowledge the abundant kindness of reviewers and friends. Amongst the latter I desire specially to mention Mr. L. M. Griffiths, who has generously and patiently done as much in the way of proof-reading for this edition as he did for the previous one. Dr. Thomas Keith has very kindly revised the description of his mode of treating the pedicle in ovariotomy. To my pupils, Messrs. G. D. Edwards, J. H. Fardon, W. S. Wright, and F. Lace, I am indebted for assistance in various ways.

CLIFTON, BRISTOL,
March, 1888.

PREFACE TO THE FIRST EDITION.

THE time seems to have come when it is proper to gather together and describe in systematic manner the surgical operations usually spoken of as abdominal. Of some abdominal operations it may truly be said that no complete descriptions have as yet appeared; others are described only in isolated monographs in scattered periodicals; while a few appear only as casual additions to large works dealing with one special disease or operation. This, I believe, is the first attempt to deal with the practical surgery of the abdomen in one treatise.

From the descriptive point of view, the features of abdominal surgery, both in grouping and in detail, lend themselves readily to comprehensive treatment. Most of the operations are performed for diseases which come, in the first instance, within the domain of the physician, and the complete and scientific accounts of these diseases—their natural history, in fact—must be looked for in works on general pathology and medicine. In their treatment by operation, the surgeon is associated with the physician for a definite practical purpose; which purpose involves, on the part of the surgeon, not only a general acquaintance with operative details, but a special knowledge of the gross anatomy of the disease, and a technical familiarity with the methods of diagnosis.

From a practical point of view, it is expedient that the surgeon, who makes an abdominal section for a certain preconceived purpose, should be ready off-hand to deal with an unexpected contingency. The recondite nature of many abdominal diseases frequently necessitates conclusions to operative procedures very different from what were contemplated. Confidence and capacity on the part of the surgeon who ventures on abdominal work can scarcely exist apart from a complete knowledge of all abdominal operations.

On these principles this work has been written: to gather together for systematic description all abdominal operations, and to do so after a method which will satisfy the requirements of the practical surgeon. In the selection of subjects, I have followed popular habit rather than strict anatomy. Thus, Hernia and Epicystotomy are not included, though they may be considered as abdominal operations. In the choice, arrangement, and balancing of material, I have steadily kept before me the main purpose of the work—treatment by operation. The anatomy—normal, of the organ on which the operation is to be performed; and diseased, of the tumour or condition for which operation is contemplated—is chiefly naked-eye anatomy; that is to say, what concerns practical manipulation. Microscopic or general pathology, except in so far as it has a direct bearing on diagnosis or treatment, has been excluded. Symptoms are quoted with a definite view to diagnosis, rather than as a part of semeiology. Statistics are provided only in detail sufficient to give fair grounds for estimating the chances of recovery and the values of operations. Finally, with each operation, is given a short history of its origin and advance. Believing, as I firmly do, that a knowledge, at first hand, of the work of surgeons in

the past is one of the most valuable means of education and improvement in the present, I regret that the space at my command prevents me from giving more than a skeleton outline of the historical material which I have collected.

Literary references are, as far as possible, kept out of the text, and placed in a separate list at the end of the book. I am conscious that the Bibliography is very far from being complete: as it represents roughly the amount of literature, either in original or in abstract, which I have read in the preparation of this work, I trust that it will be found representative. Many references in the text are not included in the Bibliography.

I have to express my gratitude for obligations. My indebtedness to my colleagues on the staff of the Bristol Royal Infirmary I have partly expressed in the dedication. To many of our leaders in abdominal surgery—it is unnecessary to name them—I am grateful for permission, always most heartily accorded, to observe their work and learn from their teaching. To my friend Mr. L. M. Griffiths I am indebted for much assistance in the correction of proofs and in the preparation of the Index. To Mr. J. W. Mills my thanks are due for the translation of monographs written in a language with which I am not familiar.

CLIFTON, BRISTOL,
May, 1887.

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Abdominal Surgery.

SECTION I.

DIAGNOSIS OF ABDOMINAL TUMOURS.

THE diagnosis of tumours in the abdominal cavity demands an accurate comprehension of the topography of the contained viscera, a practical acquaintance with the methods of physical examination, and some knowledge of the nature of the tumours which are liable to be found in connection with the individual organs.

Topographical Anatomy of the Abdomen.

For purposes of surgical diagnosis we may consider the whole of the abdominal and pelvic cavities as one. The surgical limits of the abdomen are practically those of the peritoneum; anything totally or partially covered by peritoneum we may here reckon as abdominal.

The abdominal cavity is, roughly speaking, a cylinder, flatly cordate in transverse section, pointed or arched at its extremities. The inward bulging of the vertebral column tends to bisect the cylinder in its upper portion; in its lower portion this bony ridge is bifurcated and carried outwards laterally, as the pelvic brim. At the top is the diaphragmatic arch; at the bottom is the pelvic cup, supported by the muscles in the pelvic floor.

The walls of this cavity are chiefly bony behind and muscular in front. At both extremities it is encased in bony walls, completely behind and partially in front; at the upper end by the lower ribs descending laterally and ascending in front, leaving a V-shaped gap, which is occupied by muscle; at the lower end by the iliac bones, which complete the enclosure behind and latterally, but leave a muscular space between them in front. Behind, the sacrum below and the vetebral column above, measured by inches; in front, the pubes below and the end of the sternum above, each not longer than one inch, complete the bony portion of the cylinder.

Thus the outer muscular coverings of the abdomen represent a sort of lozenge-shaped area, the four corners of which lie at the xiphoid cartilage, the pubes, the right loin and the left loin. In this area all abdominal tumours, if bulky enough, bulge outwards; and through this area the diagnosis and the treatment of abdominal tumours are mainly carried out. Through the upper muscular boundary of the diaphragm the abdomen cannot be approached; but through its lower boundary of the pelvic floor we may derive important aids in diagnosis, and carry out more than one mode of treatment.

It will be seen that in diagnosing conditions of abdominal viscera, we begin by trying to eliminate the parietes; to ignore, or at least to overcome, as far as possible, the obstacles which they present to examination. Where the abdominal wall is thinnest and most lax, in front, examination is easiest; in the loins, where the layers are thick and tense, examination is difficult; behind and under the bony walls, except by special methods in a few cases of certain diseases, physical examination

is impossible. The anatomical construction of the abdominal walls does not here concern us: this will be considered when speaking of treatment.

For convenience of localising the abdominal organs the surface has been divided by four lines, two horizontal and two vertical, into nine arbitrary regions. (Fig. 1.) The vertical lines (c.c', d.d') extend from the cartilage of the eighth rib to the middle of Poupart's ligament. The upper transverse line (a.a') is at the level of the ninth costal cartilage; the lower (b.b') at the level of the highest point of the crest of the ilium. The upper and lower limits are at the diaphragm and pelvis. The middle regions are named, from above downwards, the Epigastric, the Umbilical, and the Hypogastric. The lateral regions, from above downwards, are named respectively right or left Hypochondriac, Lumbar, and Iliac.

The contents of these regions are, according to Tillaux:

Epigastric (I.)—From before backwards we find in the Epigastrium, the left lobe of the liver, a part of the anterior surface of the stomach with its cardiac and pyloric orfices, the gastro-hepatic omentum, and the foramen of Winslow. In the anterior edge of the foramen we find: the hepatic artery in front; the hepatic and cystic ducts, and the origin of the ductus choledochus, in the middle; the portal vein behind the branches of the great sympathetic, and the end of the right vagus. Behind the stomach we have the second and third portions of the duodenum, the pancreas, the cœliac axis and its branches, the superior mesenteric artery surrounded by lymphatic glands, and the solar plexus; and behind all, the aorta and vena cava, resting on the vertebral column.

Right Hypochondriac (II.)—Chiefly occupied by the right lobe of the liver. Behind it lie the gall-bladder, a small portion of the transverse colon, the upper end of the right kidney and its supra-renal body.

Left Hypochondriac (III.)—Mainly occupied by the large cardiac portion of the stomach, and the spleen with the gastro-splenic omentum; contains also the upper end of the left kidney, the left supra-renal, a portion of the descending colon,

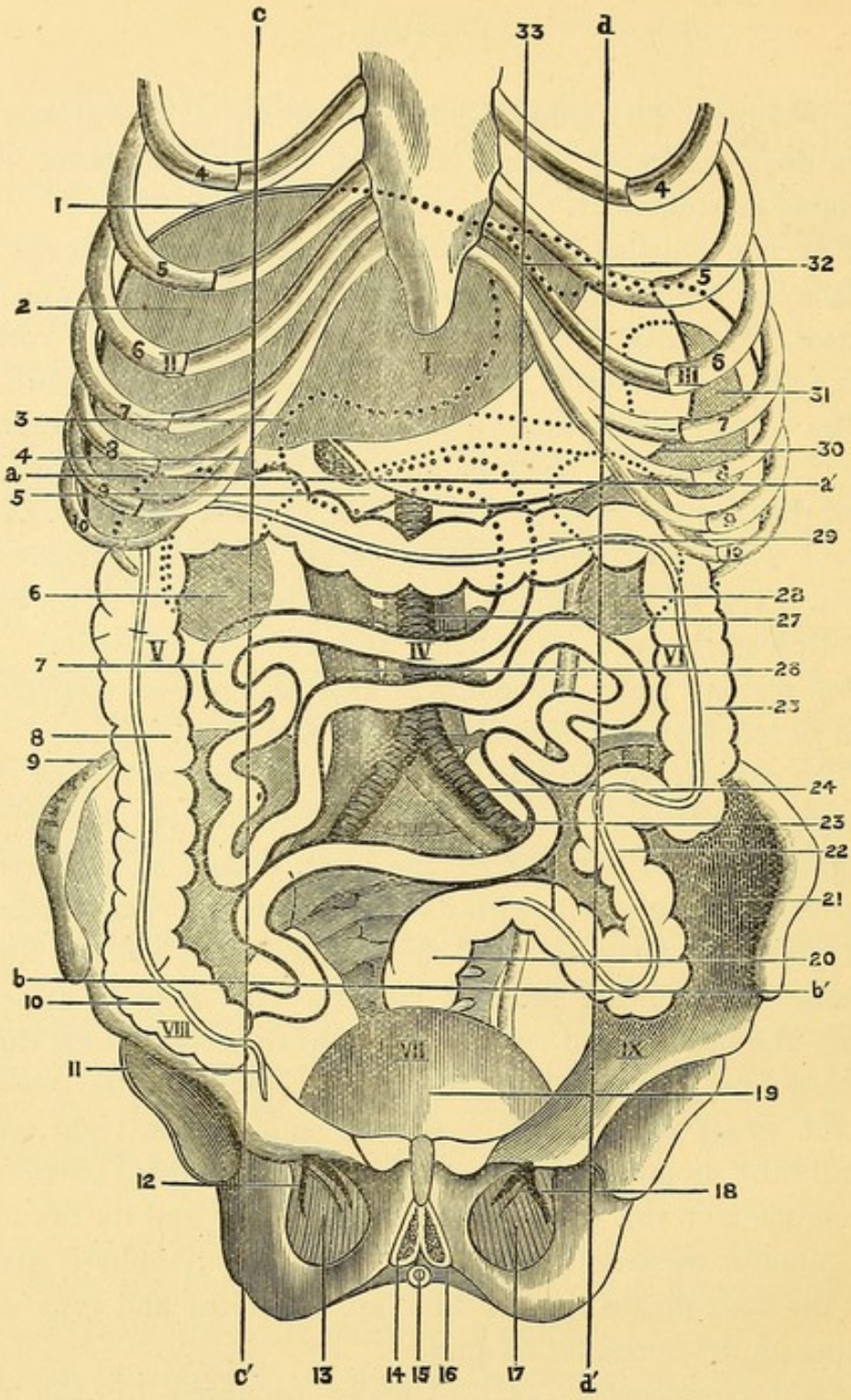

FIG. 1. *(after Tillaux).*

Showing the Regions of the Abdomen and their Contents.

I. Epigastric. II. Right Hypochondriac. III. Left Hypochondriac. IV. Umbilical. V. Right Lumbar. VI. Left Lumbar. VII. Hypogastric. VIII. Right Iliac. IX. Left Iliac.

1. Diaphragm. 2. Liver. 3. Pylorus. 4. Gall-bladder. 5. Duodenum. 6. Right Kidney. 7. Small Bowel. 8. Ascending Colon. 9. Iliac Crest. 10. Cæcum. 11. Appendix Vermiformis. 12, 18. Obturator Vessels, R. & L. 13, 17. Obturator Membrane. 14, 16. Corpora Cavernosa. 15. Urethra. 19. Bladder. 20, 22. Rectum, Sigmoid Flexure (should be Ω shaped). 23, 24. Iliac Vessels. 25. Descending Colon. 26. Vena Cava inf. 27. Aorta. 28. Left Kidney. 29. Transverse Colon. 30. Greater Curvature of Stomach. 31. Spleen. 32. Cardiac Orifice of Stomach. 33. Pancreas.

and the tail of the pancreas. Sometimes the left lobe of the liver extends into this region.

Umbilical (IV.)—The great omentum, the transverse colon, the bulk of the small intestine, the mesentery, the aorta, and the inferior vena cava.

Lumbar regions, right and left (V. and VI.)—Some convolutions of the small intestine; the colons, ascending on the right, descending on the left; the kidneys and ureters, and masses of cellulo-adipose tissue.

Hypogastric (VII.)—The great omentum, the small intestine, the bladder when distended, and the uterus when enlarged.

Iliac, right and left (VIII. and IX.)—On the right, the cæcum; on the left, the sigmoid flexure, covered by convolutions of the small intestine.

Tumours first appear in the situation of the organs from which they grow, and their main attachments are the same. Even if they encroach upon other regions, as they very frequently do, abdominal tumours usually have their chief bulk in the normal situation of the organs from which they spring. These facts are of supreme importance in diagnosis.

Diagnostic Methods.

Certain methods of examination of the abdomen in a patient suspected of abdominal disease are followed. They are: Inspection; Palpation through parietes, vagina, and rectum; Percussion; Auscultation; Exploratory Puncture.

Inspection.—If the patient is in bed, we note the position naturally assumed. We note any lack of freedom in movement, as in raising the head, in turning, or in drawing up the limbs. Any inflammation in the abdomen is inconsistent with free movement. If the patient lies very still, with the knees drawn up, we may suspect peritonitis. If, while there is much pain, the patient moves restlessly about, perhaps rolling on his face

or assuming the genu-pectoral position, we may suspect colic or some form of acute intestinal strangulation.

The abdominal walls are inspected while the patient lies comfortably in the supine position. We note the size of the abdomen generally, and whether its bulk and symmetry are in proportion with those of the chest. We mark any irregularities on its surface, particularly observing the localities in which they are placed. Uniform swelling is observed to be flat, globular, diffuse, or circumscribed. The appearance of a bulky abdomen with a lean chest contrasts with a depressed and shrunken abdomen in cases where the chest appears of normal development. We further note every peculiarity in the parietes: their fatness or leanness; whether they are white and glossy, or red and dull; whether the skin is distended with œdema, or shrivelled and puckered; whether the veins are dilated or not; and, in fact, everything which can be interpreted as being in the slightest degree abnormal.

The movements of the abdomen are watched—first during easy respiration, and then during deep respiration. The abdominal walls may move readily and freely, or they may remain fixed while the chest moves. Any conspicuous point, as the umbilicus, may sometimes be seen to glide up and down over a growth, or the growth itself may visibly move upwards and downwards with each act of expiration and inspiration.

Palpation.—For palpation of the abdomen the patient is placed supine in bed, with the knees drawn up and the head slightly elevated, to give relaxation of the abdominal muscles. Too much flexion of the spine, while giving greater relaxtion of the abdominal walls, defeats the object of palpation by deepening the antero-posterior measurement and crowding the contents forwards. A thin abdomen, or one relaxed by repeated pregnancies, is more easily examined than a fat abdomen or one of a woman who has never borne children. A stout muscular man presents the abdomen most difficult to examine by palpation.

While palpation is being performed the attention of the patient is diverted by questions about the symptoms and so

forth, which will ensure a natural condition of the abdominal walls. Any special instructions, as, to breathe deeply or to count, have a tendency to call attention to the process of examination rather than to divert attention therefrom.

The palm of the hand, which must not be cold, and which is said to be made more sensitive by being dipped in hot water, is laid flatly on the abdomen and pressed steadily and firmly, but not roughly, downwards. When it is depressed as far as possible, if no tumour prevents it, the hand is rotated outwards, and its outer margin and fingers may be pushed deeper, so as, without much discomfort, to reach the spine and perhaps the brim of the pelvis. The pressure being steadily maintained, the hand, and the abdominal wall with it, is moved hither and thither over the abdominal contents. The hand is not to be moved over the parietes, but the parietes and hand together are to be moved over the abdominal organs. Without raising it, the hand is slid on to another area, and the process repeated till the whole abdomen has been explored.

By this means we shall make out any small or deeply-placed tumour, such as cancer of the pylorus or pancreas; floating kidney; abdominal aneurism; mesenteric, omental or peritoneal growths; and small tumours of the ovary that may have escaped from the true pelvis. In this way also we shall be able to detect any undue degree of spasm or tension of the abdominal muscles, pointing to underlying irritation or inflammation. We enquire into, and observe the expression of, the sensations of the patient while being examined. In some cases, usually of colic, pressure affords relief. In others, pain, in all degrees from the slightest to the most severe, may be caused by pressure. In every case it is important to discriminate between the hyperæsthesia of the nervous or hysterical patient and the genuine tenderness begotten of inflammation. In inflammation the pain is usually limited to the inflamed area; in simple hyperæsthesia the pain radiates in various directions over the skin of the chest, thighs, or back.

If a tumour is visible, we seek by palpation to elucidate as many of its characters as possible. Is it circumscribed or

diffuse? Is it solid or fluid? Is it fixed or movable? In the case of a circumscribed tumour that is not very large, the hand can be partly insinuated between it and the resisting bony boundaries. The feel of a solid growth is characteristic: between a semi-solid or boggy growth and one distinctly fluid there are many grades difficult of recognition. We seek to detect the condition by trying to elicit the sign of fluctuation. While the fingers or the palm of one hand lie firmly pressed on one side of the growth, the fingers of the other tap it on the opposite side; if the swelling is fluid, we feel a thrill or series of vibratory thrills. The fluctuation thrill may not be detected in fluid tumours if their cyst walls are thick and tense, or if the fluid is thick or contained in many cysts. To detect mobility, the hand is laid flatly on successive aspects of the tumour, and endeavours to move it in various directions; or the tumour may be grasped bodily between the hands, and movement given to it.

By palpation also we seek to make out any irregularities on the surface of the growth, or any localised differences of consistence in its mass. The fingers will note any sensation of grating or fremitus on its surface indicating peritonitis, or they may feel that the parietal peritoneum glides readily over the tumour.

New facts may be discovered by turning the patient, first on one side and then on the other. These relate chiefly to mobility, the extent and direction of it, or its non-existence; but these characters are, perhaps, better ascertained by the palpating hand than by change of position.

Palpation by vagina in all abdominal tumours not high up, and not small, is of great diagnostic value. By this plan we may be able, not only to elicit important facts as to the physical character of the tumour, but also to make out its connection or non-connection with the uterus. Not infrequently the tumour may be poised between the finger in the vagina and the hand on the abdominal wall, and the situation and attachments of its pedicle or base made out. Very often a tumour which, through the abdominal walls, gives the characters of a single cyst, is found through the vagina to have its lower portion composed of

several cysts, and, frequently, of solid material as well. The use of the uterine sound is an aid to vaginal palpation. By means of it we can ascertain with accuracy the length of the uterine cavity, the extent and range of mobility of the fundus, and the situation of the whole organ generally with reference to the growth. In not a few cases the uterus lies immediately behind the pubes, and its fundus can be readily palpated through the abdominal wall; while the whole organ may be moved between the fingers, outside on fundus and inside on cervix. Often, again, it is pressed downwards and retroverted, and its outlines can be made out in Douglas's pouch. The middle finger in the rectum, with the forefinger in the vagina, the perineum between them being pushed upwards, will give more information usually than the simple finger in the vagina; but this plan is not always agreeable to the patient.

Palpation by the rectum may be carried out in the manner just mentioned, or by the finger in the rectum alone, or by the whole hand introduced while the patient is anæsthetised. Very rarely indeed can the last method, in itself an operation of some severity, be considered advisable. Only in certain cases of extreme difficulty, in which it is of vital importance that operation, even exploratory, should not be undertaken till diagnosis is certain, is it admissible. The results, it is very generally admitted, of manual exploration through the rectum are often disappointing. Few surgeons, even among those of the largest experience, have had recourse to this method of diagnosis.

Percussion.—Percussion of the abdomen is performed while the patient is in the same position as for palpation—that is, in the supine posture with knees drawn up. But change of position, first to one side and then to the other, though but slightly adding to the value of palpation, introduces important aids to diagnosis by percussion. The practice is best carried out by tapping the fingers of the left hand, placed on the abdomen, with the fingers of the right hand. If a wide area is to be percussed, it is a good plan to percuss by successive taps on one finger after another while they are spread out as much as

possible over the abdomen. If the wrist and fingers are kept stiff, and pressure is made with the arm, more uniform force is exerted, and more exact comparison is possible than if only one finger is used, and moved from one spot to another. Some prefer always to use a plexímeter.

It is of great importance to bear in mind the different values of deep and of superficial percussion. A "minimised note," produced by gentle taps, will reveal increased dulness in small or thin solid bodies, which would not be detected by strong percussion. A thickened omentum, or pelvic cellulitis extending up into the abdominal parietes, or a small growth lying over the intestines, would be revealed in this way. Deep percussion, again, may reveal dulness from a growth covered by intestines, which would give a resonant note to superficial percussion. In those parts where the abdominal walls are thick, as in the loins, slight percussion is useless, as it reveals only the dulness caused by the thick muscles.

In examining the whole abdomen, particular attention is to be paid to the umbilical, the epigastric, and the lumbar regions. Free fluid in the peritoneal cavity, always gravitating to the lowest part, is first detected by percussion in the lumbar regions. Circumscribed and movable growths have a tendency to rise above the intestines to the surface. It must be remembered that a dull note in the flanks may be caused by fluid fæces in the intestines; and further, that this dulness may be changed to resonance by turning the patient on one side, and so causing the fluid-laden intestines to gravitate downwards. Again, a colon distended with gas may cause resonance in the loin even when ascites is present. When only a small amount of fluid lies in the abdominal cavity, the mesentery is long enough to permit the gas-containing intestines to float to the surface, thus giving a resonant note.

In the case of a tumour being visibly and palpably present, percussion is chiefly valuable as eliciting the position of resonant intestine. Sometimes the tumour is all gas-containing intestine—meteorism or phantom tumour. Occasionally tracts of resonance passing over a growth indicate the presence of

adherent bowel. But in the great majority of cases percussion is of value chiefly as demonstrating the "tympanic corona" (as Tait well names it), which surrounds a growth overlying intestine, in contrast with the circular, semi-circular, or crescentic area of resonance which is found in cases of peritoneal dropsy.

In diagnosing ascitic fluid from cysts, in detecting slight enlargements of liver and spleen, and in demonstrating the presence of gas in a swelling, percussion is of great value: in all other respects, as a diagnostic method, it is much inferior to palpation skilfully practised.

Auscultation.—As a method of physical diagnosis applied to the abdomen, auscultation has not as yet been very fruitful of results. Vascular bruits in aneurisms, and in fibroid or sarcomatous tumours, friction-sounds in peritonitis, and the sounds of the fœtal and the placental circulation, are the most important revelations of the auscultatory method. There are signs that the use of the stethoscope in differentiating intestinal sounds may be of clinical value. Such sounds, produced by the mingling of fluid and gas during intestinal movement, and described as metallic, gurgling or splashing, may be heard during health, and, no doubt, in modified manner during disease. But clinical data as to the character of these sounds are not yet definite enough to be of practical use. In certain cases of dilatation of the stomach, in cholera and diarrhœa, augmentation or perversion of these sounds can be detected. In intestinal obstruction, any such addition to our powers of diagnosis would be heartily welcomed; but as yet no very definite clinical facts have been established by auscultation.

Exploratory Puncture.—Removal of a small portion of the contents of an abdominal tumour by a hollow needle attached to an exhausting syringe, is a method of diagnosis of somewhat uncertain value. In many cases it is useless; in others it makes a diagnosis which does not modify the treatment; in a few cases it is of real and decided benefit. There can be no doubt that the method has been employed with undue frequency,

having been adopted to solve difficulties which ought by other means to have been overcome. Furthermore, it is sometimes attended with danger, and has even caused death. Perhaps the best criterion of the value of exploratory puncture is the fact that it is very rarely used by our most skilled and experienced operators.

If it is decided to employ the exploring needle, particular care must be taken to see that the instrument is purified by repeated washings with antiseptic lotions. The skin at the site of puncture must also be purified; for a group of epidermic scales, or even a small piece of skin, may be carried along by the point of the needle and cause sepsis. Not a few cysts have undergone septic suppuration as a result of the introduction of the exploring trocar; therefore every possible precaution ought to be taken to avoid such a catastrophe.

Physical Examination of the Individual Organs.

THE LIVER.

Palpation.—In health, all of the liver that can be felt is its lower margin where it lies below the ribs, and a portion of the anterior surface of the left lobe in the epigastrium. In men, it may be impossible to palpate the liver at all, or it may simply be detected as a line of increased resistance. In women, and particularly in those who have lax parietes from child-bearing, the hepatic margin can usually be distinctly felt and traced. While the fingers examine the condition of the portion of liver within reach, we take cognisance of the freedom with which the organ moves during the acts of respiration. We note also any complaints of pain or tenderness during palpation. When the liver is enlarged it descends within easy reach, and its surface is carefully examined for abnormalities. Hardness, or bogginess, or fluctuation; irregularities of surface—their size and consistence; and the general form of the enlargement, are the points to be mainly attended to. Hepatic fremitus from

peri-hepatitis and hydatid fremitus may be felt by the hand. A distended gall-bladder may sometimes be felt in health; and Guttmann* says that by squeezing it he has caused its contents to escape through the excretory ducts. In pathological enlargement the gall-bladder is readily felt extending below the liver margin.

Percussion.—On account of the overlapping of the lung, the upper limits of the liver cannot be accurately determined by percussion. Between the highest part of liver and the thoracic wall there is such a depth of lung that a clear resonant note is given; and for a little distance lower, only relative dulness or flatness is obtained. Absolute hepatic dulness is elicited where the liver is in close contact with the thoracic wall, or, at least, not separated from it by air-containing lung. As relative dulness is very variable over the hepatic region, we use the sign of absolute dulness to define its limits. Percussion is performed during the respiratory pause, and along the four lines—sternal, para-sternal, mammillary, and axillary. For defining its upper limits: in the mid-sternal line dulness is obtained at the base of the xiphoid process; in the para-sternal line, just above the sixth rib; in the mammillary line, at the lower border of the sixth rib; and in the axillary line it is found at the level of the eighth rib. Behind, hepatic dulness is found as high as the tenth rib. The lower limits of hepatic dulness are as follows: in the mid-sternal line, half-way between the base of the xiphoid process and the umbilicus; in the para-sternal and mammillary lines, it coincides with the free margin of the ribs; in the axillary line, between the tenth and eleventh ribs; behind this, hepatic dulness is lost in that caused by the thick muscles of the back. In women, the liver dulness may extend from half an inch to an inch lower. In percussing the lower portions of the liver, a minimised note is necessary to produce absolute dulness, on account of its being thinner and lying over air-containing viscera.

As the patient lies supine, the liver rotates a little on its transverse axis, and the anterior margin slips up under the ribs,

* *Handbook of Physical Diagnosis*, New Syd. Soc., 1879.

elevating the lower limit of anterior dulness. The erect posture corrects this. The liver may be dragged up by contraction of lungs or pleura, or pushed up by growths distending the abdominal cavity. In certain diseases it becomes enlarged, often to enormous size, and in such case the increase is downwards, occupying part or the whole of the anterior abdomen. In such enlargements percussion will always demonstrate continuity in the dulness found over the hepatic area. A healthy gall-bladder cannot be detected by percussion: in disease, a dull note is given over the area of its increase.

Auscultation is of little value as a mode of examining the liver. A friction-sound may be heard in peri-hepatitis.

Exploratory puncture has been frequently employed in diagnosing diseases of the liver. It is chiefly valuable in detecting the nature of fluid in cystic or suppurative enlargements: it also helps, in doubtful cases, in diagnosing whether the enlargement is solid or fluid. Rarely a small piece of tissue removed by the needle, and examined by the microscope, has revealed the nature of a new growth. The procedure is not free from danger, remote as well as immediate.

THE KIDNEYS.

Palpation.—A kidney that lies in its proper position, and is not enlarged, is, as a rule, beyond the reach of palpation. In thin subjects, with lax abdominal walls, the normal kidney may sometimes be felt. Between the fingers of one hand pressed deeply in the costo-iliac space behind, and the opposed fingers of the other hand in front, the lower third or so of the kidney may be palpated; or with one hand, the thumb being in front and the fingers behind, the loin may be firmly grasped and the kidney felt through the muscles. Size can be estimated more accurately by the grasp of one hand than between two hands: for detecting slight enlargements, palpation between thumb and fingers of one hand is perhaps the better method. If the patient lie over a pillow on the side opposite that being examined, the costo-iliac space is enlarged, and more of the

kidney is exposed to palpation; but the advantage so gained is partly counterbalanced by the increased tension of the loin muscles. All of the healthy kidney that can be felt is the lower third or thereabouts of its posterior border, and a little portion of its lower anterior surface; the rest is merely a sensation of something grasped with a consistency like that of kidney.

If the kidney is readily felt, we may conclude that it is enlarged. A kidney increasing in size cannot extend far upwards, and not at all backwards, on account of the lumbar muscles: it grows downwards and forwards—that is, more and more within the reach of the palpating fingers. In diagnosing displacements and undue mobility of the kidney, palpation is of great value. Tenderness on pressure, in renal as in other inflammations, is a sign of importance elicited by palpation. Fluctuation or solidity, with various degrees of hardness or softness, are all signs of diagnostic value. The grating of stones in a kidney has been felt through the abdominal walls. In cases of great enlargement, the colon may be felt passing over the surface of the tumour.

Percussion.—The kidney, being in close relation with solid bodies,—liver on one side, spleen on the other, lumbar muscles and vertebræ behind, while it is embedded in a thick capsule of fat,—cannot be mapped out by percussion. The absence of kidney from one side may, in lean subjects, give a note on percussion less dull than on the other side where it is present. If there is renal enlargement, the resonant area in the loin is encroached upon and replaced towards the front by an area of dulness. At the inner margin of the kidney, extra resonance may be obtained from the colon distended by gas. In considerable enlargement, a resonant area from a distended colon may longitudinally traverse the surface of the kidney.

Exploratory puncture is used in the diagnosis of renal tumours. It will tell whether an enlargement is solid or fluid; and if fluid, it will tell the nature of it—whether suppurative, cystic, hydronephrotic, or hydatid. As puncture by trocar can, in fluid

enlargements of the kidney, more often than of other abdominal organs, be continued beyond the purpose of diagnosis into a plan of treatment, its employment is most legitimate in kidney diseases.

THE SPLEEN.

Palpation.—The healthy spleen is usually beyond the range of touch. In favourable circumstances, however, as in thin subjects with lax muscles, and during deep inspiration in the erect posture, the fingers insinuated below the margins of the ribs may feel the organ. By this plan slight enlargements are best detected. As the spleen enlarges, it appears at the costal margin below the site of the apex beat, and continues to increase downwards and forwards. It lies, when enlarged, immediately under the parietes over the intestines, and can readily be palpated. The characteristic sensation imparted by splenic substance, and its rounded inner margin indented with one deep notch and one or more others less deep, render the diagnosis of spleen by palpation comparatively easy. Its rounded posterior margin, if it do not lie behind the border of the quadratus lumborum, may sometimes be differentiated. The spleen, even when greatly enlarged, is usually movable in lateral direction.

Percussion.—The spleen, as it lies over air-containing organs, must be percussed gently. Differences in the area of dulness may be elicited as the patient lies on the back or the side, as he stands up, and as he forcibly expires or inspires. In the erect posture, the spleen descends; as the patient lies on the right side, it gravitates away from the surface; in expiration the lung ascends from it, and increases its area of dulness; in inspiration the reverse takes place, a forced inspiration sometimes causing the splenic dulness completely to disappear. The upper third of the spleen cannot be recognised by percussion. Generally speaking, the splenic dulness in its most marked condition with the patient erect, and in the pause after expiration, is represented by an oval patch lying midway between the scapular and axillary lines, and bounded above by the upper border of

the ninth rib, and below by the lower border of the eleventh rib. The healthy spleen may be pushed downwards by any pathological increase in the size of the left pleural cavity: it may be pushed upwards by ascites, tympanites, or any growth filling the abdominal cavity. It is usually indistinguishable by percussion from any non-resonant tumour or collection of fluid which displaces it.

Auscultation.—A vascular bruit is sometimes to be heard over an enlarged spleen. If there is inflammation of its capsule, friction-sounds may be audible during respiration.

THE PANCREAS.

Except in very thin patients, the pancreas cannot be felt. The head of the pancreas can sometimes be recognised as a small hard elevation, a little above and to the right of the umbilicus: the body and tail cannot be palpated. The genu-pectoral posture and bimanual pressure from both sides inwards are said to facilitate palpation of the pancreas. The gland is always fixed in disease as well as in health. The diagnosis of growths of the pancreas, solid and cystic, is always difficult and sometimes impossible, and many examples of errors could be quoted. I have had part charge of a case in the Bristol Infirmary where an aneurism in the substance of the pancreas was, for more than a month, supposed to be tumour of the gall-bladder.

Other methods of examination are obviously useless. In growths of the pancreas lying close to the abdominal wall, exploratory puncture may be employed with doubtful advantage.

THE STOMACH.

Inspection.—In health, some idea as to the emptiness or fulness of the stomachic cavity may be got by inspection. In disease, there is a marked contrast between the depression of the epigastrium in a patient with œsophageal obstruction and the tumefaction of the upper abdomen seen in cases of stomachic distension from obstruction of the pylorus. Sometimes,

in a dilated stomach, peristaltic movements may be visible through the parietes. It is not often that a new growth in the walls of the viscus is visible as an elevation in the epigastrium.

Palpation.—By touch we can detect dilatation of the stomach with fluid or gas, and the existence of growths in its walls. Local pain—an important sign in diseases of the stomach—may be elicited by pressure. A pyloric growth in its early stages is movable; later on it becomes fixed. Sometimes, on account of dilatation of the stomach, a pyloric tumour is displaced downwards from the normal position of the pylorus in the epigastrium. Tumours in the walls of the stomach descend by gravitation. Tumours in the left half of the stomach, which however are of rare occurrence, cannot, as a rule, be detected by palpation. Vermicular contraction of the stomachic walls may occasionally be felt by the examining finger.

Percussion.—Only that portion of the surface of the stomach which is in contact with the abdominal walls can be satisfactorily percussed; the sounds over the rest of the stomach are rendered uncertain in import by the overlapping of the liver and the lung. The margin of the left lobe of the liver on the right, and the lower border of the left lung on the left, mark the upper boundaries of pure stomachic resonance: the lower limit, the great curvature, is represented by a curved line lying midway between the end of the sternum and the umbilicus, and joining the costal margin at the free end of the tenth rib. The upper limits, being marked by transitions from hepatic dulness on the right and pulmonary resonance on the left to the tympanitic note given forth by an air-containing stomach, are easily mapped out. The lower limits are not so readily fixed, on account of the proximity of the colon, which frequently gives forth a percussion note identical in quality and intensity. Sometimes, however, there is a sharp distinction in the variety of note, permitting the line of the greater curvature to be marked out with exactitude.

The percussion note over the stomach is usually loud and tympanitic, but low in pitch. But the note varies greatly according to the nature and amount of contents. The stomach

may be quite full of fluid, when the note is dull or very much muffled, and this dulness may extend over an area greater than is occupied by the normal undilated stomach. Air and fluid may be present together, when each will give out its characteristic note according to its amount and the position of the patient. A common condition is seen when air and fluid are both present in moderate amount; and the stomach surface is then represented to percussion as a rounded patch of tympanitic resonance above, bounded below by a crescentic area of dulness. The metallic note described by Leichtenstern, which may be elicited in cases of over-distension by gas, is not of great clinical value. More precise results are sought to be attained by such methods as that of Frerichs, who generated carbonic acid in the cavity, and that of Schrieber, who inflated a rubber balloon introduced collapsed into the stomach, with other methods which might be mentioned; but none of them have come into general favour.

Anything which depresses the diaphragm will depress the stomach; and anything which distends the abdomen will push the stomach upwards. Its area of resonance is diminished by enlargement of the liver or spleen, and increased by contraction of the liver, as well, of course, as by gaseous dilatation from pathological causes proper to itself.

In every case important modifications of the percussion note may be got from changing the position of the patient. Resonance follows the movements of the gas, always to the surface; dulness follows the fluid, which gravitates to the lowest position and drags the stomach with it.

Auscultation.—Certain splashing, gurgling, or metallic sounds are caused by the agitation of the fluid and gaseous contents of the stomach. These sounds may be caused by the natural movements of the stomach walls, or by rapid voluntary movements of the diaphragm, or by manipulation from without. Frequently they are very loud, and can be heard at a considerable distance: in such instances we may suspect some sort of pathological distension. During the processes of swallowing and digestion, gastric murmurs, of a nature not easily described, may be heard with the stethoscope.

THE INTESTINES.

Inspection.—General fulness or emptiness of the intestines causes visible protuberance or retraction of the abdominal walls. Excessive distension of the intestines by gas produces a characteristic form of enlargement. With general protuberance in the umbilical region, there is a peculiar fulness in the epigastric and lumbar regions, which belongs to no other form of abdominal enlargement. In such cases, if the parietes are thin, peristaltic movements may be seen in individual coils of intestine. Collections of fæces in the colon may appear as localised elevations at any part of its course, or even as a general enlargement of the whole abdomen.

Palpation.—It is not often that touch is of assistance in diagnosing the condition of intestine. We can feel, and often diagnose by touch, an accumulation of fæces; and it is sometimes possible by palpation alone to tell whether the contents of a distended bowel are chiefly gaseous or chiefly fluid. Occasionally peristaltic movements, in such cases of distension, are perceptible to touch. One important sign elicited by palpation is pain, chiefly of value in the diagnosis of certain inflammatory conditions in the neighbourhood of the cæcum.

Percussion.—In health, the percussion-note all over the intestine is tympanitic. The quality of the note varies according to the proportions of fluid or gas contained. Where the intestine, still full of gas, is of small calibre from compression, the tympanitic note is raised in pitch; where its walls are greatly distended by gas, the note becomes deeper in pitch, and gradually, according to the amount of distension, becomes less and less tympanitic. In conditions of extreme gaseous distension, the character of the note is metallic. It is not generally known that percussion over the iliac bones, if the patient is not fat, will give a tolerably accurate idea as to the nature of the contents of the underlying bowel.

In certain cases the presence of fluid in the bowel may give a dull note in the flanks, which, when the patient turns over, slowly becomes resonant. In intestinal obstruction that has

lasted over a few days, this dull lumbar note from the gravitation of fluid-laden bowels is of by no means infrequent occurrence. I have more than once found, in intestinal obstruction, that dulness in the flanks, diagnosed as ascites, has turned out after operation to depend upon large quantities of fluid in the bowels.

Auscultation.—As already stated, the clinical value of auscultation applied to the intestine is not yet fully established. Beyond certain gurgling or splashing sounds produced by the mingling of fluid and gas in perturbed intestinal contractions, and which are found in a variety of conditions, chiefly medical, there is little in the way of definite abnormality which can be detected by the stethoscope. In several cases of intestinal obstruction it has appeared to others, as well as to myself, that those gurgling sounds were loudest in the neighbourhood of what was afterwards found to be the situation of the obstruction. It is possible to follow with the stethoscope the sounds produced in the colon by a fluid injected through the rectum; and this fact may be employed to diagnose the existence and position of any obstruction in this part of the bowel.

In perforation of the bowel, there are sometimes heard sounds of an amphoric or blowing character, caused by the gas rushing out of the intestinal opening into the general peritoneal cavity. These sounds are said to be most audible during the act of inspiration.

THE OMENTUM.

In health, the omentum is beyond the range of any of the diagnostic methods. In disease, inflammatory thickening can be detected by percussion; and tumours growing in its substance can be recognised by the methods proper to these.

THE UTERUS AND ITS APPENDAGES.

These are examined by methods special to themselves, which are fully described in works devoted to the consideration of their diseases. Our purpose in this work will be fulfilled by a short description of the method of palpation as applied to these organs.

The best position is generally the supine. The patient lies close to the edge of the bed or couch, and the thighs are drawn up towards the chin and separated. One hand—the surgeon ought to be able to use either hand for the purpose—is laid upon the abdomen over the pubes, and gently but firmly presses the pelvic organs downwards. Two fingers of the other hand (or one finger if there is a hymen, or the vagina is narrow or tender) are carried up to the posterior vaginal cul-de-sac, and the posterior surface and lateral connections of the uterus examined as far as possible. We now seek to get the uterus between the fingers in the vagina and the hand on the abdomen. If it is retroverted, we try to turn its fundus forwards by pushing the middle finger upwards (supposing two fingers are used) in the cul-de-sac behind, while the forefinger, by a contrary movement, tries to pull the cervix downwards in front. If it is anteverted, the forefinger pushes upwards the vagina in front of the cervix, while the middle finger behind presses the cervix downwards and forwards. The result of these movements, if adroitly performed, is that the uterus in its length is fixed between the fingers in the vagina and the hand outside. Having in this way got an accurate idea of the size and consistence of the uterus itself, we direct attention to the broad ligaments, Fallopian tubes, and ovaries. We simply try to make the fingers of each hand meet over these organs, palpating their condition between them. In moderately thin patients, with abdominal walls that are not very tense, it is nearly always possible, in health, to palpate the fundus uteri, and frequently the ovaries and broad ligaments. In diseases producing enlargement, these, and the Fallopian tubes as well, can be made out with considerable precision. In diseases not connected with increase of bulk, the production of pain on pressing in certain localities is a most valuable aid in diagnosis.

Nothing is said of the uterine sound. In bimanual examination, which is by far the most perfect method of exploring the uterine organs, its use is not called for. And in uterine diseases generally it is used with much less frequency than it was a few years ago. In cases of tumour, uterine or doubtfully uterine, it

will tell us the direction which the uterine canal takes, and, with some uncertainty, the length of the cavity; otherwise, it gives little information which cannot more accurately be got by other means.

In some cases the examination is rendered more complete by turning the patient on her side in Sims's position, and examining after the manner described. In this position the uterine organs usually rise upwards, away from the examining fingers; but this disadvantage is sometimes counterbalanced by the greater laxity of the tissues in and around the vagina.

Conditions Simulating Abdominal Tumours.

In every case of abdominal enlargement, we must be assured of the absence of certain abnormal conditions which simulate new growths. The most important of these are: distended bladder, fæcal accumulation, phantom tumours, obesity in the abdominal walls and omentum, tympanites, and œdema of the abdominal wall.

Distended Bladder.—As no surgeon who undertakes the surgical treatment of an abdominal tumour is likely to be misled by this condition, it need be little more than mentioned. A history of retention or diminished discharge of urine, median dulness from the pubes upwards as far as, or even beyond, the umbilicus, with a rounded fluctuating tumour in this region and resonance in the flanks, are the ordinary symptoms. In any case of doubt, catheterisation will settle the question. It must not be forgotten, however, that a distended bladder may accompany an abdominal tumour. This may happen from direct pressure on the urethra by the tumour, or by stretching of the urethra by a growing tumour which is adherent to the bladder wall. Retention of urine is often the most prominent symptom of retroversion of the gravid uterus.

Fæcal Accumulation.—A collection of fæces in the large bowel may be mistaken for a new growth. The collection may be found in the abdomen wherever the large bowel may be found;

and that is, practically, anywhere. It is now well known, especially through the investigations of Treves, that the transverse colon may become bent and elongated so as quite to reach the pubes, and fæcal accumulations may be found in any part of it.

A tumour of hard or doughy consistence, occasionally capable of being moulded, movable, and lying on the surface of the intestines close to the abdominal wall, may be fæcal. In size it may vary from that of a small orange to almost any dimension. When fluid or semi-fluid, its peculiar want of tension, and the absence of definite fluctuation, will probably strike us. Tympanitic distension of the bowel lying near will be found if there is obstruction as well as accumulation. A regular action of the bowels must not be taken as contra-indicating the presence of a fæcal mass; diarrhœa even is not uncommon. In cases of long-standing accumulation, diarrhœa, probably due to the formation of "stercoraceous ulcers," is the rule rather than the exception.

In all cases the existence of the condition will be proved by the administration of purgatives and enemas. If symptoms of intestinal obstruction are present, the chances of mistake are diminished.

Phantom Tumour. Pseudo-cyesis.—Phantom tumour is a localised and symmetrical enlargement of the abdomen, containing gas; pseudo-cyesis is the same associated with symptoms of pregnancy. Though similar, the two conditions are not identical. Pseudo-cyesis, or "spurious pregnancy," is most frequently found in women who have married late in life, and who are anxious for children.* Phantom tumour may occur in unmarried women, and in women who have borne children and are conscious that their condition is in no way connected with pregnancy. Both conditions have been associated with hysteria. Rarely is phantom tumour found in males.

A case of ordinary phantom tumour may present no physical signs beyond this tympanitic enlargement. A rounded, sym-

* An excellent example of the species is depicted with admirable humour and effectiveness by Smollett in the person of Mrs. Trunnion, in *Peregrine Pickle*.

metrical, movable tumour, of size varying between that of a large orange and a child's head, occupying the middle of the abdomen, not fluctuating, and resonant on percussion, is probably a phantom tumour. Examination by the vagina gives negative information. A decisive diagnosis is afforded when the patient is anæsthetised; the tumour then disappears spontaneously, though it may return as consciousness returns, or even before this.

Pseudo-cyesis is a more complex affair. Though it is undoubtedly most common in elderly women anxious for children, and in whom symptoms of ovarian or uterine disease are present, it occurs also in young women in whom no such peculiarities exist. The remarkable case of an ass, recorded by Dr. Haughton of Dublin, would seem to show that the condition exists in the lower animals. The mimicry of pregnancy is sometimes very exact. Amenorrhœa, swelling of the breasts with pigmentation of the nipples, and morning sickness, may all be present with the abdominal enlargement. At the presumed full term a false labour may take place.

In such cases, Tait thinks that a power of air-swallowing, as seen in crib-biting horses, may account for the condition. He calls attention to the frequent presence of loud intestinal gurglings in these women, and thinks their condition is caused partly by this spurious flatulence, and partly by peculiar muscular rigidities which they are prone to indulge in. No doubt the infirmity, if voluntarily produced, is an outcome of "that insatiable love of attracting attention so deeply rooted in the female mind," and is, as might be expected, most frequently found "in women to whom nature has denied the external attractions of beauty, or in whom there is not the compensation of a refined and cultured intellect."* Many speculations as to the origin of phantom tumour have been indulged in; probably Tait's account represents the full amount of our scientific knowledge of the curious ailment.

Obesity of Abdominal Walls and Omentum.—More than once the abdominal cavity has been entered to remove a tumour which turned out to be fat. The simulation of abdominal growths by

* Tait, *Dis. of Ovaries*, 1883, p. 206.

fat in the parietes or the omentum, or both, is sometimes so close that considerable care may be required in their discrimination. If obesity is general, we are more likely to be on our guard; but if, as sometimes happens, especially near the climacteric, there is a large deposit of fat in the abdomen, while the limbs do not increase in bulk, or even get thinner, the condition is more misleading.

In such cases the possibility of grasping and raising from the abdominal muscles masses of fatty tissue, the absence of any localised area of dulness, and the negative results of vaginal examination, will be our chief guides in diagnosis. A fat omentum is clinically, perhaps, an abdominal tumour; but pathologically, there is no growth of similar thickness and consistency which is spread so evenly over the bowels.

Œdema of Abdominal Wall.—Great œdema of the abdominal wall has been mistaken for abdominal tumour; but the error must be of rare occurrence. A concomitant thickness and hardness of the subcutaneous tissues, preventing pitting on pressure, would seem to be necessary to render the mistake even possible. The absence of all the physical signs of abdominal tumour except increase in size, with the presence of such signs of disease in the system as would account for the œdema, should help the diagnosis. It should be remembered, however, that œdema sometimes accompanies abdominal tumour.

Tympanites.—At least seven cases are on record where an abdomen has been laid open to find only gas. In phantom tumour this would be impossible, for the swelling disappears with the anæsthesia. The mistake, in the light of our present knowledge, seems almost inexcusable. On the other hand, it is just possible to overlook the presence of a tumour because it is resonant all over its surface. I have removed a large putrid suppurating cyst, over the whole surface of which resonance could be demonstrated on the operating table to a number of students and medical men. Half its contents were gaseous.

Having eliminated these spurious complaints, and having decided that the abdomen contains a real tumour—a foreign development constituting disease—our next duty is to make out

what this tumour is. In working out the diagnosis, it is well to follow certain lines with the mind that reasons, as well as with the senses that explore. These lines need not be laid down by science; they may be purely practical, if only they are useful. Our purpose being simply diagnosis, we are justified in adopting any procedure which will most quickly and certainly bring out the physical features of the disease. Thus, while we group together all tumours of the ovary for purposes of classification and description, for diagnosis we rather compare solid tumours of the ovary with pedunculated myomata of the uterus. A large ovarian cyst may have more physical signs in common with a cyst of the kidney than with any pathologically allied growth, uterine or ovarian.

The rarity of a disease may be a cause of meagre scientific acquaintance with it; but for diagnostic purposes, all diseases have equal importance. In abdominal surgery, in particular, it is just those rare diseases that we chiefly wish to exclude. Probably, most of the errors in abdominal surgery are made in this way. The ordinary broad signs of ovarian disease may in a score of cases have guided our diagnosis correctly, when a twenty-first case turns up with an exact repetition of all these signs, and we find ourselves in error. We have probably overlooked one or two little signs of the rare disease, because we thought little of it. We dare not essay to perform operations on the abdomen till we are familiar with the diagnosis of all abdominal tumours; and we cannot pretend to diagnose positively any one disease without being able negatively to exclude every other.

From the purely diagnostic point of view I have arranged the following plan. It is one which I have unconsciously adopted in abdominal examinations, and I present it simply as being likely to be useful. It is, of course, a mere skeleton, indicating in a few words the most prominent and characteristic signs which suggest, but do not prove, the existence of the disease. Full diagnostic details will be found under the headings of the various diseases described.

The classification is based on the most prominent physical

signs. The first question asked is, Is the tumour solid or fluid? The next question is, Is it in the middle line, or on one side? *i.e.*, Is it symmetrical or non-symmetrical, with regard to the general abdominal surface? If it is non-symmetrical, On which side does it lie? If it is symmetrical, Does it lie in the upper or lower abdomen, or in the middle? By answering these simple questions at each step in our examination, we narrow the limits of possible disease twofold, fourfold, and eightfold, at the first, second, and third steps respectively.

Schematic Arrangement of Abdominal Tumours for Purposes of Diagnosis.

SOLID TUMOURS.

SYMMETRICAL.

Upper Abdomen. — Cancer of Pancreas. Cancer of Pylorus. Fibroid Thickening of Pylorus. Morbid Growths in Stomach.

Lower Abdomen. — Solid Growths of Ovary — Sarcoma, Fibroma, Carcinoma. Uterine Myoma. Sarcoma of Uterus. Molar Pregnancy. Extra-uterine Pregnancy (also fluid).

NON-SYMMETRICAL.

Either side of Abdomen.—Solid Growths of Kidney—Sarcoma, Adenoma, Carcinoma. Displaced Kidney. Tumours of Colon.

Right Side.—Solid Growths of Liver—Sarcoma, Carcinoma. Solid Tumours of Gall-bladder. Cancer of Cæcum.

Left Side.—Enlargements of Spleen—Leucocythæmic, Amyloid, Cancerous, Syphilitic. Wandering Spleen.

INDIFFERENTLY SITUATED.

Solid Growths of Peritoneum—Cancer, Enchondroma. Cancer of Omentum. Cancer and Sarcoma of Parietes.

FLUID TUMOURS.

SYMMETRICAL.

Upper and Middle Abdomen.—Cysts of Pancreas. Peritoneal and Mesenteric Cysts. Encysted Dropsy of Peritoneum.

Lower Abdomen.—Ascites. Ovarian Cystoma. Parovarian Cysts. Papillomatous Cysts of Broad Ligament. Fibro-cysts of Uterus. Pregnancy. Hydramnios. Hæmatometra. Hæmatokolpos. Hydrometra. Extra-uterine Pregnancy. Cysts of Urachus.

NON-SYMMETRICAL.

Either Side.—Renal Cysts. Renal Hydatids. Hydro-nephrosis. Pyo-nephrosis. Nephric and Peri-nephric Abscess. Hydro- Hæmato- Pyo-salpinx. Extra-Uterine Pregnancy. Ovarian Abscess.

Right Side.—Abscess of Liver. Hydatids of Liver. Dropsy and Empyema of Gall-bladder.

Left Side.—Abscess of Spleen. Hydatids of Spleen.

Solid Tumours.

It is impossible to define the meaning of the clinical term "solidity" applied to tumours. Negatively, it has been taken as meaning "absence of fluctuation;" but this is inexact, for many fluid tumours do not fluctuate. And more than one class of tumour which is pathologically solid may give an obscure sense of fluctuation. It would be near the truth to say that most solid tumours are hard, that they communicate to the hand a peculiar sense of resistance, that none fluctuate freely, and that very few fluctuate even obscurely. But, undoubtedly, the best ultimate criterion of solidity and fluidity in tumours is the educated sense of touch. A skilled and experienced diagnostician will say almost at once, by laying his hand on a growth, whether it is solid or fluid; and such judgment, in my opinion, is more likely to be correct than the most painstaking enquiry into all the clinical features of the enlargement.

Solid Symmetrical Tumours.

By a symmetrical tumour is meant one which occupies equal parts of each side of the abdomen. The symmetry of the abdomen is not disturbed; the enlargement is bilaterally equal, or nearly so.

SOLID SYMMETRICAL TUMOURS IN THE UPPER ABDOMEN.

Cancer of the Pancreas.—A hard, rounded or irregular tumour fixed deeply in the region of the pancreas, usually covered by bowel, and perhaps giving a sense of pulsation to palpation, with a vascular bruit on auscultation, is probably pancreatic cancer. If the growth is small, nothing may be detected beyond a deep, obscure sense of resistance and hardness. It is not often that the growth acquires dimensions large enough to be visible through the abdominal wall.

Cancer of the Pylorus.—This may be felt as a small hard movable tumour situated in the epigastrium, usually a little to the right of the median line. It becomes fixed in its later stages. It always lies deeply, and is covered by bowel. Pressure causes pain.

Fibroid Thickening of the Pylorus.—Although thickening of the pylorus rarely reaches to the dimensions of a tumour, it sometimes becomes bulky enough to be obscurely felt as a localised induration. From the early stages of cancer of the pylorus, it cannot be diagnosed. The amount of pain elicited—small in thickening, considerable in cancer—may be of value.

Morbid Growths in the Stomach.—These are roughly median, but usually with the main enlargement on the left. They are usually one or other of the varieties of cancer, three-fourths of the cases being scirrhus. A growth in the stomach is at first freely movable, near the surface if in the anterior wall or greater curvature, rounded or irregular in outline, and may attain to a considerable size. On the posterior surface or lesser curvature (which is not a common situation), the growth may be only obscurely palpable when the stomach is empty. It tends to drag the stomach downwards, and from this cause, as well as

from the dilatation of the viscus which usually accompanies it, may descend as low as the umbilicus. It is painful on palpation. I have seen a case of cancer of the posterior wall which caused a visible protuberance in the epigastrium. Cancers of the stomach are late in becoming fixed; some slight degree of mobility is present to the last.

SOLID SYMMETRICAL TUMOURS IN THE LOWER ABDOMEN.

Solid Growths of the Ovary (sarcoma, fibroma, myoma, carcinoma) present clinical features which are, except where the tumours are of large size, essentially identical. When they first signify their presence, they are usually about the size of the fist, and have escaped from the pelvic into the abdominal cavity. Unless they are of considerable size, they are not strictly symmetrical, lying towards the side of the ovary from which they spring; but as they occupy more of the middle than of the sides of the abdomen, they may be considered as symmetrical. When large, they become strictly median.

Such tumours are round, hard, smooth on the surface and freely movable. They are not usually very painful on being handled. Vaginal examination reveals a normal uterus, sometimes dragged upwards, movable, and following upwards artificial elevation of the growth. By deep exploration with the fingers, it may be possible to make out tension and relaxation of the ovarian ligaments as the tumour is pulled upwards or pushed downwards. Palpation reveals the sensation that the uterus is not closely but remotely attached to the tumour. This condition may be verified by passage of the uterine sound.

Uterine Myoma.—This enlargement varies in its appearance according as it is sessile or pedunculated, single or multiple, hard or soft ("œdematous"), fixed in the pelvis or free in the abdominal cavity. A single round pedunculated myoma may be very similar in clinical features to a solid ovarian tumour. It is more exactly median, and the uterus follows its movements more closely. The sessile myoma has more of its bulk low down than the pedunculated, and the uterus seems to be part of it,

following its movements to the fullest extent. Multiple myomata exhibit several rounded bosses irregularly placed in the lower abdomen, and are usually associated with considerable enlargement of the uterine tissues, with elongation of the uterine cavity. The distinctive signs of the individual varieties of myomata need not here be referred to. There is practically no limit, consistently with life, to the size to which these tumours may grow. Auscultation over myomatous growths may reveal a vascular bruit.

Sarcoma of the Uterus.—It is very seldom that sarcoma of the uterus, in itself a rare disease, attains to such a size as to become an abdominal tumour. Its growth is usually purely intra-uterine, and the uterine walls are spread over it. From a large fibroid polypus, it cannot be diagnosed with certainty: softness and rapidity of growth suggest sarcoma.

Molar Pregnancy.—This is recognised as being an intra-uterine enlargement by the ordinary methods of physical examination. The hydatidiform mole is said to reveal to palpation "a peculiar doughy boggy feeling, in the highest degree characteristic." The abdominal tumour, which may increase more rapidly than a normal gestation, and grow to a greater size, is usually somewhat flattened. The principal signs in such cases are merely confirmatory of the more important general symptoms which accompany this form of abnormal gestation.

Extra-uterine Pregnancy.—When the fœtus is dead, and the surrounding fluids are absorbed, an extra-uterine pregnancy may appear as a hard irregularly-rounded mass fixed in the lower abdomen and pelvis. Its connections with the uterus, which is always enlarged, are close and firm. Here also history is all-important in forming a diagnosis. It may be impossible, so far as physical signs are concerned, to diagnose a uterine myoma from an extra-uterine pregnancy.

Solid Non-Symmetrical Tumours.

By a non-symmetrical tumour is meant one which, visibly or palpably, lies chiefly in and has its main connections on one side of the abdomen. The symmetry of the abdomen,

if there is evident enlargement, is disturbed. If there is no enlargement, an abnormal swelling is felt in one side of the cavity.

SOLID NON-SYMMETRICAL TUMOURS FOUND ON EITHER SIDE OF THE ABDOMEN.

Solid Growths of the Kidney.—These are: sarcoma, several varieties; adenoma; and carcinoma. Clinically, certain suppurative lesions of the kidney may be solid. From mere increase of resistance in the loin without visible enlargement, to a bulk so great that it may pass the middle line and even fill the whole abdominal cavity, there is every gradation of size in renal tumours. Generally speaking, a hard smooth body, fixed or but slightly movable, in either loin, dull on percussion from the lumbar region forwards, and completely filling the costo-iliac space, will indicate a solid renal growth. Pressure on a renal tumour from the front gives a peculiar sense of hard, unyielding resistance. In tumours of considerable size, the passage of the colon—ascending or descending, as the case may be—over its surface may be detected by percussion or palpation.

Displaced Kidney, movable and fixed.—A movable and a floating kidney, pathologically distinct, give identical physical signs. A body of the size, shape, and consistence of the kidney is felt somewhere in the abdomen between its normal situation and the middle line: it glides from under the palpating fingers, and may be replaced in the loin, when its presence may be detected by bimanual palpation. It is always covered by bowel. A peculiar sensation of nausea and faintness is produced by pressure. Movable kidney is most common on the right side.

A kidney fixed in an abnormal situation is usually found near the brim of the pelvis, close to the sacro-iliac joint. It is usually larger and more lobulated than natural, but otherwise presents to the examining finger the physical characters of renal substance. Fixed malposition of the kidney is most frequently met with on the left side. Manual exploration by the rectum may, in certain cases, be necessary for diagnosis.

Tumours of the Colon.—Solid growths of the colon are—polypus, adenoma or adeno-sarcoma, and cancer. A polypoid growth is usually found in the descending colon; it is rarely so large as an orange, and is freely movable for some inches in all directions. It lies usually at or near the surface of the abdomen. In the sigmoid flexure it is perceptible on rectal palpation. Cancer may be found in any part of the large bowel. It is felt rather as an obscure thickening than as a distinct rounded tumour, and is slightly or not at all movable. For diagnosis, other signs, especially those found in the excreta, are essential.

NON-SYMMETRICAL SOLID GROWTHS ON THE RIGHT SIDE OF THE ABDOMEN.

Solid Growths of the Liver.—Various kinds of cancer and sarcoma are found affecting the liver, as new growths; it may be enlarged from fatty or lardaceous disease, or other influences which do not here concern us. The leading physical signs in malignant disease are, a solid resisting enlargement in the hepatic region—most frequently in the right lobe, rarely in the left lobe—causing more of its surface than is natural to protrude from under the ribs, and increasing the area of dulness. From the upper limits of hepatic dulness over the ribs to the lower limits of the enlargement in the abdomen, dulness on percussion is continuous. If the enlargement is not very great, and if the growth is not adherent, the liver moves upwards and downwards during respiration. The characteristic knobs on the surface of the liver, in cancer, are almost pathognomonic. The edge of the liver may be palpated. There is practically no limit, other than the capacity of the abdomen, to the growth of malignant tumours of the liver.

Solid Tumour of the Gall-bladder.—Except as part of general malignant disease of the liver, new growths in the gall-bladder are rare. A gall-bladder full of gall-stones, and with walls thickened from inflammation, is clinically a solid tumour. A tumour of the gall-bladder appears in its normal situation at the

edge of the liver, and grows diagonally downwards and inwards towards the umbilicus. It is smooth and rounded on the surface, globular, ovoid, or pear-shaped in outline, and is movable in lateral directions, and to some extent backwards. Dulness over it is rarely absolute; an area of resonance, from the presence of colon, is occasionally found separating it from the liver margin.

Cancer of the Cæcum.—A hard irregular tumour, not of large size, in the right iliac fossa, and movable through a limited area, may be a malignant growth in the cæcum. Other signs, relating chiefly to obstruction to the passage of the intestinal contents, are necessary to the diagnosis. Inflammation in the cæcum, or near it (typhlitis or peri-typhlitis), may be associated with the development of an enlargement which simulates new growth. A malignant tumour in this part of the bowel is not usually strictly limited to the cæcum, but involves either ileum or ascending colon.

NON-SYMMETRICAL SOLID GROWTHS ON THE LEFT SIDE OF THE ABDOMEN.

Solid Enlargements of the Spleen.—With the diagnosis of the acute enlargements of the spleen found in various purely medical diseases we are not here concerned. The varieties of splenic enlargement likely to be met with in exploration of the abdomen for tumours arise from Leucocythæmia, Amyloid degeneration, Cancer, and Syphilis. In all of these, physical examination reveals little more than enlargement of the organ. Splenic tumours appear under the left false ribs, and grow downwards and inwards towards the middle line. They lie close to the parietes, and give an absolutely dull note on percussion over the surface; there is usually an area of resonance in the loin behind. The characteristic notched or festooned inner border is usually to be felt. Unless the tumour is of considerable size—and splenic tumours may attain to great dimensions—it enjoys some degree of mobility. Palpation in most cases is painless.

Wandering Spleen.—This rare condition is found exclusively in women. A displaced spleen has been found at the umbilicus, in the true pelvis, and at various other situations in the left abdomen. In one case, at least, it has been found free in the cavity, the pedicle having been twisted through. Absence of dulness at the normal site of the spleen, and the presence of a body having the physical characters of this organ, movable round a centre placed under the left false ribs, is probably wandering spleen. A dislocated spleen is, however, liable to contract adhesions in its abnormal position, and then mobility is absent.

SOLID TUMOURS INDIFFERENTLY SITUATED IN THE ABDOMINAL CAVITY.

Tumours of the omentum, the peritoneum, the small intestines, and the parietes, may appear at any part of the abdominal area. Their situation is indifferently lateral or median, high up or low down.

Solid Growths of the Peritoneum.—Excluding tubercular disease, the new developments met with, in connection with the peritoneum, are practically all cancerous. Enchondroma has been found as a new growth, originating from the peritoneum. In the great majority of cases, peritoneal cancer is secondary either to outlying disease or to local disease in the intestines. As usually met with, cancer of the peritoneum is sessile, very hard and irregular on the surface, and accompanied by a variable amount of ascitic fluid. If originating from the bowel, and seen early, it may be movable; but it very soon becomes fixed, by implication of neighbouring organs. In most cases bowel either overlies it or passes through it, and thus gives a percussion note of resonance or modified dulness. In cases of advanced disease, a large amount of ascitic fluid may be present, masking the signs and obscuring the diagnosis.

Solid growths of the small intestine not involving the peritoneum are mere pathological curiosities, and may be practically ignored.

Solid Growths of the Omentum.—Various forms of malignant disease may attack the omentum; colloid cancer is the most important. It is known by its superficial position, overlying the bowels; by its very irregular surface, hard at most parts, but boggy or even semi-fluctuating where colloid material abounds; and by the wide superficies which it occupies, as compared with its general bulk. Ascites, revealed by the ordinary signs, may be present behind the growth. In the earliest stages of omental cancer, palpation and deep percussion may elicit signs that it overlies, and is supported by, intestines.

Solid Growths of the Abdominal Parietes.—These are usually malignant, most frequently cancerous, but sometimes sarcomatous. They cause bulgings of the parietes, more prominent than their size would seem to warrant; are rounded, and not very irregular on the surface; they follow closely the movements of the abdominal walls, and, if of moderate size, appear to float on the surface of the intestines. There is absolute dulness all over the palpable surface.

Fluid Tumours.

The only definite attribute that can be attached to the clinical term "fluidity," applied to new growths, is "presence of fluctuation." Many tumours, however, that have fluid contents, and that are diagnosed as having such, do not exhibit the sign of fluctuation. Between the definite physical signs of fluidity and solidity there are gradations which we seek to describe by such terms as "soft," "boggy," "semi-fluctuating." But the actual condition, solid or fluid, is in many instances a thing to be decided simply and solely by the educated sense of touch. So many circumstances combine to obscure or abolish the sign of fluctuation, even when it ought to be present, that special pains should be taken to perfect our means of diagnosis without this sign. Thick abdominal walls, tension or thickness in the cyst-wall, great density of the fluid, or multiplicity of the loculi in which the fluid is contained, are some of the hindrances

to fluctuation. We conclude, therefore, that while the positive sign—fluctuation—is proof of fluidity, its absence is not proof to the contrary; and that, though no verbal description of it is possible, the educated sense of touch must frequently be our sole guide.

FLUID SYMMETRICAL TUMOURS IN THE UPPER AND MIDDLE ABDOMEN.

Cysts of the Pancreas.—Though not always accurately symmetrical, cysts of the pancreas lie mainly in the middle line. A rounded thin-walled cyst, distinctly fluctuating, deeply and firmly fixed, not moving with respiration, and situated above the umbilicus, may be a pancreatic cyst. Exploratory puncture reveals a fluid, viscid or opalescent, alkaline in reaction, and containing a considerable amount of albumen, which is coagulated by heat and nitric acid.

Peritoneal and Mesenteric Cysts. Encysted Dropsy of the Peritoneum.—Like pancreatic cysts, these, though chiefly occupying the middle line, are rarely exactly median. It is impossible to diagnose them with precision. They clearly contain fluid, though fluctuation is usually obscure; it is rarely possible to make out a distinctly outlined cyst-wall, as intestine is frequently intimately attached to its surface, and the percussion notes are liable to vary at different times of examination. Some degree of mobility is usually present. Such collections are usually situated either at the level of, or below, the umbilicus; occasionally, however, they are found elsewhere.

FLUID SYMMETRICAL ENLARGEMENTS IN THE LOWER ABDOMEN.

Ascites. Peritoneal Dropsy.—A fluctuating fluid collection in the abdominal cavity that changes position with the movements of the patient, always gravitating to the lowest part of the cavity and causing dulness on percussion there, but leaving resonant the highest part, or situations from which bowel cannot be displaced, is probably ascites. In the supine position, there

is dulness in the flanks; and if the amount of fluid is not very great, there is resonance in front, over a circular or crescentic area the concavity of which is towards the chest. (Fig. 2.) If the parietes are not greatly distended, the abdomen is flattened; if its walls are lax, there may be bulging in the flanks. In cases of great distension, the umbilicus protrudes. Vaginal examination gives negative results.

Ovarian Cystoma.—A rounded or irregular tumour in the middle line, or slightly to one side, always showing its presence in front to palpation or percussion, never changing its shape, and movable only in mass or not at all, may be an ovarian cyst. In the supine posture there is a circular area of dulness, surrounded by a "tympanic corona"; if no ascites is present, there is resonance in the flanks. (Fig. 3.) There is no protrusion of

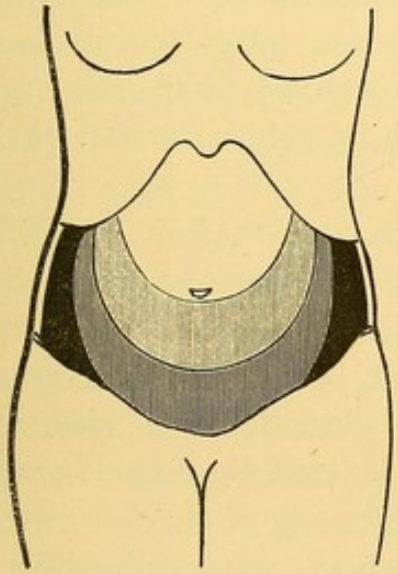

FIG 2.

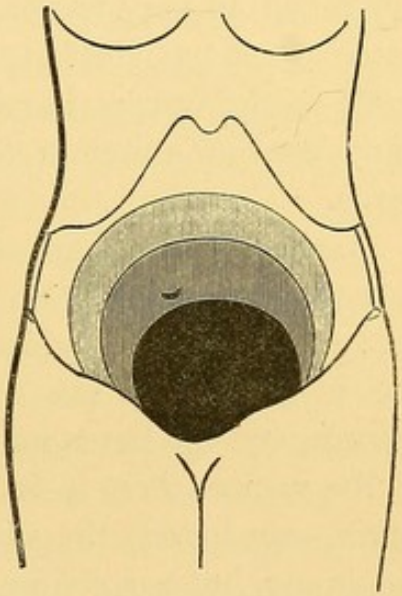

FIG. 3.

Diagrams showing development of areas of dulness in ascites (Fig. 2), and in ovarian tumour (Fig. 3). Darker shading indicates an earlier stage of disease.

the umbilicus. Vaginal examination reveals close or remote connection with the uterus, with displacement, and sometimes enlargement, of that organ.

Parovarian Cysts.—This variety of growth has the character of the preceding, as to dulness in front and resonance in the

flanks. The cyst is thin-walled, and fluctuation is very evident. By the vagina it may frequently be palpated, when its thin wall and connection with the uterus through the broad ligament will confirm the diagnosis.

Papillomatous Cysts of the Broad Ligament.—These are not usually diagnosed from ovarian cystomata. They are firmly fixed low down in the pelvis, and are frequently closely incorporated with the uterus. One or more large cysts, not often symmetrical, and with sulci between them, occupy the abdomen: by vaginal examination, several cysts of smaller size may be detected in the pelvis. Small growths of this nature are one-sided.

Fibro-cystic Disease of the Uterus.—It is probable that ovarian or broad ligament cysts have been not infrequently described as cystic disease of the uterus. True cystic disease is undoubtedly very rare. In very few cases can it be diagnosed from ovarian cystoma. It has most of the signs of the latter, and is always sessile on the uterus, moving consentaneously with that organ. Many ovarian tumours are very intimately attached to the uterus.

Pregnancy.—A pregnant uterus stands out from the pelvis more prominently than an ovarian or other tumour of the same size: more of the fundus is palpable than in other tumours. The uterine walls are of a peculiar density, fluctuation is obscure, and the fœtus may be felt by palpation or ballottement. By the vagina, there is detected a characteristic softening of the cervix—not merely the superficial softening of swollen mucous membrane, but a softening all through its tissue, extending up to the globular capsule of muscular fibre which contains the fœtus. The lower portions of the uterus move in harmony with the fundus. The other well-known signs of pregnancy will, of course, be looked for.

Hydramnios. Dropsy of the Amnion.—In pregnancy complicated with albuminuria the amniotic fluid may be in excess, giving rise to a condition that may be not unlike ovarian or parovarian cyst. The uterine walls are very thin, and fluctuation may readily be elicited, while the fœtus may be beyond

the reach of palpation. Special weight is to be given to the condition of the cervix—softened, as in ordinary pregnancy,—and to the other evidences of gestation.

Hæmatometra.—A round globular collection of fluid in the lower abdomen and pelvis of a young woman who has not menstruated, but who has passed the period of puberty, may be a collection of blood inside the uterus. The cervix uteri is not softened nor swollen, and there are no signs of pregnancy. The amount of cervical tissue felt will depend on whether the atresia is at the external or the internal os. Sometimes there is complete atresia of the vagina, which in itself suggests the diagnosis.

Hæmatokolpos. Retained Menses.—The various conditions in the vagina or hymen which prevent the outflow of the menstrual fluid at puberty may cause the appearance of a cystic tumour in the lower abdomen. The ordinary sign of a fluid encysted enlargement, with the abnormality easily discovered by vaginal examination, in addition to amenorrhœa, will make the diagnosis easy. Hæmatokolpos bulges more into the pelvis than hæmatometra; it may even cause distension of the perineum, and visibly protrude through the vulva. The uterus sessile on the top of the cyst may sometimes be palpated through the abdomen.

Hydrometra.—When occlusion of the cervical canal at its external or internal opening takes place after the menopause, there is a collection of fluid in the uterus that is not blood, but a clear or blood-stained watery or viscid fluid. The uterine walls are much attenuated, and fluctuation is well marked. As a clinical curiosity, an hour-glass dilatation of the uterus, from occlusion of the external as well as the internal os, may be mentioned. Such collections of watery fluid inside the uterus do not usually attain to large size, and they are of very slow growth. If, as very rarely happens, the contents suppurate, we get the condition called *pyo-metra.*

Extra-uterine Pregnancy.—While the fœtus is still alive, and the fluids are in normal amount, an extra-uterine gestation may appear in the lower abdomen as a thin-walled obscurely fluctuating cyst, with firm and deep connections in the pelvis. By the vagina, an enlarged and probably anteverted uterus, inti-

mately connected with the growth, will be detected. General matting and induration in Douglas's pouch, and, very likely, part of the contour of a fœtus, may be felt. The signs of pregnancy, modified and misleading, will be present.

Cysts of the Urachus.—Small cysts of the urachus containing a few drachms of fluid are sometimes found at abdominal operations. Large cysts are rare. They are exactly median, rise a little higher than ovarian tumours of the same size, have no connection with the uterus, and, if not large, may leave a resonant area between their lower margins and the pubes. They fluctuate freely in all directions. Sometimes there is a history of urinary trouble.

FLUID NON-SYMMETRICAL TUMOURS FOUND ON EITHER SIDE OF THE ABDOMEN.

Fluid Enlargements connected with the Kidney.—These are:

Renal cysts,
Hydatids,
Hydro-nephrosis,
Pyo-nephrosis.

The special diagnosis of these conditions must be carried out by methods other than the purely physical. Certain physical signs which they have in common may here be enumerated. A cystic enlargement of the kidney lies in close contact with the parietes in the lumbar region, causing absolute dulness there and, according to its size, over the anterior surface; and is either fixed or but slightly movable, having its main attachment deep in the loin. Growing from the side towards the middle line, as well as upwards and downwards, it may occupy the whole abdominal cavity. But it nearly always leaves resonance in the opposite flank, and can rarely be detected by vaginal palpation. The passage of colon over it may be revealed by percussion and palpation.

Nephric and Peri-nephric Abscess.—A collection of fluid in the region of the kidney, associated with signs of suppuration, may

be abscess in the organ itself or in the outlying tissues. It is not always possible to differentiate the two conditions; in fact, they are often associated. In cases of any standing there is discolouration of the overlying skin, with inflammatory thickening in the deep parts, and tenderness on pressure. The lumbar muscles are fixed, tense, and brawny. Positive signs of fluid are frequently absent: in most cases the early condition of renal suppuration is that of a solid, and not of a fluid, enlargement.

Fluid Collections in the Fallopian Tubes.—These are:

Hydro-salpinx,
Hæmato-salpinx,
Pyo-salpinx.

It is not often that cystic enlargements of the Fallopian tubes become abdominal tumours. They are usually confined to the pelvis, and discovered by vaginal and rectal palpation, or by the ordinary bimanual method. An ovoid or irregular fluid collection of small size lying in the retro-uterine space, and usually on one side of it, may be a cystic dilatation of the Fallopian tube. It is evidently closely connected with one side of the uterus at the fundus. If painless, it is possibly hydro-salpinx; but this cannot be differentiated from small cysts of the ovary. If painful on palpation—and pain is often a very prominent symptom—it is probably pyo- or hæmato-salpinx; but may be ovarian abscess, or localised pelvic suppuration, either primary or resulting from pelvic hæmatocele. The diagnosis of lesions of the Fallopian tubes is attended with considerable difficulty.

Extra-uterine Pregnancy, and especially Fallopian pregnancy (which all these cases probably are), is, in its early stages, unilateral, and is obscurely cystic. When rupture takes place, the enlargement is chiefly median.

Ovarian Abscess.—A suppurating ovary is usually dislocated downwards. It is rarely larger than a hen's egg, very tender on pressure, tense and obscurely fluctuating. It usually lies in the recto-uterine pouch, on one side or the other, and cannot, on account of adhesions, be moved from this situation.

FLUID NON-SYMMETRICAL TUMOURS ON THE RIGHT SIDE OF THE ABDOMEN.

Abscess of the Liver.—Only in its later stages can the presence of fluid in a hepatic abscess be detected by palpation. There is general enlargement of the area of hepatic dulness; the liver margin can be palpated under the ribs, and pressure there causes pain; there are the usual signs, not always well marked, however, of suppuration; and in advanced cases, where the growth of the abscess is mainly downwards, there may be a palpable and visible protrusion of the parietes. Exploratory puncture reveals the presence of pus.

Hydatid Disease of the Liver.—A hydatid cyst usually appears as a smooth, painless globular enlargement in the right hypochondriac or epigastric regions, obscurely fluctuating, elastic and resisting. The characteristic hydatid fremitus is not always detected. If the cyst lies deep in the hepatic tissue, or on its posterior aspect, it produces no signs other than hepatic enlargement. Exploratory puncture reveals the existence of clear hydatid fluid, with perhaps portions of the entozoa. Hydatid cysts sometimes suppurate, and then are indistinguishable from abscess.

Distension of the Gall-bladder.—A pyriform or ovoid cystic swelling in the right hypochondrium, fixed under the liver, but movable elsewhere, painless or but slightly painful, will probably be distended gall-bladder. The exact nature of its contents—watery, or purulent, or bilious—will be revealed by the consideration of accessory symptoms.

FLUID NON-SYMMETRICAL ENLARGEMENTS OF THE LEFT SIDE OF THE ABDOMEN.

Splenic Abscess.—Abscess of the spleen is of rare occurrence; and unless it is of large size, and shows a tendency to burst through the parietes, it is not often diagnosed. Fluctuation is always obscure, often unrecognisable. Though the symptoms are usually acute and attended with pain, they are sometimes

very chronic, and little more may appear in evidence of splenic abscess than a boggy semi-elastic tumour in the left hypochondrium. I have seen a case, in the practice of a colleague, where a large abscess of the spleen was opened and a piece of sloughed splenic tissue removed, nearly as large as an orange, which showed slight and unimportant signs of its presence.

Hydatids of the Spleen.—This condition is also rare. A painless tumour in the region of the spleen, smooth on the surface, but sometimes lobulated, obscurely fluctuating or only boggy, painless, and perhaps exhibiting the hydatid trembling, is probably hydatid cyst of the spleen. Exploratory puncture renders the diagnosis certain.

General Examination of the Patient.

What has been said refers merely to the diagnosis of the growth or disease for which operation is contemplated. But before such operation is decided upon, we must also make an investigation of every vital organ—diagnose the condition of the patient, in fact. The importance of this cannot be too strongly insisted upon. Many of the catastrophes of abdominal surgery are to be attributed to overlooking some lesion of an important organ, such as an exhaustive and skilful investigation of the whole of the system might have detected. The grand fact of the diagnosis of the tumour, and everything connected with it, is too apt to overshadow the diagnosis of other things. We take a pride, and justly, in the rapidity and accuracy with which we can diagnose the nature and connections of an abdominal tumour; and this cultured and impressive skill is liable to make us impatient of the tedious medical examination of the whole system. The condition of the heart, lungs, kidneys, no one would dare to overlook who was not recklessly foolish; but any abnormal symptom, however apparently trivial, ought to be followed up to its origin. For instance, in two cases of abdominal tumour, I had seen bleeding from the rectum, as an effect of pressure, which disappeared when the

growth was removed. A third case had similar bleeding, but for certain reasons was not at once submitted to operation. Later on, the continuance of the bleeding demanded a special examination, and revealed cancer of the rectum. Had I operated upon this patient when she was first seen, I should have done so in ignorance of this condition. Dr. Henry C. Coe* records a case which he lost from having overlooked a stricture of the colon; and many other similar cases could be quoted. Therefore, we ought never lightly to pass over a symptom that *might* be caused by the disease: we ought to be certain before operating that the symptom *is* so caused.

Exploratory Incision.

There is no doubt that a good deal of rashness and a certain amount of incompetence is sought to be concealed by the practice of "exploratory incisions." No incision ought to be merely exploratory: at the utmost, it ought to be ultimately diagnostic in a case of extreme doubt and difficulty. The exploratory incision of the skilled surgeon is widely different from that of the tyro. Where the former will make a correct diagnosis in ninety-nine out of a hundred cases, the latter will fail over his tenth case; but he may not conclude that the justification of exploratory operation is assured merely because he is in doubt in this case. Perhaps surgeons of large experience are somewhat to blame for so freely speaking of this tentative proceeding as being frequently justifiable and necessary. What is justifiable in their experienced hands, may not be so in the hands of less experienced men. Before submitting our patient to what, after all, is a serious operation and a trying illness, we ought again and again to return to the examination of the disease, read and re-read the exhaustive history, and decide only after having done this. At different examinations the mind focuses its attention on different points, and travels in different directions; and each examination may give us new information. The help of a skilled friend is

* *N. Y. Med. Journ.*, May 9th, 1885.

always valuable, but too much weight must not be given to it. Responsibility begets trustworthiness: the man who operates is the man who must diagnose, and additional acumen is given to his powers by the heavy responsibility that waits upon their fruition.

Having made this "exploratory incision," we must not be too rash in converting it into an operative one. We ought to be sure, before inflicting the slightest injury upon the growth, that we can remove it. To have been forced to submit the patient to exploration by incision, is grievous enough; but to have added thereto additional risks from sheer meddlesomeness, is unpardonable. Difficulties and dangers, legitimate and unavoidable, are numerous enough, in all conscience, in abdominal surgery: let us not to these add risks that are illegitimate and avoidable.

Section II.

ABDOMINAL OPERATIONS CONSIDERED GENERALLY.

Nomenclature. Historical.

The operation of abdominal section has for a very long time been known by the term Gastrotomy, from γαστήρ—belly, and τομή—incision. As the proceeding was at first carried out only for the purpose of removing a fœtus from the womb, the name came to have a limited application to Cæsarean section. Thus, in the dictionary by Blancard of Middleburg, in Zealand, published near the end of the seventeenth century, and translated into English in 1702, "Gastrotomia" is defined as "the cutting open of the abdomen and womb, as in sectio Cæsarea." Gastrorraphy about this time was chiefly used as meaning simple suture of wounds in the abdomen; but it was also

applied to the introduction of sutures in the bowel. In these instances the word γαστήρ was used in its original and legitimate sense, corresponding to the vulgar rather than the anatomical word, "stomach;" but when the stomach proper came within the sphere of practical surgery, Gastrotomy was often used for the operation of removal of foreign bodies from that viscus. Sédillot introduced the word Gastrostomy (στόμα—mouth) to indicate the formation of stomachic fistula; and Gastrorraphy has quite recently been used by Billroth and others to signify closure of an opening in the stomach by suture. In the beginning of this century the term Laparotomy (λαπάρα—flank) came into use for operations such as herniotomy, or the operation for artificial anus made in the loin. Soon it came to have a wider significance, and now it is applied to any and every operation in which section of the abdominal walls is performed. As, in the words Gastrostomy, Gastrotomy, Gastrorraphy, γαστήρ is probably now permanently appropriated to the anatomical stomach, Laparotomy is probably the best word to use generally for the operation of abdominal section. "Ventrotomy" has recently been proposed as a convenient term for abdominal section. Unfortunately, there is abundant precedent for the introduction of barbarous words into our terminology; but the practice scarcely deserves encouragement. Petit* would limit the word Gastrotomy to indicate in a general way the operations practised on the abdominal wall; Laparotomy, for the operations performed for intestinal obstruction; and Stomachic Incision (Taille stomacale), for removal of foreign bodies from the stomach. But abdominal terminology in England has already got beyond the possibility of using these limitations.

The special operation is sought to be indicated by affixing certain terminal words to the Greek name of the organ indicated. Thus, "-tomy" (τομή—incision) is added to indicate mere incision, as in nephrotomy, hepatotomy, cholecystotomy. The termination "-ectomy" (ἐκ, out of; τομή) is added to indicate cutting out or removing the organ; as in nephrectomy, splenectomy, colectomy, pylorectomy, &c. The suffix "-stomy"

* *Dict. Encycl. des Sc. Med.*, tome VII., 1881, art. "Gastrotomie."

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(στόμα—mouth) indicates the formation of an opening in a hollow viscus that is intended to be permanent; as in gastrostomy, gastro-enterostomy. In colotomy, an opening is made that is usually permanent, and the word colostomy would then be more exact; enterotomy would sometimes, but not always, be better indicated by the word enterostomy. The termination "-rraphy" or "-rhaphy" (ῥαφή—suture) is used as meaning any suturing of an organ for wound, as gastrorraphy; or to fix it, if movable, as nephrorraphy. The latter term might also be very properly used to indicate the suturing of a wound or laceration of the kidney.

The history of each operation will be given its proper place. Here it need only be noted that the progress of abdominal surgery has not been simply forward in a straight line, but in waves of advancement and retrogression. There can be no doubt that the technique of abdominal surgery was more perfect nearly two centuries ago than it was fifty years ago. Minute and excellent directions for making and for suturing wounds in the abdominal walls were given in several works on surgery published during the seventeenth and eighteenth centuries. In more than one of the works of this period instructions as to the inclusion of the peritoneum in suturing the abdomen are given with scientific precision. Heister, who wrote about the middle of the eighteenth century, so far anticipated modern art as to advocate drainage of the lower abdomen by a cannula, and washing it out by "vulnerary decoctions." In Cæsarean section, Roussetus advised this, as well as drainage of the uterus by a cannula inserted into its cavity. The directions given for closing an abdominal wound by Dionis, in his *Course of Surgical Operations* (1733), might almost be quoted bodily as the practice of the Samaritan Free Hospital to-day.

All this good work was ignored, and more which followed it; and, in times comparatively modern, much good practice that had been tried and proved by past masters in the art was neglected and overlooked. The clamp in ovariotomy was a distinct step backward; but the amount of advance which followed its abolition, being synchronous with the introduction of anti-

septics, cannot accurately be estimated. I think there can be no doubt that the most important single contribution to abdominal surgery is the gospel of surgical cleanliness preached by Lister; but along with this we must reckon the greater perfection of finish in every operation, rendering the work of the best operators something approaching the ideal in surgical art.

The Operative Surgery of the Abdomen.

The practical surgery of the abdomen presents many features special to itself. The manipulations have to be performed in an area exquisitely sensitive to traumatic influences, and in the midst of organs whose integrity is peculiarly necessary to life. The peritoneal fluids are very prone to take on septic contamination, and the inflammation thereby induced is doubly dangerous, from the great amount of surface over which it may extend, and from the involvement of the structures of the sympathetic system, which are so abundantly distributed under the peritoneal membranes.

Before an abdominal operation can be performed section of the parietes—a proceeding, in itself demanding some surgical skill and knowledge—has to be concluded; and, when the operation proper is finished, the accurate closure of this wound, in a manner fully to meet the immediate and remote demands made upon its union, requires more care than does an ordinary surgical wound. The manipulations in the cavity have to be performed frequently at some distance from the surface, sometimes out of sight, and are often of a difficult and delicate nature. Through the whole proceeding, careful avoidance of injury to vulnerable organs by rough handling or exposure, and minute and continuous attention to secure absolute cleanliness in hands, instruments, and sponges, are especially important. Lastly, certain well-established rules as to the environment of the patient, and the management of the case, must be attended to. These and such questions, being common to all abdominal operations, will now be considered in detail.

ENVIRONMENT OF PATIENT.

The Sick-room.—There is no disputing the fact that the best results in abdominal surgery are got in specially prepared rooms or wards. It is true also that the mortality in large general hospitals is greater than in small specially designed hospitals. But it is further a fact that the most experienced operators are attached to the small special hospitals; and it is therefore impossible to say how far the good results are to be attributed to the surroundings of the patient, and how far to the skill of the surgeon. That an *a priori* probability of the greatest success would be got in specially designed hospitals, fully under the control of a highly skilled surgeon, there is no question; and this would hold true of any surgical operation in the hands of a man who specially devoted himself to it. But, at the present time at least, it is perhaps nearly as true of abdominal as of other operations, that extra care in avoiding all matters conducive to septicism will, with surroundings such as most surgeons can command, justify their being carried out either in general hospitals or in private dwellings. Very few surgeons can begin an operation of any sort with the consciousness that the patient is being submitted to the best conceivable conditions for recovery: much that is justifiable is not perfect.

This, of course, is no argument against every effort being made to secure for the patient the best possible surroundings. An ideal room — situated in an open and elevated locality, ventilated with warmed (and perhaps filtered) air, wall and floor impermeable to moisture and readily and easily washed, and with many other excellences which could be detailed—is rarely in this country at the disposal of surgeons. Such rooms, abundant enough in America and on the Continent, are usually erected at the private expense of the operators. In only a few hospitals in England are there specially prepared private wards for abdominal surgery.

If the operation has to be performed in a private dwelling, a large, bright room with a southern aspect, and which can be kept comfortably warmed and well ventilated, ought to be

selected. A room that has not been constantly occupied as a bedroom is likely to be more fresh and sweet than one that has been so occupied. Carpets, curtains, and everything that may harbour dust and filth, ought to be removed. A well-kept bedroom, in a home of gentlefolks, will require nothing changed or removed.

If the windows are kept open for twenty-four hours or so, while a large fire is kept burning in the grate, the room will be freshened and purified, and thus made, not only a more pleasant, but a more safe habitation for the patient.

Admission of Visitors. — The question of the presence of visitors at the operation has been much discussed. Some surgeons admit no visitors beyond their immediate assistants; others admit a limited number, who declare that they have not recently been in contact with septic products; not many admit visitors without restriction of any sort. If the room is small, one would certainly rather not have the air made foul by crowding; and in every case, one would not care to have in the room individuals who have recently come from contact with cases of pyæmia or erysipelas. But if one has full confidence in the antiseptic spray, and the room is large, I see little necessity in being particular as to the admission of onlookers, wherever they may have come from, and whatever be their number. In the Bristol Infirmary, I operate in the general theatre, placing no restrictions whatever on visitors; and it happens by a somewhat clumsy arrangement, that the administrator of anæsthetics is also the pathologist. The results, over more than sixty cases (I purposely exclude private operations), are equal to those got in any special hospital.

Purification of Atmosphere.—Some surgeons seek to improve the purity of the atmosphere in which the operation is to be performed by making a steam antiseptic spray play in the room for a few hours. There is no strong objection to this: if it does nothing else, it lays the dust. But if the room has been properly cleansed and ventilated, and the surrounding air is of the moderate purity and freshness that may be found almost anywhere in England, the spray in the room is perhaps uncalled

for. If any objection could be raised to the proceeding, I think it ought to be on the ground of saturating the atmosphere with moisture. Respiration is not so easy in an atmosphere laden with moisture, as in one that is dry; and if a patient has to undergo a prolonged and dangerous operation, we should desire to have the recovery from shock promoted by every possible surrounding benefit—one of which is certainly not a wet, depressing atmosphere to breathe.

As to the *beds* and *bedding*, no special directions need be given. A narrow bed, preferably with spring or woven-wire bottom, on which is laid a good horsehair mattress, will satisfy all requirements. I prefer to have two beds; the patient being lifted, in the sheet on which she lies, from one bed to the other every night or morning, or both night and morning, and the unused mattress being taken out of the room to be dried and aired. This, however, is a luxury, and not a necessity.

For *clothing*, I think the best plan is to entirely discard the night-dress, and use instead a jacket, made of fine flannel, which reaches as far as the loins. If the patient desires it, linen drawers may be worn. Free access to every part of the abdomen, with warmth and lightness, are the chief requisites in the clothing of such patients.

The Nurse.—For nursing abdominal cases, no special skill is necessary in the attendant beyond ability to pass the catheter with gentleness and dexterity, and without moving or exposing the patient. Clumsiness in this art worries the patient to an unnecessary degree: and this worry the surgeon may know nothing of, as the patient believes it to be a necessary part of the treatment, and does not complain; while the nurse is not likely to speak of her own awkwardness. It is extraordinary how rarely we find even the most skilled nurse able to catheterise a patient *secundum artem*. It will, therefore, be well to see the nurse pass the catheter at least once on each new patient. If she fails in dexterity, a hint as to any peculiarity of conformation, and the way to overcome it, will give her confidence in future acts of catheterisation. Beyond this, the nurse must have a perfect familiarity with the use of the rectum tube, which may be left to

her discretion; and a practical knowledge in the administration of enemas. A perfect nurse is a perfect woman, rarely to be had; but good temper, implicit and uncomplaining obedience, gentleness, cleanliness, and some degree of physical strength and endurance, are absolutely essential.

In simple cases, one nurse will be sufficient, as after the first few days she may have full rest. In bad cases, it is wise to have a day and a night nurse. Not only will they give better nursing, but they will give some variety to the patient, and be more bright and cheerful in the sick-room than if they were tired and over-worked.

PRELIMINARIES TO OPERATION.

Preparation of Patient.—In most cases, all that is wanted by way of preparation is the administration of a purge the day before operation—supplemented, where deemed expedient, by a simple enema. The last two or three meals should be of such a nature that no residue will be left in the bowel at the time of operation. If peritonitis or enteritis supervene, it will be one point in favour of good progress that there are no irritating matters in the bowel. Starvation for two or three days before operation, as has been recommended, is unnecessary and detrimental. The advantage of having to operate with collapsed bowel inside the abdomen is more than counterbalanced by the weakening of the patient which such a procedure induces.

I think that the advantages of catheterism before operation are somewhat exaggerated. I am convinced that it is unnecessary, and I never have it done. The patient may pass water before operation: if there is some abnormal condition in the bladder which prevents her being able to empty it, I would as soon find this out after operation as before. We can see and feel, and accurately locate, an enlarged bladder if it is distended; lying flat and empty over a growth, we may unwittingly injure it. If the bladder contains so much urine as to be in the way of the operator, it may be emptied by an assistant: this, however, will rarely be necessary.

If the patient is of the lower classes, it will be well that she

should have a warm bath, and have her skin well cleansed with soap and water. Apart from the increase of comfort,—a result not to be lightly estimated,—the advantages, in aiding free cutaneous action by removing layers of effete epidermic scales and accumulated dirt, must be considerable, especially in cases where the renal functions are not quite normal. At the site of the wound, particular care is to be taken with the cleansing process. The parts are soaked for twenty-four hours previously, by several layers of lint containing 1-20 carbolic lotion; and the umbilicus and pubes are scrubbed with a nail-brush. The pubic hair need not be shaved: septic matters lodge rather in the hair follicles than upon the hair itself.

Operating Table.—Any ordinary operating table will suffice. It should be narrow, and it should not be low. A simple deal board, about two feet broad, placed between trestles or tables, or any other solid support, makes an excellent operating table. The height of it should be regulated according to the height of the surgeon. Nothing is more tiring than to bend over the work during a long operation; and such weariness would undoubtedly tell upon manual dexterity. A table, three feet to three feet four inches in height, will elevate the patient so that the surgeon can stand up to his work. The patient's arms are confined by a piece of bandage or broad webbing carried round the operating table, and fixed, by a clove-hitch or other convenient means, around the wrist. The legs are confined by tying the bandage over the knees and under the table. For confining the arms I am in the habit of using the well-known wristlets invented by Mr. Prichard for lithotomy; the hooks being fixed into holes made in a broad piece of webbing which is passed under the operating table. Apparatus specially made for the purpose may be purchased.

Coverings.—In every case the patient should be so wrapped up that as little as possible of the body heat will be lost. Two warmed blankets are placed on the operating table, and folded separately, so that one can be turned over the front of the lower limbs, and the other over the chest and upper abdomen. If it seems advisable to take extra care to keep the patient warm, a

layer of cotton wool over the chest and under the flannel jacket, and rolls of wool around the limbs under the blankets, may be added.

When the patient is properly protected against cold, the whole body, from chin to feet, is covered with a sheet of macintosh in which an opening has been made, of size and shape convenient for exposing the area in which the operation is to be done. An oval opening, about seven inches long by four broad, will be found suitable for the majority of operations; the sheet itself, so as completely to cover the patient and to hang over the sides of the table, must be about six feet square. The opening is made about two feet from the top.

On the under surface of this macintosh sheet, around the margin of the opening, is spread adhesive material, such as is used on ordinary adhesive plasters; the edges of the opening are thereby made to adhere closely to the skin, leaving exposed only as much of the abdominal wall as is necessary for operating. The impervious sheet prevents loss of heat by evaporation, and keeps the patient and her coverings clean.

In every abdominal operation I should use this sheet of macintosh. Its virtues may be more conspicuous in the removal of large cystic growths, where it keeps the patient dry and serves to guide the fluid into the receptacle provided, than in small or solid growths, where such uses may not be called for. But bowels may be extruded in any abdominal operation; and blankets, towels, or sheets may become displaced and get in the way. The impervious rubber sheeting, when washed, provides a field for operation which is always clean, and it keeps everything else out of the way.

A sponge-cloth, wrung out of warm antiseptic lotion, laid over the macintosh below the field of operation, will be found very useful for wiping soiled fingers upon, and, if requisite, for throwing over extruded intestines.

Warmth.—It is not wise to operate in a room under 60° Fah.; but the necessity of warming the room up to 70° Fah. need not be insisted upon. Evaporation is the chief cause of cooling of the peritoneum; and this is prevented by packing into the exposed

cavity soft warmed sponges, and by protecting extruded viscera with large flat sponges, or several layers of thick soft cloth. General warmth of the body is maintained by the method indicated.

Light.—The use of artificial light during daylight for the purpose of searching for bleeding points in the deep parts has been recommended. For this purpose an electric lamp is, for obvious reasons, undoubtedly the best. I have no experience of the electric lamp, and have never found the necessity for its use; though, in a badly-lighted room on a dark day, I can readily conceive that it might prove of great assistance. A hand mirror is often useful for throwing reflected light into the cavity.

Assistance.—Besides the anæsthetist, one assistant is all that is wanted for most abdominal operations. Such an assistant ought to be familiar with the methods of the operating surgeon; able, with swiftness, precision, and dexterity, to second and facilitate his proceedings at every step. He must have no opinions of his own as to operative details, but try to follow implicitly the mental direction of his chief. His duties are simply those of the operator; he acts as his third or fourth hand. A skilled assistant is thus on the high road to becoming a skilled operator; and he frequently reaches this goal. If an unskilled assistant has to be used, I think a medical student is of more use than a tried surgeon who has no experience in abdominal surgery. The student will do what he is told, and no more. As a matter of fact, in most cases of abdominal surgery, an assistant of any sort is a luxury rather than a necessity. As personal experience increases, the two hands become capable of doing more and more; and, with the exception of some minor manipulations, which might easily be performed by a nurse, the surgeon can do most things without assistance of any sort. But the unexpected often happens in abdominal surgery, and the presence of a skilled assistant in any of the numerous accidental emergencies will so frequently be of conspicuous advantage, that it will be wise never to operate without his presence.

ANTISEPTICS.

The most perfect surgery is aseptic, rather than antiseptic. All antiseptics are more or less irritating, and thereby to some extent, however small, harmful to the peritoneum; if there is no septic material in the air, fluids, fingers, sponges, or instruments that come into contact with the wound or peritoneum, they are also useless. That perfect purity of every material which touches the inside of the abdomen is absolutely essential, all are agreed: the only questions in dispute are, as to whether the air also ought to be purified—that is, whether the steam spray should or should not be used; and whether antiseptic lotions should be used for cleansing.

When the spray is condemned as harmful by such men as Keith and Tait on the one hand, and upheld as beneficial by such men as Thornton and Wells on the other, we may safely conclude that, under any circumstances which may be common to all their patients, it is unimportant. Spray, or no spray, is probably a choice of evils, and of not very great evils. On the one side, the evil is irritation of the peritoneum, from the germicide; cooling of the peritoneal surfaces, from wetting and evaporation; and poisoning, from absorption of the antiseptic agent used. On the other side, the evil is a danger to be avoided—namely, septic peritonitis, from contamination by the surrounding air.

Now, there is no doubt whatever that the greatest risk of peritonitis arises from impurity of hands, sponges, and instruments, and not from air. The spray has little influence over these: but repeated cleansing with soap and water will render them practically pure. An antiseptician who scrupulously attends to cleansing of hands and instruments is in a better position than one who places all his trust in the spray. And, as a matter of fact, those who object to the spray do, all of them, most thoroughly and efficiently purify fingers, sponges, and instruments. It has become evident that many surgeons, with implicit belief in Listerism, trust too much to carbolic acid or its allies, and pay too little attention to the cleansing of

sponges and fingers, by simply removing the filth, rather than disinfecting it. Herein non-antisepticians—or, as they might more justly be called, asepticians—teach a lesson which it would be well for all to follow.

The dangers of the spray in ordinary operations are undoubtedly very small. It is easy enough to protect the peritoneum by sponges, and to prevent cooling of the abdominal surface by a macintosh cloth. Carboluria in these cases is very rare; and even if it comes on, it is practically always slight and evanescent. In the case of prolonged and difficult operations, where the peritoneum must be exposed for the separation of adhesions, the dangers of the spray are undoubtedly real, if they are not great. Here, personal experience is everything. Thornton has strongly expressed his belief in its freedom from danger; and other operators, American and continental, agree with him. Personally, speaking from an experience of cases which, from various causes, have been of more than average difficulty, I have seen the spray do no harm.

The practical outcome of the teaching of modern surgery is probably this. All bodies that come into contact with the wound or peritoneum are to be made thoroughly clean and aseptic. The operation must be performed in air that is not only free from contamination, but very approximately pure. If the air is not in this wholesome condition, then it must be purified by the use of an antiseptic spray, either in the room before operation, or over the abdomen during the operation. In all cases of doubt as to the condition of the air—and such cases must be common—it is wise to use the spray. And some weight must be given to the personal experience and habits of the surgeon. A man who is thoroughly conversant with the use of the spray, who knows exactly how strong it may be made, and how best its evil effects may be minimised, will be loth to dispense with the security it affords, even where surroundings appear to be most favourable. Another, who uses it as a sort of experiment (and there are still many such), or who has already come to have confidence in his own methods without spray, will probably decide against it. If it is possible to create

a bias one way or the other, I think it ought to be towards the spray. If the points in dispute are narrowed down to carbolic poisoning on the one hand, and septic poisoning on the other, I should not hesitate as to which I should seek to ward off from my patient.

The Steam Spray.—If the antiseptic spray is used, certain practical details must be attended to. We must employ the least amount of spray compatible with efficiency. One nozzle is sufficient, if it throws a large finely divided cloud. A cloud that is dense and coarse is particularly to be avoided. It will be found that different apparatus throw out very different qualities of spray. Some instruments at ordinary pressure, with carbolic lotion of the strength of 1–20 in the bottle, will cast a spray of 1–50; while others, under the same conditions, will cast a spray of 1–30 strength. Every spray-producer should be tested by putting measured quantities of water and of lotion into the boiler and the bottle, and estimating the amounts used up after a given time. The position of the spray also is important. I believe that carboluria may be caused by inhalation of spray (the writer always has this symptom after a prolonged operation in a carbolised atmosphere); and to avoid this, the apparatus must be placed so that the cloud does not envelope the patient's head. This will be secured by placing the instrument opposite the patient's left shoulder, at a distance of about six feet or more from the wound.

SURGICAL ARMAMENTARIUM.

Sponges: their Selection, Preparation, and Purification.—The very finest Turkey sponges should be used. It is difficult, even in large collections, to find the sort of sponge that is suitable for abdominal surgery. They must be very soft, of the finest texture, elastic and compressible, and of various shapes and sizes. Several very large thin and flat sponges are necessary to cover extruded bowels or omentum on which a number of compression forceps may have been placed. A number of somewhat flat sponges, of about the area of the open hand, are requisite for packing inside the abdomen, to prevent extrusion

of bowels, and to absorb blood and fluid during the separation of adhesions. Lastly, small round sponges are necessary for general purposes—for sponging the wound, for packing into spaces where large ones will not go, and for mopping out the peritoneal cavity.

The preparation and purification of sponges requires the most careful and close attention. This duty cannot safely be relegated to assistants; the surgeon must do it with his own hands. The sponges are first cleansed from the sand which occupies their meshes by repeated washings in water. At the end of about a week, the water having been changed at least twice daily, all the large fragments will have been washed out. They are left for three or four days longer in water acidulated with hydrochloric acid, in amount sufficient to make the fluid taste distinctly of the chemical. This bleaches the sponges a little, but scarcely alters their texture. They are then (according to one method), after washing in pure water to remove the acid, placed in a solution of ordinary washing soda (about a pound of soda to the dozen sponges is the proportion that Tait advises), and left there for not more than twenty-four hours. They are washed and squeezed several times in this fluid, which they render slightly cloudy. They are now very soft. Finally, after being taken through clean water to remove the soda, they are soaked for a few hours in 1–20 carbolic lotion, squeezed as dry as possible, and artificially dried by heat. When they are perfectly dry, they are laid aside in a dry place, well covered up, till they are wanted.

After an operation, the sponges may be purified in a somewhat similar manner. After being washed in water to remove as much of the filth as possible, they are placed in the soda solution, which effectually dissolves out the blood and fibrine, and repeatedly washed and squeezed in it. The soda solution is changed several times. When every particle of filth has been removed, they are cleansed in water, dipped in carbolic solution, squeezed and dried, and kept in a dry place till further use.

Another very excellent mode of cleansing sponges is recommended by Borham. After giving it a full trial, I have adopted

it entirely in preference to other methods. The sponges are first soaked in a one-per cent. solution of permanganate of potash; the permanganate is then washed out by repeated squeezings in fresh water. This part of the proceeding may be neglected; I doubt if it is of much value. The sponges, ten or twelve in number, are then placed in a gallon of water, in which half a pound of sodium hyposulphite has been dissolved; the amount of solution being increased according to the number of sponges. Then about four ounces of oxalic acid are added, and a chemical action takes place which rapidly bleaches the sponges and dissolves out any fibrine contained in their meshes.*

The sulphur dioxide is a powerful disinfectant as well as a bleaching agent, and being generated in the meshes of the sponges, reaches every part of them. The sodium oxalate acts as a softening agent and dissolves out the fibrine. It takes a good many washings in water to get rid of the free sulphur; but

* Mr. W. A. Shenstone, Chemical Master at Clifton College, has very kindly supplied me with the following explanation of the reaction :—

The use of sodium hyposulphite (properly sodium theiosulphate) no doubt depends upon the formation of a solution of sulphur dioxide, SO_2, according to the equation—

$$Na_2\ S_2O_4 + H_2\ C_2O_4 = Na_2C_2O_4 + SO_2 + S + H_2O.$$

The rather tardy appearance of the precipitate of sulphur being possibly due to formation, in the first instance, of hyposulphurous acid, $H_2\ S_2\ O_3$, which, however, if formed speedily undergoes decomposition according to the equation—

$$H_2S_2O_3 = H_2O + SO_2 + S$$

If the precipitate of sulphur that accompanies the sulphur dioxide be objected to, sodium sulphite ($Na_2SO_3\ 7H_2O$), may conveniently be substituted for the sodium hyposulphite.

Small quantities of sulphuric acid are formed in the bleaching process, and a solution of sulphur dioxide absorbs oxygen from the air with production of sulphuric acid, therefore, as the presence of this compound in the water that remains adherent to the sponges when they are placed aside to dry tends to rot them, they must be very thoroughly washed with pure water after treatment with the bleaching liquid. From the above equation it will be seen that the hyposulphite and the acid may conveniently be used in molecular proportions. Both oxalic acid and sodium hyposulphite crystallise with water of crystallisation however ($Na_2S_2O_3\ 5H_2O$ and $H_2C_2O_4\ 2H_2O$), and therefore they should be used in the following proportions, viz. : 248 parts of crystallised sodium hyposulphite to 126 parts of oxalic acid. In practice two parts of the salt to one of the acid will be a sufficiently close approximation to these theoretical numbers.

this is rather an advantage than otherwise, for if we follow the rule never to consider the sponges cleansed till the water squeezed out of them is quite clear, this freedom from sulphur is a good working test of the purity of the sponges. Sulphur itself is a mild antiseptic (from slow oxidation and formation of sulphur dioxide); and the sponges may at once be dried and laid aside after washing. I usually dip them in carbolic acid, however, before doing so. If the precipitate of sulphur is objected to, sodium sulphite may, as Mr. Shenstone suggests, be used instead of sodium hyposulphite.

The sponges, for reasons explained in the foot-note, must not remain in the solution longer than ten minutes.

Ligatures and Sutures.—For ligatures, the best material is silk of the variety known as Chinese twist; for sutures, either silk-worm gut or plaited silk such as are used in rod-fishing.

As material for ligature there is no strong objection to cat-gut; I have used it and nothing else in more than twenty ovariotomies, and found it perfectly reliable. Its drawbacks are, the trouble necessary for its perfect preparation, and its tendency to deteriorate by keeping; such drawbacks being, in my opinion, of sufficient weight to justify its being displaced by the more handy and equally trustworthy silk twist.

Chinese twist is made in different sizes; the sizes ½, 2, 4, and 6 are quite sufficient for all practical purposes in abdominal surgery. The thickest is strong enough to bear as much strain as a very powerful man can put upon it, and is used for tying thick pedicles; the thinnest is adapted for the finest work, such as suture of wounds in bladder or intestine. The medium sizes are used for tying thin pedicles and ordinary adhesions. For holding these four varieties of silk, I have had a stand made which is very portable and always ready for use. It consists of a solid rubber case, on to which is screwed a cap which keeps it practically air-tight. (Fig. 4.) Into this case fits a leaden disc, which is heavy enough to remain stationary while the silk is being drawn out; and on this disc, supported by upright rods of metal are placed the four reels. A glass plate, perforated in four places for the threads, is screwed on to the top of a central

bar. Before using it, the leaden disc with the reels and thread is placed in boiling water for ten minutes, and then returned to its case, into which sufficient 1-20 carbolic lotion has been placed to cover the glass plate. To prevent their being acted upon by boiling water the reels are made of metal, and to prevent rusting all the metal is nickel-plated. After being used the lotion is poured out and the cap screwed on. The silk, treated and protected in this way, may be used daily, without further boiling, for several weeks: none is wasted; it is just as trustworthy at the end of six weeks as at the end of six days; it is always ready for use and the apparatus is so simple that it can scarcely get out of order.

For suturing the parietal wound, I have come to the conclusion, after giving it an extensive trial, that no material is superior to silk-worm gut as introduced by Bantock. In every variety of surgical operation I have tried it, and everywhere it exhibits the same virtue in causing no irritation. I have purposely left it in the tissues for weeks, and even months, and I have never seen its presence followed by the formation of pus. In the sense of being unirritating it is superior to any suture material with which I am acquainted. Its drawbacks are, that it is somewhat stiff, not very easy to manipulate till one is familiar with it, and rather friable, being liable to break if the second cast in the knot is pulled too tightly. The stiffness may be partly removed by soaking in warm water for ten minutes before operation, and the danger of its breaking may be

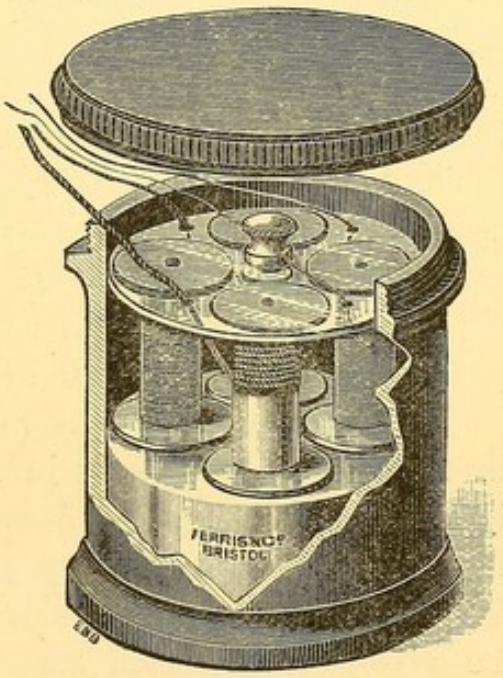

FIG. 4.

The Author's Reel-holder. Half size.

lessened by making the first cast a double one and tying the second one very lightly. Another objection, which at the same time speaks in its favour, is that, when the suture is being removed, it lies so firmly embedded in the tissues that a somewhat sharp tug is required to drag it out of its bed. This, however, may be because the suture needle which I use is smaller than ordinary. The strongest objection, in my opinion, to silk-worm gut arises in cases where there is much straining and vomiting; then it may cut through the tissues. In one such case where the incision extended through the umbilicus, the gut cut clean through the thin tissues and permitted protrusion of bowels. Care in selecting only such threads as are round and thick may obviate this; but I should always advise the placing of a few thick silk sutures at points where the parietes are thin, in cases where abdominal strain is likely to be produced.

The gut is that ordinarily used by fishermen, and need not be described. I have found the best gut in the shops of good fishing-tackle makers; in the ordinary trade bundles, perhaps a dozen threads, specially smooth, round, and thick, are found suitable for surgical purposes.

After silk-worm gut, as suture-material, I should place the plaited silk recently patented for use as fishing lines.

Its chief advantage over twisted silk is that it does not kink in the eye of the needle or in the suture-openings, while it is more closely knit and does not offer so large a surface for absorption of inflammatory products. It is also very strong. The trade reels of plaited silk used in the suture instrument to be presently described make a handy and efficient suture apparatus.

Instruments.—The instruments to be used in an abdominal operation must be thoroughly clean; they must be conveniently placed within reach of the operator's hand; and they must be of a known number.

Cleanliness, in the fullest sense of the word, is an absolutely essential quality of every instrument. To ensure this, all steel instruments (not cutting) should in the first place be nickel-

plated. Then filth is less likely to be overlooked, and not liable to be mistaken for rust or tarnish. After every operation they should be thoroughly cleansed and dried; and before every operation they must again be purified. Some surgeons, before operation, hold every instrument for a little while in the flame of a spirit lamp; others subject them to boiling. Practically it will be found that scrubbing with a brush, and the use of an antiseptic lotion, will efficiently purify every instrument. Smooth surfaces may be wiped several times with a sponge-cloth soaked in lotion; irregular surfaces and joints must be scrubbed. The notched blades and the joints of catch-forceps require most attention. A good plan is to dip the blades of each forceps into a dish containing soft soap, and then scrub it with the brush dipped in hot water till lather ceases to form. Nothing softens filth better than soft (potash) soap; and when every particle of soap has been scrubbed out of the notches and recesses of instruments, we may be certain that no filth is left behind. After they are scrubbed the instruments are thrown into hot water and left there for a few moments. Then they are placed in fluid, water or lotion, as the case may be, to be ready for use. Carbolic lotion of the strength of 1–40 is the best antiseptic fluid for placing instruments in; corrosive sublimate being inadmissible, because of its action upon steel.

Flat trays, an inch or more in depth and of various sizes, are used for placing the instruments in. Porcelain trays such as are used by photographers are best, because they are easily cleansed, are impervious to acids, and, being white, show up instruments laid in them. As they are, however, somewhat cumbersome and fragile, they are not very convenient for being carried about to private operations. For use in private hard rubber trays are best. They may be procured in "nests" of all sizes; and four or five such, of dimensions suitable to the nature of the instruments to be used, may be put in the operation bag, the total space occupied being no more than the largest tray. Each tray has its variety of instrument. In one are the cutting instruments; in another, the small catch-forceps; in another, large forceps; in another, trocars or clamps, or drainage tubes;

and so on according to the instruments to be employed. Every instrument is removed from its tray by the surgeon himself as he wants it, and after being used is at once replaced in the fluid.

The instruments should be counted before each operation, so that there may be no possibility of leaving instruments inside. In the case of bulky instruments this mistake is not likely to happen. It is a good plan to always work with simple multiples of each instrument; for example, in the case of pressure forceps, which are most likely to be lost: twelve pairs of smallest size in one tray; six pairs of medium-size in another tray; and six pairs of large size in a third tray. The habit of having two or three instruments of one sort laid out, in case one is found faulty, is not a good one; each instrument should be tested and ascertained to be perfect before operation. The surgeon who has two or three scalpels and two or three pairs of scissors laid out for operation is not likely to be so well served as he who has only one of each.

Plan of Operating Room.—The placing of patient, assistants, nurses, instruments, and operators so that the operation may be carried out with the greatest efficiency and the least amount of friction is of some importance. The annexed diagram (Fig. 5), modified from the one in Doran's valuable work,* shows at a glance the arrangement which I consider best. For reasons I have already explained the steam spray is so placed that the patient is not forced to inhale its vapour. The direction of the cloud is obliquely across the field of operation, and envelopes the hands of the assistant and of the operator as well as the instruments and the field of the operation. In the arrangement shown in Doran's work, I think it is a disadvantage that the instruments are placed outside the spray-cloud; and a danger to have the spray directed towards the patient's mouth. The operator stands on the right of the patient and the assistant on the left. The instruments are arranged in trays placed side by side on a table, which is situated within easy reach of the operator's right hand. The feet of the patient are towards the window; and the table is so placed that the best light falls upon

* *Gynæcological Operations*, p. 200. London, 1887.

the field of operation. The nurse stands behind the assistant, and takes from him soiled sponges and supplies him with clean ones. The fewer hands that sponges pass through the better; one nurse can easily clean the sponges and supply the assistant with clean ones. If a basin containing lotion is placed under the left hand of the assistant, and the nurse places the sponges, which she has cleaned in a large pan full of hot water, in this

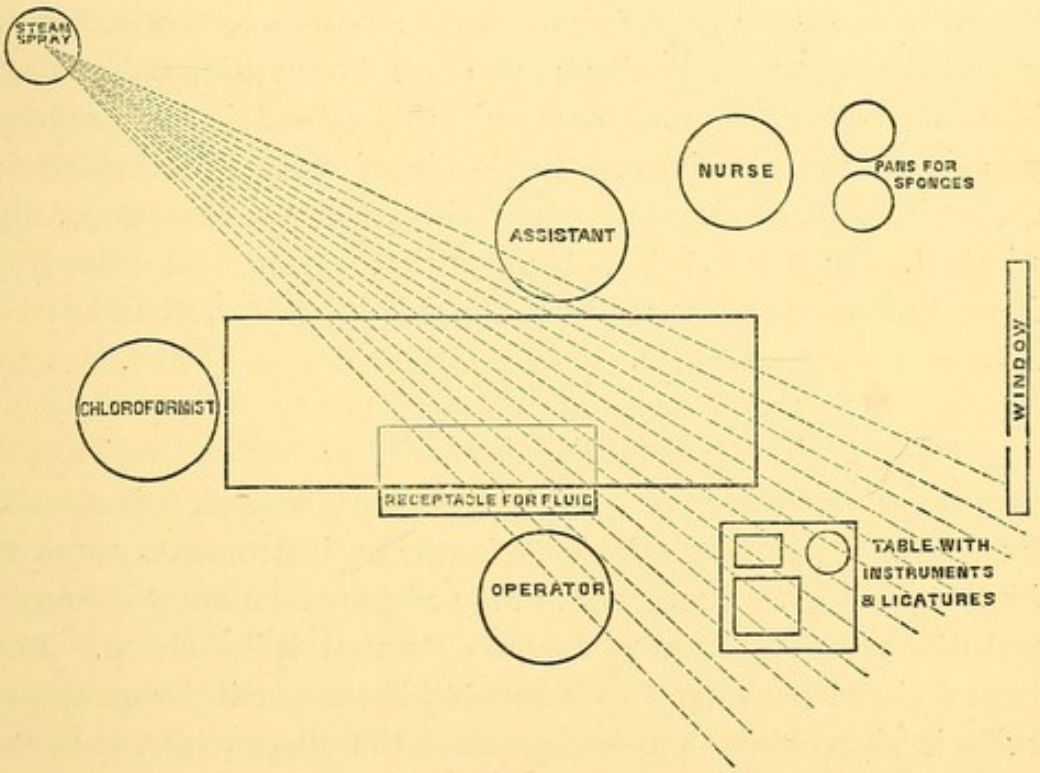

FIG. 5.

Diagram showing position of Patient, Surgeon, Assistants, &c., in Abdominal Operations.

basin as they are cleaned, the assistant can help himself at once to any sponge he wants, and as he helps himself he squeezes the sponge dry—a duty which the nurse often fulfils very imperfectly. It is not pleasant to hear the assistant call out for a "large flat sponge" or a "small round sponge" as the surgeon wants it; it should be lying ready to his hand, and he should be able silently to help himself the moment the surgeon wants it, or he foresees its usefulness.

For ovariotomy a receptacle is placed partly under, partly

by the side of, the table for holding ovarian fluid. A long narrow trough, which is out of the way of the surgeon's legs and includes half the length of the table, is most convenient.

If a second assistant is wanted, he may stand on the left side of and behind the operator.

ANÆSTHETIC.

Ether, properly administered by means of a Clover's inhaler, is generally believed to be the best anæsthetic. For old patients, or for patients who are bronchitic, chloroform is perhaps safer. Chloroform and ether mixed is favoured by some surgeons of repute. Bichloride of methylene, which is used at the Samaritan Free Hospital, has not been generally adopted. In all cases, I believe that safety and efficiency depend more on the capacity of the administrator, than on the nature of the anæsthetic.

THE OPERATION ITSELF.

The Incision through the Parietes.—A sharp scalpel, a few catch forceps, and a pair of scissors, are all the instruments required for this purpose. The surgeon may suit his own fancy as to the scalpel he uses; the only essential is that it be sharp. The most delicate workmanship is secured if the cutting edge of the knife is situated at a distance from the finger-tips, which is rendered habitual by frequent practice in other directions. This is undoubtedly the position of the point of a pen in writing. The point of the scalpel should be at the same distance from the grasping finger-tips as the point of a writing-pen or drawing-pencil, as these are held by the individual operator. The advantages, in the way of sensitiveness and estimation of movements, are self-evident. In most cases this would mean a blade shorter than that in ordinary use. The handle of the scalpel should not be too small, nor too light. Clean, straight cuts from end to end of the wound, and not nibbling dissection, with forceps and director, are to be made. The scalpel penetrates exactly the same distance from one end to the other, and divides the same structure at each stroke.

It is an advantage to have the scissors elbowed a little; and a further advantage consists in having the lower blade probe-pointed, to facilitate its being pushed along under the fasciæ or muscles that may require division. The proceeding differs somewhat, according to the situation elected for incision. In the linea alba below the umbilicus, where the great majority of incisions to enter the cavity are made, no muscle is divided. In other situations, as for gastrostomy, nephrectomy, or colotomy, several layers of muscle require division. For dividing muscle, I believe the scissors to be a superior instrument to the scalpel. Few English surgeons make a practice of using scissors, and some little practice is necessary to enable one to appreciate its virtues. Scissors-cuts are clean and straight: they do not bleed much, because compression is a factor in the division; and if one is moderately familiar with the use of scissors, the dissection is more rapid than with the scalpel.

The scissors usually recommended for ovariotomy, and in use at the Samaritan Hospital, is a large instrument with flat blades, bent on the flat near the hinge, and very blunt-pointed. It is an admirable instrument for such modes of cutting as ovariotomy offers, being well adapted for dividing adhesions, cutting through the pedicle, and enlarging the parietal wound. But for more delicate work, such as division of layers of muscle, dissecting closely adherent organs from their attachments, or resection of intestine, I do not consider it so handy as a smaller instrument, elbowed a little and with smaller and more rounded points. But much depends upon habit and practice. The shape and size of an instrument are of small importance as compared with the surgeon's familiarity with it.

If a vessel spouts, a catch-forceps is at once placed on it, and left there till the peritoneum has been opened, or as long as desirable. A few minutes' compression by forceps produces perfect hæmostasis; ligature or torsion is quite unnecessary. When the subperitoneal fat is reached, a little area is cleared out of it, and the peritoneum caught up by catch forceps and pulled forward. A second pair of forceps is placed on the raised fold of peritoneum, and the membrane divided between them. The fore-

finger is inserted at this opening, and the peritoneum divided upon it, upward and downward, by scissors, to the extent of the wound on the parietes.

In the division of layers of muscle, it is just as foolish to look for anatomical divisions, as in the operation of herniotomy, to look for the individual coverings of the sac. It is more workmanlike to estimate by touch the general thickness of the abdominal wall, and to divide the muscles with a few large cuts by scissors, than to plod through the individual layers with director and scalpel. When the subperitoneal fat is reached, it is time to be minutely careful. The director is a clumsy and useless instrument in abdominal surgery; in the hands of the most skilful operators, it is conspicuous by its absence.

The length of the incision is a matter of some importance. Elaborate statistics have been compiled to show that a long incision is attended with an increased mortality; but this is not caused by the incision itself, but by the serious nature of the work inside the abdomen which necessitates the long incision. The smallest incision compatible with the provision of sufficient room, without bruising the edges of the wound, is to be adopted. All lengths, from something under two inches in cases of oöphorectomy or simple ovarian cysts, to the whole length of the abdomen from sternum to pubes, as for some cases of myomotomy, are in use.

When the tumour is adherent to the parietal peritoneum, some care must be observed in effecting an entrance. It is quite possible to mistake the adherent peritoneum for the cyst-wall, and begin to strip it from the parietes. We may expect to find peritoneum adherent to tumour if there is more than ordinary bleeding in making the parietal incision, if the intermuscular fasciæ are pink in colour, or if the subperitoneal fat, instead of being pale yellow or white, is rosy-red or injected. But here also experience is the best guide: familiarity with the aspects of the tissues will always prevent mistakes of this sort.

Intra-Abdominal Manipulations.—During the various procedures necessary for the removal of an abdominal growth, every effort must be made to protect, and keep out of the way, the intestines.

Sponges of suitable size and shape are packed in wherever bowels appear, and the growth is isolated from the rest of the abdominal contents as far as the available space will permit. By means of sponge-packing we seek, in fact, to make the manipulations necessary for removal as nearly extra-abdominal as possible. Wherever we can, we work against or upon sponges, and not against bowel or upon peritoneum.

Sponges not only protect delicate organs; they absorb and gather up any blood and fluid that may escape. And every spongeful of fluid so removed is a saving of time and trouble against the time when it becomes necessary to perform the final toilet of the peritoneum. Whenever a sponge appears to be saturated, it ought to be replaced by one that has been squeezed dry. Of course, it must be taken out of fluid that is warm: carbolic lotion, of the strength of two and a half per cent., is as suitable a fluid for sponges as any.

Most of the difficulties in removing abdominal tumours arise from the separation and management of adhesions. When they are visible, or within easy reach of the fingers, their separation may be comparatively easy; when they lie deep, or out of sight, their division may be attended with difficulty or danger. Special difficulties arise when delicate organs are glued to thin or inflamed walls of cystic growths, or where bowels are embedded in sulci of the tumour, or where any of the large abdominal vessels or the ureters are in close contiguity. Adhesions to the omentum are, as a rule, most easily dealt with; adhesions to the bowels in the pelvis, or to the under surface of the liver or diaphragm, are among the most difficult of all. Tumours in the broad ligaments may require a prolonged and tedious dissection to separate them from uterus and bladder. Each case has its own variety of adhesion, which must be dealt with by methods peculiar to itself.

Forceps, sponges, fingers, scissors, and ligatures are in constant use during the surgical management of adhesions. Slight adhesions are best separated by means of a sponge; the adherent organ is sponged off the tumour, so to speak. At every step, bleeding points are looked for, and forceps placed on

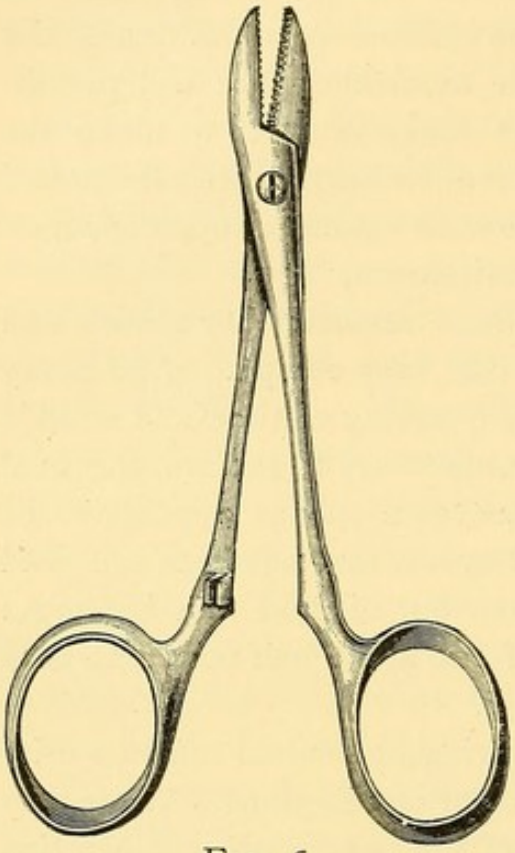

FIG. 6.

Tait's modification of Koeberlé's Catch Forceps. Two-thirds size.

strument. (Fig. 6.) But Wells's instrument is almost equally good, and surgeons who may have become accustomed to its use will desire none better. The advantage that Tait's forceps possesses is in its sharp points, which can scarcely be included in the ligature. Both instruments are superior to Péan's older forceps, in being much stronger, smaller, and more easily handled. These instruments are so well known, being in the hands of almost every operating surgeon, that detailed description is unnecessary.

them. Adhesions of some degree of firmness, if broad, must be separated by fingers: if long or thin, or of the bulk that might be classed as bands, they are divided by scissors between pairs of catch-forceps. Very dense, broad, and sessile adhesions are divided by scissors; while forceps or ligature, as may seem most suitable, checks the bleeding as it arises.

The best form of forceps for adhesions is, I think, Tait's modification of Koeberlé's in-

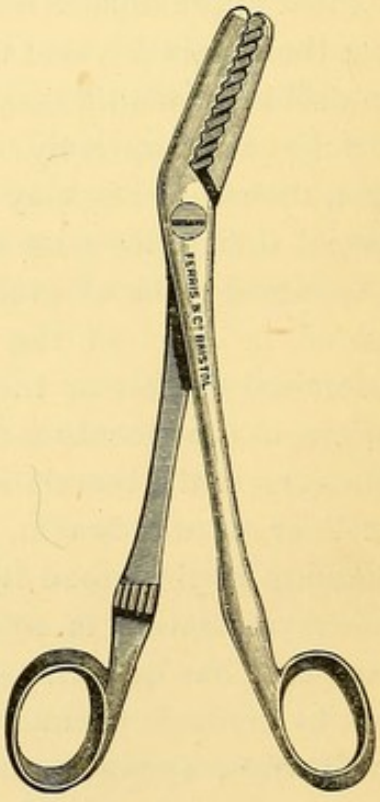

FIG. 7.

Wells's Large Pressure Forceps, blades bent at obtuse angle. One-third size.

Besides these straight small forceps, others, bent at various angles (Figs. 7 & 8), or T-shaped (Thornton's, Fig. 9) and of larger size, will be constantly found of use. Wells's large forceps (Fig. 10), on the same plan as his small one, is invaluable for many purposes. Straight forceps of medium size are very useful. I have invented an instrument which combines cutting with crushing, and which I have found of benefit in giving a bloodless division of thin flat adhesions. A knife is concealed in the powerful blades of a compression forceps, and divides the adhesion between the lines of crushing. (Fig. 11.) A very large and powerful T-shaped forceps I have found very valuable. Special instruments are necessary for special operations: these will be described in their proper places.

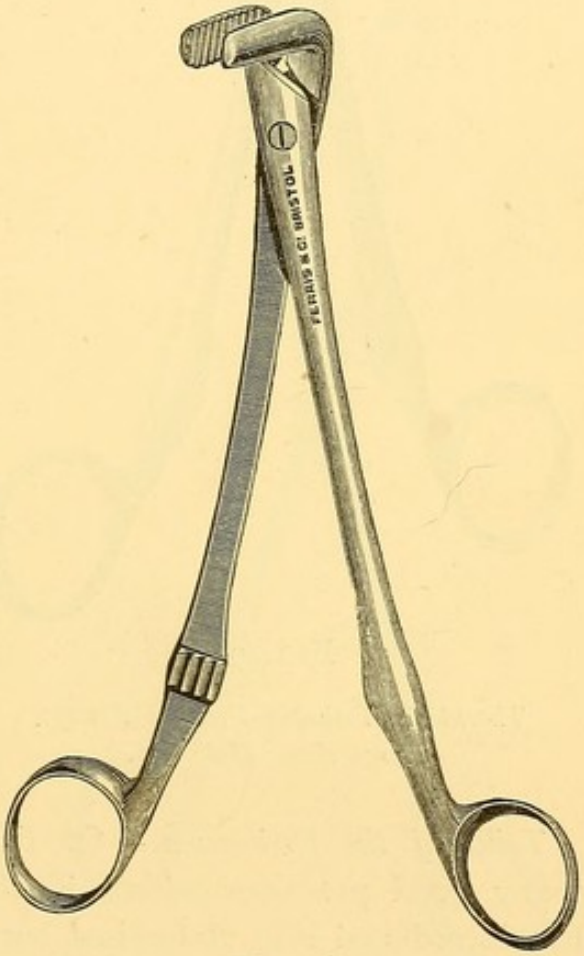

FIG. 8.

Wells's Large Pressure Forceps, blades bent at right angle. Half size.

At the end of a difficult operation, as many as two or three dozens of catch forceps may be clinging at points where bleeding had taken place. By many surgeons it is considered necessary to apply a ligature to each of these, and the time spent in doing so is of necessity very considerable. I have always acted upon the principles of general surgery, regarding a small bleeding point which has been effectually compressed as secured against hæmorrhage. Less than a third of the vessels compressed by forceps require ligature. Most of them will have been crushed;

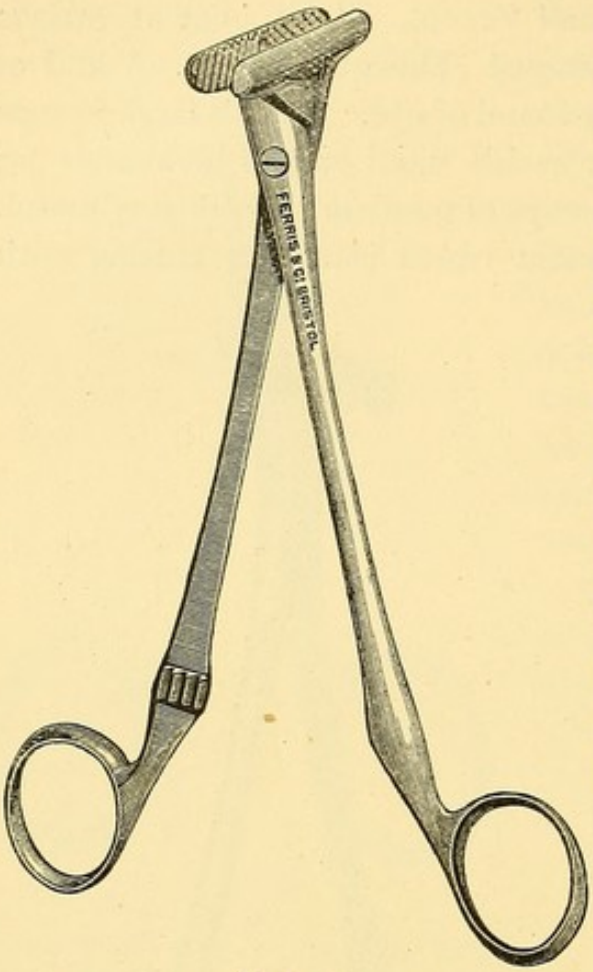

FIG. 9.

Thornton's **T**-*shaped Pressure Forceps, Large size. Half size.*

Toilet of the Peritoneum.—Of the many good practices which Keith has introduced into abdominal surgery, not the least valuable is that of removing from the cavity all blood and escaped fluids before closing the parietal wound. Most of such foreign matter, if fluid, will be removed with the sponges placed in the cavity during operation. A final cleansing by means of a sponge held between the blades of a sponge-holder (Fig. 12) and carried into and on many of them the forceps will have been hanging for ten minutes or a quarter of an hour, so that coagulation will probably have taken place above the crushed point. I am convinced that we overdo the deligation of adhesions: I believe that perfectly trustworthy hæmostasis may, in the great majority of bleeding points left after separation of adhesions, be effected by forcipressure alone.

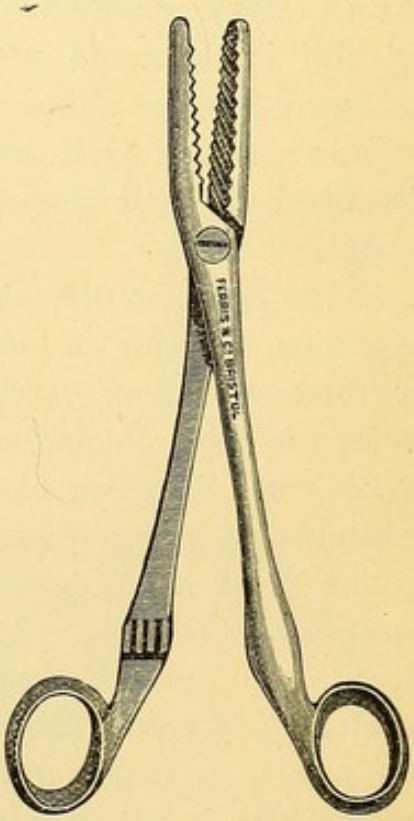

FIG. 10.

Wells's Large Pressure Forceps. One-third size.

Douglas's pouch and into each loin, may suffice. But if purulent or colloid fluids, or the contents of a dermoid cyst, or, generally, any materials which cannot easily be removed by a sponge after moderate use of it, lie in the cavity, then Tait's plan of washing out the abdomen ought to be adopted. If a tumour has been removed, and the parietes, being relaxed,

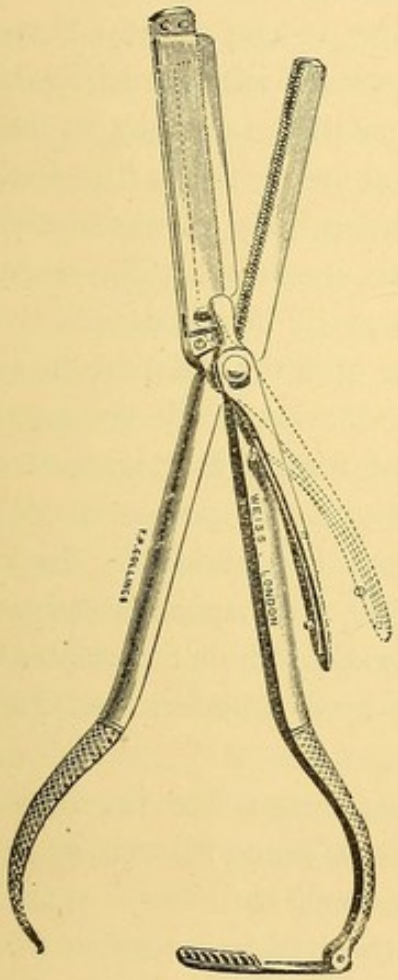

FIG. 11.

The Author's Scissors-clamp.

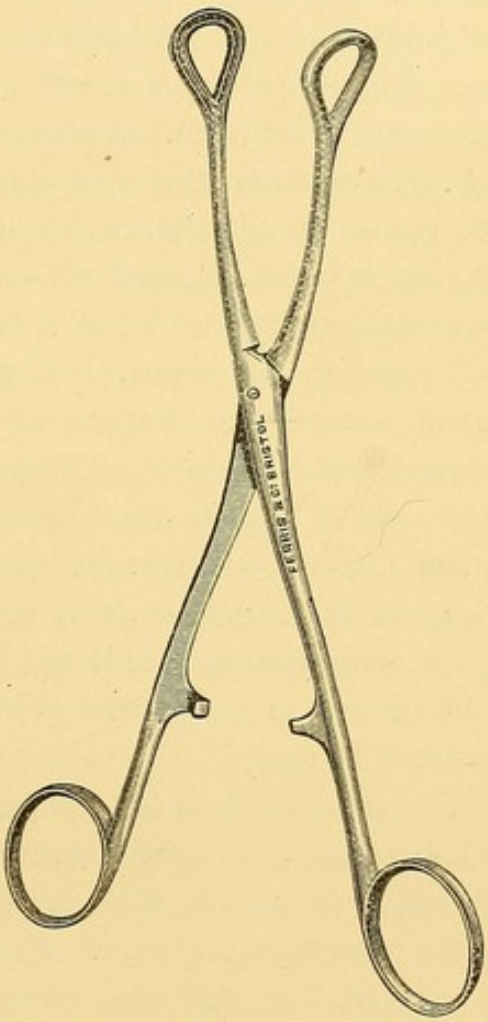

FIG. 12.

Sponge-holding Forceps. One-third size.

can be pulled forward, the cleansing fluid may be poured in from a jug. But, for most cases, irrigation is the best mode of cleansing. If a special irrigating apparatus is not at hand, the fluid may be conducted from an ordinary basin by arranging the tubing of an ordinary trocar as a siphon.

For conducting the irrigating fluid inside the abdomen, I

have had made simple glass tubes of different sizes at the nozzle, according to the size of the stream we may wish to employ, but all of one size at the other end, so that they may fit into the large rubber tubing attached to Tait's trocar. Tait's trocar used at the end of the rubber tube has this disadvantage in cases where it is desirable to direct the stream upon a certain small area, that the fluid flows out through two openings near the point, and not through one opening at the point. Sometimes it is desirable to direct a small stream with considerable force upon a very limited area, then a small nozzle may be used and the irrigating reservoir elevated: at other times it is desirable gently to fill the cavity with a large body of water, then the largest nozzle is used with moderate elevation. The size of the stream and the force of it can thus easily be regulated.

To aid in the removal of particles of filth, the bowels are moved about by the fingers, and the abdominal walls are gently kneaded and squeezed. The amount of foreign matter, such as little clots of blood, small shreds of tissue, and pieces of coagulated fibrine, which may escape from the abdomen during irrigation, is sometimes truly surprising. A conspicuous advantage of irrigation is, that it will always make visible the existence of bleeding. A very small quantity of fresh blood makes itself apparent in water.

The residual fluid left after squeezing the parietes is removed by sponges. It is often a good practice to place a large sponge in Douglas's pouch, with forceps attached, and leave it there till the sutures are placed. Fluid is attracted to a sponge from all parts of the abdomen, except perhaps from the lumbar hollows, and sometimes it may be advisable to place sponges there also. After irrigation, elaborate sponging is not required; the fluid which remains after squeezing the parietes is quietly soaked up by the sponge or sponges left inside while the sutures are being inserted. A few ounces of clear fluid left inside do no harm whatever; indeed, it is conceivable that under certain circumstances such fluid may do good. In four cases where I employed irrigation, after re-opening the abdomen for peritonitis following operation, I did not attempt to suck out any of

the fluid, but simply let it flow away through a drainage tube. Sometimes as much as a pint would be left inside, and very little of this would come away in the next twenty-four hours. All the patients recovered. In most cases where irrigation has been called for, a drainage tube will be inserted, and left in for at least one day.

Before the parietal wound is closed, all sponges and instruments are counted, to make sure that nothing has been left inside the cavity. Judging from the number of catastrophes which have been caused by leaving foreign bodies in the abdomen, the necessity of doing this would seem to be very real. Dr. Wilson* has collected twenty-one such cases, in most of which the foreign body was a whole sponge or part of one, and in a minority, forceps. It is a good rule always to begin operation with a fixed and definite number of sponges and instruments.

Drainage.—The wounded or irritated peritoneum secretes fluid in amount varying according to the extent of the traumatism. Sero-sanguineous oozing from raw surfaces adds to the exudations. The peritoneum, in its healthy regions, has a great power of absorption, and in most cases these fluids are absorbed as rapidly as they are secreted. But sometimes secretion is too rapid for absorption, and we then get a collection of fluid which has a tendency to gravitate into Douglas's pouch. This fluid is peculiarly liable to undergo decomposition—usually, no doubt, from septic influences introduced from the outside; but occasionally, I believe, from contamination through the coats of the large bowel. In any case, the accumulation of fluid in the pelvis after abdominal operations is a thing to be guarded against. If we have any apprehension that the amount exuded will be considerable, we ought to drain; and in any case of doubt, it is wise to drain. While bleeding is going on, the tube should not be removed; and if bleeding is apprehended, the tube should be inserted and left till the danger has passed. Whenever purulent or decomposing fluid has escaped into the abdominal cavity, drainage should be employed. It is

* *Trans. of American Gynæc. Soc.*, vol. ix.

said that, the older the patient is, the less is absorption by the peritoneum, and therefore the greater the necessity for draining. The special indications for drainage in special operations will be named further on.

The best drainage tubes for general use are Keith's modification of Koeberlé's. (Fig. 13.) They are glass tubes, open at both ends, with several perforations near the end of the tube which is inserted into the cavity, and a protruding lip near the outer extremity where it passes through the wound. The intra-abdominal pressure being greater than that of the outer air, most of the fluid will escape through any opening provided. A tube perforated through all its length may permit some of the fluid, as it rises from the pelvis, to escape amongst the bowels, and, if this fluid is decomposing, to infect an amount of peritoneal surface greater than necessary.

FIG. 13.

Keith's Glass Drainage Tube. Half size.

It is necessary to be certain that the tube is pervious, and that it is in the midst of the fluid. It may become blocked by clotting of the discharges; this may be guarded against by using a syringe or suction instrument. Or, pieces of bowel may be drawn into the openings, and so prevent the entrance of fluid: pulling the tube out a little way, and rotating it, will put this right. The fluids may be very thick, becoming colloid or even clotted, and then it will be necessary to use an exhausting syringe. The little apparatus of Tait (Fig. 14) is very efficient for this purpose. It is essentially a rubber bag attached to the end of a piece of glass tubing. To the side of the tube is attached a glass globe, into which the extracted fluid falls; to the free extremity is attached a piece of rubber tubing, small enough to pass down the drainage tube. The tube is inserted while the bag is empty; as the bag expands, the fluids are sucked up.

In cases where there is bleeding, it is a golden rule to keep the abdomen dry. This may be done by the frequent use of the exhausting syringe—every few minutes or every few hours, according to the case. No doubt the efficacy of this plan depends to some extent on the removal of secreted serous fluid, which would dissolve up the blood-clot. Just as bleeding is encouraged after leech-bites by the application of hot wet cloths, so is it encouraged after division of vessels in the abdominal cavity by their being bathed in abundant thin serous fluid. Keeping the abdomen dry permits clotting, and thereby promotes hæmostasis.

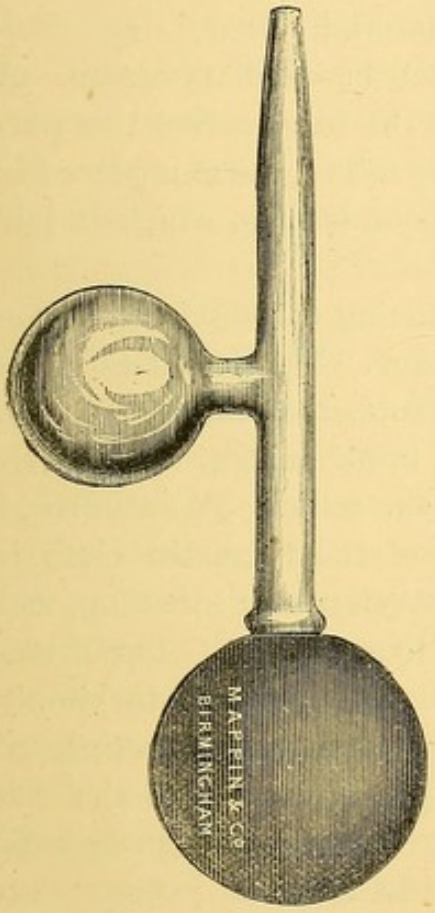

FIG. 14.

Tait's Exhausting Syringe.

FIG. 15.

Koeberlé's Glass Drainage Tube. Half size.

For the drainage of simple serous fluids, a tube on the plan of Koeberlé's original one is best. This is essentially an ordinary test tube, with numerous perforations along its whole length. Koeberlé's tube is slightly conical, and this shape renders it liable to slip out of the opening: in the tube shown in the engraving (Fig. 15) the neck is the narrowest point, and escape from the cavity is thereby prevented. The bulbous end brings a larger surface of intestine into contact with it, which is perhaps an advantage. Tait has recently recommended a tube which is cylindrical, exactly like a test-tube.

The rounded extremity of the tubes on Koeberlé's plan is less likely to cause perforation of the rectum than the annular extremity of Keith's tube. Its numerous perforations are an advantage in draining abundant fluid, and no disadvantage if the flud is not septic. Keith's tube, on the other hand, has the enormous advantage of permitting the extraction of pieces of clot, or lymph, or other aggregated material.

Drainage of fluid may be promoted by capillary action. A shred of gauze rolled up and laid in the tube, serves this purpose admirably. The free end of the roll of gauze is placed in contact with the absorbent dressing, or sponge, which is laid over the end of the tube.

The manner of collecting and removing the discharges from the drainage tube is of some importance. The end of the tube is completely isolated by a square of rubber cloth, through the centre of which a hole has been cut, large enough, with a little stretching, to encircle the tube below the collar. The absorbent material being placed over the end of the tube, the cloth is folded over it, so as to completely envelope the dressing, and the whole is retained in position by a loose binder. The dressing is changed as often as it gets nearly saturated by simply unfolding the rubber, and without disturbing the coverings of the wound. Sponges are usually employed to absorb the discharges; but the obvious objections to the use of sponges for this purpose make me prefer absorbent wool or gauze. Salalembroth wool, properly prepared, is an excellent absorbing material, not so cumbersome as sponges, and is, besides, a powerful antiseptic.

Closing the Wound in the Parietes.—When the time has come for closing the cavity, a flat sponge of convenient size is placed over the bowels under the opening. This keeps the bowels out of the way and absorbs the blood that is shed by the needle punctures. A drachm of pure blood can usually be squeezed from this sponge after inserting sutures in a wound three or four inches long.

Many plans of suturing the abdominal wound are in vogue. Some surgeons use two or three silver tension-sutures through

muscle and peritoneum, and close the rest of the wound by superficial sutures. I had used this plan in a good few cases, finding it answer admirably, till I had a bronchitic patient, whose constant coughing caused the silver sutures to partly cut their way through; and then I abandoned it. The best mode of suturing the wound is, I believe, by interrupted silk or silkworm gut sutures placed, about three to the inch, close to the margins of the wound, and every one including peritoneum. In these sutures some surgeons are careful to include only skin, fascia, and peritoneum; others include muscle as well. It matters little, as regards immediate union, what tissues are included in the suture; but it is important to provide against the remote risks of a ventral hernia, by having as broad a basis of union as possible. After a few months all uniting cicatricial tissue becomes lax and distensile; the more that there is of it, the stronger will it be. I therefore always push the needle straight through everything, at the same distance from the surface in muscle and in peritoneum as in skin. When the sutures are tied, the line of incision then bulges outwards; when only skin, fascia, and peritoneum are included, the sutured wound appears depressed.

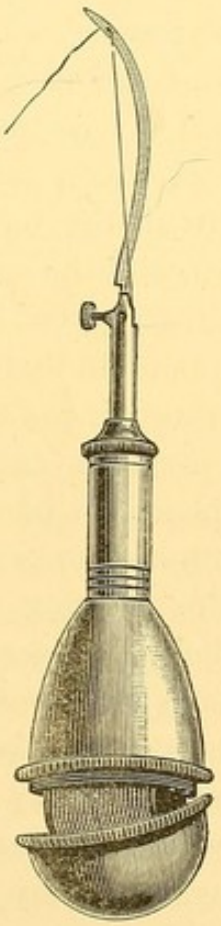

FIG. 16.

The Author's Suture Instrument. Half size.

Many surgeons close the wound by means of individual sutures, to each end of which a needle is attached. Keith uses a peculiarly fine straight needle; others use an ordinary long glover's needle. For some time past I have used a suture instrument (Fig. 16) with needles made on Hagedorn's plan, but with much shorter cutting poiuts, and I have found it exceedingly convenient for the purpose. It is essentially a handled

needle, the handle of which contains a reel on which the suture silk is wound; and it may also contain lotion in which the thread is soaked. With this instrument, after a little practice, sutures may be inserted with much greater rapidity and precision than with the ordinary needle. It also saves the trouble of threading and otherwise looking after numerous needles and sutures. The end of the handle is large enough to contain the ordinary trade reel of plaited silk, and the thread runs through the cavity of the handle, which contains lotion, to the end of the needle. While the bulbous end, containing the reel, lies in the hollow of the palm, the tips of the fingers rest at the end near the needle, and manipulation is easy and comfortable. The needle may be inserted in the axis of the handle, or at right angles to it; and various sizes of needles may be used for different thicknesses of the abdominal walls.

The needle is made to transfix skin, fascia, muscle, and peritoneum, on the right side of the wound; and then peritoneum muscle, fascia, and skin on the left side; the loop of thread is caught in the finger, the free end drawn out, the needle withdrawn, and the sutures cut, each about six or eight inches long, and their ends handed over to an assistant. About three sutures to an inch is a fair proportion. When all the sutures are inserted, the sponge is removed, the suture threads are tied, and the ends cut off. If the stitches are neatly inserted, the whole length of the wound will be perfectly and accurately closed, and no secondary or superficial sutures are necessary.

For placing silk-worm gut sutures, I employ the same needle. The needle is passed unthreaded, the gut is pushed through the eye of the needle and pulled through the tissues as the needle is withdrawn. As the eye of the needle is large and gut is a material very easily threaded, this manœuvre can be carried out with great ease. The assistant, holding a bundle of sutures in his hand, may thread the needle each time it is passed.

Hagedorn's needle and holder are employed by several well-known surgeons. I have used it somewhat extensively in general surgery, and like it for many purposes. In suturing very thick parietes the long, straight needle supplied in Hagedorn's

set, and passed by means of his holder, will be found very useful. But for general use in suturing the abdomen I consider the handled needle most convenient. In very short wounds, such as one made in uncomplicated ovariotomies, three or four stitches may be all that are required, and then it matters very little what needles are employed.

Dressings.—In a few hours after operation the peritoneal surfaces will have united, and the parietal wound will then be, to all intents and purposes, a superficial one. It matters very little what the dressing is, if it is unirritating and absorbent. A pad of alembroth wool, or salicylic silk, or carbolised gauze, or a few folds of boracic lint, will serve the purpose admirably. The dressing need not be disturbed for a week, when the wound will be found quite healed, and the stitches may be removed. On the dressing, when removed, we expect to find a thin layer of dried sero-sanguinolent discharge, two inches broad.

After removal of a large tumour, I think the plan of covering the whole abdomen with long broad layers of strapping should be adopted. The sudden decrease of abdominal tension that follows removal of an abdominal tumour no doubt favours gaseous distension of the bowels; and strapping is undoubtedly a better means of preventing this than a tight binder. The strips of plaster act as a firm unyielding splint, keeping the parts immovable, and permitting the patient whatever liberty of movement she may desire. Not only are changes of position from the back to the side very agreeable to the patient; but lying on the side, with the knees drawn up, favours the passage of flatus and the use of the rectum-tube. Hollows under the strapping are to be filled up by firm pads of some sort; folded towels do very well. A binder is unnecessary.

If drainage is used, the dressing and strapping stop short at the point where the tube emerges. Special dressings are arranged around the end of the tube in the manner already described (p. 82). The most scrupulous attention ought to be paid to the securing of perfect cleanliness in the means adopted for collecting discharges from the abdomen.

Stitch-abscesses, causing some elevation of temperatnre,

are mentioned as possible accidents during the uniting of the parietal wound. These are never seen in wounds treated antiseptically, and I think they can be caused only by the use of sutures that are not absolutely free from filth. Perhaps too much tension in the stitches might cause suppuration in their track; but if everything were aseptic, this would not cause much elevation of temperature.

In the manipulative part of the operation, absolute precision and exactitude, as far as hands and materials can secure these, are necessary to the most perfect success. Not only must no part of the work be hurried over or scamped, but every detail must be finished and rounded off with a thoroughness as minute and genuine as if that detail were the turning point of success. And, practically, it is a fact that imperfect attention to almost any detail may result in a catastrophe.

But the avoidance of bungling, oversight, or neglect is not enough. It is possible to overdo, as well as to underdo. The clamp is an example of overdoing, and the calamities that followed its use are our warning. We may run to excess in the means adopted for stemming hæmorrhage, by means other than the clamp. We see this in the double, triple, or even quadruple ligation of the most ordinary pedicles by certain operators; in an elaborate sponging of the peritoneal cavity, that is prolonged beyond cleansing into irritation; in separate suturing of peritoneal surfaces; and in many other ways that could be mentioned.

It must not be forgotten that shock is one of the chief dangers in all abdominal operations, and that tardiness in operating is an important factor in contributing thereto. In addition to the risk from extended traumatism, we must reckon with that from prolonged anæsthesia. These propositions have only to be stated, to be admitted; but not all who admit them act upon them. Rapidity in operating is a prime virtue in abdominal surgery; but this rapidity must specially be cultivated over the more subsidiary details, as in making the parietal wound and closing it. In other matters no time must

be spent in deliberating. The surgeon must be prepared with mind, hand, and instrument, to meet every emergency as it arises according to the best rules of his art. A man who enters the abdominal cavity ought to be able to do anything, from ligature of a vessel to resection of the intestine; and he should be prepared to do this in a manner which defies the criticism of his brethren. We can rarely diagnose perfectly the state of matters inside an abdomen before we open it, and we ought therefore to be able to treat anything which we find when we enter. Dexterity here comes from knowledge as much as from practice.

To be prepared, at the appearance of any complication, to apply the best known surgical technics; to do what is wanted, and no more than is wanted; to have the manner and method of each procedure mentally laid down in clear and definite lines; and generally to perform the operation in steady, straightforward, workmanlike manner through the endless complications that may arise, is no trifling call on the capacities of a human being. Much of it may be learnt by intelligent practice, at the expense of the patients; much may be learnt by careful study and practice on the dead body; but most of all will the young surgeon derive information from a close and intelligent personal attendance at the operations of our great masters. Abdominal surgery is no longer a field for legitimate and versatile experiment; certain fixed and useful laws and customs have been laid down by the dearly-bought experience of great men: the abdominal surgeon ought to begin fully equipped with such knowledge as has been gathered for him.

After-Treatment of Cases of Abdominal Operation.

A golden rule in the treatment of cases of laparotomy is—to let the patient alone. Everything approaching to meddlesomeness is to be condemned The patient must not be upset by fussy applications of tentative therapeutics: when an emergency arises, it is to be met, promptly and decisively, by a method which has been approved trustworthy.

Comfort may be regarded as a therupeutic measure of some importance. Besides the ordinary measures that would be adopted with a patient who is seriously ill, certain minor attentions in abdominal cases may be carried out with benefit. The luxury of a change into a second bed, with clean fresh linen, will be highly appreciated and will often be a means of securing a good night's rest. Changes of position—moving the patient from back to side, raising the head and shoulders a little, bending the knees over pillows, or raising the lower limbs on supports—all tend to lessen the irksomeness of confinement to bed, and by so much to increase the chances of recovery. Sponging the arms, legs, and chest, or washing them with soap and warm water, will always be grateful. These and similar proceedings are well worthy of consideration, as being items in the not inconsiderable total of the patient's comfort.

As to the administration of *food* and *drink* to the patient, it is impossible to give definite rules. Generally speaking, the gravity of the case, and our apprehension of danger, will be our guides. A simple case of oöphorectomy or ovariotomy, after the first twenty-four hours, will require little change from the ordinary diet of health. In cases of serious operation, where some degree of inflammation of injured viscera is bound to supervene, dieting may be of supreme importance. In such cases irritability of the whole digestive tract, with vomiting and tympanites, may co-exist with an urgent necessity for supporting the patient's strength by stimulating nourishment. The judicious management of these cases will tax the surgeon's capacity to the utmost.

In general, milk is a bad food for abdominal cases. It is not digested by the stomach, and, as curd, it may pass a long way down the intestine; also, it is a food that causes flatulence. Peptonised milk has not these drawbacks, but patients rarely like it. Good home-made beef tea, or any of the numerous concentrated beef jellies, taken either solid in tea-spoonfuls at a time, or much diluted if the patient is thirsty, are usually agreeable to the patient, and are of great value. Oatmeal gruel and liquid arrowroot, with similar articles of diet, varied according to the patient's taste, may be given.

"Little and often" is to be the rule of administration; but not too little nor too often. The stomach, like other organs, wants occasional rest; and to keep it in constant action for three or four days on end by hourly or half-hourly exhibitions of small quantities of nourishment, will result in functional irritation, or even exhaustion of the organ. The peculiarities of the case, and the tolerance of the stomach, must direct us. In all cases we must not forget that foods when peptonised may be retained and absorbed, when they would be rejected in their unprepared condition.

As a rule, in cases of average gravity, it will be found a wise plan to give the patient only warm water, or toast-water, by the mouth for the first twenty-four or forty-eight hours, and then begin the administration of foods such as have been mentioned. Cold water, and particularly "ice to suck," for thirst, are to be avoided: they do not allay thirst so well as warm water; and my experience coincides with that of others, that they are more commonly rejected. If the patient complains of thirst, a pint of tepid water slowly administered as enema will rapidly and effectually alleviate it. It is unwise to upset the functional capacities of the stomach by ingestion of large quantities of fluid to allay thirst, when this end may be attained by rectal absorption.

In operations upon females, special attention must be paid to the management of the *functions of the bladder*. It used to be considered necessary to draw off the water by catheter at frequent and stated intervals for some days after operation. This is quite unnecessary. The catheter need not be passed till the patient feels a desire to micturate; and as soon as she can pass water herself, she may be permitted to do so. Some patients do not require the use of the catheter at all. In the first twenty-four hours, the secretion of urine is usually scanty, and the instrument may not have to be used at all in this time. In few cases will it have to be passed oftener than thrice in the day.

Cystitis, often of a troublesome nature, is occasionally produced by catheterism. To avoid this, the catheter must be

cleansed with scrupulous care; and a new one should be provided after one has been used half-a-dozen times. A male rubber or celluloid catheter, of the size of No. 6 or 8 English make, is the best instrument to use.

The above account refers to the management of simple straightforward cases which proceed easily and rapidly towards recovery. But sometimes we have to deal with conditions which are partly outcomes of gravity of operation, and partly special to abdominal cases. Among the former we may reckon shock or collapse, restlessness, and pain; among the latter, vomiting, tympanitic distension, and peritonitis.

Severe *shock* after operation is treated on ordinary surgical principles, by hot bottles, hot blankets, stimulating applications to the epigastrium, elevation of limbs, and so forth. Surrounding the limbs in packs wrung out of hot water has often an excellent effect. Hypodermic injections of ether, ammonia, or brandy, and rectal injections of diffusive and alcoholic stimulants, are frequently administered. Gill Wylie * speaks highly of the value of irrigation of the cavity with hot water (105°—110° Fah.) as preventive of shock; and others have borne testimony to the same effect. Restlessness and jactitation must be treated by a hypodermic injection of a quarter of a grain of morphia, to be followed in an hour by a sixth of a grain or more, according to the effect of the first dose. Morphia is not to be used unless there is strong necessity for it. It lowers the functional activity of the intestines, and favours the production of tympanites—an effect which is specially to be avoided. The patient is to be encouraged to bear the pain: it rarely lasts for a long time; and it will be better for her, in the event of further troubles arising, that she should meet them with a system unimpregnated with morphia. The routine employment of morphia is to be condemned. The patient is always brighter and better without it, if there is no urgent call for its exhibition.

In grave cases it is wise to begin at once feeding by the rectum in the manner to be described. Collapse is a cause of

* *N. Y. Med. Rec.* Mar. 19th, 1887.

vomiting; and want of food and stimulants for the customary twenty-four hours may encourage the very symptoms we wish to ward off. Free stimulation, by brandy or other spirit, administered in enema, during the first day or two after a very serious operation on a weak patient, is a therapeutic measure of supreme value. In many cases a glass of hot spirit and water, taken the last thing at night, will act as a soporific.

Vomiting is perhaps the most troublesome single symptom that we have to deal with, after abdominal operations. Arising soon after operation, and lasting over ten or twenty hours, it may be nothing more than an effect of the anæsthetic. When it exists on the third or fourth day, and continues, we may conclude that it indicates peritonitis or enteritis, or some allied inflammatory condition, which causes paralysis of the functions of the bowels. In this case we must take prompt measures to deal with events which may have grave issues.

The vomiting, in this case, is not of the sort that can be controlled by medicine. Indeed, it is more than doubtful if it is desirable to seek to control it. It is almost uniformly accompanied by distension of the bowels with gas and fluid, and vomiting affords relief. It is certainly not wise to let the patient continue feeling sick and vomiting frequently small quantities at a time; but it may be wise to encourage free vomiting for a few minutes together. I have found that the administration of as much fluid as the patient will drink—soda-water, or weak tea, or simple warm water—is followed by the evacuation of large quantities of bilious fluid and gas, and makes the patient comfortable for some hours. In more than one bad case, I have found Kussmaul's treatment of washing out the stomach by the stomach pump of conspicuous benefit.

The indication is rather to remove the cause of the vomiting, than to check it when it has set in. For this end, we must at once stop the administration of everything by the mouth, and support the patient entirely by rectal feeding. By lying on the side, and wearing the rectum tube as much as possible, the passage of flatus downwards is encouraged. And at least once a day, large quantities of warm water, with a little

turpentine, are injected into the rectum, so as to completely remove whatever gas may be in the large bowel, and encourage more of it to descend from the small bowel.

We may at the same time have to deal with *peritonitis*, local or general. I am by no means alone in believing that the administration of opium is not always the best treatment for peritonitis. Where great restlessness accompanies the vomiting, opium—or, better, the hypodermic injection of morphia—may be given at frequent intervals; but, as a rule, the use of sedatives is to be condemned. Holding, as I do, that the tympanites which accompanies peritonitis is a real cause of obstruction, and thereby induces vomiting, I have for some years been in the habit of cautiously prescribing a saline purge, in the hopes of carrying off this flatulence. The results were beyond expectation, and when I had found it had been for some time a routine treatment in Tait's practice, I had no hesitation in extending it. A purge carries off great quantities of gas and fluid, relieves the distension, and probably, by its physiological action, relieves engorgement of intestinal vessels. A Seidlitz powder or a dose of Epsom salts will sometimes act like a charm in these cases, putting an altogether new complexion on the case. I believe also that a saline purge may be of advantage where there is fluid collecting in the pelvis. The engorgement of its vessels being relieved, the peritoneum is able to absorb more fluid. Tait tells us that in many cases where others would drain, he purges.

Over and over again I have been able to demonstrate to students and medical men the value of a saline purge in cases of incipient peritonitis. A case seen with distension, sickness and restlessness at the visit on one day, has a Seidlitz powder prescribed, to be followed by a hot-water or turpentine enema; and it is almost taken for granted that, at the visit next day, the patient will have a flat abdomen, the sickness will have disappeared, and she will express herself as feeling infinitely better, but weak from the exertion necessary in passing motions. A brandy enema at once counteracts any feeling of weakness. Food is now tolerated; and the patient is practically out of danger. In

grave abdominal cases, I positively like to see diarrhœa—natural or artificial: diarrhœa very rarely goes with vomiting. It is one mode of draining the peritoneum, as well as being an antagonist to tympanitic distension. It may be that purges do good rather as removing gas than as draining the peritoneum and relieving engorgement of vessels: how they do good matters not so much as the fact that they do.

Slowly but surely the therapeutic virtues of purges in operation—peritonitis are being recognised. Among the most enthusiastic supporters of the plan are such well-known surgeons as Gill Wylie,* Boldy,† Penrose,‡ and Gardner.§ The last named, the well-known Professor of Gynæcology in McGill University, in recording his highly successful work during the year 1886, thus writes of it: "In my work during the year I have given no opium, and invariably, immediately on the appearance of distension, pain, or vomiting, I have given enemas and purgatives with the most signal advantage. I am convinced that, in my own experience, I have thus seen many lives saved, besides a vast diminution of the trouble and difficulty in managing the cases afterwards."

Tympanites is a symptom which always accompanies peritonitis and vomiting. In a slight degree, elevating the infrasternal depression, it may mean nothing more than passive accumulation of gas from relief of intra-abdominal pressure. Drum-like distension accompanying peritonitis is quite another affair; it may cause distress from interfering with respiration: it is certainly a cause of vomiting, probably through its acting as an obstructive, and must be relieved as soon as possible. Tapping with a fine trocar may give temporary relief; but this relief is so slight and so evanescent as to be practically of no account. Speaking from a personal experience of six cases, and from the observation of several more in the practice of colleagues and friends, I would characterise tapping of the bowels for tympanites as a simple trifling with the complaint, and as a dangerous

* *N. Y. Med. Rec.* Mar. 19th, 1887. † *N. Y. Med. Rec.* Nov. 5th, 1887.
‡ *Phila. Med. and Surg. Rep.* Oct. 22nd, 1887.
§ *Canada Med. and Surg. Journ.*, p. 147. Oct., 1887.

trifling.* More advantage will be derived from encouraging free vomiting in the manner indicated above, and by large fluid rectal injections, supplemented, where it is considered advisable, by a saline purge. Spirits of peppermint, ether, or chloroform, facilitate the eructation of gas, and may be of some benefit.

A most valuable adjuvant in the treatment of distension after abdominal operations is the employment of the rectum tube. The vaginal tube supplied with a Higginson's syringe, or an ordinary lithotomy tube, answer the purpose perfectly well. But sometimes a longer tube, such as that used for washing out the stomach, will be required. If there is fluid in the rectum, such as remains of enemas or liquid fæces, then the long tube should be employed to carry the discharge well away from the patient's body, or a piece of rubber tubing should be attached to the ordinary tube, and carried outside the bed-clothes. As soon as there is a collection of gas in the bowel which the patient cannot pass, the rectum tube should be inserted and left in position. When there is much distension, the tube should literally be worn for as long periods as possible consistently with the administration and retention of enemas. The patient very soon appreciates the virtues of the rectum tube, and frequently will ask that it be inserted.

The trinity of peritonitis, tympanites, and vomiting are the furies of abdominal surgery. When they have taken firm hold of a case, we may make up our minds for a fierce struggle before they can be ousted. The longer they abide, the more difficult are they to be got rid of: therefore, we ought to be prepared at every point to meet them with the most trustworthy weapons and the most approved tactics.

Rectal Feeding.—The frequent necessity, in abdominal cases, of feeding by the rectum demands a practical familiarity with

* See, on this subject, Ogle, *Lancet*, July 16th and 23rd, 1887. In cases of tympany occurring in cattle, the part punctured is not the bowel, as Dr. Ogle seems to suppose, but the rumen or paunch. Not only in this respect but in others, such as the thickness of the visceral walls, and the nature of the contents, the analogy between human beings and cattle is not correct.

the best modes of preparing the food, and the best means of administering it. I have closely followed the accounts of modern improvements in the artificial digestion of foods, and have specially taken note of the results found from introducing these into the system by rectal absorption. Most of the plans recommended I have either tried or seen tried in practice. Now, it is of supreme importance that feeding by rectum shall produce a maximum of result with a minimum of disturbance. The worry of rectal feeding must be counterbalanced by very definite and palpable results; it must be something very much more than an interesting physiological experiment.

I have come to the conclusion that all rectal foods ought to possess two qualifications—namely, that they should be peptonised, and that they should be very dilute. It is idle to argue that enemas are not nutritive unless they are peptonised; long and extensive experience has abundantly proved the contrary. But it seems fairly well established that digested food is more readily absorbed by the mucous membrane of the bowel than undigested food, and is possessed of a higher nutritive value. The nutritive value of dried bullock's blood, or any of the nutritive boluses or capsules which are now prepared by various chemists is no doubt considerable. But, for the treatment of abdominal cases at least, I believe that the best results are got from enemas that are dilute.

It is just possible that the benefits of dilute enemas, may, to some extent, be accounted for by the relief to thirst which they give. Thirst is undoubtedly a frequent complaint in abdominal cases; and in such as have vomiting, the thirst is often trying. No doubt the fluids of the blood are largely drawn upon to provide the intestinal fluids which are secreted so abundantly; but the feeling of thirst may also be partly accounted for, as analogous to the thirst which is felt after shock or fainting. However it is explained, there is no doubt that the feeling is removed by the use of liquid enemas, when drinking of fluids may be ineffectual. On the other hand, as regards the supply of nourishment, enemas are not, in operation cases, usually administered because the patient is famished for want of food, but

because we wish to provide temporary support, to enable the patient to tide over a few days of exhausting sickness. Only in the case of gastrostomy for stricture of the œsophagus have we to combat real hunger; in other operations, it is temporary support or stimulation which we seek to provide. Prof. Bauer* insists upon it that by the help of nutrient enemas, however prepared, it is impossible to effect the absorption of more than a fourth part of the nourishment necessary for subsistence. This tells in favour of the exhibition of stimulants in the enemas, which undoubtedly are absorbed.

Now, in practice these principles may be carried out in two ways—either by the administration of enemas that are very dilute, and therefore in considerable bulk, or by the administration four or five times in the twenty-four hours of small concentrated bulks of food, with, once a day, the ingestion of a considerable quantity of tepid water. Some patients will, without discomfort, retain a pint of fluid in the large bowel; these I should feed with dilute peptonised enemas. A few can retain no more than four or six ounces; these I should feed with concentrated or solid peptonised materials, supplemented by the administration, once or twice daily, of a pint or more of warm water.

Pyrexia.—A few surgeons consider it necessary to make special provision for the treatment of excessive pyrexia occurring after abdominal operations. Nothing perhaps is more remarkable in the whole range of practical surgery than the slight amount of febrile reaction which is observed after abdominal operations. Case after case occurs in which the maximum temperature does not reach 100° Fah.; in fact, a temperature of 100° may be considered as abnormally high. It is also true that the greatest dangers after laparotomy are not associated with severe pyrexia. Peritonitis of the most virulent sort may co-exist with a normal or even sub-normal temperature; and ordinary peritonitis, mild or local, rarely causes great elevation of temperature. Pyrexia after laparotomy is not of the nature of the pyrexia in specific diseases such as typhoid fever;

* Von Ziemmssen's *Handbook of General Therapeutics*, vol. i. p. 266.

it does not continue for weeks together, and it is not at all likely to cause danger from mere continuance of excessive fever heat. It is probably true that laparotomy involves a likelihood of rapid and dangerous rise in temperature no more than any other major surgical operation; and this likelihood must be exceedingly small. In the unrivalled experiences of Tait and Keith, such dangerous rises of temperature have not occurred; and it may reasonably be argued that, in the practice of others, no special preparations need be made to meet them.

In the Samaritan Hospital, the ice-cap is kept in reserve and frequently used for the treatment of rises in temperature. Cold packs on the limbs are used for the same end. And in America a few surgeons speak of the value of Kibbee's fever cot, which is essentially a water-bed, through which cold water can be passed, so as to abstract heat from the body with which it is in contact. If I had to deal with a temperature above 104° lasting for more than two hours, I should administer a full dose of antipyrin, and possibly supplement it with sponging of the cutaneous surface. Under 104°, I should adopt no special treatment to reduce the temperature; the strong probability is, that it will soon drop of its own accord.

Parotitis.—Mr. Stephen Paget has called special attention to the fact, that after abdominal injuries and operations a small proportion of cases is attacked with inflammation of the parotid gland, which may or may not proceed to suppuration. The explanation of this curious fact we cannot here discuss. The treatment is carried out on ordinary surgical principles.

(*See Bibliography at end of Book.*)

Section III.

OPERATIONS ON THE OVARIES, THE FALLOPIAN TUBES, AND THE BROAD LIGAMENTS.

By far the most important and extensive part of abdominal surgery is concerned with tumours of the ovary. It was here that the surgery of the abdomen signalised its first triumphs; and it has been chiefly through the practical experience gained in this field that the present proud position of peritoneal surgery has been established.

In this section we have to deal with the ovaries, the broad ligaments and parovarium, and the Fallopian tubes. For the sake of practical convenience, inflammatory diseases of the ovaries are considered along with diseases of the Fallopian tubes; the whole being collectively treated under Removal of the Uterine Appendages. Operations for growths in the broad ligament and parovarium, though they are usually described as ovariotomies, are here separately considered.

Ovariotomy.

SURGICAL ANATOMY OF THE OVARY.

The ovaries lie in the posterior fold of the broad ligament, at the level of the brim of the pelvis. In front, they are in contact with the broad ligaments; behind, they are separated from the rectum by the coils of ileum which usually occupy Douglas's pouch. Their position is not fixed and stable; displacements are caused, normally, by the filling and emptying of the bladder and the rectum; and, pathologically, by enlargements and malpositions of the uterus.

The ovary is attached to the broad ligament along one border, and to the uterus by a rounded fold of peritoneum containing muscular fibre (the utero-ovarian ligament), which is inserted into its internal extremity; at its external extremity is attached that part of the upper border of the broad ligament known as tubo-ovarian or infundibulo-pelvic. The ovary therefore occupies the apex of a ligamentous triangle, the base of which is in the broad ligament, and the angles of which lie at the uterus and the pelvic brim.

At the junction of the ovary with its fold of broad ligament is the hilum of the ovary. Here is situated the mass of spongy vascular erectile tissue known as the bulb of the ovary, and to this point converge the numerous small vessels, branches of the ovarian artery, which supply the gland. The ovarian artery, a branch of the aorta, leaving the inner aspect of the iliac vessels at the pelvic brim, runs a tortuous course along the upper border of the broad ligament, between its folds, to its bifurcation near the uterus. On the outer side of the ovary, it gives off branches to the ampulla; and on the inner side, to the isthmus of the Fallopian tube and to the round ligament; midway, it gives off the branches which supply the ovary. As many as ten or twenty branches may be given off. The veins are even more numerous, and constitute a closely-set network, which communicates above with the pampiniform plexus, and below with

the vaginal plexus, and is finally gathered into the ovarian vein, which discharges itself into the renal vein on the left side, and into the vena cava on the right side.

The fold of broad ligament containing these numerous arterial and venous branches constitutes the surgical pedicle. A ligature placed close to the ovary necessarily constricts all these, but may not include the trunk of the ovarian artery. Under ordinary circumstances, however, constriction of these branches by ligature interferes with the circulation of the ovarian artery, and may even check it: if the Fallopian tube is included as well, the chances of complete occlusion of the ovarian artery are increased.

The relations of the ovary to the Fallopian tube are of importance. The observations of His, confirmed by Doran, Tait, Hart, and others, seem to show that the generally accepted views as to the mutual position of these organs are erroneous. The ovary hangs obliquely from its ligament, and the Fallopian tube forms a loop round it, running from without inwards and downwards. The fimbriæ of the tube thus lie behind and below the ovary, covering a considerable portion of its surface. It would further appear that the long axes of the ovaries do not lie transversely, but in lines extending forwards and outwards. Considerable variations in position are, however, compatible with normal conditions.

In tumours of the ovary which rise into the abdomen, the ovarian attachments are stretched and drawn out, forming the so-called "pedicle." Such a pedicle contains, not only the true ligaments of the ovary, but also part of the broad ligament, and in the great majority of instances the Fallopian tube as well. The surgical management of this pedicle, not yet finally settled, has been one of the most fertile sources of dispute in abdominal surgery.

The weight of the healthy ovary, according to Farre, varies from 60 to 135 grains. Its average diameters are: longitudinal, $1\frac{1}{3}$ in.; transverse, $\frac{3}{4}$ in.; perpendicular, $\frac{3}{8}$ in.; but these are liable to considerable variations.

It is necessary to emphasise the fact, that in women who

have borne children, as well as in many who have not, the normal topography of the ovary may be much disturbed without causing symptoms. I have, for some time past, noted the position of the ovaries in cases which have appeared on the post-mortem table of the Bristol Infirmary, and I have been much impressed with the variety of position which the ovaries have assumed without causing symptoms which were noted during life. The most common displacement is downwards, chiefly from elongation of the infundibulo-pelvic ligament, permitting the outer extremity to drop lowest, and the whole to gravitate towards Douglas's pouch. On the left side, displacements are perhaps most common. I have found healthy non-adherent ovaries on the brim of the true pelvis at the insertion of the broad ligament, at the sacro-iliac articulation, in front of the broad ligament, behind the internal inguinal ring, and in an almost endless variety of abnormal situations.

This distensibility of the ovarian ligaments has advantages from the surgical point of view. It permits of the glands being brought to the surface in abdominal sections; or into the vagina, where removal by this method is contemplated.

MULTILOCULAR AND GLANDULAR CYSTS OF THE OVARY. OVARIAN CYSTOMA.

Pathological Anatomy.—The investigations of our most competent pathologists would seem to favour the view that true cystic disease has its origin in connection with the natural retrograde metamorphosis of the Graafian follicle.* The steps which lie between the first changes in the ovary and the fully-developed cystoma have not been clearly traced. The pathological appearances vary much in detail, but they are sufficiently definite in general to make the recognition of an ordinary cystoma a matter of no difficulty.

An ovarian cystoma usually consists of one large cyst and a varying number of small ones. As a rule, the large cyst lies

* This and other questions in ovarian pathology are philosophically handled by Alban Doran, in his work on *Tumours of the Ovary, Fallopian Tube, and Broad Ligament.* London, 1884.

farthest away from the peduncular attachment of the tumour, the smaller cysts being placed near to this site of attachment; but there are many exceptions to this rule. The walls of the cyst are composed of pure fibrous tissues of varying thickness. They are covered, on the outside, with flattened cubical cells, closely resembling ordinary endothelium; on the inside, with endothelium and varieties of glandular cells. The fluid in ovarian cysts is typically of a glairy or colloid nature; white, or grey, or greyish-yellow, in colour; very albuminous, and of high specific gravity.

When exposed to view, an uninflamed multilocular cyst presents a white glistening or pearly surface, perfectly smooth to the touch. If secondary cysts be in the cyst wall, they may protrude outwards, forming smooth rounded bosses of varying size on the main cyst; or they may bulge inwards, showing areas of different colour and consistency on the surface of the cyst-wall. The fluid found in the chief cyst is usually of the glairy nature already described; but sometimes it is watery and colourless, when we are told to expect papillomatous growths inside; and not infrequently it is dark red, brown, or chocolate-coloured, from admixture with blood. When masses of glandular semi-solid material are developed in the centre of the cyst, the fluid is said to become thick and colloid, almost coherent. In the secondary cysts the nature of the fluid is still more variable. Some of these have pale watery contents; others, almost pure blood; others, very thick stringy or colloid material; and some may contain fluid indistinguishable from pus. In closely-set small cysts the contents are most frequently colloid or jelly-like, capable of being lifted out by the fingers, and too thick to be drawn off by cannula.

Much has been written on the possibility of diagnosing ovarian fluid through its chemical composition and microscopic constituents: even the spectroscope has been called in to aid us. Chemistry has certainly failed, and so has the spectroscope; and the presence of certain peculiar cells, which were for some time considered as pathognomonic, has now been proved almost valueless for diagnostic purposes. The vacuolated cells of

Thornton and Foulis are now known not to be characteristic of malignant disease, as was at one time thought certain; and we are now practically left without any single reliable physical test of the contents of an ovarian cyst. We can say that a fluid is ovarian with a greater probability of truth than we can say that it is not; and in most cases the grounds of this statement might rest as securely on the simple visual appearance of the fluid, as on its composition or the nature of the cells contained in it. But the value of all such tests is best estimated by the weight which practical men put upon it—and that is almost nil. We never hear of the removal of ovarian fluid for examination; the diagnosis is made by other means.

Certain developmental changes are found in cystomata. Thus, from crowding of secondary cysts, their contiguous walls may disappear, and the cavities may communicate. Or the wall of the main cyst may be ruptured, and the secondary cysts, protruding through the opening, may form the chief bulk of the tumour. In such cases the operation for removal is usually difficult, on account of the tenuity of the cyst-walls, the density of their contents, and their tendency to become adherent to abdominal organs. A rare and somewhat puzzling condition arises when there are two ovarian cysts, and their walls become fused, while their cavities communicate. In this case there are two pedicles to deal with. Solid matter inside a cystoma, Doran* found present in 26 out of 366 cases, and in 14 of these the structure was adeno-sarcoma. In nearly a third of his cases glandular material was present in varying amount. Thin-walled pedunculated and sessile cysts are sometimes found attached to the main wall. Other peculiar developments—as, small localised masses of connective tissue, or wart-like bodies, or even true papilloma—may be found growing on the inner surface of the cyst. Certain changes or accidents liable to take place in the developed growth will be referred to further on.

All such growths have a pedicle: a so-called sessile ovarian

* *Loc. Cit.*, p. 21.

cystoma is simply one with a very short pedicle. This pedicle is a very variable structure. In length, it varies from six inches, or even more, down to a vanishing point; in breadth, it varies between that of the whole length of the broad ligament and some fraction of an inch; and in thickness, its dimensions lie between the tenuity of membrane and the bulk of the palm of the hand, or even more. The vessels that supply the growth, also most variable in size and number, lie in the pedicle. Anatomically, a true pedicle is composed of the ovarian ligaments, some portion of the broad ligament, and the Fallopian tube—all of them hypertrophied.

Diagnosis.—There is something characteristic in the appearance of an abdomen enlarged by an ovarian tumour. There is a bulging forwards, not so marked as in pregnancy, where the tumour appears to start straight out of the pelvis; and more marked than in ascites, where the enlargement involves the whole abdomen and causes bulging in the flanks. The position of an ovarian tumour of moderate size is best suggested by supposing that it rests chiefly upon the promontory of the sacrum. It occupies the lower portions of the abdominal cavity, and causes stretching of the parietes, chiefly in these portions. This is apparent by the increase of distance between the umbilicus and pubes, greater than between the sternum and umbilicus, and by the appearance of lineæ albicantes (where they exist at all) at each side of and below the umbilicus.

Palpation reveals a rounded, cystic, and probably fluctuating growth, movable in most cases, and remotely connected with the uterus. Small tumours appear to be perfectly globular, and are smooth on the surface; large growths are usually somewhat irregular in shape, from the development of secondary cysts in their walls. In thin-walled cysts which are not greatly subdivided by septa, or in which one cyst considerably exceeds the others in size, a fluctuation thrill may be distinctly felt. If the cyst-wall is thick, or if the growth is very mutilocular, or its contents colloid, fluctuation may be absent.

A sensation of crepitus may be produced by the friction of

inflamed surfaces; such crepitus, of course, contra-indicates adhesions at the spot where it is felt. The diagnosis of adhesions is very uncertain: free mobility of parietes over tumour indicates that there are not closely-set, dense, or short adhesions; long bands may permit considerable mobility. A condition of fixity between cyst-wall and parietes, it is very difficult to be assured of. Doran mentions a case in which he and several of his colleagues thought that a cyst was fixed to the abdominal walls; but not a single parietal adhesion was found when the operation was performed. I have met with several analogous instances; and I am convinced that the diagnosis of parietal adhesions is most difficult and uncertain.

Vaginal palpation reveals a uterus normal in size, displaced either backwards or forwards, or to one side, and most frequently depressed. The uterus is somewhat frequently enlarged—always so, if the growth is closely adherent to it. If the tumour is small and has not escaped from the pelvis, the uterus will be displaced forwards; when the growth is of considerable bulk and placed in the abdomen, the uterus lies indifferently in front of or behind the growth. When it lies in front, it is sometimes quite easy to palpate its outlines through the abdominal wall above the pubes. Rotation of the growth on its tranverse axis, by no means a rare occurrence, causes the uterus to be dragged upwards. If the growth is movable and the pedicle not very long, movements communicated to it are felt in the uterus. If the growth is large or fixed, and the pedicle short, or the uterus adherent to it, passage of the sound will show that the fundus of the uterus cannot be moved away from the tumour. This sign introduces an element of confusion between ovarian and uterine growths.

By percussion we diagnose the presence of a non-resonant body in the lower, or lower and middle, abdomen. From the point where the growth comes into contact with the parietes above, down to the pubes, dulness is absolute. Over the anterior aspect of the tumour there is also absolute dulness; at the sides this dulness is not so absolute, and in the flanks there is positive resonance. Tait well describes the ovarian tumour

as being surrounded with a "tympanic corona," a ring of resonance marking the lateral and upper limits of growth, where the bowel crowds round it and comes into contact with the parietes. If the tumour is large, there may be dulness in one or even both flanks; sometimes, in very large growths, resonance is absent over the whole abdominal area. Ascites associated with the tumour may cause lumbar dulness, as may loaded bowels.

Auscultation reveals little of positive value in the diagnosis of ovarian cysts. Negatively it may be useful, as showing the absence of sounds characteristic of other conditions. Exploratory puncture has practically been abolished as a means of diagnosing ovarian cysts.

As regards general and subjective symptoms, experience shows that they are almost valueless. Some tumours grow quickly, some slowly; some are very painful; others attain to enormous dimensions, producing nothing more than discomfort from their bulk. Menorrhagia, amenorrhœa, or normal uterine functions, are found present with equal impartiality. Disturbances of micturition or of defæcation may exist, or they may not. Sickness is not a very common symptom, but there are cases where sickness and vomiting are very troublesome. Œdema of legs, parietes, or vulva, may be found in small growths, and they may be absent in very large ones. Disturbances of the renal functions are present or absent. And so it is through the whole group of rational and associated symptoms: there is not one whose absence disproves ovarian disease, and not one whose presence proves it; indeed, there is perhaps no association of such symptoms which would be of the slightest value for accurate diagnosis. This must rest on the physical bases alone.

The diagnosis of ovarian from other abdominal tumours is a very large subject indeed. It is literally the fact that there is scarcely a single form of abdominal growth, of dimensions as large as a child's head, that has not been mistaken for ovarian tumour. No doubt some of these mistakes are to be accounted

for by carelessness or ignorance; but many of them have occurred in the hands of our most distinguished operators. But such mistakes are daily becoming less common; advancing knowledge of all tumours is narrowing down the diagnosis of each. The earlier writers put before us a list of growths which might be mistaken for ovarian that was almost co-extensive with abdominal tumours: at present, we should be perhaps right in limiting our differentiation to half-a-dozen. Ovarian cystic disease is, I think, most liable to be confounded with the following:—

Encysted Peritoneal Dropsy.
Renal Cystic Tumours.
Cysts of the Broad Ligament.
Fibro-cystic Disease of the Uterus.
Ascites.

In many cases *encysted dropsy of the peritoneum* cannot be diagnosed from ovarian cyst. The points specially to be looked into are: whether or not there is resonance between the pubes and the tumour—a condition sometimes found in encysted dropsy, but never in ovarian cyst; whether, on deep pressure at the periphery of the cyst, the bowels appear to be sessile on its walls—or rather, whether the growth appears to spring from the midst of the coils of intestine. It is rarely the case that an ovarian cyst small enough to be examined in this way is palpably connected closely with bowel. The walls of an encysted peritoneal collection of fluid are thin; and there is no evidence of secondary cysts, and herein it resembles parovarian cyst. But the latter is very rarely adherent to bowel, and still more rarely appears to be embedded in intestinal coils. The fluid is under low pressure, and fluctuates freely, in encysted dropsy.

In the case of *cystic renal tumours*, mistakes are not likely to arise unless the growth is of a large size, filling the whole of the cavity, and unless there is absence of special urinary symptoms. The most important differentiating sign is, in the case of renal growths, deep and firm fixation in one or other loin. It is not often that an ovarian cyst, even of very large

growth, so completely occupies a lumbar hollow as a renal growth. An ovarian growth may completely fill the costo-iliac space, and may cause the flanks to bulge; but it does not appear to spring from this region, having most of its bulk in and around it. Not much value can be attached to the absence of signs derived from vaginal palpation. A sign of importance is the palpation of large bowel on the surface of a renal tumour.

Cysts of the broad ligament may be simple monolocular growths containing fluid, which are best known as parovarian cysts; or polycystic growths, arising in the hilum of the ovary, or elsewhere in the broad ligament, which most frequently contain papillomatous material. A simple parovarian cyst is thin-walled, fluctuates freely, and is globular and smooth on the surface. A papillomatous cyst of the broad ligament is multilocular, deeply sessile in the pelvis, and is often intimately connected with the uterus, which is usually dragged upwards. If the papillomatous material is abundant, there is bogginess rather than fluctuation.

Fibro-cystic disease of the uterus is more rare than is commonly supposed. It is probable that most of the cases described as fibro-cyst of the uterus would, in the light of our more perfect recent pathological knowledge, have been recognised as ovarian or broad ligament growths which had become intimately adherent to the uterus. Beyond an intimate connection with the uterus, which may exist in other growths, there is little to guide us in diagnosing fibro-cyst. The striking cases described by Spencer Wells presented symptoms which were not very characteristic.

Ascites is perhaps least liable of the conditions mentioned to be mistaken for ovarian cystoma. Error can scarcely arise unless the abdominal distension is very considerable. In distinguishing minor degrees of enlargement, the most important guides are the sites of the areas of resonance and dulness. An ovarian cystoma grows upwards from the pubes, and gives a circular area of dulness in the middle, surrounded by a ring of resonance which extends backwards into the flanks. (Fig. 3.) Ascites increases from the flanks forwards (speaking of the supine posture), and when the fluid comes into contact with the

anterior parietes, gives a crescentic area of dulness, the concavity of which looks upwards, with resonance only between the sternum and this crescentic hollow. (Fig. 2.) In ascites, when the enlargement is very great, there may be dulness up to the sternum; and when ascites is present with ovarian tumour, there may be dulness in both flanks. Under these conditions diagnosis may be somewhat difficult. Variations of posture increase the resonant areas in ascites more than in cystoma, and the fluctuation thrill is more distinct in ascites. Also, in ascites, there is more bulging or bagging of the distensile portions of the abdominal sac at the loins, in Douglas's pouch, and at the umbilicus; and the whole belly is flatter than in cystoma.

DERMOID CYSTS OF THE OVARY.

About one of ten ovarian tumours is either entirely or partially dermoid. Their exact origin is still matter of uncertainty, and need not here be discussed. It is generally agreed that the rudiments of all dermoid cysts exist at birth, and that they may remain quiescent indefinitely, or start into active growth at any period from, or even before, birth to old age. Dermoid ovarian growths most frequently manifest themselves after puberty.

Dermoid cysts are rarely of large size; it is not often that they are larger than a child's head. The bulk of their contents is composed of a thick greasy material, such as is found in sebaceous tumours of the scalp. The cyst-wall inside the fibrous envelope is composed of structures similar to those found in the skin. From within outwards, we meet, first, with a layer of epidermis, from which sprouts a growth of hair, and in which we may often detect rudiments of all the elements found in healthy skin; outside of this lies a layer of connective tissue, corresponding to the cutis; and outermost of all, under the fibrous capsule, is a layer of fatty tissue, corresponding to the panniculus adiposus.

A dermoid ovarian cyst is usually divided by septa into separate portions; and the contents may differ in the various

loculi. The main cyst often contains a greasy chocolate-coloured fluid, while the others are full of the characteristic sebaceous material. Hairs may be shed into the cavities in large quantities, and sometimes form masses which appear as if they had been rolled into balls. But the most striking contents are pieces of true bone, most frequently stunted alveolar processes, with teeth either free or embedded in the alveoli. As many as three hundred teeth have been found in one dermoid cyst.

There usually exists a very perceptible enlargement of the sebaceous follicles in the cyst-wall. Frequently they attain to the dimensions of secondary cysts, and a similar development may take place in the sweat glands. Hyaline cartilage is often found in the cyst-wall; and nerve-tissue, unstriped muscular fibre, and other elements may be detected. Malignant tumours have been found growing in dermoid cysts.

Both ovaries are liable to be diseased in a proportion of cases larger than in cystoma. Also, ordinary glandular cystic disease is found to co-exist with dermoid cyst in a proportion of instances larger than would be likely if it were mere coincidence. Any casual connection between the two is not likely to be more than a stimulus to development started by increased vascular supply from the one which first began to take on diseased action.

The outer aspect of a dermoid cyst is different from that of an ordinary cystoma. The glistening pearly aspect of the latter is replaced by a muddy or opaque appearance darker in colour, sometimes even approaching to brown. Adhesions are common in dermoid cysts, chiefly because they are liable to become inflamed.

Diagnosis.—A dermoid cyst may be suspected; but it can rarely be accurately diagnosed. The history and physical signs of dermoid growth may be identical with those of cystoma containing colloid material. In the very rare event of bone being discovered by bimanual palpation, diagnosis is certain; and this is perhaps the only sign, short of operation or exploratory puncture or discharge of contents by suppuration, which

can be looked upon as definitely diagnostic. A thick cyst-wall, bogginess and not fluctuation, and a size less than that of a man's head, nearly always found in dermoid cysts, are not infrequently found in other cystic growths of the ovaries.

ACCIDENTAL CHANGES IN CYSTIC GROWTHS OF THE OVARIES.

Cystic ovarian growths are liable to certain accidents which are not necessarily connected with their pathological development. The most important of these are, Rupture of the Cyst-wall, Twisting of the Pedicle, and Inflammation or Suppuration in the growth.

Rupture.—Any breach in the continuity of the cyst-wall may be defined as a rupture. It may exist either as a slow leakage through a minute opening or openings, or as a rapid evacuation of contents through a large rent. The general effects of rupture will depend on the size of the cyst, the nature of its contents, and the rapidity with which they are discharged into the peritoneal cavity. Simple oozing or leakage may, if the contents are benign, produce no symptoms beyond diminution in the size of the cyst. A large rent may result in collapse or rapid death, or may slowly pass off, or may terminate in peritonitis. If the contents are suppurating, death usually results from peritonitis, unless operation is performed; if they are benign and watery, recovery may take place without much difficulty.

The causes of rupture are varied. A frequent cause is over-growth of intra-cystic solid matter, usually papillomatous; and in this case the rupture is of the nature of a slow leakage through thinned and necrosed portions of the cyst-wall, and does not produce very acute symptoms. Spontaneous rents may take place in thin parts of over-distended cysts. A tense, but otherwise healthy, cyst-wall may be ruptured by a blow, or even by rough handling; and in such a case the immediate symptoms may be very acute and very alarming. The rupture of an acutely inflamed or suppurating cyst is of the nature of the bursting of an abscess inside the peritoneal

cavity, and is immediately followed by grave and alarming symptoms.

Hæmorrhage, after rupture of a cyst, is not usually severe. If bleeding is free, it is more likely to arise in the form of a passive oozing from the abundant vessels of intra-cystic papillomatous growths, than from the torn vessels in the rent.

Cysts containing papillomatous growths are peculiarly liable to undergo rupture—not once only, but several times. The immediate danger is not great, because the free flow of fluid is prevented by the villi plugging the opening; but the remote danger is considerable from infection of the peritoneum. In multilocular cystomata, the thin-walled secondary cysts are most liable to rupture. Dermoid cysts usually rupture into some neighbouring cavity—bladder or rectum most frequently—rather than into the peritoneum.

Twisting of the Pedicle.—Rotation of ovarian tumours, resulting, as it sometimes does, in twisting of the pedicle and strangulation of its vessels, may be an accident of serious moment. Much speculation has been offered as to its cause. Tait very ingeniously seeks to explain it as caused by repeated small displacements of the growth round its axis, through the passage of the fæces along the sigmoid flexure and rectum. Slight twisting may produce no effects; but the result, if the twisting is two, three, or more times,* may be atrophy, rupture, or gangrene of the tumour. Complete detachment is rare.

In many cases a twisting of the pedicle is attended with no symptoms. In such the pedicle will probably be long, thin, and lax. Usually, however, with pedicles of ordinary conformation, signs of congestion or inflammation are present, such as opacity and want of lustre in the cyst-wall, with extravasation of blood into the cyst-cavity. The hæmorrhage into a cyst whose pedicle has been twisted may be so considerable as to produce symptoms of loss of blood. Inflammation may proceed to suppuration in these cases; and not a few of the described cases of gangrene have been attributed to twisting of the pedicle.

* See Hunter in *N. Y. Med. Rec.*, 1885, xxvii., p. 359.

Doran,* Chalót,† myself,‡ and others have recorded some remarkable cases where the vitality of the tumour has been maintained by adventitious adhesions after the pedicle has been twisted through. It is probable that many dermoid cysts of the abdomen that have been described as non-ovarian are really ovarian cysts that have been separated from their pedicles.

Suppuration in Cysts.—Suppuration in the growth, attended, as it always is, with acute peritonitis, is a most serious complication. The immediate causes of suppuration are various: inflammation, from traumatism; localised gangrene; strangulation of the pedicle, from twisting; introduction of septic matters into the cystic cavity, from tapping. Inflammation in the cyst-wall is communicated to the peritoneum, and may set up general peritonitis of the most dangerous character. Localised inflammation of a non-septic nature may exist in a minor secondary cyst without producing alarming symptoms: as a rule, however, suppuration signifies its presence in an unmistakable and emphatic manner.

When any of these accidents occur—suppuration, twisting of pedicle, or rupture,—immediate operation is indicated. The danger from suppuration is greatest: twisting of the pedicle is dangerous chiefly when followed by congestion, which runs on to gangrene or suppuration, and is only inferred from the existence of such inflammatory disturbance; rupture is least dangerous as a rule, but is sometimes rapidly fatal. In all, danger to life, immediate as well as remote, is lessened by operation. Keith first taught us how to deal with suppurating cysts: his successful teaching has been extended to the treatment of the other accidents to which pedunculated cystic growths are liable.

Some reference must be made to that peculiar variety of ovarian cystoma called by Tait "Rokitansky's tumour." It

* *Med. Chir. Trans.*, vol. lxviii., 1885.

† *Ann. de Gyn. et d'Obst.* Mar., July, 1887.

‡ *Brit. Gynæc. Journ.*, Nov., 1887—where there is a full description of the growth with drawings by Mr. Bland Sutton.

was first described by Rokitansky as a special variety of cystoma; and Ritchie first discovered the presence of ova in its cysts. "These tumours are always double, no case having yet been described as having occurred on one side only. They are always of very slow growth; their cysts are uniformly small, rarely reaching the size of an orange, and generally being little bigger than grapes. The tumours are never large, and it is only the fact that both ovaries are always affected that makes them objects of surgical interference. The contents of the cysts are invariably limpid, and the ovum may nearly always be found; and in these two respects, as well as in the immense number of the cysts, the tumours differ absolutely from ordinary cystoma."* Tait has operated upon two such cases, and a preparation from one of his cases is placed in the Hunterian Museum. A full account of this rare disease is given in Tait's work.

TAPPING OVARIAN CYSTOMATA.

The present position of tapping as a surgical procedure in ovarian cystoma is rather as a measure for temporarily relieving symptoms, than as a plan of treatment. As an aid to diagnosis, it has been practically discarded. As a method of cure, it has long been accounted futile. And even as a means of ameliorating symptoms, it is doubtful if the combined risks, immediate and remote, are not often as great as those following complete removal of the tumour.

The occasions on which tapping may be legitimately adopted are twofold: firstly, when removal of the growth is inadmissible; and secondly, when the patient is suffering from some incidental ailment which renders postponement of operation necessary. In the first case, tapping is used simply to promote euthanasia; in the second, to gain time for improvement of the patient's condition. The coincidence of any grave and incurable disease, such as cancer, phthisis, or advanced disease of the heart, or in fact any condition which negatives surgical operation of any sort, negatives ovariotomy. Here tapping may

* Tait, *Diseases of the Ovaries*, p. 169, 1883.

be advisable, to prolong life or to render it less painful. On the other hand, if a patient is suffering from an acute disease—such as bronchitis, or pneumonia, or typhoid fever—which negatives ovariotomy, and the progress of which is likely to be favourably influenced by relieving a distended abdomen, tapping is expedient. Also in chronic complaints, such as bronchitis with dyspnœa, tapping may contribute to the patient's improvement, and so increase the chances of success for the major operation. When the renal functions are upset, or when there is œdema of the limbs from pressure, or generally where the condition of the patient is deteriorated by the existence of intra-abdominal pressure, tapping may, by temporarily removing this pressure, cause material improvement in the patient's condition.

FIG. 17.

Wells's Ascites Tube. Half size.

The operation must be conducted with a supreme regard to antiseptic purity. The skin at the site of puncture must be thoroughly cleansed; and the instrument, inside as well as outside, must be perfectly pure. The antiseptic trocar of Ward Cousins is a very suitable instrument for the purpose; and the blunt ascites tubes of Tait and of Wells (Fig. 17) would leave nothing to be desired, if they did not require previous puncture of the abdominal walls by lancet—a necessity which many would consider a disadvantage. The exact nature of the instrument matters little, provided it be small, simple, and as nearly as possible a closed tube. It ought not to be larger than a No. 6 English catheter. A large trocar is doubly objectionable, as causing a large opening in the cyst-wall, which may leak; and as permitting too rapid a flow of fluid, which may cause shock to the patient. A long rubber tube is attached to the end of the cannula, and conducts the fluid into a suitably placed receptacle. Bandages to compress the abdomen are quite unnecessary. The patient lies on her side near the edge of the bed, and the trocar is inserted at a suitable place, usually

somewhere in the middle line, between the umbilicus and pubes. The end of the rubber tube is kept under carbolic lotion, and never removed therefrom, as air is liable to enter. A piece of glass tubing inserted in the middle of the rubber tube will show whether fluid continues to flow. When the cannula is removed the opening is pinched between the fingers, and the tissues moved about, so as to destroy the continuity of the perforation. A small piece of lint, soaked in collodion, is sufficient to close the opening. A binder relieves the uncomfortable sense of emptiness which usually remains after relief of abdominal tension.

Conducted properly, the operation of tapping is attended with very slight risks. It is just possible that the disrepute into which the proceeding has fallen is to be attributed to careless manipulation or unclean instruments. Men who have not before their eyes a complete foreknowledge of its possible effects are liable to have recourse to tapping on every occasion when they have a patient suffering from fluid distension of the abdomen, and such men are not likely to take full scientific precautions.

HISTORY OF OVARIOTOMY.

The history of ovariotomy reads almost like a romance. From being dreamed of as a remote possibility by advanced thinkers some century and a half ago in the capitals of Europe, and attempted by one or two daring enthusiasts, it first reached its consummation as a definite schemed operation far away from the centres of civilisation. In Great Britain, as in its birth-place, America, the operation had struggled into existence and was thriving in the provinces, before it had established a footing in the capital. It was true of this, as of so many other improvements in practical surgery, that it owed its birth to the freedom and independence of the provincial mind: the spirit of the pioneer had certainly entered the soul of Ephraim McDowell, almost in the backwoods of Kentucky.

There is no doubt but that some form of mutilation of the female sexual organs has been practised from the most ancient times. In most instances this was probably removal of some

parts of the external organs of generation; in some, however, it would appear certain that the ovaries were actually removed. This was essentially female castration, or spaying; and the removal, in righteous anger, of the ovaries of his unchaste daughter by the Hungarian sow-gelder, two centuries ago, is probably the last operation of this sort known to history. Such operations, demonstrating, as they did, the possibility of removing ovaries that were healthy, were probably not without their value in clearing the way for the removal of ovaries that were diseased. The value of such operations, however, will be best estimated in considering the operation of oöphorectomy.

To the active and enquiring minds of many surgeons living in the early parts of the eighteenth century, the possibility of removing cystic ovaries was often presented. Willius of Basle, in 1731, spoke perhaps most clearly in favour of the operation, though he had not the courage to attempt it. Delaporte* actually treated an ovarian cyst by incision through the abdominal wall, but did not remove it. Morand, who follows up Delaporte's paper in the same volume by some remarks of his own, desires to give the latter credit for having been the first definitely to propose the removal of an ovarian cyst, and expresses his own opinion that the operation is feasible, provided there be no adhesions. Hunter, in 1762, with the far-seeing genius which we now fully appreciate, actually suggested the small incision, tapping the cyst, removing it, and ligaturing the pedicle. The surgeon who came nearest to being the first ovariotomist was Chambon, who, in 1798, published in Paris a treatise on The Diseases of Women, wherein he strongly recommended the removal of diseased ovaries. He gave accurate accounts of the anatomy of cystic tumours of the ovaries, and tried to show how to diagnose adhesions, and how to deal with them. John Bell, no doubt familiar with the work of French surgeons, constantly dwelt in his lectures on the possibility and the advisability of removing such tumours, and his teachings bore fruit; for one of his pupils, Ephraim Mc Dowell, was the first ovariotomist.

* *Mem. de l'Acad. Roy. de Chir.*, tom. ii.; Paris, 1753.

The claims of Mc Dowell of Kentucky to be considered as the first surgeon who deliberately and scientifically planned and performed the operation of removal of an ovarian tumour are now established beyond dispute. The operation of Houston of Glasgow was almost certainly not a complete ovariotomy,* and those of Lammonier of Rouen, Dzondi of Halle, and Galenzowsky of Wilna, even if thay had been ovariotomies, which they were not, were performed subsequently to the first operation of Mc Dowell. In December, 1809, Mc Dowell operated on Mrs. Crawford, and seven years later he published his report of this and two other operations. In America, the operation thus initiated was taken up by Nathan Smith of Connecticut, by Alban Smith of Kentucky, by Gallup of Vermont, and by many others. Up to the end of 1863, according to Peaslee,† ovariotomy had been reported as performed in America 117 times, with 68 recoveries and 49 deaths. Since then, American surgeons have taken a prominent and honourable share in perfecting the operation, which is now performed everywhere throughout the Continent.

In Great Britain, the operation did not at first make much progress. Lizars operated in Edinburgh once in 1824, and three times in 1825, but with such small success that Liston boasted that he took good care that Lizars did not set about any such operation in the Infirmary after he became attached to it.

* It is right to say that Tait, who has made special enquiries into the subject (*Dis. of Ovaries*, 1883, p. 239), claims for Houston the honour of having been the first ovariotomist. Now, an ovariotomy is not complete unless the tumour is removed and the pedicle is secured. In Houston's account of his case there is not a suggestion that he did either. It seems to me scarcely credible that a surgeon who could describe, as minutely as Houston did, the somewhat trivial expedient adopted for removing the glairy fluid should leave unmentioned the far more important proceeding of removing the tumour, and dividing and securing the pedicle. "I then squeezed out all I could [of the contents] and stitched up the wound in three places." If between the squeezing and the stitching the grand measures of removing the tumour and securing its pedicle really did occur, I think he must have at least mentioned them. Houston says the tumour was of the left ovary, but the only proof he adduces in support of this is that it lay on the left side. The after-history of the case is in no way inconsistent with his having incised an ovarian growth. † *Ovarian Tumours*, p. 247; London, 1873.

The medical papers of those days were also dead against the operation; and few attempts and an equal number of failures were recorded till 1836, when William Jeaffreson, a surgeon of Framlingham, operated successfully by the small incision. In the same year, King of Saxmundham had a successful operation; and in 1839, West of Tonbridge had two successes. A few London surgeons operated in the next year or two, in every case unsuccessfully. The thread of success was then picked up by Charles Clay of Manchester in 1842, who, in the words of Peaslee, "soon became the most successful ovariotomist living," and to whom, "more than to all other operators, the credit belongs of having placed the operation of ovariotomy on a sure foundation." Up to 1850, eight years before Spencer Wells began to operate, he had chronicled twenty-one successes out of thirty-three operations—a result more favourable than Wells could show in the same number of cases, not finished till twelve years later. Between 1852 and 1856, Baker Brown operated nine times, with seven deaths. This mortality checked him for four years, when he began a career which, but for its untimely and unfortunate termination, would probably have done much for ovariotomy.

The year 1858 brings us to the beginning of the remarkable career of Spencer Wells. Commencing with a promise faithfully to record every case, successful or unsuccessful, upon which he operated, he has pursued this course to the present day, when he has well passed the thousand. Round his personality centred all the changes, improvements, and, we must add, retrogressions, which have followed the fortunes of the operation. His hearty readiness to try the recommendations of others, though it has not always been conducive to reduced mortality, has testified to his honesty of purpose and breadth of view.

The next prominent figure in ovariotomy is that of Thomas Keith of Edinburgh. In 1863 he performed his first ovariotomy, and he very soon proved himself the most skilful of all. To-day some of his operations, such as those for removal of large fibroids, seem almost to have reached the limits of successful human surgery.

And, among those who have more recently entered the field, the brilliancy of results seems still to be on the increase. Tait of Birmingham has attained to a success which is as remarkable as it is well deserved. He can show the extraordinary record of one hundred and thirty-nine ovariotomies without a death, a result which could scarcely be shown for the most trivial surgical operation. At the Samaritan Free Hospital, in London, the mantle of Wells has worthily fallen on the shoulders of Thornton and of Bantock. On the Continent, the names of Koeberlé, Schroeder, Billroth, Martin, and a host of others, are honourably associated with the operation. And all over the civilised world, in every capital, town, and village, there are surgeons who, with honour to their art and credit to themselves, successfully perform the operation, which half a century ago was condemned by the leaders of surgery as being little removed from murder.

APPRECIATION. INDICATIONS FOR OPERATION.

Ovariotomy is the most successful major operation in surgery. Within the memory of living surgeons its mortality has diminished from what was almost the limit of the justifiable in surgery, to a figure which, as statistics are estimated, is practically zero. Our best English operators—Keith, Thornton, Bantock, and others—in the last few years had brought their death-rate down to the marvellously low figure of about ten per cent., more or less, when Lawson Tait's records beat all, by the extraordinary result of one hundred and thirty-nine cases without a death, and a general mortality over several hundreds of cases of less than five per cent. Keith's recent mortality, in private operations with cautery-clamp, is, he tells me, under two per cent. Surely this is the *ne plus ultra*, not only of abdominal surgery, but of all surgery. If it is not a justification for the performance of ovariotomy, wherever an ovarian tumour exists, it is undoubtedly a stern command to all who seek to perform the operation, so as to give their patients the best chance of life, to spare no pains to perfect themselves in every detail of attainable knowledge.

With such prospects of recovery, it would seem that little more than the diagnosis of ovarian cystoma was necessary to justify operation. Excluding the just and proper contra-indications to this or any other serious surgical operation, and which need not here be mentioned, there is scarcely a condition in the tumour itself which absolutely forbids operation. The only question is as to the best time for operating. The futility of all modes of medical or incomplete surgical treatment has long been admitted; complete removal alone gives certain recovery. When twenty or thirty, or even forty, per cent. of the cases operated upon died, there was some justification for the postponement of the operation till such time as the patient's health and comfort were being interfered with. But with such mortality as the operation now gives in the best hands, this position is scarcely tenable; in fact, it has been quietly given up. The rule is now to operate early—as soon, in fact, as the existence of the tumour has been proved. The arguments in favour of early operation need not here be dilated upon.* Suffice it is to say, that as there is but one escape from the disease, by removal; and as delay involves the risks of changes and accidents in the tumour, of secondary disease in other organs, and of general impairment of health, it is right that the operation should be performed as early as possible.

The question of ovariotomy during pregnancy can scarcely be answered in general terms. A good many successful ovariotomies performed during pregnancy have been recorded; and many examples of healthy gestation, followed by normal parturition, going on side by side with the growth of an ovarian tumour, could be quoted. Ovarian cystoma no doubt predisposes to abortion, and other dangers of the pregnant state; and pregnancy renders more likely the ordinary accidents to which cystoma is liable. Each case must be judged on its merits. The points specially to be attended to are: the rapidity of the growth of the tumour, the period of gestation, and the condition of the patient. A tumour of rapid growth, discovered in the early stages of pregnancy, might be removed, when another of

* See Dr. Bantock's *Plea for Early Ovariotomy*, London, 1881.

slow growth, large, and possibly difficult of removal, might be tapped, particularly if the expected time of delivery was close at hand. Beyond these general statements, it would be unwise to dogmatise.

THE OPERATION OF OVARIOTOMY.

Preliminary.—The patient will have been prepared according to the general directions already given. Her bowels will have been opened by aperient, and she will have passed water immediately before the hour fixed for operation. She is placed on the operating table, dressed in a flannel jacket, and her limbs are covered by warm blankets or surrounded in cotton wool; and, if deemed expedient, a layer of cotton wool is laid over the chest and abdomen, up to the limits of the opening in the macintosh sheet. The sheet is placed in position so that the hole leaves exposed the site of operation, and elsewhere completely covers the patient, and hangs over the edges of the operating table. The adhesive material spread round the margin of the opening keeps the sheeting closely in contact with the skin on the parietes. The exposed skin and the macintosh around are once more cleansed with carbolic lotion, and a sponge-cloth wrung out of 1-40 carbolic lotion is laid over the macintosh covering the thighs, which will have been confined by a broad bandage. The spray is placed opposite the patient's left shoulder, at a distance of six feet or more from the wound. This position is selected so that the patient shall not respire a carbolised atmosphere. A receiver, to collect the fluid, is placed at the side of the table next to the operator.

Assistance.—Besides the anæsthetist, one assistant is all that is necessary. His special duties will be, to sponge, to manipulate forceps during the application of ligatures, and to help during the deligation of the pedicle and the suturing of the abdominal wound; besides these, he will be frequently called upon to discharge other minor functions, too numerous to be mentioned.

A nurse will be wanted, to cleanse and hand sponges, and to see to the provision of hot water, lotions, and such minor necessities. The operator helps himself to instruments, which are placed in trays upon a table placed conveniently within the reach of his right hand. The assistant stands on the left side of the patient, facing the operator. (See Fig. 5, p. 69.)

Instruments.—The following instruments are recommended for the performance of ovariotomy:

Tait's hæmostatic pressure forceps	12
Thornton's T-shaped pressure foceps	2
Wells's large cyst forceps—angular and straight...	4
Wells's medium cyst forceps	4
Nelaton's cyst forceps	2
Knife	1
Scissors	1
Pedicle needles, in handles, blunt	2
Cyst trocar, with tubing, Tait's large (Fig. 20) ...	1
„ „ Spencer Wells's, with Fitch's dome (Fig. 21)	1
Suture instrument	1
Reel-stand with silk ligatures	1

With these instruments most ovariotomies may be satisfactorily performed. In routine operating, they are laid out in three trays containing enough carbolic lotion to cover them. One tray contains the small hæmostatic forceps, fourteen in number; another, of larger size, contains the large and medium cyst forceps, ten in number; while the third contains the knife, scissors, pedicle needle, and suture instrument. The trocars, with tubing attached, are kept apart, in a large basin. The ligature silk, of assorted sizes of finest Chinese twist, is kept on reels in carbolic lotion—the reel-stand already described (Fig. 4) is very convenient for this purpose—and ligatures cut off as they are wanted.

These, or similar instruments, are absolutely essential; but few surgeons would care to begin operation without several other

instruments being at hand, in case they were wanted. Among these might be mentioned:

Koeberlé's clamp, with pedicle skewers.
Cautery irons. (Paquelin's thermo-cautery requires a separate assistant.)
Six Keith's glass drainage tubes—assorted sizes.
A second dozen of pressure forceps.
Two retractors.

Each operator will probably like to have, in reserve, a few special instruments to which he has become accustomed: the writer, for instance, never likes to be without his crushing scissors. A Lister's sinus forceps, with points a little sharper than ordinary, is an excellent substitute for the needle which carries the ligature through the pedicle: the point is pushed through, the blades are separated, and they catch the ligature thread and draw it backwards through the opening made. Many surgeons use a director and a dissecting forceps. Special instruments for crushing the pedicle before tying it; an exhausting air-pump, attached to the trocar; peculiar needles for suturing the abdominal wound, and many other appliances, are in vogue; but the above may be taken fairly to represent the instrumental aids necessary to a skilful performance of the operation.

Some of the instruments require special description. Tait's pressure forceps (Fig. 6)—a modification of Koeberlé's—is superior to Wells's instrument in being more pointed, thus permitting the ligature to slip over it in tying adhesions, and in being more powerful in grasp. In other respects, the instruments are practically identical. Thornton's T-shaped forceps is a most useful addition to our hæmostatic agents. It is scissors-handled like the other catch forceps, with a rack catch, but differs in having the compressing blades set at right angles to the handle. For holding broad adhesions, or compressing a piece of omentum which has to be secured with multiple ligature, or closing a small rent in a cyst, Thornton's instrument is simply invaluable. I have found a very large forceps on the same principle most useful for like

purposes. For firmly grasping and holding the tumour itself, the cyst forceps of Nelaton (Fig. 18) and of Spencer Wells leave nothing to be desired. Nelaton's forceps, with its round, serrated, and spiked biting surfaces, maintains a grasp on the cyst-wall which is as powerful as the area it grasps can make it. Wells's large cyst forceps, on the same principle as his small pressure forceps, is perhaps less likely to cause tearing, and holds nearly as firmly as Nelaton's. They are made with straight and with bent blades. (Figs. 7, 8, 10.) A size of Wells's forceps midway between the smallest and the largest will be found very handy. Wells's clamp forceps (Fig. 19) may occasionally be found useful for closing rents in the cyst, or for compressing large bleeding areas. The only advantage which they possess over large pressure forceps is that they occupy less room.

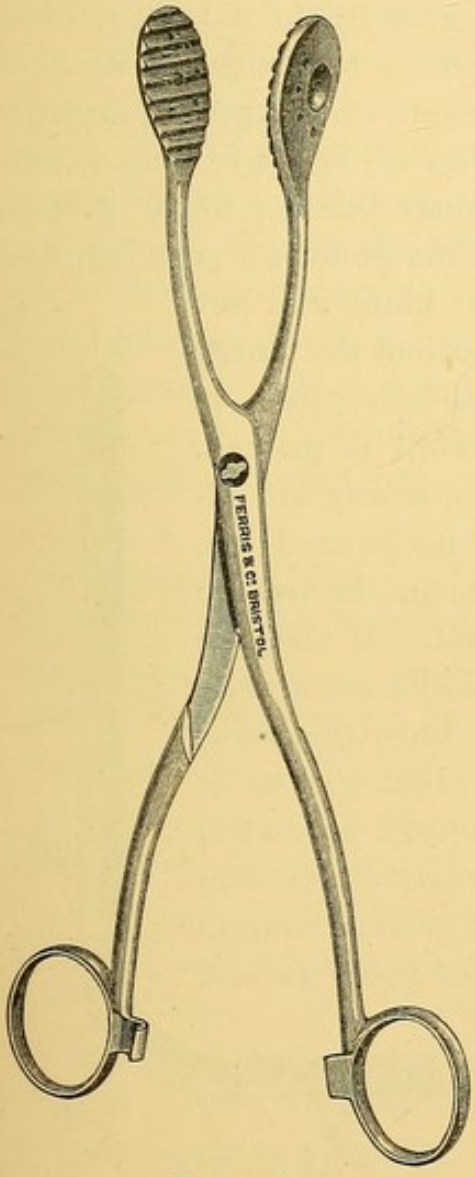

FIG. 18.

Nelaton's Cyst Forceps. Half size.

For evacuating the fluid, we have a choice of many trocars. It is wise to have two instruments in readiness—one of large size, and another not very

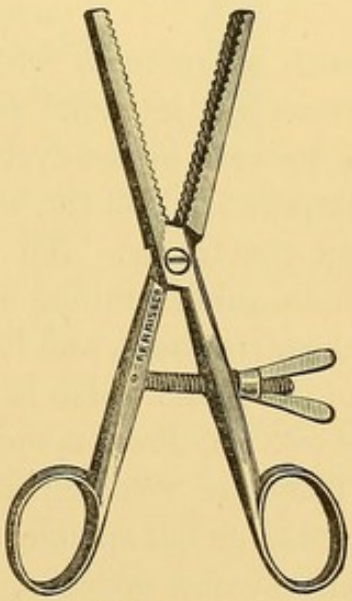

FIG. 19.

Wells's Clamp Forceps. One-third size.

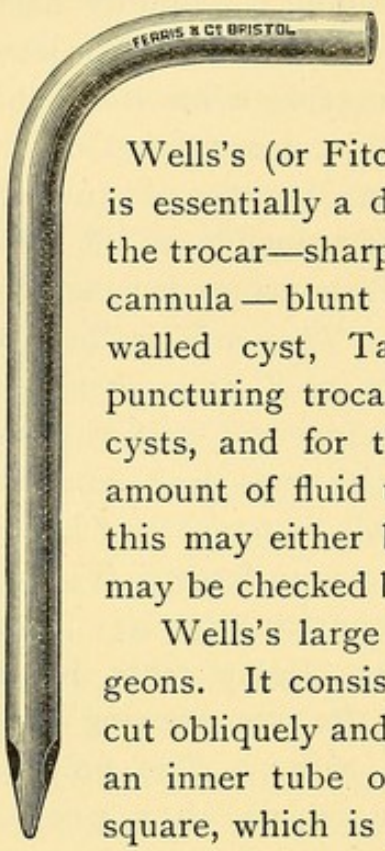

FIG. 20.

Tait's Cyst Trocar. One-third size.

large. The two I should select are Tait's large instrument (Fig. 20), conical pointed, but not cutting, and Wells's (or Fitch's) small instrument (Fig 21), which is essentially a double tube, the outer one of which is the trocar—sharp and pointed, and the inner one is the cannula—blunt and extrusible. For a large thick-walled cyst, Tait's trocar is best. Wells's small puncturing trocar is suitable for small and multilocular cysts, and for those which have thin walls. Some amount of fluid usually escapes by the side of it; but this may either be collected by a sponge, or its flow may be checked by the pressure of a large cyst forceps.

Wells's large trocar (Fig. 22) is used by many surgeons. It consists of an outer tube or trocar proper, cut obliquely and sharp at the point, for piercing, and an inner tube or cannula, blunt and cut square, which is pushed beyond the trocar by an attached thumb-piece as soon as the cyst-wall is pierced. To the sides of the trocar are attached two spring hooks or clasps, with sharp teeth which fit into pits on the trocar; these are intended to grasp the cyst-wall and pull it forward as the cyst empties. Volsella are usually required to pull the wall of the cyst under the hooks on the trocar. To the trocar is fitted a piece of india-rubber tubing of a calibre as large as that of the instrument, and long enough to reach the bottom of the vessel which is intended to receive the ovarian fluid. A dozen sponges are prepared ready for use. They are selected as follows: one large flat sponge; four moderately flat sponges, about six inches long and from three to five inches broad; and seven round sponges, of various sizes.

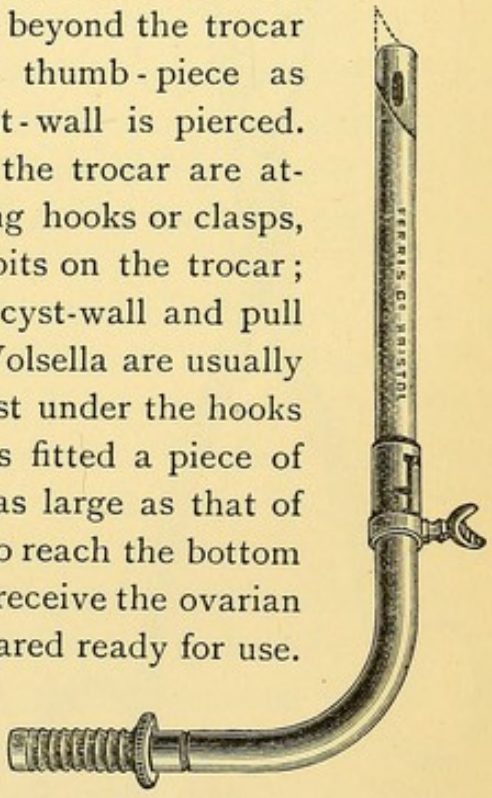

FIG. 21.

Wells's Small Cyst Trocar, with Fitch's Dome. Half size.

They are kept in warm 1-40 carbolic lotion, and wrung out of this fluid by the nurse or assistant when required. As they are soiled they are handed to the nurse, who cleanses them thoroughly in warm water, and then places them in the warm carbolic lotion. A continuous supply of clean sponges is thus provided.

For use in ovariotomy, and indeed in all other surgical operations, I become daily more impressed with the value of sponge-cloths for many purposes for which sponges are used. They are thick, very soft, have great absorbing powers, and are very easily cleansed. Most important of all, they are improved by being boiled, whereas boiling destroys sponges. Laid over the abdominal wound under a bleeding tumour; coiled around a piece of intestine while it is being sutured; folded over omentum which has been stripped off a tumour, and in many similar ways, sponge-cloths will be found very useful.

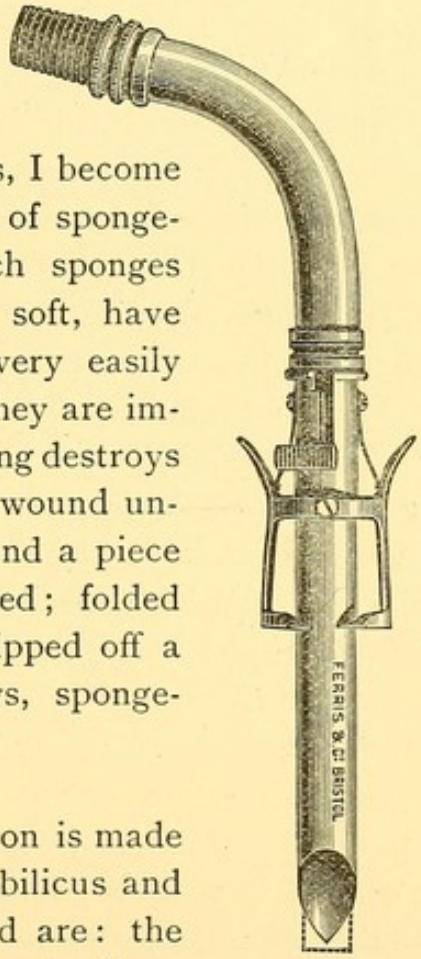

FIG. 22.

Wells's Large Cyst Trocar. One-third size.

The Abdominal Incision.—The incision is made in the middle line between the umbilicus and the pubes. The structures divided are: the skin, the subcutaneous fatty layers, the linea alba, the layers of the fascia transversalis with the subperitoneal fat, and the peritoneum. The skin in this region does not usually present features of special practical interest. It may be firm and resilient, and intimately adherent to the sub-cutaneous fat; or it may be flaccid and soft, and readily movable over the underlying tissues. In the former case, it is easily divided in a straight line by the knife held in the first position; in the latter case, it may run before the knife, and will be most satisfactorily divided by pinching it up and transfixing it, as in herniotomy. The thickness of the subcutaneous fatty layer varies very con-

siderably. In cases where there is much emaciation, it may be practically absent—the first incision exposes the fibrous aponeuroses; in very stout individuals, the subcutaneous fat may be several inches in thickness. The thickness of this layer may be increased by œdema. In most cases, the subcutaneous areolar tissue is divisible into two layers. The outer layer is pre-eminently fatty; the inner, mainly fibrous. Only in young subjects, however, is this distinction well marked. The vessels ramify mainly in the outer fatty layer; usually they are quite small, but sometimes a moderately large branch is divided. The veins are occasionally large and tortuous, and sometimes bleed so freely after division as to require forcipressure or even deligation.

The linea alba is a structure of fairly constant composition and thickness. In muscular individuals with small tumours, the recti lie quite close to each other, and the linea alba is then little more than a fibrous partition; in thin subjects whose abdominal walls are distended, the linea alba may be stretched so that the recti are separated by half an inch or even more. In the latter instance, it is easy enough to divide the linea alba without opening the sheath of the rectus; in the former, this is a matter of some difficulty, and in practice one or both sheaths are frequently opened. Indeed, in some cases the linea alba is so narrow that division of it accurately in the middle line must result in exposure of both muscles. It must be remembered that the posterior wall of the sheath of the rectus stops short at the falciform edge, and that the aponeuroses of the muscles below this—in the lowest fourth, that is to say—all pass in front of the recti. If the sheath is opened above this point, an additional layer of fascia, the posterior wall of the sheath, has to be divided before the subperitoneal fat is reached; below this point there is no additional layer, or only a thin fascia. As a matter of fact, the cavity is usually entered below the falciform edge; and if the opening is too small, it is extended upwards with scissors, when no account is taken of anatomical layers.

If the incision has to be carried above the umbilicus, it is wise

to deviate a little way to the left, and not to pass through it. This is done partly to avoid the round ligament of the liver, which passes from the umbilicus obliquely upwards and to the right, and may contain an unobliterated umbilical vein, but chiefly because the tissues in the umbilical area are thin and liable to be cut through by the sutures if there is straining from sickness. Such an accident happened to me in a case of hysterectomy, and a large coil of intestine escaped. Fortunately the accident was soon discovered and no harm was done. The urachus, normally transformed into the vesico-umbilical ligament, may also be found pervious. Sometimes small openings exist in the linea alba, through which masses of fat protrude (herniæ adiposæ).

The areolar tissue between the fascia transversalis and the peritoneum is very loose and elastic, and contains a varying amount of fat in its meshes. Its fibres can easily be teased apart, so as to expose the underlying peritoneum; and if it contains little fat, or if the peritoneum is adherent to an abdominal tumour, it may be mistaken for the tumour wall, and be separated from the parietes for some distance before the mistake is discovered. It may usually be separated into two or more layers.

The peritoneum varies in thickness according to idiosyncrasy, or as it is thickened by inflammation or thinned by distension. When there is much inflammation, the peritoneum may be a thick highly-vascular tissue, which bleeds freely on division: when the acuteness of the inflammatory process has subsided, it may be united more or less firmly, by organised bands of fibrous tissue, to the underlying tumour; and in this case also its vascularity will be increased. Generally speaking, an undue amount of bleeding during division of the parietes may be taken as indicating adhesion of peritoneum to intra-abdominal structures.

The first incision need not be longer than two or three inches, according to the thickness of the abdominal walls. The lower extremity of the wound is at a distance of two inches from the pubes. Lower than this it is not advisable to go, on account of the proximity of the bladder; if the opening is found to be too small, it is enlarged upwards. The amount of subcutaneous fat

is estimated by touch, and the first incision divides skin and more or less of the fatty layer. One or two rapid cuts along the whole length of the wound complete the division of this layer, and expose the linea alba. Bleeding points are caught up in pressure forceps. A glance at the fibrous aponeurosis may, by showing a symmetrical arrangement of its fibres, indicate exactly the middle line. One or two dexterous movements of the scalpel divide the aponeurosis in the middle of the wound. If the muscle is exposed, a little movement of the divided fibres over it will show on which side of the linea alba the opening has been made, and the rest of the division is completed, upwards and downwards, close to the middle line. This exposure of muscular fibre is of little practical moment. Indeed, some operators prefer always to expose muscle, and more than one skilled operator recommends that the opening be made through the muscular fibres. The reason given is, that a firmer and broader cicatrix is got from union of muscle than from union of fibrous tissues. Whether this be true or not, which is more than doubtful, it is certain that perfectly good union is obtained when exposed muscular surfaces are brought into apposition. The division is made by the knife alone, or by scissors; no director is required.

The loose transversalis fascia is now exposed. If it contains a considerable amount of fat, this is pushed aside, and the peritoneum exposed by teasing. The deeper fibres of this fascia are usually divisible into several layers. These may be divided in various ways—by director and knife, by director and scissors, by scissors alone, or by forceps and knife. As a general rule, I think the last is the best plan. Where it seems to be feasible, the best plan of all is to pinch up fascia and peritoneum between the forefinger and thumb; roll it from side to side to make certain that no bowel is included, and open the peritoneum by a minute incision, through which the blade of the scissors may be inserted to complete the division. The most generally applicable proceeding is, to catch up a small portion of fascia between pressure forceps and divide it between them, pulling the peritoneum outwards; if this does not effect an entrance, another little piece is caught between two pairs of

forceps, pulled outwards and divided till the cavity is entered. The peritoneum is thus divided towards the outside, and all risk of wounding intra-abdominal structures is avoided. The completion of the opening is made by scissors, protected by the finger inside the abdomen. The forceps may, if so desired, be left lying on the abdominal wall attached to the edges of the peritoneum, keeping it everted, and preventing it from being stripped in the subsequent manipulations. For picking up the peritoneum, Spencer Wells recommends the use of Adams's double sharp hook. Before opening the peritoneum, all bleeding must be checked by forcipressure; and after dividing the peritoneum, before proceeding further, its edges should be inspected to see that no hæmorrhage is going on.

The incision should be long enough to admit of the extraction of the collapsed and empty cyst without using force; that is to say, it will range between one and a half or two inches to eight or ten. The size of the tumours and the efficient treatment of adhesions alone should regulate the length of incision. While the chances of ventral hernia are diminished by a short incision, the actual difficulties of the operation should never be increased by working through a cramped opening. The rule to make the first incision long enough to admit the hand should be abolished: the length of the incision is to be regulated by principles more weighty than mere exploration, which is usually both meddlesome and unnecessary.

Emptying and Removing the Cyst. Separation of Adhesions.— Some idea of the nature of the exposed tumour will have been rapidly formed by sight and touch. The characteristic appearances, already described, of a cystoma and of a dermoid growth; the density, toughness, or friability of the cyst-wall; the nature of the contents as to fluidity or viscidity; the multiplicity of secondary cysts; and the presence or absence of adhesions or inflammation, will all be noted. A skilled surgeon will instantaneously decide as to the best practical means of dealing with each and all of such peculiarities in the growth to be removed: here it is possible to give only general directions.

Whatever be the condition, it is always best to begin by emptying the cyst. To explore with the finger is, in the great majority of cases, to satisfy curiosity rather than to help in the treatment. And to begin by separating adhesions, is a double mistake. By so doing, not only do we run the risk of rupturing the cyst-wall and letting the contents of the full cyst escape into the peritoneum, but we also deal with the adhesions at the most inopportune period, when there is little room for manipulation, and a likelihood of leaving bleeding points unsecured because they may not be seen.

The best mode of emptying the cyst is, in the large majority of cases, by tapping. When the growth is divided into a great number of cysts, or if the cyst-contents be very viscid, incision may be the best plan.

For a cyst of small size, the best tapping instrument is Wells's small cyst trocar (Fig. 21); for a large cyst, Tait's instrument, with blunt conical point, may be used. (Fig. 20.) Keith uses a very large exhausting aspirator, and this is probably the best plan of all. To prevent the escape of fluid by the side of the trocar, a sponge is all that is requisite. To keep the bowels from extruding the best plan is, not to push the abdominal walls backward on the cyst, but to pull the cyst forwards on the edges of the opening. As the cyst becomes flaccid, Wells's large forceps are made to grasp the cyst-wall and pull it steadily but gently out of the wound. A flat sponge placed between the cyst and the parietes, may be useful in preventing the escape of fluid into the abdominal cavity. Secondary cysts may be emptied without removing the cannula from the main cyst: but, whilst this is being done, the fingers, inside the abdomen, should make certain that the trocar is not pushed through the main cyst-wall. As the cyst becomes flaccid the trocar opening is pulled over the edge of the wound; and as soon as it is clear of the abdominal opening, a fold of the cyst-wall, above and below, is caught in strong forceps, the trocar is removed, and the wall freely incised between the forceps, permitting the cyst contents to run over the macintosh into the receptacle below. Secondary cysts are broken down by two fingers inserted into

the incision in the large cyst, or, if necessary, by the whole hand. Should bleeding be free during the breaking down of the septa, the incision must be prolonged, to permit of the whole tumour being delivered so that its pedicle may be compressed. If adhesions do not prevent it, the whole cyst is delivered as soon as it is sufficiently diminished in bulk; if adhesions do exist, they are divided as they come into view, in a manner to be presently described.

When it is deemed advisable to evacuate the cyst contents by incision (a few surgeons always adopt this method), two large Wells's forceps are attached to the cyst-wall, opposite the ends of the wound, and an incision made between them, while they are forcibly pulled upwards, so as to keep the cyst-wall in contact with the parietes. Interposed flat sponges gather up any escaping fluid. The cyst-wall is sometimes so tense that it is not easy to get a grip by the forceps; in this case, as much as possible is first pinched up by small forceps, and the large forceps are placed below the fold thus made. Dermoid cysts are in most cases best emptied by incision.

If, after emptying the cyst as completely as possible, adhesions prevent its being delivered, a larger T-shaped forceps is placed on the opening, so as to close it, and the important steps of separating the adhesions are begun. For separating very soft, fine, and recent adhesions, nothing is better than a sponge. The adherent organ is, so to speak, sponged away from the tumour, and the sponge is left overlying the adhesions it has pushed aside, so as to absorb any blood that may ooze from the divided minute vessels. Adhesions of firmer consistency are dealt with in various manners. If comparatively recent, they may be carefully peeled off the tumour with the fingers, while forceps are applied as often as necessary and left attached. If the adhesions are old, fibrous, and thick, they are surrounded by ligatures and divided. Speaking generally, soft adhesions which may be sponged off are usually found on the parietes or the liver; adhesions which may be peeled off by the fingers are most frequently omental; and division between forceps is in most cases required when bowel is attached to the tumour.

Attachments to uterus and bladder, if they exist at all, are usually intimate and dense, and their separation requires care and judgment.

Wherever it is possible, forceps are brought out through the wound and left there while the soft tissues are placed between the folds of a flat sponge or thick sponge-cloths. And, generally, as the separation proceeds, sponges are placed in every gap made between the tumour and the detached organ. When the whole tumour is delivered, a large sponge is placed over the bowels, to protect them and to prevent their escaping.

During the separation of adhesions the walls of any of the hollow viscera may be torn. Such lacerations must, of course, be immediately closed by suitable sutures. If at any point the connection to bowel or bladder is so intimate that complete separation seems fraught with danger to the integrity of the organ, then the adherent portion of cyst-wall must be cut off and left behind. In removing a very large suppurating, putrid, and universally adherent Fallopian cyst, I had to leave behind a considerable portion of the thick cyst-wall in a matted mass of inflammation sessile on the left iliac vessels and the sigmoid flexure. After drainage and daily syringing for more than a month, this came away through the drainage opening as a slough which filled a three-ounce bottle. A fæcal fistula resulted, which spontaneously healed. Considerable portions of uninflamed and healthy cyst-wall may be left behind without incurring risk.

For the management of many abnormal conditions which are constantly arising in bad cases, definite instructions can scarcely be given. Such instructions would be as endless as the complications; they could never be exhaustive. If broad guiding principles are fully mastered, and the surgeon has a fair knowledge of the general surgery of the abdomen, he may safely be left to manage the ordinary complications met with in ovariotomy.

Treatment of the Pedicle.—The pedicle has been subjected to almost every conceivable surgical treatment. "It has been tied entire, tied in sections, been twisted off, burnt off, crushed off,

cut square off, cut off in flaps, left inside, left outside, and been made to slough off."*

It has always seemed to me that this *quæstio vexata* of ovariotomy has been unduly magnified in importance. To a surgeon accustomed to deal with amputated limbs the pedicle is, comparatively, a small matter. A few small vessels to supply a pound or two of not very vascular tissue, with slight fluid pressure and little foreign material around them, ought not to alarm us. We rarely have a vessel larger than the radial to deal with, and very rarely one that will spout a stream to a distance of six inches. The cases are few indeed where the whole of the vessels may not be easily compressed between the fingers. True, the very facts that the blood-pressure in the vessels of the pedicle is low, and that the vascular walls are thin, are against their capacity for self-occlusion by the ordinary pathological process after deligation. If hæmostasis is easy,

* Sutton, *Trans. Amer. Gyn. Soc.*, 1883, vol. vii., p. 119.

From this source is derived the following instructive historical summary of the treatment of the pedicle in ovariotomy :

1809. McDowell tied with single ligature, and left ends outside.
1820. Chrysmar of Würtemberg tied in two portions, leaving ends out.
1821. Nathan Smith tied arteries separately with strips cut from kid glove, cut ligatures short, and dropped in pedicle.
1837. Stilling of Cassel used cautery, and suggested stitching pedicle in wound.
1846. Handyside of Edinburgh carried ligatures through Douglas's pouch into vagina.
1848. Stilling treated pedicle outside peritoneal cavity.
1850. Duffin, London, began Stilling's plan in England.
1849. Maissonneuve of Paris twisted the entire pedicle.
1850. Atlee used the ecraseur, and many followed him.
1850. Hutchinson invented clamp.
1860. Sir James Simpson, acupressure inside abdominal wall.
1865. Kœberlé invented his serre-nœud, or wire-constrictor, with which he grooved the pedicle prior to ligation.
1864. Baker Brown used Stilling's cautery.
1868. Masslovsky, double-flaps, and stitched them.
1869. McLeod of Glasgow, torsion between two pairs of strong forceps.
1870. Emmet, 18 cases treated with silver wire.
Billroth catches pedicle between two forceps, ligatures, and divides with thermo-cautery.
Nussbaum ties pedicle in sections with catgut and drops in.

it must be thorough and all-embracing. But it need not be overdone.

At present we are practically left to choose between two methods of securing the pedicle, both almost perfect—the ligature, complete and intra-peritoneal; and the clamp and cautery. It is almost certain that extra-peritoneal treatment by the clamp is now permanently abolished, and I shall not describe it. With scarcely an exception, there is no sort of pedicle which can be clamped that may not be tied; and almost any form of deligation is as good as any method of clamping.

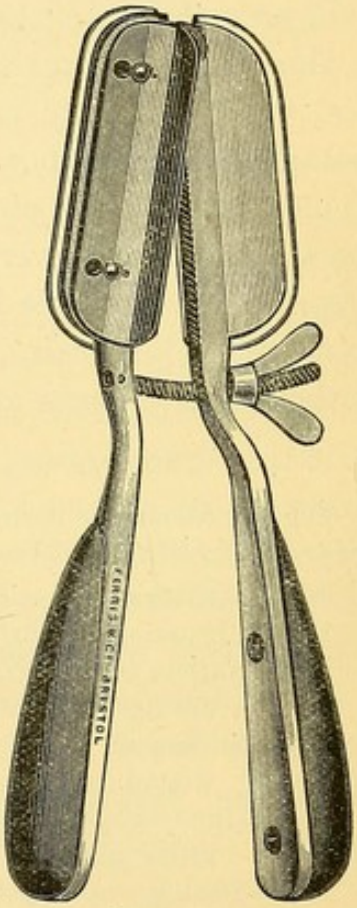

FIG. 23.

Keith's Cautery Clamp. One-third size.

In the hands of Keith, the method of *cautery and clamp* has reached perfection as nearly as any surgical procedure can. The minute accuracy of his manipulation, leaving a thin, grey, translucent band of anæmic but still living tissue, few surgeons can hope to equal, and certainly none to excel; and, in the face of the undoubted safety of the more easy and rapid ligation, I doubt if many surgeons will seek to imitate him.

The clamp which Keith uses is essentially that introduced by Baker Brown in 1864. (Fig. 23.) Two flat steel bars, each provided with a powerful handle, are joined at their distal ends by a strong hinge; on their under surface are two thick ivory plates, which extend a little way beyond the metal and act as non-conductors. On the left blade is fitted an upright guard, against which the cautery may be pressed, so as to prevent slipping. The cautery irons are very large, so that they retain their heat for a long time, and they are variously shaped

(Figs. 24 & 25) to suit the nature of the work. A hatchet-shaped cautery may be used for cutting through the pedicle, pressing it into the angle formed between the guard and the clamp. Disc-shaped cauteries are used for smoothing down and finally coagulating the seared edge. The cauteries, of which there should be two or three at hand and ready for use, are heated in an ordinary coal fire.

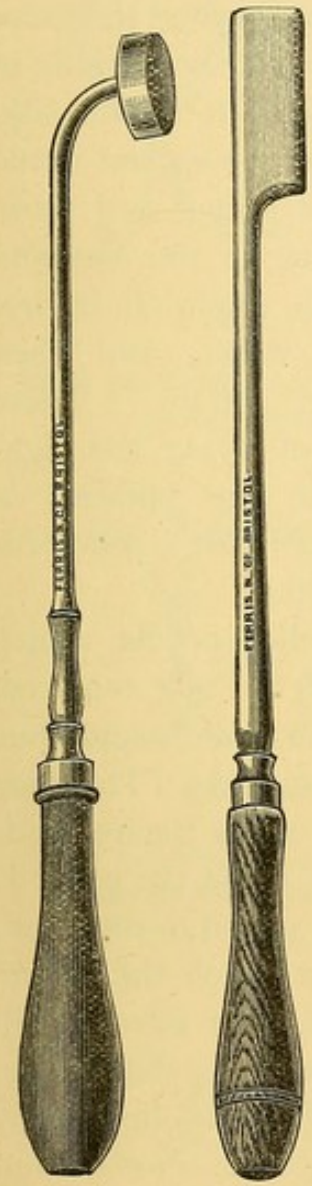

FIG. 24. FIG. 25.

Cautery Irons for Searing the Pedicle. One-third size.

In using the cautery-clamp, the pedicle is laid out at a convenient distance from the tumour between the blades. The tissues in the pedicle are left undisturbed as far as possible; compression is put upon them in the position which they naturally assume, and there is thus no tendency for the pedicle to untwist. The blades are tightened up by the screw as firmly as possible. Then the tumour is cut off with scissors about half an inch from the clamp. Before applying the cautery to the pedicle, wet cloths are laid around the clamp under the ivory, so as to prevent over-heating of the neighbouring tissues.

The cauteries used must be as hot as possible. They are rubbed up and down the blades of the clamp against the upright guard, till the line of compressed pedicle lying between the steel blades is perfectly smooth and level. No black charred tissue is left behind to slough; when efficiently dealt with, the stump terminates in a thin grey margin of dry semi-translucent tissue, not unlike cartilage in appearance and consistence. The clamp is removed with circumspection, catch forceps being placed at each side of the pedicle, to prevent its slipping into the

abdomen. Sometimes a seared vessel sticks to the blades of the clamp, and may be torn through if the blades are roughly removed.

The *silk ligature* is now almost universally used for securing the pedicle. There is no objection to catgut, beyond the extra trouble necessary in preparing it; I have used it successfully in more than twenty cases, but have now given it up for silk. And, as far as written records may be trusted, no special virtue resides in any form of silk, provided it be strong and pure. Chinese twist, of thickness varying according to the size and vascularity of the pedicle, is most generally used. It is first scalded in boiling water, and then soaked in antiseptic lotion. There are many methods of tying the ligature; no method, in my opinion, is superior to Lawson Tait's Staffordshire knot. (Fig. 26.)

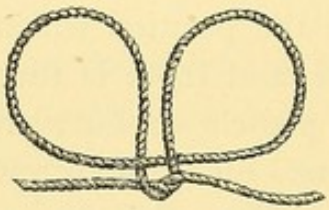

FIG. 26.

Tait's Staffordshire Knot.

"An ordinary handled needle, armed with a long piece of the silk required, is passed through the pedicle and then withdrawn, so as to leave a loop on the distal side. This loop is then drawn over the ovary or tumour, and one of the free ends drawn through it, so that one end is above, while the other is under, the retracted loop. Both ends being seized in the hand, they are drawn through the pedicle, against which the thumb and forefinger of the left hand are pressed, as a fulcrum, till complete constriction is made. A simple hitch is then made, as in the drawing, and tightened; and that is followed by another, as in ordinary ligature-tying. There is another and more complicated way of making the knot, by passing each end of the thread round the corresponding half of the pedicle, and crossing them within the loop in front, which is equally effective, and which may be used in cases of large solid tumours. But the former is by far the more elegant and rapid method."

The advantages which Tait justly claims for his knot are, that "while it ties the pedicle in two halves, these halves are

compressed really into one surface; the two halves are equally well compressed; and from the mechanical arrangement of the knot, very great constricting force can be employed."

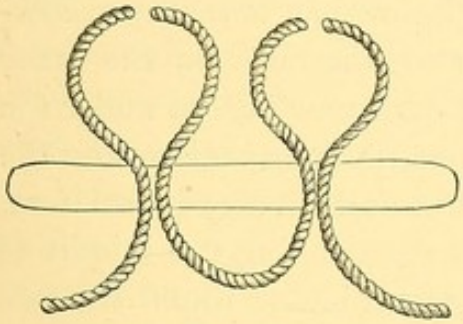

FIG. 27.

Triple Interlocking Ligature. The threads inserted.

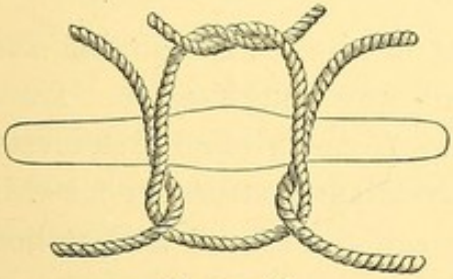

FIG. 28.

Triple Interlocking Ligature. The threads interlocked ready for tying.

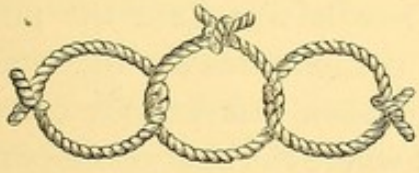

FIG. 29.

Triple Interlocking Ligature Tied.

The Staffordshire knot is, as every ligature applied to the pedicle should be, an interlocking one. Ligatures should never be applied to the pedicle in sections so as to split it. Such splitting extends downwards some way below the site of deligation, and may pass through a thin-walled vessel which may bleed very freely. In some cases of thick or broad pedicle, double deligation by the Staffordshire knot may not seem sufficient; then ligation in three or four portions may be advisable. In such a case the threads must be interlocked so that the pedicle, while it is tied in sections, is still compressed as a whole towards its centre, and splitting is thus rendered impossible. The accompanying diagrams (Figs. 27, 28, 29) show how this may easily and rapidly be done, when we desire to make deligation in three portions. A piece of silk long enough to form three ligatures is threaded in the blunt pedicle needle. The needle is passed, at about a distance of one-third of the breadth of the pedicle from one of its margins, through an area in which there are no vessels, or from which the vessels have been pushed aside; the silk is caught in a loop over a finger of

the left hand, and the needle withdrawn still threaded. It is re-inserted midway between the point of insertion and the other margin, the loop is caught up on another finger, the needle is withdrawn unthreaded and laid aside. The pedicle is now transfixed by a continuous ligature, which has two loops showing on one side, and one loop and two free ends on the other side. (Fig. 27.) The two free ends are now passed under the loop lying on their own side. (Fig. 28.) The two loops on the other side, still held on the fingers, are now divided by scissors, and the ends of the middle ligatures surrounding the middle of the pedicle, and including the ligatures which surround the two sides of the pedicle, are tied as tightly as possible. The lateral ligatures are then tied one after the other. Thus a complete interlocking ligature holds the pedicle. (Fig. 29.) The same process may be carried out with four or five, or indeed any number of ligatures.

It is always wise to use a blunt needle for transfixing the pedicle, as there is often some risk of wounding vessels. I use an aneurism needle for this purpose. A finely-pointed forceps, like a Lister's sinus forceps, is an excellent instrument for this purpose; the thread is caught between the blades and pulled backwards through the opening. If the pedicle is very bulky, it may be advisable to squeeze it in a temporary clamp, or between the blades of powerful compressing forceps at the site of deligation, before tying the thread. Bantock in particular uses this method, employing two powerful Wells's forceps, bent at an angle, for the purpose. The needle transfixes the pedicle near the tips of the blades, and the ligatures are tightened while the forceps are being removed. Such compression drives the fluid out of the tissues at the point where the ligature lies, and prevents their slipping away from under the encircling thread. In thick œdematous pedicles this plan is valuable, and should be always adopted; for ordinary pedicles, experience has abundantly shown that it is at least not essential. It is possible to overdo crushing of the pedicle; there is undoubtedly some theoretical force in the reasoning of Thornton and Doran, that over-compression is likely to lead to sloughing. But, as a

matter of fact, it would appear that no positive harm arises from the almost universal practice of pulling the ligatures as tightly as possible. It will always be found that in fleshy or œdematous pedicles the ligature may be drawn more tightly after the tumour is cut away. While the first hitch is being drawn tight the pedicle is cut through about half an inch above the ligature by successive snips of the scissors cutting from periphery to centre; the tissues at once become softer, and the thread may be drawn in more tightly. But this is rarely necessary. With Tait's knot, very ordinary force will be amply sufficient to render hæmostasis complete and permanent.

Experienced operators use other modes of securing the pedicle by ligature. But for simplicity and efficiency, no methods are superior to those described.

A single thickness of silk, placed by transfixion as described, and secured by a true reef-knot, will suffice for the great majority of pedicles. Extra ligatures, to provide against the chance of hæmorrhage, import a new danger in the risk of their not becoming absorbed or encapsuled. The thinnest silk compatible with safety, the smallest knot, and the least possible handling of the pedicle, is the most perfect surgery.

The pedicle, secured and divided, is dropped into the cavity and, in most cases, need not be again looked at. If there is any doubt as to its being properly secured, a catch forceps may be attached to the stump, whereby it may be drawn to the surface and inspected before finally closing the wound. The sponges, however, which are subsequently carried into Douglas's pouch will scarcely fail to show if there is bleeding from the pedicle. At this stage the alternate ovary should be inspected. If it is diseased, it should be removed.

Cleansing the Peritoneal Cavity.—One of the most important steps in the operation is the complete removal of all foreign material from the cavity—the "toilet of the peritoneum," as it has well been called. McDowell himself partially anticipated this proceeding; but to Keith we are indebted for fully demonstrating its extreme value. The modes of carrying out this

proceeding are the same for all abdominal operations, and need not again be fully described. (See p. 76.) With a suitable sponge-holding forceps, sponges are successively carried into Douglas's pouch and into the hollows of the loins; and they are re-introduced till they return dry. If glutinous or semi-solid foreign matter is present, Tait's excellent plan of washing out the abdomen by warm fluid should be adopted. If there is no special apparatus, the rubber tubing of the trocar, to act as an irrigating tube, and a basin or ewer to hold two or three quarts of fluid, will suffice. The wound is kept as close as possible with one hand, while the fingers of the other are moved about among the intestines, washing and cleansing them thoroughly. The process is continued till the fluid returns clear. Dry sponges are then placed in the pelvis and in the loins, to be removed after the sutures have been inserted, but before they have been tied. In many cases the fluid may be poured in from a jug.

It is impossible to insist too strongly on the importance of removing all foreign matter from the peritoneal cavity. But a judicious balance between efficiency and excess must be observed here, as well as everywhere else. Too much sponging may irritate the peritoneum; one may go on for a considerable period squeezing out a few drops of fluid from the sponges, which contain nothing more than peritoneal secretion thrown out from irritation. And if the patient is seriously collapsed from a prolonged operation, it may be wise, in balancing possible evils, to curtail the cleansing of the peritoneum, and either run the subsequent risks or drain.

Drainage.—The question of drainage is a very difficult one to speak about in theory. In practice, a good rule to follow is, "When in doubt, drain." If little or no fluid comes away through the tube, it may be removed in twenty-four hours, and no harm is done. If fluid does come away, we have the satisfaction of seeing that a danger has been avoided. Fewer cases have died from drainage than from the want of it.

In cases with deep pelvic adhesions, the bleeding from which

it may be impossible to see or effectually to control, drainage is specially indicated. Where a raw surface has been left behind—on bladder, pelvis, or parietes—we may expect subsequent sero-sanguinolent oozing, and we drain if we expect the amount to be considerable. In any case where putrid fluid had escaped into the cavity we should be careful to drain. If, generally, we apprehend an excessive secretion of fluid, or if we are in doubt as to the peritoneum being thoroughly cleansed, drainage ought to be adopted.

Keith's glass tubes are the best for use after ovariotomy. The tube must not be too long or too short. The end of it should touch the bottom of Douglas's pouch, without pressing upon the rectum; while the collar rests upon the edges of the wound, at its lower extremity. Pressure must not be put on the tube by dressing or binder. The end of it is passed through a button-hole opening in a sheet of rubber; over the end is placed an absorbent dressing; and in the tube is placed a twisted roll of gauze, to exhaust fluid by capillary action. If capillary action and intra-abdominal pressure do not remove the fluid from the abdomen, then a suction apparatus, such as Tait's Fig. 14), must be used at frequent intervals.

Suturing the Wound. Dressing.—Little need be added to the general remarks already made on these points (p. 82). At the lower extremity of the wound, the first suture is placed very carefully, so as to close completely the opened connective tissue spaces, and the peritoneum is here brought together with special accuracy. The needle is inserted about two lines from the edge of the wound, and carried straight through all the layers in the parietes; the peritoneum usually requires adjustment, so that it is pierced in a corresponding position. When the sutures have been inserted, and the underlying sponge removed, the wound is finally sponged free of all blood, while it is pulled outwards by the sutures gathered together in the hand. The sutures are accurately tied and their ends cut off.

For dressing, carbolised gauze or boracic lint cut into squares and secured by strapping is as good as any. As we expect very

little discharge from the wound, and no subsequent dressing is required, the full Listerian dressing with macintosh and gauze bandages is unnecessary. The advantages claimed for strapping over the whole lower abdomen, fixing its walls as in a splint, and preventing passive gaseous distension, need not be recapitulated. I have practically given up the binder, as I believe it causes more annoyance, from getting into folds under the patient's back, than the little good it does is worth. Putting on the binder, as the completion of every form of surgical interference with the abdomen, is a time-honoured observance; it is difficult to say how much more it is.

ACCIDENTS DURING THE OPERATION.

Mishaps may occur during the most simple ovariotomies; they are especially frequent in difficult cases. It behoves the surgeon to be able, promptly and efficiently, to deal with these; for such accidents, unattended to, may involve consequences far more serious than the operation itself.

Vomiting and retching during operation is a disagreeable complication. The straining, which is sometimes quite violent, tends to force the intestines out of the wound. While the cyst is being emptied, merely dragging it forwards, so as to keep it in close contact with the abdominal wall, will probably suffice to keep back the bowels. As the cyst collapses, its place may be taken by large sponges packed around the abdominal opening. Sometimes it will be necessary to cease operating, and temporarily to close the wound by hooking the forefinger under the upper extremity of the abdominal opening and squeezing the walls together between the thumb and fingers. The force of the contracting abdominal muscles is sometimes enormous, and requires considerable exertion to oppose it.

Stripping the Parietal Peritoneum is an accident likely to occur only with inexperienced operators. In thin subjects the peritoneum may be peculiarly well defined, while it is loosely attached to the abdominal wall; and if, in addition to these

peculiarities, it is adherent to the underlying cyst, it may be peeled off the parietes to a considerable extent before the error is discovered. In such a case it is better to cut the peeled flap clean away, than to leave it to run the risk of becoming gangrenous.

Tearing of the Cyst-wall and escape of the cyst-contents into the cavity is not a serious accident, unless the contents are putrid. A large tear at the site of puncture is best managed by grasping the edges of it with forceps and pulling the opening out of the wound. A laceration elsewhere is either closed by forceps, or, if large, is surrounded by flat sponges. Bleeding from such tears is sometimes profuse, and must be treated by immediately delivering the tumour and securing its pedicle.

Injuries to the Hollow Viscera are likely to occur only when there are dense, strong adhesions between them and the cyst-wall. The walls of any part of the intestine may be torn through; such a tear must be stitched up before doing anything else. Removal of a considerable portion of mesentery, incurring a risk of gangrene of the intestine, raises the question of resection. I have had to remove the vermiform appendix, for injuries done to it during operation. Rupture of the bladder, if properly treated by accurate suturing, is not so dangerous an accident as might be supposed. I have wounded the bladder somewhat extensively on two occasions, once followed by free escape of urine; in neither case did any harm result. If the gall-bladder is ruptured, we may, according to the extent of the injury, either remove the whole viscus or establish a fistula; to stitch up the laceration is not always safe. Rupture or division of the ureter is a serious accident. The ureter has been included in a ligature more than once. Only once (Nussbaum's case) after such injury to the ureter has permeability been restored; if the patient does not die, a fistula remains, which can be cured only after removal of the kidney. If the patient is fairly strong and the ovariotomy is not a severe operation, perhaps the best treatment of complete division of the ureter is to remove the kidney. If suturing the division is out of the question, and it does not seem wise to attempt nephrectomy, the next best plan is probably to

bring the end of the ureter out of the wound, and wait for the recovery of the patient before taking any further steps. Simon's first nephrectomy was performed for a fistula of the ureter made during an ovariotomy.

Injuries to the Solid Viscera—liver, spleen, or kidney—are not common. If bleeding continues after sponge-packing, the raw surface must be mopped with iodine or perchloride of iron solution. A serious injury to the kidney involves risk of urinary extravasation, and the best treatment may be nephrectomy.

Foreign Bodies—instruments or sponges—may be left in the abdominal cavity. The best preventive is the use of a definite number of each sort of material, and counting after operation. The counting of the instruments would seem to be a simple enough proceeding; yet it is a fact that no one but the operator himself can be made to recognise the vital importance of being absolutely exact in this duty. Time after time have skilled assistants and nurses been found at fault; and this petty duty, like every other one, is almost forced upon the operator. It is a good plan to make the assistant count the items aloud in the hearing of the operator; and if the surgeon has secretly abstracted one or other of the instruments, it will add to the security. A foreign body must of course be removed as soon as it is certain that it is left behind.

ENCAPSULED OVARIAN CYSTS.

Doran has given this name to ovarian cysts which grow between the layers of the broad ligament and carry it, along with the pelvic peritoneum, upwards into the abdominal cavity. The capsule on exposure is of a pale red colour, contrasting with the glistening white appearance of the underlying cyst-wall.

The cyst is tapped and delivered in the ordinary way. Should the capsule completely envelop the cyst, and show a marked constriction between the uterus and the tumour, the whole of it may be removed with the tumour, and the constriction treated as an ordinary pedicle. More commonly, however, the tumour is not completely encapsuled; it has burrowed down-

wards into the pelvic fascia, and the broad ligament and pelvic peritoneum may be but slightly disturbed from their connection with important organs. Then the tumour must be shelled out from the capsule; and the capsule must, in whole or in part, be left behind. Whilst the collapsed cyst is being dragged upwards by the assistant, the operator peels off the capsule by sponging and tearing, placing forceps on bleeding points, till the true pedicle, which is represented by a few large vessels at the bottom of the tumour, is reached. The vessels are tied and the tumour is cut away.

The empty capsule, if it can be drawn together at the base, and has no important outlying connections, may be cut completely away after deligation. If it lies very deep, or has a broad base, or is intimately connected with important structures, it may be necessary to leave the whole or a portion of it behind. If the cavity left after removing a portion of the sac is small, and there is no oozing, the edges may be drawn together by a continuous suture and the abdominal cavity closed over it. Usually, however, there is some oozing, and then it is wise to stitch the edges of the capsule, gathered together by a purse-string suture, to the bottom of the parietal wound and insert a drainage tube.

TREATMENT AFTER OVARIOTOMY.

One of the first lessons that experience teaches in ovariotomy is the futility of all fussy regulations as to feeding, medicines, catheterism, posture, and such like. It is wise, for the first twenty-four hours, to give nothing but small quantities of hot water, or hot toast-water. In the next twenty-four hours, a little oatmeal gruel, or Brand's essence of meat, or similar preparation, may be given with the water. Thereafter, if the case is doing well, the patient may have almost what she asks for. Milk as food is to be avoided; sucking ice for thirst usually results in accumulation of fluid in the stomach, which is rejected. Thirst is usually considerable after these operations: the best way to allay it is to administer

a pint of tepid water by the rectum. Often, after such an enema, not only is the thirst relieved, but the patient breaks into a gentle perspiration and falls off into a refreshing sleep. The best foods, from the third day to the fifth or sixth, are: arrowroot, sago, oatmeal gruel, ordinary beef-tea, and such like. A cup of tea with thin bread and butter is often much appreciated. At the end of a week the patient may have ordinary diet.

All medicines are, if possible, to be avoided, particularly opium. Pain I believe to be not so strong an indication for opium as restlessness. Sickness and tympanites are predisposed to, if not often caused, by opium. One expects, after the first dose has been administered, to see the patient wake up in the morning with a dry tongue, increased thirst, and some feeling of nausea, which during the day do not pass off, but culminate in restlessness at night, requiring the administration of a second dose. We rarely see a case treated throughout with a perfectly flat or retracted abdomen if opium has been administered. When the patient tosses about in bed, fidgety and restless, without any particular symptoms beyond those incident to a serious operation, opium is undoubtedly of great value. Many surgeons administer the opium by the rectum, and leave its administration to the discretion of the nurse: I believe that a hypodermic injection of morphia, administered by the surgeon himself, is a more satisfactory and efficient method.

Of other medicines, all that need to be kept in readiness are, a saline purge—a Seidlitz powder is as good as any—and turpentine for giving in enemas. Of all the effects of therapeutics, none is perhaps more striking than that following the exhibition of a saline purge, supplemented, if necessary, by a turpentine enema, in abdominal distension, on the third or fourth day after ovariotomy. Such distension is usually taken as indicating peritonitis, and so, no doubt, it frequently is; but this is no contra-indication—rather the reverse. For moderate degrees of flatulence, wearing the rectum-tube is usually quite sufficient; in greater amount, the flatus may be removed by a hot-water enema, with or without turpentine; when the abdominal walls begin to become brawny, these means ought to be supplemented by

a purge. Opium, except in the special circumstances mentioned and in others to be noted, is in such conditions to be avoided.

The urine need not be drawn off till the patient asks to be relieved, and this may not be for twelve hours or even longer. The secretion of urine, in these cases, is at first scanty; from fifteen to twenty ounces in the first twenty-four hours is about the average amount. The full amount is not usually secreted till five or six days have passed. Catheterism twice on the first day, and three times on the second, will usually be all that is required; thereafter the patient will probably be able to pass water herself. To ensure absolute cleanliness of the catheter, and avoid the risks of vesical catarrh, it is wise to give the nurse a new instrument when the one in use has been passed six times.

From the beginning the patient may be permitted to lie in whatever position is most comfortable, the nurse moving her. If the abdomen is supported by strapping, this change of position involves no risk. I have often seen a patient, wakeful in the supine position, drop off to sleep at once when turned on the side. Raising the limbs on pillows, elevating the head and shoulders, and numerous little attentions of this sort, which an intelligent and conscientious nurse will observe, all add to the patient's comfort. The advantages of two beds, one for the day and one for the night, are self-evident.

The condition of the wound may be absolutely ignored till the seventh or eighth day, when, for the first time, the dressings are removed and the stitches taken out. Almost without exception the wound will be found perfectly healed. Stitch-abscesses ought never to occur. They are caused either by filthy sutures, or by tying them too tightly. When the stitches have been removed, a piece of dry boracic lint or absorbent wool is placed on the wound, and the abdomen is strapped up again. It is wise not to let the patient get up within the fortnight, however much she may desire it.

Such is the ordinary treatment of a simple, straightforward case of ovariotomy; and the large majority of cases proceed in this satisfactory manner. In skilled hands, the average case

goes on, almost as a matter of course, in an uneventful manner; only difficult and severe cases are expected to be followed by serious illness. We often see cases recorded as severe which recover "without a bad symptom." Every genuinely severe operation must be followed by grave symptoms; and it is in the saving of such cases after operation, almost as much as by skill in the operation itself, that the greatest triumphs in abdominal surgery are secured.

The first danger to be surmounted is shock and collapse. This is combated on ordinary principles by hot-water bottles, warm blankets, elevating the limbs, stimulating enemas, and, if necessary, by hypodermic injections of ether or brandy. In such cases feeding by the mouth is out of the question. In every bad case rectal feeding and stimulation should be begun almost from the moment the operation is concluded. Nutritive enemas with brandy, graduated according to necessity, administered every few hours for the first forty-eight hours or so, will tide the patient over the first stage. Restlessness and jactitation are here best treated by full hypodermic injections of morphia.

All cases of severe operation are of necessity followed by more or less peritonitis. The symptoms of peritonitis appear from the second to the fourth day, and manifest themselves by sickness, vomiting, and tympanitic distension of the abdomen. The pulse is small, wiry, and rapid; the breathing is quick, superficial, and entirely costal; the countenance becomes dusky, the lips blue, and the aspect generally that indescribable but characteristic one which is familiar to every experienced operator. Therapeutic measures must now be prompt and decisive, and of vigour corresponding to the gravity of the case.

In the first place, the administration of all foods, drinks, and medicines by the mouth must be stopped. They are simply vomited, and perseverance in their exhibition is bootless, and only worries the patient. A definite system of feeding by the rectum is at once instituted and continued. A good routine enema is, an ounce of brandy, a teaspoonful of Valentine's fluid meat or Brand's essence or Benger's peptonised jelly, and four ounces of peptonised milk; to be administered every

five or six hours. Once in the twenty-four hours a pint of tepid water is passed into the bowel: much of it is absorbed and relieves thirst; some of it may be returned with flatus and the residues of the enemas. For an hour or more at a time before the period when an enema is due the rectum-tube is worn, and much flatus may pass through it. If morphia is given at all, it must be given in full doses and continuously, so as to keep the patient semi-narcotised. If the distension is excessive, causing dyspnœa, a large turpentine enema, or, perhaps better, repeated small turpentine enemas are of conspicuous benefit. Though it is not always possible to give it on account of the vomiting, it must not be forgotten that the greatest good will probably follow a saline purge: liquid and flatus may be passed in enormous quantities, to the patient's great relief.

In the worst cases, passage of the stomach-tube may be called for. I have more than once seen the passage of this tube in cases of extreme distension followed by a forcible ejection—almost an explosion—of fluid and gas that produced instantaneous relief. Once or twice a day the patient may be encouraged to drink a large amount of hot water or hot tea, with the purpose of causing free vomiting. A free vomit is less exhausting than continual retching, and it is highly effectual in getting rid of intestinal accumulations.

When it is evident, after two days of this treatment, that the patient is losing ground, that the distension increases and the vomiting continues unabated, I believe that we ought to re-open the wound and wash out the abdomen with a stream of warm antiseptic lotion. Two or three stitches at the bottom of the wound are removed, and two fingers are gently insinuated amongst the bowels. A celluloid catheter attached to a piece of rubber tubing, coming from a cistern elevated a few feet above the level of the patient, conveys the fluid into the cavity. The fingers move the bowels about, while the stream of fluid cleanses the peritoneum. Probably the bowels will be glued together at one part or everywhere by soft adhesions: these are broken down by the fingers. If a drainage tube has not been used, it is now inserted. It is unnecessary to sponge out the

peritoneum, unless a collection of septic pus is discovered—an unlikely accident in these days. I believe that these cases die as much from a form of intestinal obstruction induced by the adhesions and the distension, as from mere peritonitis. A separation of these adhesions, setting the bowels free and keeping them floating in non-irritating boracic lotion or similar fluid, gives the patient a chance of life which is by no means a remote one. No case ought to be permitted to die without giving it this chance of recovery.

With reference to subsidiary details in treatment, little need be said. If drainage is used, the sponge which collects the fluid is changed as often as necessary, not less frequently than twice a day; and the most scrupulous care is given to keeping those sponges, and every part with which the fluids come into contact, sweet and pure.

As regards the temperature, I truly believe that it is the least important of all the signs. Case after case occurs in which the temperature after the second day becomes and continues absolutely normal. A rise on the second day to 99.5° or 100° is the rule: in the simplest cases this rise is usually higher; in the worst cases there may be no rise at all, or even depression. It is better to have elevation than depression of temperature in the first few days. A rise later on indicates some inflammation, probably of a simple traumatic nature: the most severe cases of peritonitis cause little elevation. The ice-cap and such devices for lowering abnormal temperatures are very rarely called for: probably a dose of antipyrin or thallin would be preferred.

Solid and Malignant Growths of the Ovary.

Solid tumours of the ovary are rare. Of all tumours of the ovary, probably not more than three per cent. are solid. Most of them are malignant, sarcoma or cancer: true myoma has been found; pure fibroma is almost unknown. Doran has never met with fibroma. Tait says that "growth of the fibrous stroma of the ovary, so as to form a large abdominal tumour requiring removal, has not yet been described." I have, however, successfully removed a solid ovarian tumour as large as a child's head, in which repeated examinations by competent histologists failed to show any other histological element than pure fibrous tissue. Pain was the most prominent symptom in this case. Curiously, in the only other case I have seen recorded* pain was described as being very intense. The so-called ovarian fibroid is usually a pure myoma, though we have the authority of Virchow for believing that considerable amounts of pure fibrous tissue may co-exist with the muscular fibres. Cysts have been found in these tumours; and Waldeyer† has recorded a case which was almost completely transformed into bone.

Malignant growths are either sarcomatous or cancerous. Papilloma of the ovary—a very rare disease—may also be reckoned among malignant growths. Sarcoma is usually of the spindle-celled variety. The blood-vessels are usually of very large dimensions, giving the divided tumours almost a cavernous appearance, and cysts are frequently found containing blood or serum. In one case recently operated upon, I shelled out nearly a bucketful of blood-clot from the centre of a sarcomatous growth. These tumours often attain to enormous dimensions, and their existence is usually accompanied by ascitic fluid, which is often stained with blood.

Prof. Leopold‡ considers that malignancy, as a character of tumours of the ovary, is far more common than is generally

* Ricord. *Lyon. Méd.*, Nov., 1886. † *Archiv. f. Gynäk*, Bd. ii., p. 440.
‡ *Deutsche med. Woch.*, Jan. 4th, 1887.

supposed. Among 600 ovariotomies in Schroeder's Clinic, no fewer than 100 are said to have shown signs of malignancy; and only 19.5 per cent. of the cases operated upon remained free from disease for more than a year. Many of these cases were no doubt malignant disease grafted upon cystic ovarian growths. Leopold found that in 110 completed ovariotomies, 20 (18 per cent.) had malignant growths. If to these are added six cases where removal was not completed, on account of implication of neighbouring structures, we have 116 operations for removal of ovarian tumours, in which 26 were found malignant—a proportion of 22.4 per cent., greater even than Schroeder's. Of the cases where the tumour was removed, 20 per cent. made complete recoveries.

Butlin* has collected from the writings of Cohn, Olshausen, Billroth, and Thornton 78 cases of operation for malignant diseases of the ovaries of various kinds. Cohn's collection of cases (from Schroeder's Clinic), when weeded out, gave 55, of which 13 died; Olshausen, 13 cases, with 3 deaths; Thornton, 10 cases, with 3 deaths; Billroth, 21 cases, with 14 deaths. The general mortality was thus 33 per cent. And the after-results were not very encouraging, for only 5 out of 47 patients whose cases could be followed were alive and well three years after operation.

The results of these operations, when carefully worked out, are not, I suspect, so favourable as they are generally supposed to be. In the previous edition of this work I quoted Cohn's statistics† in support of his statement that the number of permanent cures would be found about equal to the number of deaths after operation. This was clearly too sanguine an expectation. Still a certain proportion do, apparently, recover permanently; and it is reasonable to believe that this proportion would be increased if operations were done at the earliest possible period after diagnosis. And of those cases in which recurrence takes place, the subsequent course will usually be less painful than in cases not interfered with. As a matter of

* *Operative Surg. of Malig. Disease*, London, 1887, p. 346.

† *Zeitschr. f. Geb. und Gyn.*, p. 14., 1885.

fact, however, malignancy is rarely diagnosed till after operation; the fact that so many ovarian tumours are malignant is another and a very strong argument in favour of early operation for all ovarian tumours.

Diagnosis.—Solid tumours of the ovary cannot be diagnosed from each other, and with great difficulty from similar growths arising from the uterus. In the case of cystic sarcoma, the diagnosis from polycystic glandular tumour and from soft nodular uterine myoma is practically impossible. Mobility and ascites are perhaps the most important single features pointing to solid ovarian tumour. The rapid accumulation of ascites around a solid movable tumour that has its deep attachment in the pelvis points to malignant disease of the ovary. A round extra-mural myoma may present clinical features identical with those of non-malignant solid tumours of the ovary. It is possible to confound these growths with pregnancy; and special care may be necessary when vascular bruits are heard in the tumour. In a majority of cases the diagnosis is not completed till the abdomen has been opened.

Operation.—The only peculiarities of the operation for solid growths are, the length of the incision which it is necessary to make, and the treatment of the pedicle. In average cases the incision will require to be prolonged above the umbilicus. When the tumour is fully exposed, it is lifted out by means of a Tait's handled screw placed in its substance. Removal is helped by lateral movements of the tumour; and the force of suction, which is often considerable, may be overcome by permitting air to enter the cavity with fingers or hand carried round the growth. As soon as the growth is delivered, large sponges are placed in the cavity to prevent extrusion of the bowels; it may even be expedient to insert a few sutures at the top of the wound before doing anything else.

The pedicle in these cases is often thick, fleshy, and vascular. The Fallopian tube does not often form part of it; it is composed simply of mesovarium. The vessels are usually thin-

walled and very large, so that they are liable to be injured by transfixion even with blunt instruments. Here, if anywhere, a second ligature below the double perforating ligature may be applied with advantage. The operation is completed and the case managed on the same principles as an ordinary ovariotomy.

The removal of sarcomatous cystic growths requires no special description. The pedicle is usually very thick, and peculiarly inelastic.

Operations for Cystic Growths in the Broad Ligament and Parovarium.

SURGICAL ANATOMY OF THE BROAD LIGAMENTS.

The broad ligament on each side is composed of a double layer of peritoneum enclosing cellular tissue in which lie blood-vessels, nerves, lymphatics and muscular fibres. The internal attachment is to the side of the uterus from the cornu to the level of the internal os; the external attachment is to the side of the pelvis in a vertical line about midway between the obturator foramen and the great sciatic notch. Following its line of attachment from the cornu of the uterus to the cervix, the following structures are met with: At the cornu is the Fallopian tube; a little lower down and more to the front is the round ligament, and close to these is the spermatic artery; at the bottom is a space in which lies the uterine artery, usually dividing into several branches with numerous veins, nerves, and lymphatics. The convex base of the broad ligament lies upon the lax connective tissue which separates the vagina from the fascia which covers the levator ani muscle. In this tissue lies the large uterine artery, forming a loop with its concavity upwards as it courses between the internal iliac and the neck of the uterus. This vessel is likely to be pushed downwards by tumours growing in the broad ligaments; but if the growth is dragged upwards during removal it is not out of the range of possible injury. The ureters, embedded in connective tissue, pass from behind forwards and inwards to the base of the bladder, crossing obliquely below the base of the broad ligament. They also are not beyond the risk of injury. In the pelvic attachment no vascular or other structures of importance are found. It must be remembered, however, that if the broad ligaments are pushed apart by an enclosed tumour, the posterior layer may be forced backwards so as to uncover, not only the ureter and the uterine artery, but the iliac vessels as well.

The free upper margin of the broad ligaments, looked at from above, is broader at its pelvic than at its uterine attachment. This is caused by the divergence of the round ligament, which curves forward to the inguinal opening, and which is so far removed from the broad ligament proper as to be described as lying in separate folds. The position of the ovary and tube in their folds of broad ligament have already been described (p. 99). The veins in the broad ligaments form closely-set plexuses, which are of importance in relation to sub-peritoneal hæmatoma. The veins of the uterus, ovaries, and Fallopian tubes, after being gathered together in the pampiniform plexus, finally coalesce in the internal spermatic vein which follows the course of the spermatic artery.

The structures in and adjacent to the broad ligaments which are liable to be the starting points of disease are admirably depicted in the diagram here copied from Doran's work.

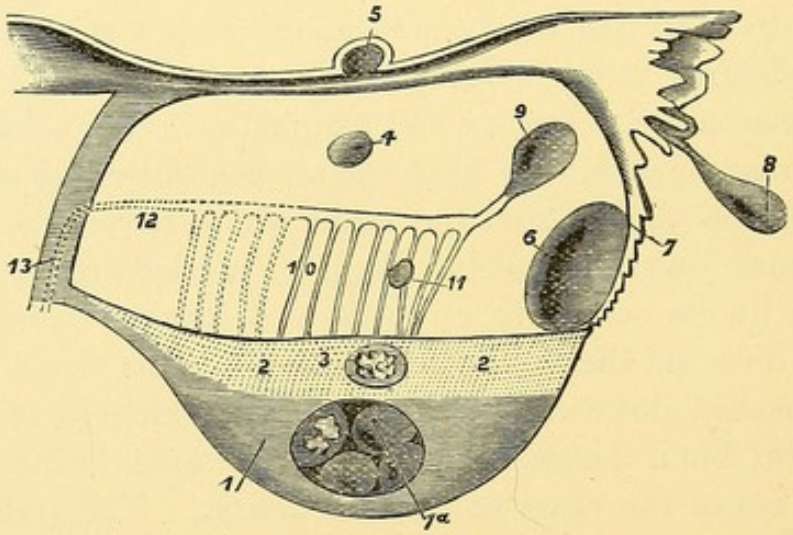

FIG. 30.

Diagram of the Structures in and adjacent to the Broad Ligament. (DORAN.)

1. Framework of the parenchyma of the ovary, seat of 1*a*, simple or glandular multilocular cyst. 2. Tissue of hilum, with 3, papillomatous cyst. 4. Broad ligament cyst, independent of parovarium and Fallopian tube. 5. A similar cyst in broad ligament above the tube, but not connected with it. 6. A similar cyst developed close to 7, ovarian fimbria of tube. 8. The hydatid of Morgagni. 9. Cyst developed from horizontal tube of parovarium. Cysts 4, 5, 6, 8, and 9 are always lined internally with a simple layer of endothelium. 10. The parovarium; the dotted lines represent the inner portion, always more or less obsolete in the adult. 11. A small cyst developed from a vertical tube; cysts that have this origin, or that spring from the obsolete portion, have a lining of cubical or ciliated epithelium, and tend to develop papillomatous growths, as do cysts in 2, tissue of the hilum. 12. The duct of Gartner, often persistent in the adult as a fibrous cord. 13. Track of that duct in the uterine wall; unobliterated portions are, according to Coblenz, the origin of papillomatous cysts in the uterus.

Operation may be indicated in any of the following conditions residing in the broad ligaments:

(1) Simple cysts of the Broad Ligament. Parovarian cysts.
(2) Papillomatous cysts of the Broad Ligament and hilum of the Ovary.

In addition to these, myomata may develop in the broad ligament in connection with its enclosed muscular tissue. These are rarely of any surgical importance. The same may be said of the small pedunculated cysts attached between the oviduct and the ovary, and arising from a parovarian tube, and of those others originating among the fimbriæ and known as Hydatids of Morgagni. Other diseases of great variety need not be described. One of these has recently been described by Mr. Taylor as having been removed by Tait, and which consisted of numerous minute vesicles like those of herpes.

Simple Cysts of the Broad Ligament.

These are frequently described as parovarian cysts. But it is now known that many simple cysts developed in the broad ligament do not originate in the tubes of the parovarium, but elsewhere between its layers. The profoundly interesting questions, from a developmental as well as a pathological point of view, which surround the origin of these cysts cannot here be discussed. Suffice it to say, that the cyst arising outside of the parovarium is of the simplest possible nature, containing clear fluid in a translucent wall, and not developing adventitious new growths in its interior. According to Doran, it is lined with flat or low columnar epithelium. Cysts arising from the tubes of the parovarium—though they are, in the majority of instances, of the simple character indicated above—are further peculiar in showing a tendency to develop papillomatous outgrowths in their interior. If of small size, their lining may be of ciliated epithelium. According to Doran (p. 49), "Histologically and pathologically, they are identical with the papillary cysts . . . that appear in the tissue of the hilum of the ovary where relics of the Wolffian body exist, and do not tend to invade the stroma of the parenchyma, but rapidly grow into the broad ligament, forcing apart its layers."

The leading surgical peculiarity in these growths is, that they are unilocular. No true ovarian cystoma is unilocular. As a rule, they grow away from the broad ligament, pushing aside the ovary and the tube, and occasionally they exhibit a well-marked pedicle. Sometimes, however, they grow downwards, widely separating the layers of the broad ligament, and stretching out the tube and the ovary over their walls. They contain nearly always a clear limpid fluid with but little albumen. Sometimes, however, it is thick or semi-purulent, from inflammation; or dark, from intermixture with blood. Adhesions are rare. Tait describes an occasional great thickening of the cyst-wall consisting

of fusiform muscular cells. Rupture is not infrequent; the results are not often serious.

Diagnosis.—A parovarian cyst is diagnosed from other cystic growths having similar attachments by the laxity of its walls, and the free and rapid wave of fluctuation which is given on palpation. It is perfectly round and globular, forming, if of moderate size, an evenly symmetrical tumour in the lower abdomen. Its growth is painless and unattended by symptoms of disturbance of the sexual organs. It is almost free from the dangers and complications which are sometimes found in connection with ovarian cystoma, and never produces the cachexia which so often accompanies that disease.

The diagnosis from such conditions as ascites and renal cystic developments is the same as the diagnosis of ovarian cystomata from these conditions. These being negatived, the separation is then simply from ovarian growths. Fibro-cystic disease of the uterus is a possible source of confusion.

THE OPERATION.

Tapping.—There is no doubt that tapping may permanently cure a simple cyst of the broad ligament. More than one surgeon of repute, and particularly Keith of Edinburgh, employs tapping as routine treatment in these cases. The cyst, being emptied, may not refill, and the patient is cured by the simplest possible treatment.

But objections may be urged to this simple proceeding. It is not always successful: some cysts refill. Bantock had a case which was tapped seven times. Tapping, even in the most skilful hands, may cause suppuration in a cyst. But the most weighty objection is the fact that papillomatous growths occasionally develop inside these cysts, and tapping then provides an avenue for infection of the peritoneum, a result which is inevitably fatal.

As a counterpoise to these objections, there exists the important fact that removal of these growths is peculiarly free from danger. If, in exceptional circumstances, we may feel

justified in giving the patient her chance of cure by tapping, I believe that the best routine treatment in these cases is removal.

Removal.—In most cases of simple cyst of the broad ligament, removal is a very simple proceeding. The parietal incision need not be more than an inch and a half or two inches in length. The cyst-wall is very thin and easily torn, and fluid is very liable to escape by the side of the trocar. If no special appliance is used to avoid this, the simplest plan is probably to lay aside the trocar, catch the edges of the opening in the cyst-wall with forceps, pull them out of the wound, and let the fluid run over the macintosh into the vessel on the floor. The tumour usually is delivered without any trouble whatever. The pedicle is not often long, but it is rarely difficult to deal with. Vessels are neither abundant nor large, and the tissues are but slightly hypertrophied. Though there may be no very strong objection to leaving a portion of the cyst-wall behind, the ligature should always be carried below the limits of the growth. The ovary and tube may frequently be left behind; but unless this can easily be done, it is best not to complicate the operation in the slightest degree by seeking to separate them. Besides, any traumatism applied to the appendages is likely to beget trouble in future by the formation of adhesions.

In those somewhat rare cases where the cyst grows between the layers of the broad ligament, removal may be attended with considerable difficulty. Here there is no pedicle, and the base of the cyst lies deep in the pelvis. The growth must be dissected out from between the layers of the ligament in the manner already described for encapsuled ovarian growths (p. 146). It is usually best to begin from the side next to the uterus. The flaccid cyst-wall is pulled out of the wound, which will have been enlarged as far as necessary, the peritoneal investment is teased open, and the wall of the cyst is exposed. The finger, pushed into the cellular tissue, separates the cyst from the ligament by stretching rather than by tearing. The larger bundles of cellular tissue containing vessels are caught in catch-forceps and divided by scissors; and this process is repeated, step by step, till the cyst is completely enucleated from its bed. As a

rule there is but little hæmorrhage. In the deeper and outer portions, special care must be taken that the ureter or the uterine artery, or any other branch of the iliac vessels, is not injured. The two flaps representing the layers of the broad ligament may, according as seems best at the time, be either left untouched or united by suturing with or without removal of portions of them. In a case of this sort, it will be wise to insert a glass drainage tube.

Papillomatous Cysts of the Broad Ligament.

In a practical as well as in a pathological treatise these well deserve separate consideration. They are not common; but, from the peculiar and difficult nature of the operation necessary for their removal, they deserve close attention.

The origin of these growths is not yet finally settled. The painstaking and able investigations of Doran leave little doubt that a frequent and favourite starting point is in the hilum of the ovary. It is well known that papilloma may develop in parovarian or other cysts of the broad ligament; it is certain that growths arising from the hilum are peculiarly liable to develop abundant papillomatous material. Papillary cysts may appear in connection with the ovary, and may overgrow the broad ligaments and the uterus, but here they exist almost entirely as accidental, and not as ordinary or essential, concomitants.

As a matter of practical surgery their remote origin is of little moment. What concerns us most is the fact that such growths always burrow between the layers of the broad ligament, and there develop peculiarities which may be made use of for purposes of diagnosis, and which make these growths among the most difficult to remove in abdominal surgery.

In the early stages the diagnosis from ovarian cystic disease is uncertain or impossible. The clinical features of a well-developed papillomatous cyst are fairly distinctive. These I have elsewhere* described at some length; they may be here abstracted as follows:

1. In their growth, papillomatous cysts of the broad ligament are not symmetrical. Growing as they do in the broad ligament, and having no pedicle to permit their escape from the pelvis, they are fixed down on one side, and cannot, even when large, rise to the position of least pressure in the middle of the abdomen. Minor cysts bulge out where they can find room in

* *Annals of Surgery*, Dec., 1885.

the pelvis or on the side not occupied by the main cyst; but their aggregate bulk and arrangement are not such as to produce a balancing symmetry. Ovarian cystomata are not so persistently one-sided or so irregular in shape as these, and they are not so deeply nor so firmly attached in the pelvis.

2. In these cases there is usually found, in addition to the large papillary cyst, several small thin-walled cysts packed round the uterus and crossing to the opposite side of the abdomen. It is not a development of a multilocular growth, one large cyst divided by septa into several, but rather of several separate cysts sessile on a common base. These secondary growths are usually very thin-walled, and fluctuate freely. They can be felt through the vagina in Douglas's pouch, and through the abdominal walls, frequently overlapped by bowel on the side opposite to the main cyst.

3. Papillomatous cysts of the broad ligament are but slightly movable. In the pelvis, through the vagina, this sense of immobility is peculiarly striking. The growths are doubly fixed by the broad ligament in which they lie, and by the minor cysts packed in the pelvis which spring from them.

4. In most of these cases there is considerable enlargement and elevation of the uterus. That the uterus should be enlarged is readily understood, from its close physical and vascular connection with the very vascular growth. That it should be elevated is a necessary consequence of the direction of the growth of the tumour which is attached to it. This enlargement is in excess of what we find in adherent ovarian cystoma. The uterus usually lies in a deep sulcus between the major cyst and the minor cysts, giving an appearance of two growths; but sometimes it lies behind the growths, being overlapped by them. The bladder may be dragged upwards with the uterus.

5. As a corollary from the preceding propositions, we might infer physical interference with the processes of defæcation and micturition. The enlarging growth being fixed in the pelvis, of necessity compresses the hollow viscera. In one case upon which I successfully operated the frequency of micturition

almost amounted to incontinence; in this case, the difficulties on defæcation more than once amounted to positive obstruction. A curious feature in the case of this patient was that she could defæcate only when standing upright, probably because the sitting posture forced the growth down into the pelvis. In two other cases* troubles on micturition were considerable, but not urgent.

6. Papillomatous cysts are peculiarly liable to undergo rupture. This is an indication to operate, because of the danger arising from infection of the peritoneum. In one of my cases there was an extraordinary and perhaps unique history of rupture on, at least, twelve occasions. Most of these ruptures were, however, in my belief, confined to the minor cysts; but there is no doubt that rupture of the papillary cysts frequently takes place. It is, however, more a leakage through a small opening than a gush through a large one, and the opening is usually blocked by the papillary growths floating into it.

THE OPERATION.

The first element of danger in these cases refers to the possible elevation of the bladder, and the risk which it thereby incurs of being wounded in making the parietal incision. The incision ought therefore to be made higher up than usual, and it should be short. If the bladder is out of the reach of danger, the incision may be prolonged downwards to the requisite distance.

The second peculiarity refers to the mode of tapping the cyst. It will not always be possible to bring the cyst-wall to the surface; and as peritoneal infection might be caused by the escape of cyst-contents into the peritoneum, extraordinary precautions must be taken to collect all fluids which may escape by the side of the trocar. And when no more fluid flows, the opening must be perfectly closed by forceps or clamp. It is not wise to break down and remove papillomatous material by the hand; the bleeding is so free, and the risks from escape of the

* *Loc. Cit.*

growth are so serious, that it is better to enlarge the incision and deliver the tumour bodily.

Tapping of the secondary cysts is best done by aspirator. They can rarely be brought to the surface, and they are very thin-walled and peculiarly liable to be ruptured in manipulation. A large trocar attached to an aspirating bottle is inserted, sponges are placed round the site of puncture, and the fluid is drawn off from the various cysts in succession.

When the cysts are emptied the process of separation begins. It may be impossible to tell where uterus ends and tumour begins, so closely are they sometimes incorporated. It may therefore be wise to depute an assistant to pass and manipulate the uterine sound as a guide. The same may be necessary in the case of the bladder, especially if it is empty, and its walls are collapsed and flaccid. Here the disadvantage of an empty bladder is conspicuous. It may even facilitate operation to inject a few ounces of fluid into the bladder, so as to accurately show its limits. The peritoneum covering both uterus and bladder may be thickened, movable, and very similar in appearance to that covering the growth.

It is impossible to give useful instructions as to where the process of separation is to begin for any case. This depends upon the position of the growth and the nature of its attachments. If possible, I would recommend that a beginning be made near the uterus, so as to cut off as much of the blood supply as possible early in the process of separation. A small incision is made by knife or scissors, the finger is pushed through this and rapidly separates as much of the growth as possible. This separated portion is either surrounded by ligature or caught in large pressure forceps, and the tissue cut through beyond. If the operation can be continued and completed by repetitions of this process, it will be much simplified. But we must expect to have to carry out a much more complicated process of dissection, in which scissors, knife, forceps, ligature, and even actual cautery, are in constant requisition. I know of nothing which more fully tries the patience and skill of the surgeon than such a dissection. At a distance probably

of several inches from the surface, not easily seen and with difficulty handled, each area of adhesion has to be dealt with promptly and decisively. If the adhesion can be surrounded by forceps or ligature before being divided, enucleation is simplified. But often the adhesion must be separated by fingers alone, and the raw surface bleeds freely. Forceps must be placed on the bleeding points where they are visible: for a general oozing sponge-packing or the cautery must be used. In separating adhesions from the bladder, special care must be taken to avoid tearing its walls; and if points bleed and forceps are placed on them, we must be particularly careful to see that the strong locking instrument does not grasp a piece of bladder-wall and so cause a risk of sloughing. If the adhesions to the posterior surface of the uterus are particularly strong, it may facilitate matters to prolong the incision upwards for such a distance as to permit the whole to be turned out over the pubes with the uterus, and then proceed with the parts in sight. In one such case I had tumour, enlarged uterus, and greatly distended bladder lying, apparently as one homogeneous mass, on the macintosh covering pubes and thighs. If this can be done, it greatly simplifies operation.

We must expect to find intestine adherent to the surface of the growth and in the sulci between the smaller cysts; and here special delicacy in separating must be observed. The ureter too, and the uterine artery with branches of the internal iliac, may be within reach of danger, and they must be looked for in manipulations near the lower and outer attachments of the broad ligaments.

The toilet of the peritoneum must be carried out with particular scrupulousness. Tait's plan of washing out the cavity may here be used with special advantage. The insertion of a drainage tube will almost certainly be called for.

Removal of the Uterine Appendages.

Nomenclature.—The want of a good name for this operation is already being felt. At first, when its object was supposed to be limited to the production of an artificial menopause, the operation was known as "normal-ovariotomy." Battey, who introduced the name, was among the first to recognise its unsuitability. As a matter of principle, the operation was by no means restricted to ovaries that were normal; and, as a matter of practice, it was found that most of the ovaries removed were actually diseased. The term, "Battey's operation," while suitable within the limits which Battey laid down for it, does not include the more extended modern proceedings. "Oöphorectomy" had already been used by Peaslee and others as a synonym for ovariotomy before it was sought to limit it to removal of small ovaries; and as oviducts are now, in most cases, removed as well as ovaries, the term is in a double sense objectionable. In connection specially with disease of the Fallopian tubes, Tait's name became associated with removal of the uterine appendages; and when, in harmony with certain beliefs which he holds as to the functions of the oviducts, he practised removal of the tubes as well as of the ovaries where others had been content with removal of the ovaries alone, the proceeding of "Removal of the Uterine Appendages" came to be known as Tait's operation. Men performed Tait's operation with Battey's motives; hence a confusion which has been rendered more confounded by more than one surgeon calling it the "Battey-Tait operation." The German terms, "spaying" and "castration," are objectionable on the grounds both of good taste and of exact naming. In many of the operations performed the effect of castration, as usually understood, is an undesirable accident rather than a definite aim. "Salpingectomy" for removal of the tubes, and "salpingo-oöphorectomy" for removal of the appendages, are fairly exact but decidedly cumbrous. "Prosthekotomy" is equally applicable to caudal and to uterine appendages. A friend has suggested to me the word "thelytectomy" (Θηλύτης=feminine principle); but this, perhaps, is

too suggestive of castration. Under any of these names, it is impossible to give a complete account of any recognised surgical operation; therefore, in place of a better, the vague but comprehensive title, "Removal of the Uterine Appendages," is adopted. Even to this name the objection may justly be raised, that the uterus is an appendage to the ovaries, rather than the ovaries to the uterus. From a surgical stand-point, however, the objection has less weight than from a physiological.

History.—As a barbarous custom, the castration of women dates from a very remote antiquity. In the case of female domestic animals, such as cows, camels, sows, bitches, mares, and ewes, we have abundant evidence in the writings of Aristotle, Pliny, Galen, Suidas, and others, that castration was very generally practised. The practice is said to have been extended to women at the instigation of certain kings of Lydia. According to Xanthus, a Lydian historian who wrote in the sixth century before Christ, the Lydian king Andramyte first introduced female eunuchs into the service of his palace. Gyges, another king of Lydia, is said to have caused the removal of ovaries from women with a view to prolonging their charms—"*quo illis semper aetate florentibus uteretur.*" Various authors have thrown doubt on the reality of this proceeding, saying that the so-called castration was either removal of the uterus (which is most improbable), or ablation of the nymphæ or the clitoris, or even (which seems an unwarrantable postulate) padlocking or "infibulation," a proceeding analogous to that which Celsus describes as having been carried out on boys. If the Lydians really castrated animals for domestic purposes,—and of this there can scarcely be a doubt,—it is quite within the bounds of possibility that they castrated women also. It is certainly unlikely that with the Lydians any other form of mutilation than removal of the ovaries should be considered as constituting castration.*

* Many classical writers of the Middle Ages refer to the practice. For more detailed accounts see—

Dujardin, *Hist. de la Chirurgie.* Paris, 1774.
Mahon, *Médecine Légale et Police Médicale.* Paris, 1801.

Much interesting information will be found in the second volume of Pierre Dufour's laborious work, *Histoire de la prostitution chez tous les peuples du monde;* and a moderately full summary, with numerous references, is given by Boinet in the article, "Ovariotomie," in the *Dict. Encycl. des Sc. Med.*

Even in times comparatively modern it is stated that the practice has been in vogue in Central Asia. A medical missionary, Dr. Roberts, is said to have met, in Bombay, Hedgeras —attendants in harems—who were spayed.* He remarks that they did not menstruate, and that they had no sexual desire.

The story of the Hungarian sow-gelder who, in a fit of parental anger, castrated his unchaste daughter, is supported by testimony of real weight.† Schurigius speaks of two similar cases; and other cases, with less weight of authority, have been recorded.

These ancient practices were not, however, therapeutic measures. Among the earliest operations performed with a beneficent purpose is that related by Franck de Franckenau, in which an ovary, prolapsed through a wound accidentally made over the pubes, was successfully removed. Percival Pott's well known case of removal of herniated ovaries occurred in 1756. Thereafter the history of the operation is merged in that of modern ovariotomy for tumours.

In 1823 James Blundell, of Guy's Hospital, a man far in advance of his times, in a paper read before the Medico-Chirurgical Society of London, suggested removal of healthy ovaries in cases of severe dysmenorrhœa, or metrorrhagia from inverted uterus. His advocacy of removal of the whole uterus in place of ordinary Cæsarean section, and the scientific manner in which he sought to sustain his arguments by experiments on rabbits, have scarcely received the attention which they deserve. As more germane to the subject in hand, special reference must be made to his proposed method for producing sterility in cases of malformed pelvis, where Cæsarean section had been called for. His words are as follows: "I would advise an incision of an inch in length in the linea alba above the symphysis pubis; I would advise, further, that the Fallopian tube on either side should be drawn up to this aperture; and, lastly, I should advise that a portion of the tube should be removed, an operation easily performed, when the woman would for ever after be sterile."‡

* "Hedgeras de l'Asie Centrale," *Journal l'Experience*. 1843.

† See particularly Wierus, *Opera*, lib. iv., cap. xx.

‡ *Principles and Practice of Obstetricy*, p. 580. Ed. by Th. Castle. London, 1834.

Dr. Robert Battey, of Rome, Georgia, generally gets the credit of having been the originator of the operation as it stands in modern surgery. In 1865 he "conceived the idea of producing an artificial menopause for the remedy of disease;" but he did not publish his ideas till 1872. In February, 1872, Lawson Tait removed with complete success an ovary the size of a pigeon's egg, which contained a chronic abscess. This he claims* as being "the first record in the history of surgery of the removal of a small ovary for pain." Encouraged by this success, on August 1st, 1872, he successfully removed both ovaries for the purpose of arresting intractable hæmorrhage.† A few days before the date of Tait's second operation, Hegar operated on his first case with fatal result. On August 17th, 1872, Battey performed his first operation, which was successful, and in the following month he published it.‡

In discussing the history of the operation, it may be objected that Tait's first operation was not performed with the aim which Battey proposed. The ovary was felt enlarged in Douglas's pouch; and as only one ovary was removed, the operation was not intended to "produce an artificial menopause." There is no suggestion that the proceeding was the fruit of any preconceived theory: it was a local operation for a local disease. But who shall say of the original work of a practical man that it was not preceded by theory? Tait's second case was undoubtedly a physiological and pathological experiment; in favour of its probable success only theoretical reasons could be advanced. Hegar, too, must have independently thought out the operation; it has certainly been his fortune materially to influence its progress. To claim a priority measured by days or months is to be exact at the expense of liberality or even of justice; the time was ripe for the operation, and three independent workers—Battey, Tait, and Hegar—may be permitted to share the honour of introducing it.

* *Dis. of Ovaries*, 4th Ed., p. 324.

† By some mistake Battey records this case as being fatal. *Trans. Internat. Med. Congress*, vol. iv., p. 287. Lond., 1881.

‡ *Atlanta Med. and Surg. Journal*, Sept., 1872, p. 321.

As might be expected, the work of these three men has tended to run in different directions. Battey's name has continued to be associated chiefly with the operation as performed for what may loosely be called "neuroses." Tait's name is mainly connected with inflammatory diseases of the tubes, and his influence has been strongly felt in the substitution of operation for actual disease as against vague nerve-symptoms. Hegar, again, is best known in connection with the operation for uterine myoma. Trenholme, in January, 1876, claims to have been actually the first to remove ovaries for bleeding myoma; but his influence has not been so great as that of others.

The practice of numerous followers in the footsteps of these pioneers has widened the range of the operation, at the same time that it has narrowed down its indications. Greater exactitude in diagnosis, and increasing knowledge in pathology, have largely replaced functional neuroses by palpable disease. Except for uterine myoma, the field for spaying, properly so-called, is being greatly narrowed; on the other hand, the field for the removal of incurably diseased organs is being immensely widened.

The Aim of the Operation.—The purpose of the operation, as enunciated by Battey, was "to determine the change of life for any grave disease which is incurable without it, and which is curable with it." Though this definition may have held good for his own operation in its first conception, it is obviously imperfect as regards the operation in its modern development. In fact, a complete change of front would probably cover more cases; it would certainly be more correct to say that removal of the uterine appendages is performed for local disease in the ovaries or tubes, than that it is done "to determine the change of life." But the operation has more than one aim; the definition of its purpose cannot be gathered into one sentence. It has a threefold purpose: (1) to remove organs incurably diseased; (2) to check or modify the discharge of blood from the uterus; and (3) to completely abrogate the process of ovulation.

1. The removal of organs incurably diseased, and causing danger to life or serious disablement, is, undoubtedly, the most justifiable aim of the operation. Under this head we have to deal with such conditions as abscess in the ovaries or tubes, Fallopian pregnancy, and strangulated ovarian hernia which cannot be reduced; these endanger life: also with the various cystic diseases of the tubes, the more chronic and subacute inflammations of the ovaries, and their displacements; these cause disablement in varying degrees.

2. It may be necessary to check bleeding from the uterus, either on account of its being excessive in amount, or because its discharge is attended with danger or great pain. Uterine myoma is the chief cause of metrorrhagia; incurable obstruction in the vagina or elsewhere to the menstrual flow causes both pain and danger; and certain malformations and malpositions of the uterus may be attended with so much pain at menstrual periods as to render life a sort of recurrent martyrdom.

3. To unsex the woman—the aim sought when castration is spoken of—is the least definite and the least satisfactory purpose of the operation. The ill-defined class of so-called reflex neuroses is not here specially meant: all, or at least the great majority of, inflammatory diseases of the appendages are attended by "reflex neuroses." Here we particularly refer to actual nerve diseases, such as mania or epilepsy, which we have reason to believe are either caused or kept up by the processes attendant on ovulation.

These theoretical "aims for operation" will be put into actual concrete and positive "indications" when the diseased conditions are specified and described. But with the purpose sought we must reckon the result achieved; and this result often oversteps the purpose. We may desire to put a stop only to that part of the sexual process which consists in the discharge of blood from the uterus, whereas the actual effect of operation is to strike at the root of the whole function of ovulation and destroy it. What exactly is the value of this *per contra* which we have to reckon with?

Here we have to deal with sentiment as well as with science.

The question is dragged hither and thither between the practical enthusiasm of the operating surgeon and the destructive criticism of the arm-chair theorist. It is the pride and glory of abdominal surgery that it lives and thrives upon statistics; and it is, perhaps, true that some men ask us to estimate their capacity in general by their experience in detail. This is a fault, but it is a fault in the right direction. And here the legal maxim, "*Ex abusu non arguitur in usum*," holds true. The evils produced by some men doing too much will never be counterbalanced by other men doing too little.

Practical men care little for fine-spun theories; they want to get their patients well. If objection is taken to the operation on the ground of the loss of sexual feeling, they say that this is a petty and contemptible thing to be weighed against prolonged suffering. If loss of the power of reproduction is the complaint, this is a weighty reason,—one in which those first interested must have the last word. Put to the patient herself, or to her husband, these objections—if the case is one in which operation ought ever to be contemplated—are usually promptly and summarily dismissed. And when the actual fact—that the womanly attributes are lost no more after the artificial than after the natural menopause—is borne in mind, the objections have still less weight. In most cases, child-bearing was either impossible or dangerous: here there is no loss; and, in many, dyspareunia is changed into eupareunia: here there is a gain. The general effects of the operation are nowhere better expressed than by Koeberlé, as translated by Barnes:* "The subjects may be regarded as women who have suddenly attained the menopause. The affective sentiments remain untouched. They are no longer under the dominion of an imperious erotic want; but they are not the less good, loving towards relatives and husband. The genital organs remain excitable; the character becomes gentler, less irascible; the breasts do not atrophy; the tone and voice are unaltered." In one sentence, the change is one from active uxoriousness to staid, gentle matronliness. There is nothing very repulsive in this. Here,

* "On Hernia of the Ovary," *Am. Journ. Obstet.*, January, 1883, p. 22.

so far, the matter may rest. The definite results for the definite diseases will be indicated further on.

Considerations that ought to have at least as much weight as the ethical or sentimental ones just mentioned are, firstly, the danger of the operation itself, and, secondly, the not absolute certainty as to permanent cure among cases that recover. The average operator cannot count upon a mortality of less than 8 per cent.; and, as results go, he may expect a perfect cure in no more than 90 per cent. of all the cases that recover from the operation. These are grave facts to be dealt with in an operation not always intended to save life. The patient may be suffering a prolonged martyrdom; but a surgical operation which does not bring cure is scarcely a respite, and death is a terrible penalty to pay for relief. On these grounds we ought to be assured, in the first place, that there is a clear case for operation; and, in the second place, that the full ratio of probability of favourable result belongs to the case under consideration.

CONDITIONS INDICATING OPERATION.

The disease—the extent of it and the symptoms which it produces—is the final criterion as to operative interference. It serves no good scientific purpose to describe a symptom as a cause of operation; it is unfortunate that so many operations are recorded as being for ovaralgia, dysmenorrhœa, and such like. The evil has not been diminished by the recent appearance of certain valuable papers in German periodicals, entitled "Castration for Neurosis." In most of the cases described pain was the only neurosis, and in most of them also there was actual disease in the appendages. It is just as scientific to speak of excision of the hip for reflex pain in the knee, as of excision of the appendages for reflex pain in the back. Wherever it is possible the disease ought to be quoted as the cause for operation, and not the symptoms of it. In a small and diminishing class of cases a profound neurosis, mania or epilepsy, may, under very special restrictions, be quoted as an indication to operation. Yet even in these, with

a curious frequency, disease of the organs is found at operation. For the rest, the disease will be spoken of as the indication for operation. Thus, instead of speaking of removal of the appendages for ovaralgia, dysmenorrhœa, or menorrhagia, we speak of the operation as being for ovaritis, pyosalpinx, or myoma. With this view the indications for operation may in skeleton outline be presented as follows:

A—The Appendages.

(1) *The Ovaries.*

(*a*) Inflammation—acute, chronic, and suppurat ve (abscess).

(*b*) Displacement (prolapse, hernia).

(*c*) Cirrhotic and cystic ovaries.

(2) *The Fallopian Tubes.*

(*a*) Inflammation—Salpingitis.

(*b*) Pyosalpinx.

(*c*) Hæmatosalpinx.

(*d*) Hydrosalpinx.

(*e*) Fallopian pregnancy.

B—The Uterus.

(*a*) Uterine myoma.

(*b*) Errors of development—absence or mal-development of uterus with menstrual molimen.

(*c*) Incurable displacements with severe nerve-symptoms.

(*d*) Insuperable obstruction to menstrual flow (may reside in vagina).

C—The Nervous System.

(*a*) Mania; puerperal mania, menstro-mania, nymphomania, &c.

(*b*) Epilepsy; hystero-epilepsy, convulsions, cramps, dancing fits, &c.

(*c*) Hysteria.

It need scarcely be pointed out that the mere existence of any of these abnormal conditions is (with possible exceptions in the case of three or four of them) no indication for operation.

The essential concomitants of these diseases must be of a grave nature—there must be danger of life or serious impairment of health—before operation is contemplated. With this preliminary and comprehensive proviso we may proceed to consider the indications in detail.

Ovaritis, Oöphoritis, Inflammation of the Ovaries.—The chronic form of ovaritis arising from excessive functional activity, which is found in prostitutes, rarely calls for operation. So also those temporary acute congestions, as obscure in origin as they are in pathology, require no notice. The majority of cases requiring operation have their origin in gonorrhœa. Septic matter may be carried along the tubes to the ovaries by puerperal inflammation in the uterus, and there is no doubt that a septic catarrh of the endometrium set up by traumatism, as from the sound or tangle tent, may also be a cause. The exanthematic fevers and acute rheumatism sometimes beget a form of ovaritis which is attended with troublesome symptoms. Cases following septic inflammations at childbirth always pursue a rapid course and eventuate in abscess, which may be rapidly or even suddenly fatal, or may pursue a more chronic course, bursting into one or other of the neighbouring hollow organs. Following gonorrhœa, or simple traumatism, or any of the exanthemata, ovaritis is liable to become very chronic, and here indications to operate are most frequent and most legitimate.

In such cases the local signs may be marked enough, but urgency is usually bespoken by the reflex or the functional symptoms. The ovary is exquisitely tender to all mechanical disturbance, when the patient stands or moves quickly, and it drags on its ligaments or is jerked; and when it is pressed upon by the fingers through vagina or parietes. Engorgement at the menstrual period aggravates the pain. In the intervals also it causes pain, local on various provocations, and outlying and reflex in the groins, in the back, down the thigh, in the hypochondrium, and elsewhere. Almost every known form of functional sexual derangement may be associated with ovaritis—dysmenorrhœa, menorrhagia, amenorrhœa.

Some weight must be given to the physical signs. An inflamed ovary has a tendency to fall downwards into Douglas's pouch and to become fixed there. Here it may be felt exquisitely tender, and sometimes causing a peculiar feeling of nausea on being pressed upon. In this situation it may readily be mistaken for the fundus of a retroverted uterus. A skilled diagnostician will at once recognise the shape and consistency of the ovary; he may even palpate its ligaments, and with a high degree of probability diagnose the presence of fluid or cysts in its substance. In thin patients the unprolapsed ovary may be palpated between the fingers in the vagina and on the parietes.

In a case diagnosed as chronic ovaritis, from whatever cause arising, if remedial treatment has had a full and fair trial, and if the patient's health is being undermined by the constant pain and other accompaniments, operation may be recommended. If abscess exists, life is endangered and operation is imperative. In the former case the indication follows on the gravity of the symptoms; in the latter, the indication is positive and absolute on the existence of the disease.

Displacements of the Ovary—Hernia: Prolapse.—Among the first, if not actually the first, oöphorectomies for a beneficent purpose were one for *hernia of the ovaries* through a wound, and one for hernia into the inguinal canal. Hernia in itself is not an indication for operation. The herniated organs must be irreducible or the source of great pain, or the seat of some form of degenerative or inflammatory disease, before operation is contemplated. A traumatic hernia following strain or parturition is not so likely to be attended with troublesome symptoms as a congenital hernia. The latter variety is twice as frequent as the former, and is usually not of so simple a nature. Congenital hernia always contains tube as well as ovary; not infrequently it is associated with uterus bicornis, and one horn of the uterus occasionally follows the appendanges into the hernial sac; also under-developed uterus, with its accompanying symptoms of aggravated molimina, may complicate the condition. In at

least six cases complete absence of the uterus has been noted as accompanying inguinal ovarian hernia.

The diagnosis is not often difficult. The characteristic size and shape, the sensations upon pressure, the increase in size at the menstrual periods, and the frequent association with malformations of the uterus, form a combination which can scarcely be imitated by any other condition. A sign of importance, where it can be elicited, is an associated movement with lateral displacement of the uterus.

The tumour increases in size at the periods, and becomes more tender. Then the symptoms may mimic those of strangulated hernia. Actual strangulation may take place, and then operation is imperative. So also if extra-uterine pregnancy takes place in the sac, an occurrence of curious frequency, operation is indicated. And any degenerative or novel development in its tissue, cystic or glandular, demands operation. Otherwise the indications rest upon its resistance to palliative measures, its irreducibility, and the urgency of the symptoms which it produces.

Prolapse of the ovaries is a condition by no means always demanding surgical interference; it is often accidentally discovered during examinations for other purposes. Symptoms of urgency are produced only when they become inflamed or are bound down by adhesions. The existence of adhesions between mobile abdominal organs as a cause of pain, or other abnormal symptoms which may be of grave import, has probably not received the attention which it deserves; in the case of the ovary, from the nature of the organ, it is certain that this condition is peculiarly liable to breed trouble. Adhesions in Douglas's pouch are most common, but they may be attached to almost any part of the intestinal or pelvic peritoneum. I have successfully operated upon a case where the left ovary was closely adherent on one side to the sigmoid flexure, and on the other to the tip of the vermiform appendix. The ovary being dragged upon between these restless organs, it was not surprising that acute symptoms of ovarian irritation were produced. Sometimes mere prolapse started by congestion may be continued by

a sort of strangulation of the blood supply; in such cases operation may be required, though no adhesions exist. Oöphorraphy, or fixation of the ovary by a special proceeding, has been devised to meet this condition; the value of it has yet to be decided. The left ovary is more frequently prolapsed than the right, probably because it is more liable to become congested on account of the left ovarian vein having no valve.

Cystic and Cirrhotic Ovaries.—Though it is probable that small cystic ovaries have their origin in chronic inflammation, and it is almost certain that cirrhosis or fibroid thickening of the ovaries claims this cause, yet in actual practice the condition is not found to be inflammatory. In the cystic ovary the disease is not that of ordinary cystoma—a glandular new growth, but simply a distension of follicles in the thickened and contracted stroma. In true cirrhosis the gland tissue is replaced, in whole or in great part, by fibrous material; the surface is puckered and scarred, and the size of the organ is diminished. It would seem that one termination of the ovaritis found after the exanthemata, especially after scarlet fever, is in this cirrhotic atrophy with follicular distension. The pathology of this condition is still but ill understood.

It is a clinical fact that small cystic ovaries are often attended with profuse and uncontrollable menorrhagia. On the other hand, pure cirrhotic atrophy may be accompanied by amenorrhœa, though the molimina may be excessively severe. In many all the varied and shifting symptoms of deranged sexual function are present in their most aggravated forms. And in such—partly, no doubt, because local disease cannot be physically made out—ovarian neuroses are abundantly called in to justify operation. Taking Schmalfuss's statistics of Hegar's operations as fairly representative, quite one-half of the so-called functional neuroses own such parenchymatous changes in the ovaries as causes.

These cases run a very prolonged course; they are peculiarly resistant to palliative measures, and the reflex disturbances are

liable to be marked and numerous. If the patient cannot put up with her troubles, and the menopause is not near, operation may be performed: it is the only cure.

Diseases of the Fallopian Tubes.—Half a century ago, diseases of the Fallopian tubes were well described by more than one writer;* but so completely had all knowledge of them dropped out of mind, that when, a little while ago, a distinguished provincial surgeon published results of operations for such diseases, an equally distinguished metropolitan brother expressed a somewhat emphatic disbelief, not only in the operation, but in the diseases as well. It betokened an extraordinary, and almost discreditable, ignorance of the work of our predecessors that Tait found it necessary to send far and near specimens of these diseases, in order to establish a belief in their reality. It is well enough known now that diseases of the oviducts are a prolific cause of serious functional disturbances, and that they may even cause death. The difficulties are now not so much theoretical as practical: how to diagnose them, and how best to treat them; when palliative measures may be persevered in, and when operation becomes necessary.

Clinically, it is impossible to separate simple salpingitis from hæmatosalpinx and pyosalpinx. The last two may, in fact, be considered as varieties of the first. When the septic inflammation reaches the fimbriæ, it binds them together and to the ovaries, sealing up the opening. The opening into the uterus is either closed or too small to permit exit to all the fluid; thus we have catarrhal inflammation in a closed sac, the mucous lining of which bleeds every month. While the peritoneal covering exhibits the usual changes consequent on inflammations of serous surfaces, the cavity may contain blood or pus or a mixture of both. The amount of the blood or pus contained in the tube varies greatly. Sometimes it may be less than a drachm: collections of blood rarely exceed an ounce. I have

* In Dekker's *Exercitationes Practicæ*, published at Leyden in 1695, there is a description of a case of Fallopian distension, with a highly artistic drawing of the state of parts found after death.

removed a Fallopian abscess which contained more than a pint of putrid pus along with a considerable amount of gas.

Most cases of salpingitis are septic, the result of inflammations of the endometrium, gonorrhœal or puerperal. Some cases originate in leucorrhœa, and in such Wylie tells us he has, by squeezing the tubes, made the pus flow into the uterus and appear in the vagina. A few are caused by syphilis; some are tubercular. Sänger has found actinomycosis as a cause of suppuration.

Martin* of Berlin has made an elaborate study of tubal disease from a collection of 287 cases. The great majority (220) were married; 113 were barren; 61 had aborted once or oftener. The causes were, in 147 cases, acute or chronic endometritis; in 70, puerperal inflammations; in 55, gonorrhœa; in 3, syphilis; and in 10, tubercle. Tubal inflammations Martin divides into Salpingitis Catarrhalis, where there is infiltration into the mucous membrane; Salpingitis Interstitialis, where the muscular coat is involved; and Salpingitis Follicularis, where pouches are formed on the surface of the mucous membrane. The whole question of gonorrhœal inflammation in its bearing on tubal disease has been treated in a masterly and almost exhaustive manner by Sinclair of Manchester,† and to his paper I must refer my readers.

An inflamed and engorged or distended tube usually falls downwards into Douglas's pouch, and becomes more or less intimately adherent there. By the vagina it may be felt as a moderately soft, boggy, irregularly rounded tumour, not unlike the fundus of a retroverted uterus. It is exquisitely tender to the touch, causing dyspareunia, and cannot readily be pushed upwards. Attacks of pelvic pain, greatly increased at the periods, but aggravated at other times with or without provocation, accompany the complaint. Menstruation is fitful and irregular, usually increased but sometimes diminished in flow. Each period, in hæmatosalpinx, adds to the danger as well as to the pain. Most cases occur in married women, and, according to Tait, "a very frequent feature in the history of the cases was

* *Zeitschr. f. Geburt.*, XIII., ii. † *Med. Chron.*, Aug., Sept., Oct., 1887.

found to be that they had one child, and after that were never free from pain till relieved by the operation."

In every case of true and persistent salpingitis operation is indicated. With judicious treatment and rest, mild cases may get well; but when the ends of the tubes are blocked, and they contain pus or blood, removal gives the only chance of relief. It must not be forgotten, as an indication to operate, that there is real danger to life in septic inflammations of the Fallopian tubes.

Hydrosalpinx is a milder affair, and may be attended with very few symptoms. In many cases it is simply a retention cyst in a functionally inert duct containing clear fluid; in others, epithelial *débris* or pus, sometimes mixed with blood, is found. The cause of the occlusion being usually inflammation extending from the uterus, both tubes are often found blocked. In a case on which I operated, one tube contained several ounces of clear fluid; the other contained a fluid so thick with flakes of cholesterine, that it looked like molten silver when poured from one vessel into another.

The diagnosis is physical. A sausage-shaped or tortuous cyst in the retro-uterine space, with symptoms of disturbed sexual functions, worst at the periods, and less severe than in acute salpingitis, suggest the disease.

As to operation, hydrosalpinx is said—I believe on insufficient grounds—sometimes to last a lifetime, producing no symptoms and causing no harm. In many cases the symptoms are so severe as to demand operation; in all operation is advisable. The disease will not improve; from accidental or other causes the sac may suppurate and burst, and so endanger life.

The death-rate in 274 cases of operation for diseases of the tubes, collected by Schlesinger, was found to be 8.76 per cent. Of these, 20 operations were said to have been for cancer of the tubes (note that Martin does not mention a single case of this disease); 115 for pyosalpinx; 46 for hydrosalpinx; 19 for hæmatosalpinx; 43 for salpingitis; 7 for tuberculosis; and 23 for papilloma. This list must be very far from complete; the operation has been performed in Great Britain alone more than 400 times. I

doubt also whether the proportions of the varieties of diseased onditions would be found to hold good over a greater number of cases. The general mortality is, however, probably near the truth; if anything, rather favourable than otherwise. Special mortality in the hands of a few operators, covering nearly 300 operations, would be found considerably under 5 per cent.

Fallopian Pregnancy.—Most men are now agreed as to the truth of Tait's opinion, that all examples of extra-uterine gestation are in the beginning either wholly or partially Fallopian. The risks of rupture before the fourth month are very great; and danger to life has by no means passed when the ovum is killed by electricity or otherwise.

I hold strongly to the belief that as soon as an extra-uterine pregnancy has been diagnosed, operation ought to be performed. Though Thomas and others claim to have diagnosed the condition before rupture (and their diagnosis has in several cases been verified by subsequent events, not always favourable to the patient however), it is unfortunately the case that the first sign of it usually appears at rupture, when the woman is dangerously ill from intra-abdominal bleeding and shock. In such an event it would be a surgical crime to let the patient die without an attempt at relief. But under all circumstances, the safety of the patient, immediate as well as remote, is best consulted by removing the ovum with the tube at the earliest possible period. According to Parry, the mortality of extra-uterine pregnancy is 67.2 per cent.; early operation in competent hands would certainly give a death-rate of not more than 6 per cent. In the hands of Tait, whose operations have all been at the time of rupture, the mortality has been very little greater than this. In America, where electricity is in vogue for these cases, the successes claimed rest on doubtful diagnoses, and even then they do not equal those after operation.

Conditions mainly Uterine.—Of these, the condition requiring operation most frequently is myoma, or uterine fibroid. The exact position of the operation for uterine myoma is not yet

fixed. It has been much discussed and written about at meetings and in journals; and the general outcome of the discussion has been that cause for interference resides, not so much in the tumour itself, its size or situation, as upon the symptoms it produces.

Uterine myoma has many phases. We find it frequently in post-mortem examinations of patients who have died of something else, and in whom it produced slight or no symptoms during life. We find it of moderate size in young women, where it causes excessive metrorrhagia, completely or partially disabling them. And most frequently of all it is met with in women near the menopause, as a large slow-growing mass, prolonging the periods and causing excessive flow, but not endangering life or causing much disablement. Lastly, we have a class in which the tumour goes on growing till it reaches dimensions so great as to interfere with the vital processes. The rapidly growing œdematous myoma of Tait deserves special mention. These groupings may be modified and interchanged in numerous ways; they broadly represent the conditions as most frequently met with, and that is all.

It is impossible, without fully entering into the whole question of the treatment of uterine myoma, to discuss the pros and cons of removal of the uterine appendages for it. The treatment has its origin in a *vera causa*—the atrophy of such growths with the natural atrophy, at the menopause, of the reproductive glands. By removal of the central glands we seek to produce atrophy of the organs whose functions are dependent on these glands. The results have been encouraging, and the operation is received with growing favour. Even in the hands of such skilled hysterectomists as Keith, Thornton, and Bantock, removal of the appendages is a favourite operation. Tait has always been its chief advocate in this country.

The indications for removal of the appendages cannot easily be laid down in general terms. The leading indications are hæmorrhage and rapidity of growth. Circumstances of weight are the age and condition of the patient and the size of the tumour. In large tumours it is difficult, and sometimes

impossible, to remove the appendages. If the patient is near the menopause, we may temporise, using the ordinary remedial measures; if the patient is under thirty-five, we must take into account the past history of the growth as to rapidity of enlargement and amount of hæmorrhage, and try to forecast the probable risks of leaving it. If the patient is married, the risks are increased from pregnancy. If she is in poor circumstances, forced to earn her living, operation may be indicated; while in a well-to-do patient, to whom chronic invalidism is not an unmitigated evil, it may not be indicated. With the above reservations, free bleeding, which cannot be controlled by ordinary means, is the leading indication for operative interference. If a growth of small size is growing rapidly and producing symptoms of its presence other than bleeding, and if the woman is some way off the menopause, we may interfere. And, finally, the possible effects of Apostoli's method of applying electricity must be taken into account.

The general mortality of the operation for myomata is somewhere near ten per cent. In the hands of individual operators it is, however, less. As to the results, we may, in every thirteen cases of recovery after operation, reckon upon complete cure—*i.e.* shrinking of the tumour and menopause—in ten cases; improvement in two; and failure in only one. But these results, with increasing care and judgment in the selection of cases and the period of operation, will no doubt improve. If cases of uterine myoma are kept under close and constant observation, and treated by removal of the appendages sufficiently early, the field of hysterectomy for this disease will become greatly diminished.

Certain congenital *anomalies and defects in the uterus*, associated with a normal development of the appendages, may be attended with moliminal disturbances so severe as to justify operation. These are: complete absence of the uterus; embryonic, fœtal or infantile uterus; the so-called "uterus pubescens." In these the menstrual functions subsidiary to well-developed tubes and ovaries cannot be properly discharged. There is, not retention,

but a complete absence or imperfect establishment of the menstrual flow. The uterus is overburdened by its ovaries and tubes, so to speak, and at the periods of menstruation it gives no relief to their engorgement by bleeding. The moliminal pains in such cases are often very severe, confining the patient to bed, driving away sleep, and requiring the administration of opium or even chloroform. In the intervals there may be comparative ease; but frequently the pain spreads over these intervals as well, and the patient becomes broken down in health and glides into chronic invalidism. It is often possible in such cases to detect the ovaries enlarged, prolapsed, and tender, and the tubes are sometimes abnormally large as well.

The operation is sometimes performed for *incurable displacements of the uterus* when the symptoms are severe and irremediable. Retroversion and retroflexion, where the uterus has become adherent in its abnormal position, is the most frequent condition. The uterus is enlarged and tender, free bleeding takes place at the periods, pessaries are either useless or unbearable, or both, and other local measures, after prolonged trial, prove ineffectual. The patient is a chronic invalid, probably confined to bed or couch, and there is no prospect of cure. In such an extreme case removal of the uterine appendages, causing atrophy of the uterus, affords the only chance of cure.

Insuperable obstruction to the flow of the menstrual fluid is sometimes an indication for removal of the appendages. In such cases there is extreme pain at the periods, and sometimes, according to Battey and others, even danger to life. Injuries during labour, such as extreme cicatricial contraction of the vagina, and destruction with occlusion of the lower part of the uterus, are the most frequent causes. Congenital imperforate uterus is another cause.

The operation in *mania* has an extremely limited range. The proposal of Goodell to remove the ovaries from all female lunatics who have abnormal sexual propensities cannot be regarded seriously, any more than we should regard castration

under similar circumstances in the male. Certain cases of mania, in which the attacks come on solely or chiefly at the periods, and in which a sexual element strongly predominates, might, under very special restrictions, be properly treated by removal of the appendages. In puerperal mania, particularly if the disease has recurred after a second confinement, the removal of portions of the Fallopian tubes to prevent future pregnancy rather than complete removal of the appendages is indicated. For nymphomania the position of the operation is less assured. The operation has been performed for confirmed masturbation; but for this purpose it does not appeal strongly to the sympathies of the surgeon. Indeed, as the operation may not remove sexual feelings, it may not cure the habit.

In true *epilepsy*, the operation has not been attended with very favourable results. A few cases of recovery are recorded, but the accounts of these do not leave it certain whether the disease was true epilepsy or not. It is not sufficient to justify operation that the fits are worse or more numerous at the menstrual periods; this is true in many examples of confirmed epilepsy. Before operation is thought of, there must be a very strong presumption that the disease had its origin in perturbed sexual function, and the disease must not be so far advanced as to preclude the probability of cure. Actual disease in the appendages is an indication for operation.

In *hystero-epilepsy* there is, undoubtedly, a fair and promising field for operation. But here, also, the mere existence of the disease does not indicate operation. Clear and definite evidence of its connection with the sexual functions must be forthcoming. If the first fit occurred at the first menstruation; if subsequent fits occurred exclusively at the periods, and if they became intermenstrual only after having existed over several years; if there is an aura starting from the region of the ovaries; if the fits do not increase in severity; if they are unaffected by the bromides; and, finally and most important of all, if there is palpable disease of the appendages, we may consider the case as suitable for operation. The minor symptoms of hystero-epilepsy, such as muscular cramps and spasms and disturbances

of sensation, are not of importance surgically. Of more importance are the general condition of the patient as to health, and her position in life—that is, whether she must earn her living or not. If the health is failing, and the patient is becoming a helpless invalid; or if she is absolutely precluded from supporting herself by her own exertions, and has no future but the workhouse, these we should rightly consider as additional indications.

In not a few of the cases where cure has followed operation, there has been very slight or no disease of the appendages; in others, uterine stenosis and incurable displacements are found. The amount of disease does not *pari passu* increase the urgency of operation. Just as many women whose sexual organs appear to be perfectly normal, and who bear children, suffer more at their periods than others who are sterile from palpable disease, so may a slight amount of disease in one woman produce hystero-epilepsy, where in another it would produce no symptoms whatever. The index of excitability to reflex neuroses varies in different constitutions. In a sliding scale downwards, it is easy to reach the condition of no local disease at all, and speak only of disturbed function; and, according to a good few reports, we must at present accept this functional disturbance as a real cause. But it is only provisionally so accepted; future investigations will probably displace it altogether.

For *hysteria* the operation has been performed, and with success. But operations of less severity than removal of the appendages have been successful in hysteria,—a small cut on the abdomen, for instance. For mere hysteria, even if accompanied by "convulsive attacks" or "dancing fits," few surgeons would care to remove the appendages. The attacks would have to be very troublesome indeed, and the case would have to be surrounded by every conceivable inducement to operate, before interference could be contemplated.

THE OPERATION.

What will be the exact nature and extent of the operation depends partly on the disease for which the operation is performed, and partly on the end which the operator seeks to secure.

In diseases purely local and one-sided, such as ovarian hernia, single hydrosalpinx, simple ovarian abscess, uncomplicated prolapse of one ovary, and many examples of Fallopian pregnancy, there need be no hesitation in leaving the sound organs untouched. In double hydrosalpinx without adhesions, the ovaries may be left behind. But in all cases where nerve disturbances have existed for some time, we must reckon with the force of diseased habit; and here complete delivery from pain may be secured by nothing short of complete abrogation of function. If a patient had been suffering for years from a small abscess in one ovary, the appendages being otherwise normal, her cure would almost certainly be more speedy and more complete if the whole of the appendages were swept away. The experience of Tait* and others is decidedly in favour of bilateral removal of the organs for inflammatory disease. After 26 cases of unilateral removal for inflammatory conditions, Tait found that a second operation was called for and performed in 4; that 5 cases of pyosalpinx had subsequently died, presumably from rupture of abscess of the other side; and that, in 7 others, a second operation would be required. In 13 out of 26 cases the unilateral operation was a complete failure, and complete success could be chronicled for only 3, in the sense that the disease had not recurred on the opposite side. Each case must be judged on its own merits. The duration of the disease and the extent of it, the age of the patient, her position in life, her own and her husband's wishes, must all be taken into account.

It happens in most cases of inflammatory disease that the lesions are bilateral; and here the question is settled for us. In those cases where the motive is abrogation of function, or cessation of uterine bleeding, we have to decide between simple removal of the ovaries—oöphorectomy; and removal of both tubes and ovaries—salpingo-oöphorectomy.

Into a discussion of the influence which the tubes may possess over the function of menstruation I cannot here enter. Suffice it to say, that if Tait's theories have not everywhere

* *Birm. Med. Rev.*, June, 1887.

been admitted, his practice has been very generally followed. The modern operation is removal of the appendages, and not merely removal of the ovaries.

Only practical considerations in support of this practice need be given here. A few of these are as follows:

(1) More than one case has been recorded in which removal of tubes without ovaries has been followed by menopause. One such case has occurred in my own practice. In this case menopause was not sought. On the other hand, many cases of double oöphorectomy have not been followed by complete change of life. The best results published so far have been got from complete removal of the appendages.

(2) A better pedicle is afforded for deligation when both tubes and ovaries are included. A ligature surrounding the ovarian attachments alone is liable to cause kinking of the tube with subsequent risk of occlusion or distension. The hilum of the ovary, with its plexus of vessels, is not satisfactory tissue for inclusion in ligature.

(3) By removal of the tubes, all further risks of disease in them are done away with. The ovaries can scarcely be removed without upsetting the blood supply to the tubes, and causing some physical injury to them as well. Venous congestion or actual inflammation in the tubes might readily follow simple oöphorectomy, and nullify the benefits of the operation.

(4) The tubes are useless when the ovaries are removed. If one good reason for their removal can be given, and none for their being left behind, the question at issue is settled.

Removal of the uterine appendages may be either a very simple or a very difficult proceeding. If the organs occupy their normal situations and there are no adhesions, as in the cases to which the term castration may with least impropriety be applied, for small bleeding myomata, or absent or malformed uterus, or cystic ovaries, or such like, the operation is easy. If, as in inflammatory disease, they are displaced and matted together and to the surrounding organs, the operation may be one of great difficulty and delicacy. For large myomata, again,

the operation presents special features which may cause difficulties; and, finally, the proceeding in the case of ovarian hernia is peculiar to itself.

Where the Appendages are Anatomically Normal, or nearly so.—The incision, made in the ordinary median position between the umbilicus and pubes, need not be longer than an inch and a half or two inches—enough easily to admit two fingers. At the second or third cut the fibres of the linea alba are laid bare through the whole length of the wound. Pressure forceps are placed on any bleeding points, and left attached. As the parietes are not thinned and distended by a tumour, the linea alba is very narrow, and it is not often that it can be divided without exposing one or both recti. A small opening is made in the fascia: if it is in the linea alba, well and good; if not, the layers are pushed to one side or the other, and when the situation of the fibrous septum is found, the fascia is slit up to the length of the wound by the point of the knife cutting forwards. The muscular fibres are pushed to one side with the handle of the scalpel, and the sub-peritoneal fat exposed. This is caught up on two catch forceps, and carefully divided between them; and the rest of the division is made while the tissues are pulled out of the wound. The peritoneum is easily recognised: a small opening is made in it while it is thus everted; the finger inserted into this opening acts as a director upon which the division is completed, preferably by scissors. By this method there is no danger in wounding bowels; as each fold of tissue is pulled up and made tense, it is cut on its folded edge by the blade of the knife, held horizontally: and when the very smallest opening has been made in the peritoneum the air rushes in, and the bowels, if they have been dragged forward by suction, fall back at once. With moderate care, there is not the slightest danger of wounding bowel: it is idle to use it as an argument against the operation, as one distinguished gynæcologist has done, that there is great danger of wounding the intestine.

The first two fingers are now inserted into the wound. If

omentum covers the bowels, it must be dragged upwards; if not, the fingers are pushed straight down to the fundus uteri. The fingers, one on each side of the broad ligament, and grasping it between them, are now carried outwards till the ovary is felt; it is then lifted out of the wound, with its mesovarium and its oviduct. Still held in this position in the left hand, the Fallopian tube is pulled out as far as it will readily come, and the pedicle spread out for ligature. The parts to be removed are the ovary with its mesovarium, and the Fallopian tube in its outer three-fourths, with the double peritoneal fold in which it lies, and which contains also the parovarium and the vascular erectile tissue known as the bulb of the ovary. The ligature is placed double by transfixing with a blunt needle. The inner pedicle contains the utero-ovarian ligament, the Fallopian tube somewhere near its isthmus, the spermatic artery and its veins, and the small branch which accompanies the Fallopian tube. The outer ligature lies at the retiring angle where the infundibulo-pelvic and infundibulo-ovarian ligaments meet, takes its half of the mesovarium, and also constricts the spermatic artery. In most cases no method of ligature is, in my opinion, superior to Tait's Staffordshire knot. The loop carried through by the needle (which must be very blunt, to prevent the accident of wounding any of the numerous small veins) is caught by a finger and the needle withdrawn. The loop is then raised over the parts to be removed, and one of the free ends drawn through the loop and over it. The free ends are now caught in one hand and pulled tight, while the fingers and thumb of the other hand act as an opposing force at the site of deligation. The knot is then cast and tied tightly, either by the operator unaided, or with the help of the assistant, who pulls on one end of the ligature. The parts are then cut away, by successive snips of scissors, at a distance of about a third of an inch from the ligature. Before making the last cut the surface must be carefully inspected, to see that there is no bleeding. The pedicle is then dropped in. A more deliberate, and perhaps more clumsy, plan is, to catch the sides of the pedicle in fixation forceps, hand these over to an assistant, and apply the ligature below them.

The same proceeding is then carried out with the appendages on the opposite side.

A small, thin, flat sponge is now placed over the bowels under the incision; and the sutures, four or five in number, are introduced.

When the Appendages are Inflamed and Adherent.—The previous operation is a very simple one. From first to last, in competent hands, it can scarcely occupy more than ten minutes. But it is a very different thing if the appendages are adherent or inflamed, or suppurating and matted together. Then the operation may be one of the most difficult in surgery. Even in the hands of surgeons of the highest skill, it has not infrequently been abandoned as impracticable.

The first difficulty met with is, probably, that the appendages are fixed and cannot be drawn to the surface. They may be represented by an irregular conglomeration of cystic and cicatricial material, sessile on the broad ligament or in Douglas's pouch, and perhaps intimately adherent to bowels. They are beyond the reach of sight, however much the abdominal walls are depressed. To deal with such a state of affairs, one of two courses is open. The first is to enlarge the incision to five or six inches; to pull the bowels out of the pelvis and keep them in the abdomen by one or more sponges packed under them; to pull the parietes apart by spatulæ, and seek by a strong light to expose the parts to view, and operate by the aid of sight. This may be safe, but it is clumsy and difficult. If the parietes are muscular and firm, considerable force may be required to crowd the bowels into the abdomen, and to keep them there is still more difficult. And it is not easy at the bottom of the pelvis to perform delicate surgical manipulations with knife or scissors and ligature. Several operators have had recourse to the doubtful expedient of making space by turning the bowels outside the abdomen altogether.

The other course is that followed by Tait. As a result of his unrivalled experience, Tait has come to the conclusion that it is best to depend entirely on the fingers to deal with such a con-

dition, relying on the skilled sense of touch to guide against the dangers of tearing bowel or other structures. To control bleeding he recommends sponge-packing. Firstly, the fingers map out the actual limits of the diseased organs; then these are gently separated from all surrounding organs, and gradually the mass is unfolded upwards from behind till the only attachment left is the proper pedicle of the parts to be removed. Even as thus separated the appendages will probably be found sessile on the broad ligament, so that they can be little more than brought within the range of sight. The broad ligaments are stretched tightly across the pelvis, and dragging on the appendages may tear them. The pedicle ligature may have to be carried under the diseased parts at a considerable depth from the surface. If possible, all the tissues are gathered together in one pedicle, as by the Staffordshire knot; but the puckering so produced may drag upon the opposite ligament to such an extent as to cause tearing. To tie in two parts almost of necessity tears open the tissue between them. It has happened to me in one case, while putting on a ligature, that the broad ligament was torn clean away from the side of the uterus for a distance of more than an inch.

In dealing with such a difficulty, Tait, always fertile in expedients, tells me that he is in the habit of pushing his finger down on the broad ligament, close to the pelvic insertion of it, and so causing a series of minute tears through the fibrous fasciæ and peritoneum, but leaving the elastic, distensile, and tortuous vessels uninjured.

I have thought that an air bag inflated in the rectum might sometimes be of use by raising the whole pelvic floor.

The bleeding in these cases is sometimes described as being truly alarming, and I have had practical experience of this fact. Sponges are packed in everywhere as the adhesions are separated, and as the hæmorrhage is started. If, after the appendages have been removed, bleeding still goes on, a little solution of iodine on a sponge may be applied to the raw surfaces. Of course visible bleeding points are dealt with by ligature or forci-pressure. And it may sometimes be good

practice to leave forceps attached to bleeding points for twenty-four hours or so, their handles being left outside. In all such cases the insertion of a glass drainage-tube for a day or two is advisable.

During the performance of these operations we must bear in mind the fact that adhesions between intestines may cause great pain. If it is possible to separate such adhesions without endangering the intestinal walls, the intestines should be set free. The separation must be done with great care and delicacy, and always, if possible, within the range of sight.

If an abscess or abscesses exist, extra care is necessary to avoid rupture of the abscess wall. It will be wise before beginning separation to aspirate the contents, and place a pressure forceps on the opening so made. In such cases the placing of sponges all round the diseased parts is peculiarly necessary.

For Uterine Myoma.—For small myomata the proceeding may be in no way different from the simplest operation. In fact, as the appendages are raised with the fundus, and the broad ligaments are usually soft and distensile, the operation may be rendered easier.

When the tumour is large, and especially when it is adherent, the difficulties may be great, even insuperable. Not a few such operations, begun as oöphorectomy, have had to be finished as hysterectomy. If the tumour grows away from the uterus, being sub-peritoneal and near the fundus, the appendages may be deep in the pelvis. Where the growth lies between the broad ligaments the ovaries will be elevated, and squeezed between the tumour and the parietes. In an unsymmetrical growth one ovary may be quite conveniently near the surface, while the other lies out of reach and behind. Indeed, we must expect an endless variety of situation, and in some cases be prepared not to find ovaries at all.

When one ovary is found, we must, before proceeding to remove it, find the other: and before removing one we must be

certain that it is possible to remove both. Having decided to remove the appendages, we rotate the tumour to one side, so as to bring the parts first to be removed as close as possible to the surface. The pedicle is secured in the ordinary way by a Staffordshire knot, or in any other way that seems suitable for the case. Thornton's plan, of not cutting off the first ovary till all manipulations are over with the second, is a good one: it minimises the risk of bleeding from the divided pedicle. Forceps are left attached to the appendages first ligated: the appendages on the other side are brought as near to the surface as possible by rotating the growth, tied, cut off, and covered with a flat sponge. The appendages on the other side are then cut off, and also covered with a sponge. When the sutures have been inserted in the parietal wound, the sponges are removed and the wound closed.

For Ovarian Hernia.—When, from pain or symptoms of strangulation, it has become necessary to operate upon an ovarian hernia, it is usually found the best surgery to remove the herniated parts. The incisions are made as for ordinary hernia, and the appendages are removed according to the principles laid down. Mr. Lawson advises that the divided end of the Fallopian tube be fixed in the wound by a suture: this procedure seems to be no more necessary in operating here than by abdominal section. In most cases there will be found adhesions fixing the herniated organs in the sac. Hulke has operated upon a case in which one cornu of a bifid uterus lay in the sac with the appendages, and "the inguinal portion of the uterus was invested by peritoneum, which passed directly into that of the hernial sac, and thus fixed the organ *in situ*." In herniated ovaries which are easily reducible there is danger of their slipping into the abdomen during operation: to avoid the risk of this, it is suggested that a needle be passed behind the ovary to fix it—a proeeeding which is open to the objection that bowel may be pierced. In some cases, where the hernia only occasionally takes place, it may be most expedient to remove the appendages by abdominal section.

Ligature instead of Removal.—In cases where removal is extremely difficult, or impossible, the proposal of Professor Simpson, to strangulate the blood supply by ligation, is worthy of a trial. In his hands, and in the hands of Leopold of Leipzig, and others, it has done good. Dr. Geza v. Antal, of Buda-Pest,* urges atrophic ligature of the ovaries, not only for uterine fibroids, but for uterine versions or flexions, ovarian displacements, and other conditions. More than one writer has suggested that the whole proceeding of removal of the appendages does good entirely by cutting off blood-supply.

Removal by the Vagina has now practically been abandoned, and need not be described. I have once operated in this way with success.

PROGRESS AFTER OPERATION.

The progress immediately after operation in all essential particulars so closely resembles that seen after ordinary ovariotomy, that it need not be described. Two peculiarities may be mentioned—pain and uterine hæmorrhage.

After removal of the appendages there is usually, for a day or two, considerable pain in the hypogastrium, far more than is seen after removal of cystomata. We ought to be chary of having recourse at once to opium. Flatulence and sickness are such frequent sequences of opiates, however administered, that it is always wise to postpone their administration up to the limits of the patient's endurance. The pain soon passes off; it rarely continues over the second day. Battey used to divide the pedicle by ecraseur, to try and do away with this pain; statements as to the success of his practice are not published. If there is restlessness or jactitation, opium is specially indicated.

On the second, third, or fourth day after operation we may expect bleeding from the uterus to take place. The bleeding is usually considerable in amount, and may continue over four or five days. It is in no way harmful; indeed, it is usually accompanied by amelioration of the subjective symptoms. Some

* *Centralbl. f. Gynäk.*, 1882, No. 30.

surgeons consider it part of the cure in the operation for myoma. It requires no treatment, and need cause no anxiety.

Remote Effects of the Operation.—The individual results of the operation as performed for specific disease have already been described, and the general results so far as they affect the feminine attributes have been sufficiently discussed. It remains shortly to give an account of the behaviour of cases, with particular reference to the uterine functions and with general reference to bodily health as observed for a year or more after operation. Each disease has its own record, and all diseases have points in common.

For inflammatory disease, which is perhaps the most satisfactory source of operation, the record is broadly as follows:— At the end of a fortnight or three weeks the patient will probably express herself as feeling peculiarly well, and will be anxious to get up. When she has been getting about for a week or so, and at the time when menstruation is due, she will probably complain of backache and feelings of weight in the hypogastrium, and possibly her spirits may become a little depressed. Most probably there will be molimina, but no menstrual flow. During the next month slight backache, with some general weakness, may be complained of; and somewhere near the next period these symptoms may be aggravated. These cases do not get quite well very quickly as a rule; and this, of course, is not to be expected, considering their previous prolonged illness. In from three to six months perfect recovery may be expected. But all the old pain will have disappeared; and this alone, even in the most tedious cases, the patient will say was more than enough to justify operation. Regular menstruation is very rare, irregular and slight bleedings are more common; neither is likely to continue over more than six months. In a considerable majority amenorrhœa, immediate and permanent, follows the menorrhagia which occurs a few days after operation.

In myoma the result is very variable as to subsequent course. There occurs the ordinary metrorrhagia immediately after operation. Thereafter we may expect complete arrest of menstruation, with at first cessation in the growth of the tumour,

and then slow but steady diminution in size. This shrinking is by no means confined to small tumours, and it is rarely possible to tell what tumours will shrink and what will not shrink.

There is one variety of myoma—the soft, œdematous—which, Tait tells us, goes on growing after removal of the appendages, and which can be treated only by hysterectomy. I can find no definite information as to the utility of removal of the appendages after the period of the menopause has passed; and it would be dangerous, considering how little we really know of their functions even when supposed to be physiologically inert, to speculate as to the possible benefits to be derived from the proceeding. A tumour may not show signs of diminution in size for several months, when it may begin to decrease in bulk over one or two years, and then reach dimensions which are stationary.

For the neuroses, the results are at once highly encouraging and deeply disappointing. The balance, however, lies largely on the side of encouragement. The failures have been chiefly in cases of epilepsy; and here, no doubt, errors arising from an improper selection of cases have been most numerous. In favourable cases we are not to expect complete and perfect cure from the beginning. For the first few weeks there may be a complete cessation of the abnormal nerve-phenomena; at the time of the next period there may be a few fits; then in diminishing numbers a few more fits, lasting over several months. Perfect recovery must not be counted upon within six months at least; and this recovery must be encouraged by strict attention to regimen and surroundings.

Battey, at the twelfth annual meeting of the American Gynæcologists, held in New York, September 15th, 1887, read a paper on the matured results of 54 cases operated upon by him. His conclusions seem to fairly and clearly state the experience of others. He says:—

(1) That the change of life is the most important factor in securing the complete result of the operation.

(2) That only in exceptional cases did cure immediately follow operation; in the vast majority the patient had to pass through the ups and downs incident to the change of life before

the restoration to health was complete. This period lasted from one to five years.

(3) Very long standing cases reach a stage when they become absolutely incurable by any operation.

(4) In some cases which seemed suitable for operation the pain continued; and his experience has not yet taught him how perfectly to select the cases.

SECTION IV.

OPERATIONS ON THE NON-GRAVID UTERUS.

In this section we have to consider removal of the uterus for malignant disease, for incurable inversion, and for myoma. For malignant disease, removal by the vagina—Kolpo-hysterectomy—is the operation described; it means complete excision of the whole organ. For incurable inversion, removal may or may not be complete. For myoma the operation is in the first place a myomectomy; in most cases, however, it is also a hysterectomy, total or partial. The operations are usually named according to the purpose for which they are performed—Hysterectomy for malignant disease, for inversion, and for myoma.

SURGICAL ANATOMY OF THE UTERUS.

The relational anatomy of the uterus is of extreme practical importance. It is chiefly the close contiguity of bladder, ureters, and other important structures which renders removal of the

uterus such a difficult and delicate proceeding. No surgeon ought to attempt the operation of hysterectomy who has not previously made himself familiar, by study, dissection, and operation on the cadaver, with every anatomical and technical detail.

The ligaments of the uterus have already been sufficiently described; here we have specially to consider its vascular supply, and its relations to bladder, ureters, rectum, and peritoneum.

Over the fundus uteri the peritoneum is closely adherent. In the front, as it descends to the junction of the body and the cervix, it is less intimately attached to the muscular tissue; and, at the bottom of the vesico-uterine depression, it is so loosely attached that it can readily be stripped with the finger. Here is the most important surgical region. The reflection of peritoneum from uterus to bladder is usually at the level of the internal os, but it is liable to be elevated or depressed. (Fig. 31.) In children it is higher up, in multiparæ and old women it is lower down, than the average level. In close relation with the under surface of the vesico-uterine pouch lie the base of the bladder, and the ureters imbedded in cellular tissue. The bladder wall, for a distance of fourteen millimetres, lies on the cervix uteri; below this, as far as the pubes, it rests on the vagina. Courty found, as a result of a great number of measurements taken at all ages, that the distance between the opening of the ureter into the bladder and the insertion of the

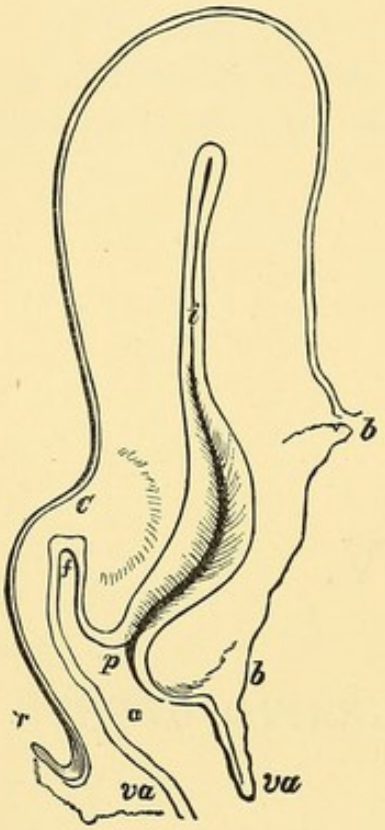

FIG. 31.

Vertical antero-posterior section of the uterus. (COURTY.)

i, isthmus separating the cavity of the body from that of the cervix; *a*, anterior lip of the cervix; *p*, posterior lip; *f*, posterior vagina-uterine *cul-de-sac*; *va*, *va*, vagina; *b*, *b*, connections of the urinary bladder with the anterior surface of the cervix; *r*, reflection of the peritoneum from the posterior surface of the uterus and vagina to the rectum; *c*, commencement of the utero-lumbar suspensory ligaments.

vagina into the cervix was on an average between one and two centimetres in length. The distance between the margin of the uterus and the ureter varies according to the size of the cervix, and also according to the condition of the bladder as to emptiness or distension. With an empty bladder and a normal uterus a distance of quite half an inch may be reckoned upon as separating the cervix from the insertion of the ureter into the bladder wall.

The peritoneum covering the posterior surface of the uterus is continued over the utero-sacral ligaments, and carried down for about three-quarters of an inch over the posterior vaginal wall, when it is reflected up the rectum, forming Douglas's pouch. Though the sub-peritoneal cellular tissue is not so abundant behind as in front, the peritoneum can be readily peeled off as high as the level of the internal os.

The cellular tissue lying between the folds of the broad ligament is continuous below with that which ascends in front over the lateral surfaces of the bladder up to the hypogastrium, and that which descends behind over the levator ani and upper perineal aponeuroses. In this cellular tissue course the uterine vessels and the ureters.

The uterine artery, a branch of the anterior trunk of the internal iliac, passes obliquely downwards and forwards from its origin near the synchondrosis towards the spine of the ischium. Just above the ischial spine it leaves the pelvic wall, but continues to descend half-way to the tuberosity of the ischium, where it turns upwards bending towards the vagina to which it gives branches, and reaching the uterus at its junction with the vagina. It runs up the side of the uterus between the folds of the broad ligaments, supplying the organ with vessels, and finally anastomoses with the ovarian artery near the cornu. (Fig. 32.) Opposite the external os the uterine artery gives off a considerable branch, the circular artery of the cervix, and it gives off other branches in its course upwards. Throughout its course the vessel is tortuous and loosely supported by cellular tissue. At its lowest point it is on a level with the external os, and here it passes directly over the ureter, almost in contact with it, but not

at all attached. The lateral branches given off to the uterus by the uterine artery are so numerous that local compression from flexions or other causes can scarcely render any part of the organ anæmic.

The ovarian or spermatic arteries arise from the aorta below the level of the renal arteries, and cross the pelvic brim at, or in front of, the bifurcation of the common iliac, crossing the ureter, and running along the upper border of the broad ligament to the cornu. More exactly, they may be said to lie between the folds of the infundibulo-pelvic ligament. In the round ligament is a branch from the epigastric artery which reaches the uterus.

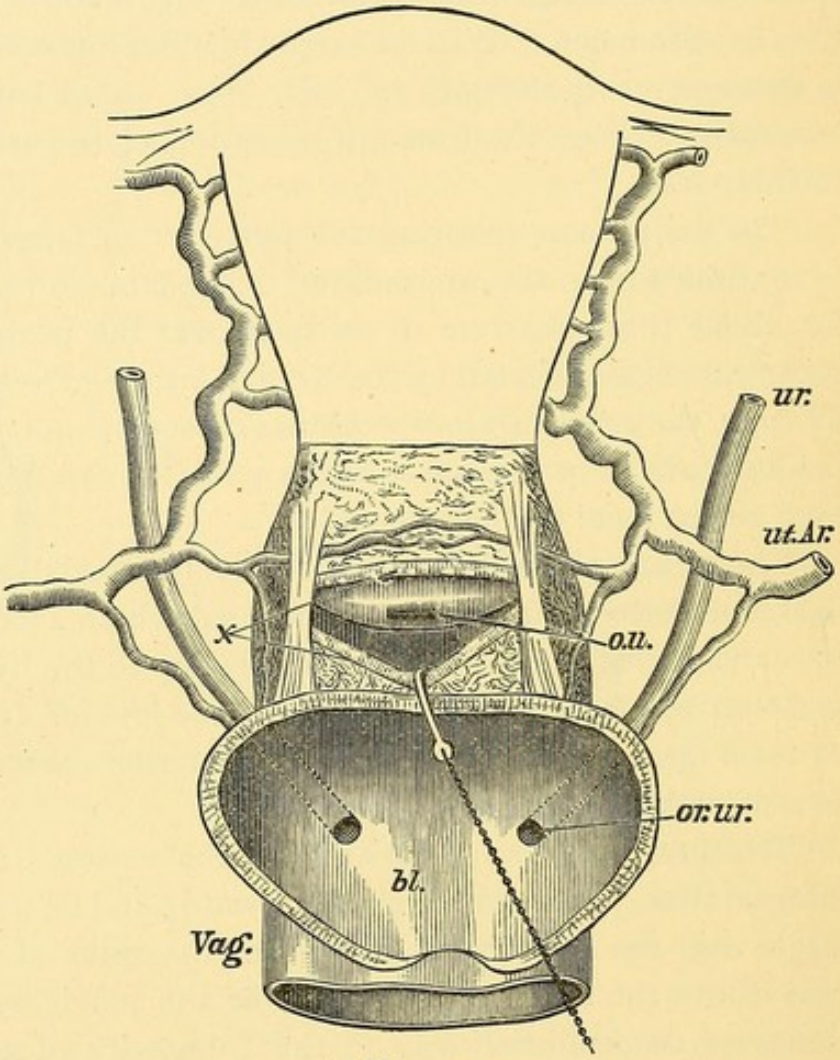

FIG. 32.

Drawing from a dissection made to show relations of ureters, uterine arteries, bladder, &c.

ur., ureter; *ut.Ar.*, uterine artery; *ou.*, os uteri exposed by an incision, *x*, made through the top of the vagina; *bl.*, bladder, the walls of which are cut away down to the insertion of the ureters into its base, *Vag.*, vagina. Two bands of fibrous tissue are seen passing between the cervix uteri and the top of the vagina. Arterial branches of considerable magnitude accompany the ureters. The space between the bladder wall and the unshaded body of the uterus (artificially enlarged by traction of hook) is covered by peritoneum, in the loose cellular tissue underlying which the bladder wall rises upwards to a varying distance.

Although the uterine artery is usually larger than the ovarian, the reverse is occasionally the case. Their relative dimensions are liable to endless variation.

The relations of the ureters to the uterus are of prime importance. The researches of Holl of Innsbrück,* Garrigues (quoted by Hart and Barbour) and Polk,† painstaking and thorough as they are, by no means agree. Mr. J. Collier and Prof. Morrison Watson, quoted by Dr. Thorburn,‡ have given a description of the course of the ureters, which I have several times verified by dissection, and which, I think, may be trusted. Entering the pelvis, the ureter crosses the common iliac near its bifurcation, and then runs downwards and forwards in front of the internal iliac and its anterior divisions. Where this division of the internal iliac splits into its branches, the ureter bends backwards and is crossed to the inside by the uterine artery. (Fig. 32.) The ureter then turns forwards at the level of the internal os, and at a distance of about half an inch from it runs along the side of the vagina for a little way, finally bending over it so as to enter the junction between the vagina and bladder. It perforates the latter organ just above the middle of the anterior vaginal wall, and obliquely enters the viscus a little lower down.

* *Wiener med. Woch.*, Nos. 45 and 46, 1882.

† *New York Med. Journ.*, May 3rd, 1884. ‡ *Dis. of Women*, 1885, p. 534.

Hysterectomy for Malignant Disease.

History.—It is probable that excision of the uterus was practised by the ancient Greeks, but it is certain that the operation was subsequently forgotten. Soranos of Ephesus, in his book on *Diseases of Women*, published a century before Christ, speaks of the operation. It is probable, however, that it was performed for prolapse only. We hear nothing of hysterectomy till 1560, when Andreas a Crucé is said to have performed it. In 1813 Langenbeck successfully removed the whole uterus, for what was supposed to be cancer. The reality of his operation was questioned; but, when the patient died nearly thirty years later, it was proved at the post-mortem examination that he had removed the whole organ. Mikulicz* tells us that one Gutberlet received a prize in Vienna, in 1814, for proposing a mode of removing the uterus not unlike that of Freund. In 1822 Sauter of Constance had the first successful vaginal exterpation for cancer; but a urinary fistula remained. In 1828 Blundell recorded four cases of removal of the uterus for cancer, only one being successful. In 1829 Recamier registered one success; but this was followed by failures in the hands of Siebold in 1831, of Delbech in 1839, and others: so that the operation fell into disuse till 1879, when Czerny,† struck with the report of Langenbeck's case, re-introduced the operation with a success. Billroth, Mikulicz, Schroeder, Condereau, Hennig, Freund, and others, soon followed; and the operation now took its place among established proceedings in surgery.

Freund struck out a new path for himself by using abdominal section. Credé modified Freund's operation by making a resection of the pubes. Massari, Spiegelberg, Baum, and others, proposed modifications more or less ingenious. But Freund's operation has died out. It has had a mortality of nearly seventy per cent. in 106 published cases, and it has been almost univer-

* *Wiener med. Woch.*, 1880, No. 47, *et seq.*

† *Zeitschrift für Geburtshülfe und Gynäkologie*, Bd. vi., Heft. 1., 1881.

sally discarded for the vaginal operation—Kolpo-hysterectomy (κόλπος = vagina). To the latter operation we shall therefore confine our attention.

Mortality and Appreciation.—By some authorities the operation of removal of a cancerous uterus is absolutely condemned as unjustifiable. The objections offered are mainly on three grounds—the high death-rate, the liability to recurrence, and the favourable results got from partial removal.

Kolpo-hysterectomy has been performed about 350 times, with a general mortality of under 27 per cent.* This death-rate is spread over nearly 50 operators. Martin† collected 311 cases reported up to the end of 1886, with a general mortality of 15.1: this, I think, must be a little too favourable. Now, it may be pointed out that ovariotomy itself, in the first 300 operations performed by a few selected surgeons, had a mortality greater than kolpo-hysterectomy has had. And it is certain that if the combined results of all operators at the present day were tabulated, the death-rate would be nearly as large for ovariotomy as for kolpo-hysterectomy. The statistics of individual skilled operators in excision of the uterus are nearly as favourable as the average statistics of ovariotomy. Thus, Brennecke has had 18 cases, and Staude 16 cases, all successful; Fritsch lost 7 out of 60 operations; Martin lost 11 out of 66 operations; and Sänger, Olshausen, Leopold, and a few others have had results nearly as brilliant. Dudley‡ has collected 38 cases of operation done in America by 22 surgeons, with 13 deaths. It should be noted that Bernays of St. Louis had 6 cases, all recovering; and Bull of New York, 5 cases, with one death. It will therefore be seen that, in skilled hands, the operation is far from being unjustifiable on account of its mortality. The operation has suffered at the hands of untrained operators; but the operation itself must not therefore be condemned.

* See Post's elaborate paper, *Internat. Journ. Med. Sc.*, Jan., 1886.

† Internat. Med. Congress, 1887.

‡ *N.Y. Med. Journ.*, July 9th and 16th, 1887.

With regard to the objection urged against hysterectomy, that the disease is extremely liable to recur, we have no trustworthy data to argue from. This objection holds good against all operations for malignant disease; and there is no evidence to show that this recurrence is more likely to take place after excision of the uterus than after other excisions for cancer—of the tongue, for instance. Reasoning on theoretical grounds, we might infer that an organ, so much differentiated as the uterus, would be as likely as any to have the disease limited for a definite period. As a matter of fact, in those cases where the after-results have been carefully noted, as in Schroeder's and Martin's, the per-centage of permanent cures is fully equal to that got after extirpation of cancer in other regions. No doubt recurrence has taken place more frequently and more rapidly than it ought to have done, because unsuitable cases have been submitted to operation.

Partial or cervical amputation is sometimes compared with total amputation, to the disadvantage of the latter. No fair comparison is possible. As well might we compare excision of a small epitheliomatous ulcer of the tongue with removal of the whole organ. The operations are quite distinct. Where the one is proper, the other is improper; where the minor operation is likely to succeed, it would be wrong to perform the major. And in the case of cancer of the uterus, the minor operation is, in the large majority of cases, the proper one: my own experience is, that for ten cases in which partial excision is the proper operation, total excision is called for only once.

It should be noted that certain authorities maintain that total removal should be adopted for all cases of cancer of the uterus, even in those cases where the disease is confined to the cervix. Fritsch, in particular, has identified himself with this view; and gives as reasons, besides the admitted ones of subsequent painful menstruation and liability to recurrence after the partial operation, the somewhat remarkable one that total extirpation is less difficult and less bloody than cervical amputation. He would operate, however, only when operation is easy; that is to say, when the uterus can be easily drawn down.

Fritsch's experience and his extraordinary success in the operation give his opinion great weight. Additional strength has been given to Fritsch's position by Schuta of Prague,* who states that 70 per cent. of the patients submitted to total extirpation remained free of the disease one year after operation; while only 50 per cent. remained free after the partial operation. After two years 100 per cent. of the survivors were free after the radical operation, while only 40 per cent. were free after the partial one. These statistics, however, require corroboration.

I have no hesitation in expressing my belief that, in carefully selected cases, the operation is both justifiable and proper. The immediate mortality does not forbid it. Recurrence is almost certainly not more rapid than in other operations for cancer, and permanent recovery is just as likely to be secured. And, finally, there seems to be an almost unanimous opinion that death after recurrence is not attended with so much suffering; that perforations of bladder and rectum are not so liable to take place after the uterus is removed; and that existence is prolonged.

CONDITIONS FOR WHICH OPERATION MAY BE PERFORMED. INDICATIONS AND CONTRA-INDICATIONS.

The varieties of malignant disease for which excision of the uterus may be performed are: epithelioma, scirrhus, encephaloid, and sarcoma.

Epithelioma may be found attacking the vaginal portion of the cervix, the cavity of the cervix, or the interior of the body of the uterus. The varieties may be clinically spoken of as epithelioma of the os, the cervix, and the body. On the os the diagnosis is easy. The characteristic hard, nodular, friable and vascular granulations, and the proneness to hæmorrhage on being touched, are, with the peculiar acrid watery discharges and certain other well-known symptoms, sufficiently diagnostic. In epithelioma of the cervix, the development of the cauliflower excrescences is hindered by the encircling tissues. The new

* *Wien. Med. Presse*, July 3rd, 1887.

growth infiltrates the parenchyma as hard nodular masses, leaving softened intervals of uninvaded tissue. Granulations may protrude at the os, or they may grow inwards towards the uterine cavity. The epitheliomatous granulations soon break down, and the cervical cavity becomes a large, open, rounded channel, with irregular nodulated masses bulging into it. Cancerous discharges are said to come on earlier, and to be more abundant, in this than in the previous form.

Epithelioma of the body, as a primary disease, is not so rare as it is frequently supposed to be. Its behaviour is very similar to what is found when the disease attacks the cervical mucous membrane. There is greater enlargement of the fundus, less marked hardening of the cervix, and it is frequently associated with symptoms of uterine contraction or spasm. The diagnosis is made certain by dilatation of the cervix and introduction of the finger.

In every case of doubtful diagnosis, a piece of the granulations should be removed and examined under the microscope.

As to operative treatment. In every case of epithelioma confined to the vaginal portion of the cervix, amputation of the cervix alone is, in my opinion, called for. And as the majority of examples of epithelioma of the uterus are of this limited nature, the greater number of amputations will be partial.

Cancer of the cervix may occupy the lower portion of the canal, or extend upwards through its whole length. The selection of partial or total hysterectomy must depend on the extent of the disease. It is possible to remove the whole cervix and some part of the uterine body without entering the peritoneum, and in many cases it may be ascertained with a considerable degree of probability that such operation is well clear of the disease. But epithelioma in the cavity of the uterus burrows more extensively than on the os, and infiltration may have extended some distance beyond the limits of the superficial and palpable growth. Such cases can be cured only by total hysterectomy.

For epithelioma of the fundus and body of the uterus, total hysterectomy alone is permissible.

Parenchymatous cancer of the cervix may be either scirrhus or encephaloid: diagnosis between the two is rarely possible till the disease is too advanced for operation. It is known by the increased tumefaction of the cervical tissue; by its general density, marked at several points by masses of specially hard consistence; by the dark-red, angry colour of the visible parts; and by the tenderness on pressure. Scirrhus is harder than encephaloid, and is more liable to form multiple masses of induration. The progress in both is very rapid.

Scirrhus or encephaloid may attack the fundus, and may develop towards the uterine cavity or towards the peritoneum. In the early stages it is exceedingly difficult to diagnose parenchymatous disease of the body of the uterus from simple myoma. Undeniable evidence is afforded only when ulceration takes place. But much may be inferred from the urgency of the symptoms as to bleeding, pain, the rapidity of progress with attendant cachexia, and the nature of the discharges.

Sarcoma of the uterus is a rare disease, and is not easily diagnosed. Hæmorrhages, a watery discharge "like the washings of meat" (Schroeder), moderate enlargement of the uterus, often markedly in one direction, and rapid increase of the growth, suggest the disease. There may not be much pain, and such pain as is found is usually intermittent and of the nature of uterine colic. The growth is soft, often semi-fluctuating, and it grows irregularly, while still continuing as one mass. Quite recently I removed, in the Bristol Royal Infirmary, a sarcoma of the uterus containing great quantities of blood-clot. The patient died within three weeks with secondary deposits in the lungs, and suppurative peritonitis.

In malignant disease of the uterus, where removal of the whole organ is contemplated, the grave nature of the operation demands that the indications and contra-indications should be peculiarly definite and unmistakable. They are in no way different from those in force with reference to malignant disease elsewhere; but the risk to life from the primary operation

is so great, that special weight must be given to any element which is likely to interfere with success. The liability to recurrence in a given case of epithelioma of the lip may appear to be greater than in one of epithelioma of the cervix uteri after removal; but the immediate danger after operation from the one is so much less than after the other, that the one operation might be surgically permissible when the other would not.

Before proceeding to operation in any given case of malignant disease, the most careful and rigid scrutiny must be instituted, not only into the amount of local disease and its limits, but into the general condition of the patient. Marked anæmia, evident cachexia, or a faulty condition of any of the vital organs or viscera, at once forbids operation. The patient must be in fair health, with a prospect of average longevity from general soundness of organs apart from the malignant disease.

Locally, a precise examination by vagina and rectum must reveal complete absence of extension of disease to any surrounding organ or gland, to peritoneum, broad ligament, bladder, or rectum. One finger in the rectum and another in the vagina may cause the cervix and the wall of the bowel to glide over each other; and a sound in the empty bladder may, to a less extent, elicit the same symptom for that organ. Bimanual examination will detect thickening of the broad ligaments and enlargement of glands. The uterus must be freely movable in all directions, and the movements ought not to be associated with severe deep pelvic pains. Local extension of the growth to the vagina, of course, contra-indicates operation.

CERVICAL AMPUTATION.

Although this operation for cervical cancer is not strictly within the limits of this work, and was omitted in the previous edition, I now include it, because it is germane to what follows, and because it makes complete the account of the operative treatment of uterine cancer. I confine my description to a short account of the operation which I have performed for the past

five years with uniform success. The cases are too few to draw conclusions from; but, judging from the behaviour of patients submitted to the operation, I believe that one may go on operating with a mortality under 2 per cent.

The vagina is disinfected thoroughly by irrigation before operation, and by swabbing at the time of operation. The patient is placed in the lithotomy position and kept there by means of Clover's crutch. (Fig. 33.) The cervix is caught in powerful locking volsella, by means of which the uterus is forcibly dragged down: these are handed over to an assistant, who directs the movements of the uterus according to the instructions of the surgeon. The only instruments necessary are, two Spencer Wells's large compression forceps, a scissors curved on the flat, and a straight uterine probe.

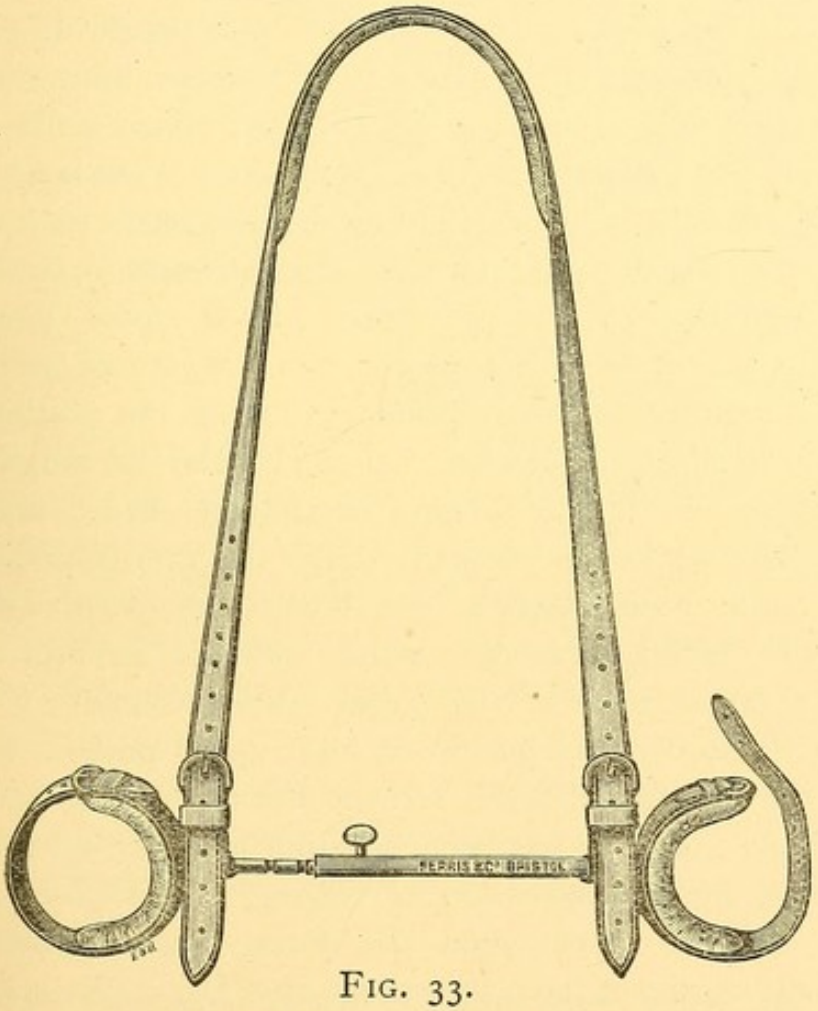

FIG. 33.

Clover's Crutch. One-eighth size.

The mucous membrane surrounding the cervix, well clear of the disease, is divided circularly with the scissors. With the forefinger of the left hand, and the scissors in the right, the

cervical mucous membrane is dissected or peeled off in an upward direction, in front and behind, but not at the sides, as high as possible. The dissection is made close to the uterus in front to avoid the bladder and ureters, and behind to avoid perforation of the peritoneum; the dissection may be carried higher in front than behind. Practice on the cadaver will soon enable one to judge by touch when the upward limits of safety have been reached; these are known by the increased resistance met with. At the sides, where the broad ligaments are inserted and the uterine arteries are met with, no dissection is made, but cellular tissue is stretched and peritoneum is pushed aside. The cervix is now cleared of mucous membrane up to the limits of undetachable peritoneum; it must be noted, however, that the peritoneum at the sides is less closely adherent than in front and behind; and two pouches may be formed between the layers of the broad ligaments, higher up than the highest limits of the peritoneal reflexions from the uterus. The peritoneum is, in fact, stripped from the broad ligaments for some distance along the sides of the uterus; and between the two layers of peritoneum lies a stratum of cellular tissue containing the uterine vessels. This layer of undetached cellular tissue is caught between the fore and middle fingers of the left hand, and stretched laterally while the assistant drags the uterus in an opposite direction, thus clearing the lower sub-peritoneal portions of the broad ligament, which contain important vessels, for the application of the large compression forceps. The blades of the forceps are pushed as high up as possible in the tracks of the fingers and firmly locked, first on one side and then on the other. If there has been bleeding from the epitheliomatous tissue, from compression or tearing by the volsella, this bleeding at once stops when the forceps are applied. Indeed, the continuation of the hæmorrhage after the application of both pairs of forceps I should regard as indicating that they were not properly applied.

The cellular tissue between the forceps and the side of the uterus is now divided by scissors. Such division nearly always permits the uterus to be dragged down lower. The uterine

probe is now placed inside the cavity as a guide to the lines of division. The uterine tissue is divided obliquely upwards b the scissors, the division all round converging to the probe as centre. The fingers of the left hand push the loose tissues out of the way of the scissors, while the assistant manipulates the uterus by volsella and probe, so as to assist the division. The cervix and a considerable portion of the body of the uterus may be removed in this way without any trouble from hæmorrhage. The uterine mucous membrane may be removed in its whole length without much difficulty, if it is divided while it is gradually pulled down after the muscular tissue has been cut through.

The gap in the uterus is swabbed out with an antiseptic lotion; a pad of antiseptic wool closes the vagina and surrounds the handles of the forceps, which are left *in situ*. In twenty-four or thirty-six hours the forceps are removed. Daily irrigation of the vagina may be continued for a week or longer, and in a fortnight the patient may be permitted to get up.

KOLPO-HYSTERECTOMY.

An extraordinary amount of literature has accumulated around the description of Kolpo-hysterectomy. Much of it represents early crude and tentative proceedings which have been generally ignored or abandoned; but some of the described methods have survived the natural processes of selection and evolution, and have now crystallised into generally accepted plans of operation. Finality has not yet by any means been obtained, and permissible variations in each step of the operation may be properly referred to.

The operation may be conveniently described in successive stages.

Preparatory. — Three or four days must be devoted to thoroughly cleansing the whole of the parts concerned in, and contiguous to, the seat of operation. The external parts, the folds between the labia at the top of the thighs and around the clitoris and pubes, are washed at least once a day with soap (preferably with pure potash soap) and hot water. The vagina

is irrigated twice daily with some trustworthy antiseptic, such as 1–30 carbolic acid or 1–1500 perchloride solution. After irrigation, iodoform powder is to be insufflated, and a plug of cotton wool, impregnated with antiseptic material (iodoform is suitable), is to be inserted, and removed for the next irrigation. Some writers recommend that the cavity of the uterus should be purified; but, if the uterus has to be turned over, risk of infection may be avoided by placing a sponge between the cervix and the peritoneum; while if it is not turned over, the proceeding is unnecessary. A few surgeons go so far as to recommend that the protruding and foul granulations should be removed some days before removing the whole organ. When the patient is placed ready for operation, a final and thorough douching with a strong antiseptic lotion will be instituted. The bladder and the rectum are, of course, thoroughly emptied.

The best *position of the patient* is that of perineal lithotomy; and the posture is best maintained by Clover's crutch (Fig. 33), which keeps the knees apart, and maintains flexure of the thighs on the pelvis by means of a strap carried round the neck. Ordinary lithotomy straps, joining wrist and ankle, permit movements of the limbs, and require an assistant to keep them still. The table must be of convenient height, so as to bring the parts easily within the reach of manipulation and sight. A few surgeons prefer Sims's position.

Fixation and Manipulation of the uterus is managed by means of a powerful volsella, with three or four broad interlocking teeth. Many surgeons recommend the use of a thick ligature, carried through the cervical tissue. But a ligature, however thick, is more liable to tear the tissue than volsella of proper shape and dimensions; and an assistant cannot move the uterus about in the vagina, as the operator directs him, with so much rapidity and precision by a thread as by a strong stiff instrument. Volsella need be in the way of the operator very little more than a string.

The surgeon pulls down the uterus as far as possible by means of the volsella, and then hands it over to an assistant. The next step is:

Dissection of the vaginal mucous membrane off the cervix. If the patient is stout, lateral retractors may be of advantage in giving more room and more light. In most cases the fingers of the left hand will be quite sufficient to expose the parts. In those cases where the cervix can be brought without the vulva, retractors will not be necessary.

A scissors, curved on the flat, is made to cut through the mucous membrane around the cervix, at a distance well clear of the disease. As a general rule, it will be wise to carry this line as high up as possible, short of the limits of danger to bladder or ureters in front, or rectum behind. When the uterus has been much dragged down, the normal relations to bladder and rectum are disturbed; and if deep cuts are rashly made, these viscera may be wounded. (Fig. 34.) The finger moved over the cervix, and judging of the mobility of the mucous membrane covering it, will always be a reliable guide.

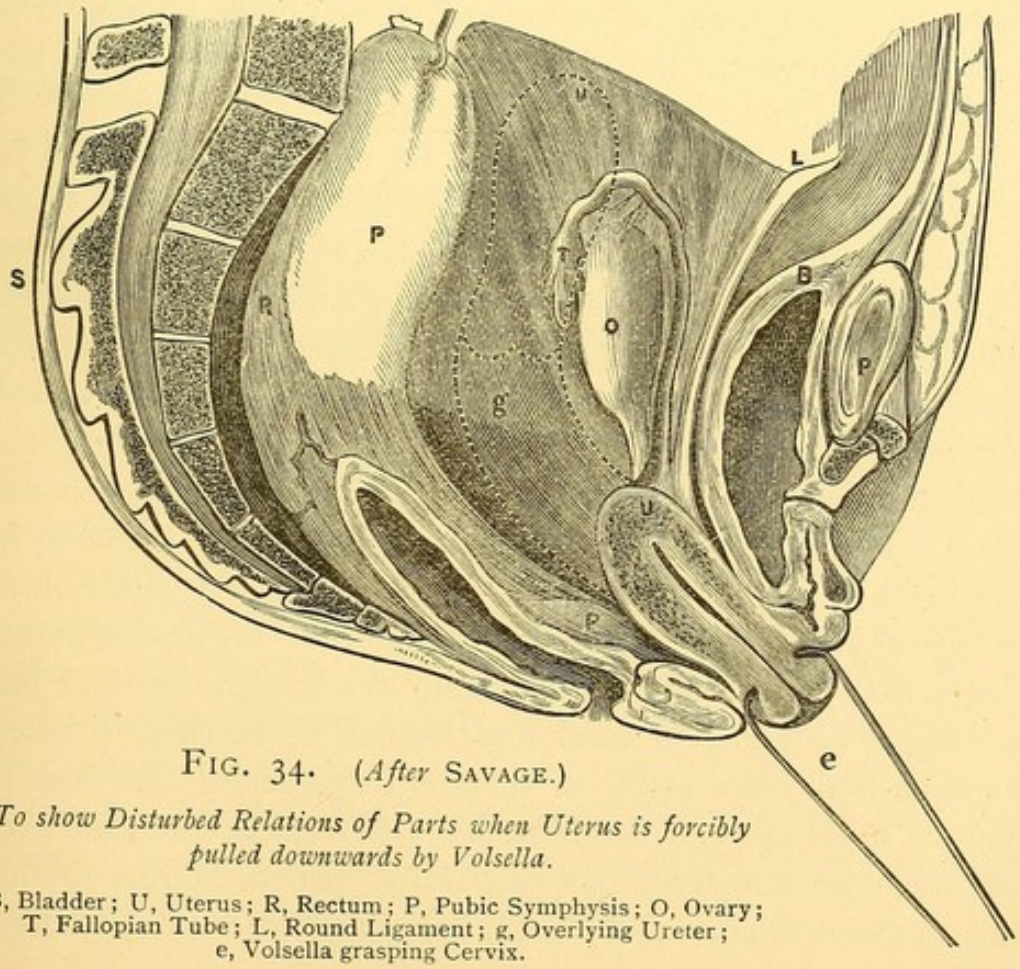

FIG. 34. (*After* SAVAGE.)

To show Disturbed Relations of Parts when Uterus is forcibly pulled downwards by Volsella.

B, Bladder; U, Uterus; R, Rectum; P, Pubic Symphysis; O, Ovary; T, Fallopian Tube; L, Round Ligament; g, Overlying Ureter; e, Volsella grasping Cervix.

The mucous membrane is now elevated from the cervix, connecting cellular tissue being divided by forefinger and scissors. A catch forceps placed on the anterior flap and handed to the assistant, who pulls it forward while he depresses the cervix with the volsella, will facilitate the dissection in front; while a reversed manipulation will be of equal advantage behind. Laterally, no cutting must be made after the mucous membrane is divided. The cellular tissue must be pushed up as high as possible by the finger without tearing it; frequently the upward limit will be defined by a feeling of pulsation in the uterine arteries. Under all circumstances, in the dissection, it is a wise plan to keep close to the uterus.

A sound in the bladder is by many operators considered an assistance. If there is any doubt as to the position of that viscus, and any apprehension of its being injured, then the sound ought to be inserted. But if the rule to keep close to the uterus is followed, and if the finger has been made familiar with the feel of the parts by practice on the cadaver, the sound will rarely be wanted.

Opening the Peritoneum. — When the mucous membrane has been cleared from the cervix as high up as the peritoneum, that membrane is perforated in front and behind, and the abdominal cavity is entered. The forefinger is the best perforator. Above the internal os, the peritoneum is closely adherent to the uterus anteriorly and posteriorly, and here the finger may be pushed through it by a little judicious manipulation. If it is more than ordinarily tough, and it seems to be yielding and stretching in front of the finger, a Lister's sinus forceps sharply pushed through it will, after separation of the blades, make an opening large enough to admit the finger. The opening is enlarged in front and behind by tearing with the finger on both sides as far as the broad ligament. Braithwaite makes a great point of leaving the peritoneum behind intact till that membrane in front has been fully opened, hoping in this way to prevent access of blood, cancerous or septic matters.

Before making the posterior opening the parts are thoroughly cleansed.

A soft sponge is now pushed through the opening into the posterior cul-de-sac, and left there. It serves to protect the bowels and keep them out of the way, while it absorbs any effused fluids and lies between the general cavity and any possible infection from the cancerous uterus.

Division of the Broad Ligaments.—The most difficult and delicate step in the whole proceeding is the separation of the uterus from the broad ligaments, and the securing of the vessels lying in them against bleeding. For this purpose an almost endless variety of plans has been devised. The ligaments have been secured in mass by ecraseur, wire, silk, and elastic; they have been divided and seared by cautery; and they have been secured in separate divisions by loops, chain ligatures, and continuous sutures. To facilitate manipulation, the uterus has been turned upside down in backward and in forward direction, and it has been completely bisected from fundus to os. Minor varieties of these varieties have been recommended and carried out; as, for instance, the division after ligation of the lower portion of the broad ligaments; then turning the uterus upside down, and ligating and dividing the upper portions. One writer is of opinion that the Fallopian tube ought to have a catgut ligature of its own; and special needles are accredited with special virtues for the placing of ligatures.

The best results will be got from the selection of an efficient plan which is at the same time simple, and endeavouring to perfect it. The application of ligatures is always difficult; in the most skilled hands it has sometimes failed to check bleeding. The simplest plan is undoubtedly that of temporary pressure by forceps or clamp, and it can undoubtedly be made efficient. Quite recently a good deal of evidence in favour of this plan has appeared in the journals. Richelot of Paris, in particular, has devoted attention to the method with conspicuous success. I have for some time advocated this principle by the use of a specially devised clamp.

The instrument (Fig. 35) is simply a straight clamp with long and powerful handles, and grooves on its lateral aspect to guide a small knife which is intended to cut through the clamped ligaments. It is deeply slotted on its compressing aspect, to prevent slipping; elsewhere it is smooth and rounded. Through the posterior opening the forefinger is carried over the top of one broad ligament, hooking it down as far as possible. This manœuvre may be facilitated by a blunt hook, handed over to an assistant. The posterior blade is now carried upwards along the finger, at a distance of about half an inch from the uterus, and the end hooked over the top of the ligament. Its handle is pressed backwards on the perineum. The anterior blade is introduced in front of the ligament, parallel to the posterior blade, and its end is locked by a simple mechanism into the end of the posterior blade. The clamp is then closed, and the handles screwed up tightly outside the vulva. A second clamp is similarly applied on the opposite ligament. When both clamps are applied, the knife is run up the grooves and the ligaments divided on the uterine side of the clamps, when the uterus is freed. Or scissors may be used for this division. The instruments may be easily removed at the end of two or three days, when the natural process of vascular closure will provide against the occurrence of hæmorrhage.

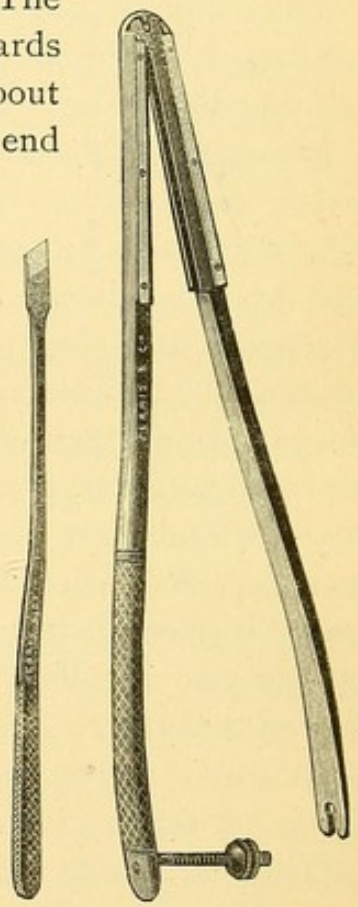

FIG. 35.

The Author's Clamp for Kolpo-Hysterectomy. One-third size.

The use of these instruments renders the operation a very simple one. It is possible, in the deadhouse, to remove the uterus by means of them in five minutes, and leave the parts in a condition anatomically and surgically satisfactory; and on the

operating table, the proceeding ought not to occupy more than of half an hour.

The use of strong compression forceps, to be removed after one, two, or three days, would secure the same result with somewhat less facility and greater cumbersomeness. Müller* has advocated the use of two pairs of forceps, one pair to each broad ligament, and supports his recommendation by records of five cases, with one death. The disadvantages of the use of forceps are, that several pairs would have to be applied, and left in the vagina; while both sides of the uterus could scarcely be secured against bleeding before the uterine connections were severed.

But, in some cases where the uterus is considerably enlarged, as in malignant disease of the fundus, or as in a case on which I operated where pregnancy co-existed, the tops of the broad ligament lie beyond the reach of the finger, and the whole structures are voluminous, the clamps are unsuitable, and either forci-pressure or deligation must be instituted. In the application of either method, I believe that turning the uterus upside down will be found an advantage: and this I should select in preference to all other methods which have been recommended. Complete rotation of the uterus on its long axis materially shortens the depth of the broad ligaments, brings them more fully within the field of operation, and leaves the most important stage of the proceeding—division of the uterine arteries—to the last, when it is also rendered most easy.

Against the plan of turning the uterus upside down it is urged that thereby a cancerous and perhaps foul mass is brought into contact with the peritoneum. To avoid this risk the superadded operation of excising the cervix has been recommended and performed. Now it is easy enough, by the use of germicides, to render the cervix not only aseptic but, if the fluid is strong enough, actively antiseptic. But all such risks may easily be avoided by the ordinary expedient in abdominal surgery of placing a sponge between the possibly noxious substance and the peritoneum.

It matters little whether the uterus is turned backwards or

* *Centralbl. f. Gynäk.*, 1887, No. 12.

forwards. If rotation can be performed by the finger alone, it is most easily carried out in the backward direction, with the finger in the posterior opening and hooked over the fundus uteri. If the finger does not suffice, anterior rotation by means of forceps may be carried out. A firm hold of the anterior surface is taken with catch-forceps, and the uterus is pulled down as much as possible; a second hold is secured higher up, and so on, one above the other, till the fundus is grasped, and the uterus pulled down and completely inverted. The fundus now lies in the vagina, and perhaps presents at the vulva, and the upper insertions of the broad ligaments are within sight and reach.

Where it is possible to apply it properly, a satisfactory ligature is probably better than the best forci-pressure. With an inverted uterus, deligation of the broad ligaments presents no special difficulties. Firstly, a powerful Wells' forceps grasps as much as possible of one broad ligament, close to the uterus, and a strong silk ligature is carried round a corresponding depth of the ligament at a proper distance beyond. Braithwaite found that it was not necessary, in two successful cases, to place forceps on the uterine side of the divided tissues; bleeding was checked by the forcible traction on the uterus. The intervening tissue is divided with scissors. Two or three successive pieces of ligament are so treated, and one side of the uterus is set free. The other side is similarly treated, and the whole uterus is then removed. The broad ligaments are thus secured by three or four ligatures on each side, and they are cut off short. If there is any doubt as to the security of the deligation at any points, catch-forceps are placed on the visible vessels, and these are either ligatured subsequently, or the forceps are left hanging and removed next day or the day after.

Ovaries and Fallopian tubes, if they are healthy, need not be removed.

When the uterus is pulled down, and particularly if it is inverted, the broad ligaments are stretched and tense. As soon as the uterus is cut off, the ligaments recoil, become flaccid, and retract, tending to cast ligatures loose. Therefore the ligatures

should be tightly drawn, and they should have a considerable hold upon the tissues. These precautions ought to be specially observed in the lower portions of the ligaments, where the uterine arteries lie. And it must be remembered that it is here where the risks of wounding the ureters, or of including them in the ligatures, is greatest. These dangers are enhanced by inversion of the uterus. They are minimised by a thorough separation of surrounding cellular tissue in the early stages, and by keeping always as close to the uterus as possible.

The Peritoneal and Vaginal Wounds do not require suture. No better results are got from suture than from leaving them to fall into apposition, and unite as best they can. Some surgeons recommend that the peritoneum should be sutured to the vagina; others, that the vagina alone should be sutured; and others say that if the peritoneum is sutured, the vagina may be left to look after itself. But suturing of any sort has been proved to be unnecessary. A positive objection to the employment of sutures, whereby flaps are kept in close apposition, is that the discharges which ooze from their surfaces are locked up and may become sources of septic infection. The parts fall naturally into apposition, and remain apposed. It is true that the best and quickest healing will be got if like tissue is apposed to like; and advantage ought to be taken of the remarkable rapidity with which inflamed serous surfaces cohere. Further, it is advisable that all oozing from rawed surfaces should find its way into the vagina, rather than into the peritoneum.

This end may be simply effected in the withdrawing of the sponge placed inside the abdomen through the opening. It pulls down the flaps with it, and in so doing leaves serous surfaces in contact and rawed surfaces closed in, while it leaves the flaps so that discharges from them run into the vagina. The serous membranes first unite, and as soon as they close the peritoneal cavity is shut off.

Drainage of some sort is advisable for the first day or two. If the clamps are used, they will act as drains. If not, a glass drainage-tube of ordinary size and shape is as good as any. It

should be placed very carefully, without disturbing the relations of the serous and mucous flaps. A T-shaped tube has the advantage that it will not slip out of the abdomen; but it has the disadvantage that it cannot be removed without breaking down recent adhesions.

For the first twenty-four hours sero-sanguinolent fluid will be discharged through the tube; thereafter for a day or two, serous or sero-purulent fluids, in diminishing amount. At the end of three or four days, if all goes well, the tube may be removed.

In view of the fact that all fluids lying in Douglas's pouch have a tendency to undergo decomposition, and that in hysterectomy there may be actual entrance of air or vaginal secretions into the abdominal cavity, it will be a wise plan at stated intervals to irrigate through the drainage tube. This may be easily done by passing a catheter attached to an irrigator along the drainage-tube to the abdominal cavity, and sending a stream of warm lotion through it. When the fluid returns clear, irrigation may be stopped.

A roll of antiseptic gauze or cotton passed up the drainage tube will act as an antiseptic plug, and as a capillary extractor of fluids. Plugging of the vagina is troublesome and unnecessary. If the tube is surrounded with antiseptic wool where it lies between the labia, and if the external parts are kept thoroughly clean and sweet, there is little danger of septic infection. Indeed, it is notorious that tampons in the genital passages have of themselves a strong tendency to become putrid.

A good working method is to draw the urine through the catheter every five or six hours. When the bladder is emptied the wool surrounding the end of the drainage tube is withdrawn, and the cavity is irrigated. Then the external parts are thoroughly cleansed; boro-glyceride is smeared all over them, and a new dressing is applied.

It has been recommended that the patient's shoulders should be raised, so as to permit of downward drainage. This is quite unnecessary; and it may be harmful by encouraging the access of air. The extensive experience of drainage through the

anterior parietes has proved that intra-abdominal pressure is quite sufficient to force free fluids upwards through a patent opening; and to prevent the admission of air, it would be wiser to have the external end of the tube in the vagina on a higher level than the end in the abdominal cavity. But a plug of cotton wool, while encouraging the escape of fluid, will prevent the insufflation of air.

The general treatment requires no special description. The histories of recorded cases seem to show that there is more than the ordinary tendency to tympanites. The use of the rectum tube, the exhibition of turpentine enemas, and the administration of saline purges, will most efficiently remove this condition. In all respects the general management is similar to that after other abdominal operations.

Complications and Accidents.—Wounds of the bladder or ureter are much less frequent than might be expected. The bladder is most likely to be wounded during the early stages before the peritoneum is opened, and while the relations are disturbed by the uterus being dragged down. The best way to avoid the accident is to keep close to the uterus and push the bladder forwards out of the way. If the bladder is wounded, it ought to be at once sutured.

Wound of the ureter is a more serious affair, and may demand extirpation of the kidney. It is most likely to suffer injury at the end of the operation; and more particularly is it liable to be included in the lower ligatures applied to the broad ligament. Keeping close to the uterus is here also the best mode of avoiding the risk. But the accident very rarely happens.

Cases are recorded where intestinal fistula has been caused by pressure from the drainage-tube.

Hæmorrhage, either during or following the operation, is the chief risk. If the bleeding points cannot be included in ligatures, pressure-forceps are left attached. After the operation, if hæmorrhage takes place, a Ferguson's speculum must

be passed and the source of the bleeding sought for. When discovered, the simplest method of checking it is to apply and leave on a powerful compression forceps. For general oozing, a stream of water heated to 110° Fah. may be safely and advantageously passed over the bleeding surface.

The ordinary complications of operations in the pelvis may occur: such are—pelvi-peritonitis, phlebitis, lymphadenitis. They are to be treated on ordinary principles.

Hysterectomy for Intractable Inversion.

With the help of the admirable repositors of Aveling and others, it now rarely happens that an inverted uterus cannot be replaced. But it does sometimes happen that, in spite of the most skilled and patient trials, an inversion cannot be cured, while the resulting condition to the patient is so grave that a means of cure is urgently demanded. Under such circumstances hysterectomy may be called for.

History.—Paulus Ægineta speaks of the removal of a prolapsed uterus which had mortified as having been carried out with success. But this probably was merely the removal of a sloughing polypus. In 1678 Arnould excised an inverted uterus, with fatal result. Deleurye, Assilini, de Bardol, Beaufils, Faivre, Hunter, and others, have operated by ligature, mostly without success. At the end of the eighteenth century Baudelocque made an elaborate study of the treatment of uterine inversions, and formulated some very sensible conclusions. He clearly differentiated between an extruded polypus and an inverted uterus, and laid down definite rules for diagnosis and treatment. In recent times, Denucé* has been conspicuous in advancing our knowledge of the subject.

The *diagnosis* of complete uterine inversion is sufficiently easy. It can be mistaken only for a polypus. Conjoined manipulation, under anæsthesia if necessary, will show the presence of the uterus in its normal position in polypus, and its absence in inversion. The finger in the rectum may further detect the funnel-shaped depression into which the round ligaments and Fallopian tubes pass, and in which occasionally the uterine appendages may be detected. Pulling down the uterus aids the diagnosis in those points. The absence of os uteri, the continuity of the tumour with the uterine cervix at every point, and occasionally the presence of the two small openings at the cornua

* *Traite de l'Inversion Uterine.*

leading into the Fallopian tubes, will be determined. Polypus may be associated with inversion: here extra care must be observed.

THE OPERATION.

A good many methods of removing the inverted uterus have been employed. They may be classified under three heads:

(1) Immediate removal, at one sitting.
(2) Gradual removal, by compression or cautery.
(3) Excision and compression combined.

Immediate removal has been performed by a simple cutting operation, by crushing with ecraseur, and by the actual cautery. Velpeau is credited with a success after excision. Mc Clintock, Sims, Denucé, and others, have had successes with the ecraseur. Ligature, immediately followed by excision, and searing of the raw surface after excision, has also been employed more than once with success.

But no method of immediate removal has had favourable results: according to Schroeder, a 57 per cent. mortality may be expected. The objection to this method is the very serious one, that it leaves the peritoneum exposed to infection from the traumatic and suppurative processes induced in the stump. Even if adhesions form after deligation or charring, they are too flimsy to act as an efficient barrier to the entrance of septic products.

Gradual removal by sloughing, induced by compression or cautery, has had better results. Of all methods of gradual compression, the elastic ligature has been found most successful. Courty has had a few successes by the use of the galvano-cautery, applied slowly and at several sittings. The ecraseur and the wire serre-nœud have been used in this way also.

But here also the mortality has been high—27 per cent. And gradual strangulation causes severe pain, and frequently begets serious nervous disturbance—sometimes even alarming collapse. The presence of a large sloughing mass in the vagina is neither agreeable nor free from danger.

Compression and excision combined have given the best results—17 per cent. mortality. The principle of the proceeding is, to keep up compression for a few days, till strong adhesions have formed on and around the inner serous surfaces, and then to amputate the uterus below the site of constriction. This is the plan recommended by Schroeder, and successfully modified by Pouissot, Despres, and more recently by Schülein.

The constricting agent may be a simple ligature of silk or catgut; or an elastic ligature, prevented from slipping by previously charring a circle of tissue with the galvanic cautery; or an ecraseur, such as that of Cintrat or Koeberlé. As simple and efficient as any is the application of a strong ligature of silk, and the superimposition of an elastic ligature in the groove so caused. The silk ligature, pulled very tightly, fixes and steadies the underlying tissues; the elastic keeps up a continuous pressure on the receding tissues after the silk ligature gets loose; and, at the end of three or four days, closure of vessels and adhesion of peritoneal surfaces may be confidently expected.

The uterus will have been well soaked in glycerine of carbolic acid, or some similar antiseptic that will penetrate its tissue. In spite of this, a gangrenous odour will usually appear in a few days. On the third day, or later according to the behaviour of the strangulated uterus, amputation may be performed. This operation must be carried out with as little disturbance of parts as possible. A series of cuts with scissors whose blades are at right angles to the handles, and whose movements are guided by a finger in the vagina, would fulfil this requisite. The section is to be made close to the ligature, so as to completely remove all tissue which is, or is likely to become, necrosed. A cylindrical speculum cautiously introduced into the vagina will afford a good view of the stump left. If it seems healthy and compact, the ligatures may be removed and the raw surface smeared with an antiseptic. The vagina is then thoroughly cleansed and kept clean, and the stump is left to its fate.

Hysterectomy for Myoma.

Perhaps "Removal of Uterine Myoma by Abdominal Section" would be a better name than the above for the operation to be described. In some cases, it is possible to remove the growth without removing any part of the uterus; in others, a part of the uterus may be removed, while the uterine cavity is not entered; while, in a third class, the uterine cavity is entered, and varying amounts of its structure removed, up to complete hysterectomy. But, as the operation is very generally known by the name given, it is here adopted.

History.—Lizars in 1825, and Dieffenbach in 1826, encountered uterine myoma on opening the abdomen; but neither endeavoured to remove the growth.

In 1837 Granville is said to have unsuccessfully removed a pedunculated uterine fibroid. In 1843 Heath operated unsuccessfully, and in 1844 Clay of Manchester operated with like result. Burnham, an American, is credited with the first success, in 1853; and in 1855 Kimball, another American, had a success. Péan, Hegar, Billroth, Kaltenbach, and Schroeder, on the Continent, did much to advance the position of the operation; in our own country, Keith, Bantock, Tait, Thornton, and others, have been conspicuous among operators and teachers. For magnitude of operations, perfection of methods, and brilliancy of results, Keith holds a commanding position among all operators.

Mortality and Appreciation. Indications to Operate.—It is impossible so to present the statistics of hysterectomy for fibroids as to give a fair idea of the results which may be fairly expected to-day. Thus, Bigelow,* in a total of 573 cases, gives 311 recoveries and 241 deaths—the results in some not being recorded. Vautrin,† in his valuable mono-

* *Amer. Journ. Obstet.*, Nov., 1883, *et seq.*

† *Du Traitement Chirurgical des Myomes Utérines*, Paris, 1886.

graph, classifies operations for myoma as—myomectomies, or simple removal of a subserous myoma; enucleations; partial amputations of the uterus; and complete supra-vaginal hysterectomies. He gives tabular descriptions of operations under each head. In 32 myomectomies there were 24 recoveries; in 23 enucleations there were only 9 recoveries; in 36 partial amputations there were 26 recoveries; and in 82 supra-vaginal amputations there were 44 recoveries.

Gusserow's statistics, comprising 359 cases operated upon between the years 1878 and 1885, give 237 recoveries and 122 deaths—a mortality of 33.9 per cent. If to these are added 180 cases operated upon by Schroeder, Olshausen, Braun, and Tauffer, we get a total of 539 cases, with a 30 per cent. mortality.

The general mortality in the last few years is nothing like so great as this; and in the hands of a few operators it does not exceed 15 per cent. Keith's mortality, in most unpromising cases, is only 8 per cent.; Tait's mortality, in his latest cases, is very low; and Bantock and Thornton are getting results equally good. On the Continent, half-a-dozen operators could be named whose mortality is under 15 per cent. Into the further details of the abundant statistics it is not necessary to go. It is clear that, in the hands of properly qualified operators, the proceeding, from the point of view of immediate mortality, is as justifiable as any other major operation.

A further and more important consideration is, whether, with a death-rate even of one in ten, the operation is ever justifiable. It is urged by several writers that uterine myoma is not a fatal disease; that palliative treatment will always tide the patient over periods of danger, and often effect a cure; that the life-history of the disease is limited; and that a death-rate of even five per cent. absolutely forbids surgical operation. On the other hand, it is argued that myoma is often fatal; that, in many cases, medicinal treatment is utterly futile; that a considerable number of cases go on causing danger or serious trouble long after the usual period for menopause; and that, in a selected series of cases, the operation is not only justifiable but necessary. It would be tedious and useless here to go over

the often-repeated arguments for and against the operation. As usual, the safe course is the middle one.

Of all operators, want of caution can with least justice be urged against Keith. The indications which he gives for operation are as follows:

"1. In very large rapidly growing tumours of all kinds in young women. By a large tumour, I mean a tumour upwards of 20 lb.

"2. In all cases of real fibrous cystic tumours, if they can be removed. Also in all cases of suppurating tumours.

"3. In most of the cases of the soft œdematous tumours. These often grow to an enormous size—far larger, often, than any ovarian tumour. I have seen one that would not be less than 200 lb. in weight. Sometimes large quantities of red serum can be removed with much relief, and I have several times been able by this means to carry patients over the menopause, when the necessity for further puncturing ceases. These tumours seem to open up the broad ligaments more than the ordinary hard tumour, and some that I have removed have had very extensive pelvic attachments. These tumours are much reduced by free purgation.

"4. In cases of large bleeding fibroids of any age, provided that the patients are not approaching fifty years of age, and provided that the lives are practically useless, and that further experience in the operation shall show that the mortality of hysterectomy is likely to diminish.

"5. In certain cases of tumours surrounded by free fluid, the result of peritonitis, provided that the fluid shows a tendency to re-accumulate after two or three punctures. . . ."

These are clear and distinct indications for the performance of hysterectomy, the operation being begun with the view of finishing it as such. Another indication may be given as follows: An operation is begun with the view of removing the uterine appendages; this is found impracticable, and an examination reveals that myomectomy or hysterectomy may be performed without undue risk: in such a case the major operation may be proceeded with. Since Keith wrote the above, Apostoli's

method of treating myoma has been introduced, and from the trial he has given it he believes that it will be of value as rescuing many cases from operation. It is as yet too early to speak definitely and conclusively on the subject.

Symptoms and Diagnosis of Uterine Myoma.—The well-known classification of uterine fibroids into interstitial, sub-mucous, and sub-peritoneal, sufficiently indicates the position which such growths may occupy with regard to the uterine walls. With regard to the region in which they lie, they are spoken of as fibroids of the fundus, the body, or the cervix. They are most frequently globular in shape, especially when they are not of large size; but they may assume most irregular, even grotesque, forms. In size, they vary from that of a pea to dimensions as great as the capacity of the abdomen. They are of hard dense texture, cutting with a peculiar gritty sensation, and exhibit a dull white or glistening surface on section, which has been likened to mother-of-pearl. Frequently they contain cysts in their substance, and occasionally they are soft, œdematous, almost fluctuating. Often they are traversed by enormous vascular channels.

A developed fibroma may be said to live outside the uterine fibre, even when it is encapsuled in its substance. Courty well describes it as parasitic; sometimes its nutrition may be said to be carried on by imbibition. In such cases the fibroid is completely encapsuled, lying in a bed of loose cellular tissue, and may be enucleated like a foreign body. These tumours are liable to undergo changes in structure. After inflammation they may become very dense, being little else than a mass of fibrous tissue with scanty muscular elements; and this fibrous tissue may undergo general or peripheric calcification. They may become fatty, and undergo liquefaction with the formation of cystic cavities. Occasionally they suppurate, or even become gangrenous. Finally they may undergo regressive involution, and completely disappear. It is generally observed that uterine fibroids increase in size during pregnancy.

The first sign is usually metrorrhagia. At first the excess of bleeding occurs only during the normal period; then it comes

on in the intervals as well; and in the worst cases there is a continuous discharge of blood, in varying quantities, at all times. The blood is frequently discharged in clots of considerable magnitude. Pains of a down-bearing expulsive character, and shooting across the hips and down the thighs, with feelings of weight or pressure inside the pelvis, and dragging sensations in the loins, are frequently complained of. In the intervals of bleeding, a glairy semi-purulent fluid is discharged. Symptoms of mechanical pressure on the pelvic organs, such as dysuria, excessive frequency of micturition, constipation, or diarrhœa, are frequently observed.

The physical signs vary according to the size of the tumour, and its situation in relation to the uterus and the abdominal cavity. Through the parietes a tumour is felt arising out of the pelvis—hard and incompressible, in most instances; occasionally soft or even fluctuating; usually rounded and smooth all over, but not infrequently covered with bosses; movable from side to side, if it does not fill the abdominal cavity, and moving in company with the uterus as felt through the vagina. Absolute continuity of uterus and tumour may be made out by vaginal and rectal palpation. The uterine sound will show enlargement of the cavity, with some deviation in its direction. From being a simple canal some two or three inches in length, the uterine cavity may be elongated and spread out into a flat fan-shaped space in which the sound can be freely moved from side to side. In some cases, where the growth lies on one side and is mainly extra-mural, the uterus is forcibly pushed over to the other side. This lateral version of the uterus is often described as being a valuable presumptive sign of myoma. In other cases the uterus is dragged upwards into the abdomen, or pushed downwards on the perineum, according to the direction in which the tumour grows from its seat of attachment.

Interstitial fibroids cause general hypertrophy of the uterine walls, with vascular engorgement of the mucosa. Located in the fundus, they may, when small, cause marked version or flexion; when large, they produce displacements — upward, downward, and lateral—of the most varied description.

Sub-mucous fibroids may often be felt through a softened and dilated cervix. Their tendency to become polypoid and to be extruded by uterine action is well known. They set up great irritation of the uterine mucous membrane, causing much muco-purulent and sanguineous discharge. The uterine cavity is at the same time dilated and encroached upon; the uterine wall on the side opposite the growth is spread over it and in close contact with it. These signs can be made out only with the help of the uterine sound.

Sub-peritoneal fibroids tend, at an early stage, to rise upwards into the abdominal cavity. There may be little change in the uterus as regards either shape or position: there is usually, however, some uterine enlargement as well as displacement, which may be found to vary at different examinations. Sub-peritoneal growths, if multiple, are usually small; if single, they are rarely larger than a child's head. They are freely movable, and the associated movements of the uterus may be not more marked than in ovarian tumours. Sometimes their pedicles are as long as two or three inches; and cases have been recorded where their connection with the uterus has been completely severed, and they have lived either through the vessels in adventitious adhesions or by imbibition from the peritoneum. Their symptoms are rarely urgent; often, there is little beyond discomfort and metrorrhagia to complain of. Hardness is said to be a characteristic of sub-peritoneal fibroids.

THE OPERATION.

The nature of the operation for uterine myoma will vary according to the situation and attachments of the tumour. The varieties of operation have been classified by Vautrin* as follows:

1. For the removal of sub-peritoneal, pedunculated myomata —*simple myomectomy*.

2. For the removal of certain tumours encapsuled in uterine tissue—*enucleation*.

* *Du Traitement Chirurgical des Myomes Utérines*, Paris, 1886, p. 124.

3. For the removal of tumours incorporated in the uterine tissue, in which it is impossible to remove the growth without opening the uterine cavity—*partial amputation of the uterus.*

4. For the removal of tumours with extirpation of the uterus above the insertion of the vagina—*supra-vaginal amputation of the uterus.*

5. For the removal of multiple myomata with enlargement of the uterus, in certain cases—*complete extirpation of the uterus.*

This classification—simple, natural, and consistent with the pathology as it is—does not fully satisfy practical requirements. Thus, no distinct line can be drawn between partial and supra-vaginal amputation of the uterus. Complete extirpation—that is, removal of every particle of uterine tissue, leaving the vagina and the broad ligaments only as pedicle—is very rarely called for; and when it is, the details of operation differ so little from partial amputation, or amputation through the cervix, that a separate description is not necessary. Indeed, from a practical point of view, a classification of operations depending on whether or not the growth extends between and opens up the layers of the broad ligament would probably be of more practical value than that of Vautrin.

The operations for uterine myoma are here described as:

1. *Simple myomectomy* or removal of the tumour without any of the uterine tissue, by excision or by enucleation, and without entering the uterine cavity.

2. *Hysterectomy*, total or partial; or removal with the tumour of more or less, or all, of the uterine tissue proper—usually, with entrance of the cavity.

This subdivision broadly corresponds to the all-important one of pedicle and no pedicle, and, still more broadly, to intra-peritoneal and extra-peritoneal completion of the operation.

It may truly be said of the operation for myoma, that the exact mode of operating can never be decided upon till the abdomen is opened and the condition ascertained by digital examination. In cases of small growths which are not pedunculated, removal of the uterine appendages may be indicated; then the major operation is not called for. In cases of simple

pedunculated sub-peritoneal growth, ligation of the pedicle and removal of the growth may be sufficient. Again: other growths, encapsuled and lying near to the uterine surface, may be properly treated by enucleation. But, in the majority of instances which call for removal of the tumour, a complicated operation, involving delicate and difficult proceedings to separate the mass from the bladder or to enucleate it from the broad ligaments, will be necessary. The operative details are schemed out after inspection; they are finally determined upon after the tumour has been turned out, and are frequently modified as the operation goes on.

Myomectomy.

The incision is made in the middle line below the umbilicus, and is long enough to admit the whole hand. The lower end of the incision should not approach the pubes too closely, as the bladder in these cases is often elevated. It is usually found that the parietes are abnormally vascular in cases of uterine myoma. A complete examination of the mass is then made by the hand carried through the opening, and the advisability of removal is decided upon. The incision is prolonged upwards with scissors, guided by the fore-finger, as far as is necessary for delivering the tumour without bruising the edges of the wound. Tait's screw (Fig. 36) with broad blade is placed in the tumour, and used as a handle by which to pull it out and to manipulate it. In the case of large tumours, two such screws, placed at some distance apart, may be found of great assistance in the necessary manipulations. When the tumour is removed from the abdomen, large sponges are packed inside the cavity to keep the bowels in place and to absorb extravasated blood.

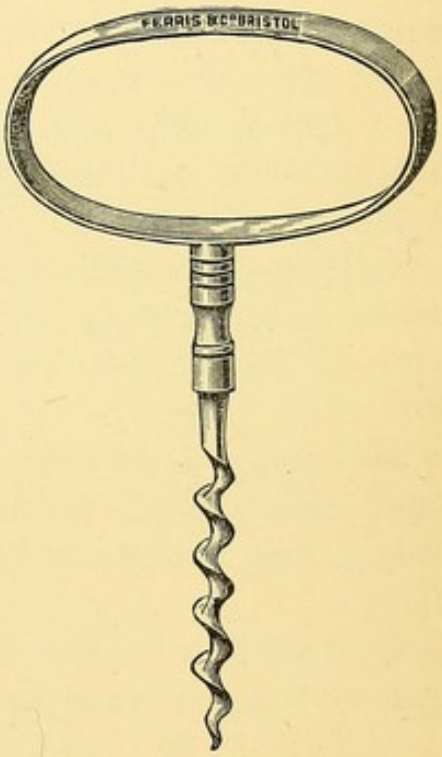

FIG. 36.

Tait's Screw for Myoma.
Half size.

Adhesions to the parietes must be separated before the tumour can be delivered. Adhesions to bowels or omentum may be divided after the tumour has been delivered, or during its delivery. As the tumour is being pulled out, great caution is necessary to make certain that adherent bowel is not torn; and with this

object, the hand is placed inside the abdomen, under the tumour, to ascertain that undue traction is not being exerted on attached organs. Parietal adhesions may usually be severed by the fingers. Adhesions to bowel, omentum, or other organs, are divided between pairs of catch-forceps or double ligatures. Vessels in the omentum sometimes attain to enormous dimensions, and require great care in their division and ligation. If their walls are very thin, seeming scarcely strong enough to carry a ligature, the vessels must be followed upwards till a sufficient bulk of omental tissue to form soft packing around the vessel is met with; and here the vessel is tied along with some of the surrounding tissue. As Thornton points out, much blood may be lost by dividing vessels coming from solid vascular tumours; such vessels do not contract on division, as they do in adhesions attached to an empty and contracted ovarian cyst-wall.

Pedunculated sub-peritoneal growths are removed after securing the pedicle. The mode of treating the pedicle will depend on its thickness, length, and vascularity. In some cases a simple ligature will be sufficient. Kaltenbach, Olshausen, Billroth, and others, have related cases in which simple ligation *en masse* has proved efficient. I have successfully removed a sub-peritoneal myoma as large as a child's head in which the pedicle was secured by a simple silk ligature, gradually tightened while the tumour was being cut away. If the pedicle is short, this plan of coaxing tissue off the tumour by successive snips of a scissors while the ligature is tightened on the relaxed and isolated fibres is an excellent one; certainly better than simple deligation, followed by amputation. The tissues may always be drawn together more closely after amputation than before; and by this process of gradual constriction, combined with piecemeal amputation, all the vessels are caught in the ligature, and there is no likelihood of their recoiling afterwards.

In other cases the pedicle is too large to be safely included in one ligature, and here it is necessary to transfix. A blunt needle which will not wound a vessel is used, and it is inserted at a convenient distance between uterus and tumour, not too close to

either. Thornton first ties in mass, and then transfixes and ties doubly beyond the single ligature. The Staffordshire knot may be used—supplemented, if necessary, by a second simple ligature. In fact, the mode of ligation must depend on the nature of the pedicle; and many efficient modes are available. The use of strong crushing or clamp forceps to diminish the bulk of the pedicle has its disadvantages as well as its advantages. If the pedicle is a broad one, the outlying vessels may be torn through by the strong compressing blades, and escape from their grasp, while only the vessels in the centre are caught. Olshausen* has laid down directions as to the mode of ligation, depending on the thickness of the pedicle. But points of equal importance are—its length, its density, and its vascularity. A thick pedicle which is long and compressible may be efficiently secured in a single ligature, when a less thick one which is short and dense may require multiple deligation. No definite rules can be laid down: the surgeon must be guided by general principles.

Gusserow† and others have been able to secure the vessels separately; and where this can be done, it is undoubtedly the best plan. A separate ligature to each vessel produces a hæmostasis which is independent of retraction of vessels or shrinking of uterine fibre. This plan can be adopted only where the pedicle is not large and where the vessels are not numerous.

The elastic ligature is favoured by some surgeons, particularly of the French school. Its advantages are more conspicuous in cases where some considerable bulk of uterine fibre is included in the ligature; that is to say, in cases where atrophy and shrinking of the pedicle are likely to follow operation.

When the pedicle has been efficiently secured, its peritoneal margins may be drawn over the divided surface by means of a continuous suture. This diminishes the area of exposed raw surface, which is liable to become adherent to contiguous intestine, and so lessens the risk of danger from intestinal obstruction. Uterine stumps do not become quiescent so quickly as ovarian

* *Deutsche Zeitschr. f. Chir.*, Dec. 1881, p. 171.

† *Die Neubildungen des Uterus*, Stuttg., 1886, p. 103.

stumps: this is another reason for taking every precaution against their begetting trouble.

The pedicle, in myomectomy for sub-peritoneal growths, is dropped inside the abdomen, as in ovariotomy. In a few cases the extra-peritoneal method has been adopted; but such a course is justifiable only on the proved impossibility of treating the pedicle otherwise. Dragging on, with sloughing in the contiguity of, a uterus which is enlarged and sensitive from the presence of a myoma cannot be other than dangerous. The clamp and extra-peritoneal treatment of the pedicle in myomectomy for sub-peritoneal growths, is likely to be more disastrous even than in ovariotomy.

Enucleation is available in certain cases of myoma where the growth lies near to the uterine surface, and is evidently encapsuled. Spiegelberg* is said to have first practised enucleation with suture of the uterine wound. Martin, Billroth, Hegar and Kaltenbach, and others, have used the method, with not very encouraging success. Schroeder† identified himself with the practice of enucleation of fibroids, and obtained fair results; but other surgeons have not been prone to follow his example.

Before commencing enucleation, an elastic or rope temporary ligature should be carried round the body of the uterus below the fibroid to be enucleated. Incisions are then made through its capsule, circular or V-shaped according to the degree of bulging, and arranged so as to leave flaps which, when approximated, will completely overlap the bed from which the growth is enucleated. If the flaps do not fit accurately, they are trimmed down. Rows of buried sutures are placed from the bottom of the wound upwards, in succession, completely approximating the sides of the wound; finally the peritoneal surfaces are approximated by a row of superficial sutures.

Theoretically, this operation of enucleation is admissible; but practically, its mortality is high. In the hands of Schroeder

* *Archiv. f. Gynäk.*, Bd. iv., p. 340.

† *Krankheiten der Weibl. Sex. Org.*, Leipzig, 1884.

himself, its chief advocate, 18 operations were followed by 11 deaths—chiefly from hæmorrhage and peritonitis; and the results of other surgeons are just as bad. The great risk is that, when the inevitable uterine contraction takes place, hæmorrhage may set in; the almost equally great danger of peritonitis would seem to be favoured by the inclusion of discharges under pressure in the uterine wound. It may be taken as practically true, that it is not safe to leave a wound through hypertrophied uterine tissue with no more perfect guard against hæmorrhage than a non-contractile ligature, which constricts uterine fibre as well as vessels; and even less safe to leave hæmostasis to the mercy of mere compression by flaps sutured over the wound.

Hysterectomy, total or partial, for Myoma.

For the great majority of cases requiring operation, removal of some portion of the uterus is either necessary or expedient. And of this majority, the greater number result in exposure of the uterine cavity. The typical operation is removal of the tumour with the uterus at some convenient point above its attachment to the vagina. Complete supra-vaginal hysterectomy for myoma rarely means more than amputation through the cervix, low down.

It is absolutely impossible to give a description of hysterectomy for myoma which shall be applicable to all cases. No two cases are alike; and the variations are so numerous and so diverse, that a useful classification is scarcely feasible.

Besides the ordinary cutting instruments, the surgeon ought to be provided with at least two trustworthy clamps, a temporary elastic or rope ligature, two myoma screws, and the actual cautery. Koeberlé's well-known serre-nœud (Fig. 37) is generally admitted to be the best instrument to use as a clamp. It is simple and trustworthy. Tait has modified it in a manner which permits of more rapid and easy fixation of the wire, without interfering with its simplicity and efficiency. (Fig. 38.) In Tait's modification, the

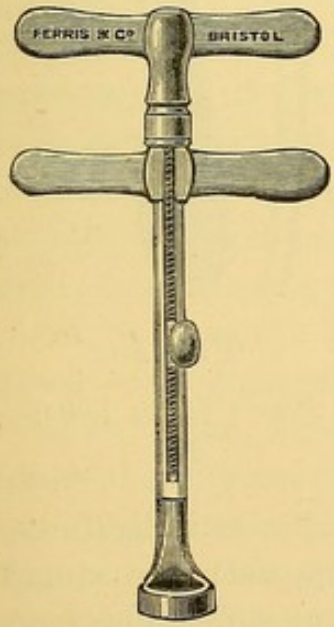

FIG. 37.

Koeberlé's Serre-nœud. Half size.

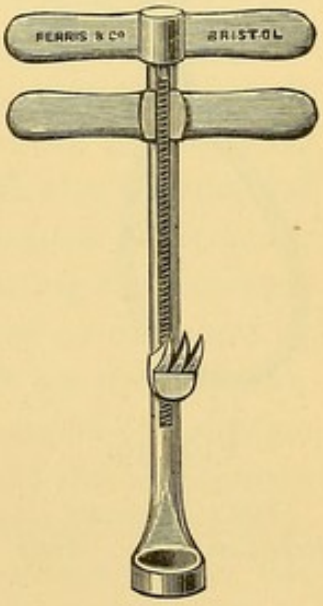

FIG. 38.

Tait's Modification of Koeberlé's Serre-nœud. Half size.

wires are simply placed in recurved V-shaped claws, which bite the more firmly as traction is increased. In Koeberlé's original instrument, one end of the wire is formed into a loop, which is placed over the button; the other end is fixed by twisting or otherwise. Keith at first used Koeberlé's instrument; but this he gave up in favour of a very large thin clamp, which he finds causes less sloughing than a wire.

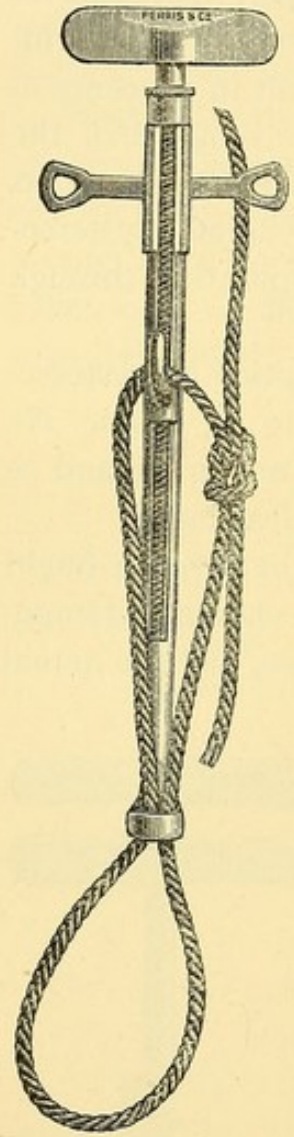

Fig. 39.

Tait's Temporary Rope-Compressor. Half size.

Some form of instrument for temporary compression of the pedicle during manipulation, and before placing the clamp in position, will be found of great assistance. Tait's temporary rope-compressor (Fig. 39) seems to be the most convenient of these instruments. Pozzi's elastic tourniquet (Fig. 40), with self-acting grip, is an excellent instrument for temporary compression: but its action is not so rapid nor so powerful as Tait's; and it is open to the objection, which may be urged against all elastic ligatures, that it is liable to slip over the stump when the tumour is cut off. The rope texture in Tait's instrument is preventive against slipping.

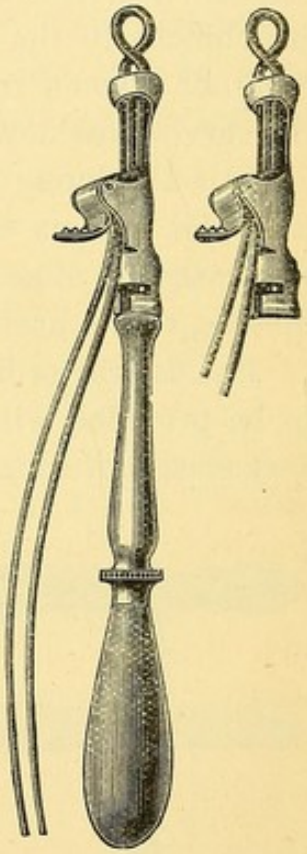

Fig. 40.

Pozzi's Elastic Tourniquet.

A few feet of strong soft wire should be held in reserve—piano-wire serves the purpose admirably; and an abundance of

the strongest Chinese silk ligatures should be at hand. Other instruments necessary are: strong handled needles with blunt points, for placing ligatures by transfixion: powerful locking forceps, straight and bent; and needles for transfixing and holding the pedicle outside the abdominal cavity.

A four-inch incision, extending downwards from the umbilicus, is first made, and the tumour examined as far as possible with the hand; we note the position of the broad ligaments, the ovaries, and the tubes, with the general relations of the growth to the uterus. It is important to determine the limits of the bladder, and with this view the operation should be begun with the bladder full. If it is found to be in the way, it may be emptied by an assistant through the catheter. The incision is prolonged upwards and downwards, as far as is necessary and proper, by means of scissors cutting over large flat sponges, and guided by the forefinger. Bleeding points are secured as they appear by catch-forceps.

All adhesions to the parietes in front having been separated by tearing, or cutting and deligation, one or more screws are twisted into the tumour, and the mass lifted out of its bed. Considerable force may be necessary for this manœuvre; but the force should be guided and regulated by the hand on the under surface of the tumour, to make certain that no injury is being done to underlying and attached structures. Atmospheric pressure often accounts for much of the difficulty experienced in delivering such tumours; and the mere insertion of the hand, by separating contiguous surfaces and permitting the entrance of air, may lessen this difficulty. Adhesions to omentum or bowel are ligatured, divided, and returned as they appear. Frequently the tumour comes out with portions of intestine adherent at several points on its under-surface; these adhesions are caught in forceps, divided, and ligatured afterwards. The tumour being completely delivered, several large flat sponges are placed in the cavity over the bowels. If the patient is sick or straining and the bowels tend to protrude, a few sutures may at once be inserted in the upper portion of the abdominal wound.

A minute examination of the tumour and its connections is now instituted. The position of the bladder is first ascertained. Keith has met with the bladder nearly as high as the umbilicus, so that it had to be dissected downwards: this happens more especially when the tumour dips deeply into the pelvis, and where the broad ligaments are much opened up. On the tumour aspect, the separation of the bladder is not often difficult. In every case, diagnosis of the position of the bladder, and separation of it from tumour and parietes, is much facilitated if the viscus be moderately distended. When it is sufficiently freed, it may be emptied through the catheter. If the dissection has to be carried down to the base of the bladder, especial care must be taken to avoid injury to the ureters. It need scarcely be said that all manipulations involving the bladder must be carried out with great care.

Supposing that the relations of the bladder to parietes and to uterus are normal, and that the tumour has not grown between the folds of the broad ligament, and does not lie deep in the pelvis; and supposing, further, that the direction of the growth of the mass has been mainly towards the abdominal cavity, and that the neck and part of the body of the uterus are but little enlarged, we have to deal with the simplest of all varieties of hysterectomy for myoma. In such a case, the operation may be at once completed by fixing the wire clamp at a suitable place around or near to the neck of the uterus, and the tumour cut away above it. The wire includes in its grasp round ligaments and broad ligaments, as well as uterus, and the ovaries and tubes are also included in the amputation. Enucleation is not called for; the peritoneum, intact, surrounds the whole of the tissues included in the clamp. Two pedicle needles are passed through the stump, above the constricting wire, and their broad ends are made to rest at convenient points on the abdominal parietes. The stump is fixed in the bottom of the parietal wound, the abdominal cavity is cleansed, the wound is sutured, and the operation is finished.

But few operations are of this simple nature. The pedicle must be manufactured or isolated, after a more or less difficult

process of enucleation or dissection. In the worst cases this is a most tedious and delicate operation, severely testing the surgeon's practical knowledge and technical skill. A perusal of the detailed cases of our most experienced operators, such as those of Keith or Schroeder, while emphasising the fact that no two operations are alike, can scarcely fail to convince the reader that the details are, after all, very similar. It seems to me that Schroeder's magnificent operations have suffered a little from the operator's desire to carry out a principle—enucleation with salvation of uterus and appendages. Keith, on the other hand, has evidently no preconceived principle whatever: relying on his own experience, he attacks off-hand every complication as it arises, with the simple aim of curing his patient. And Keith is right. Every consideration whatsoever must give way in the face of the risks of life and death. Schroeder's work is valuable, as teaching us how to enucleate; Keith's is still more valuable, by showing to what extent enucleation may, with best results to the patient, be carried. The result of their practice and of that of others has shown that, while enucleation from peritoneal and fibrous investments is often necessary and proper, enucleation from uterine tissue is rarely necessary, and still more rarely proper.

Schroeder's work, though it is not antecedent to Keith's, is worthy of special description. His purpose was, to spare the uterus and its appendages as much as possible. His mode of operating may be given in his own words.* A case is supposed in which "the uterus is found enlarged by an interstitial fibroid, dislocating upwards the appendages on both sides. In this case it is not possible to place the India-rubber ligature around the cervix: besides, there is no pedicle; the first thing therefore, is to form one. For this purpose, I sever the appendages by first doubly ligaturing the infundibular pelvic ligament with its spermatic vessels, and dividing between these ligatures; then, by repeating the same process with the round ligament, which generally is found to be in a hyperplastic state. After this has been executed on both sides, it is easy to separate the tumour

* *Brit. Med. Journ.*, 1883, ii., p. 714.

from the surrounding tissue without causing any considerable hæmorrhage; and now the India-rubber ligature is placed around its base. The tumour is then cut away with the uterus above this ligature. Care must always be taken to catch the stump in a vulsellum as soon as part of the tumour is divided; for this prevents the rubber ligature from slipping off. After thus securing the stump, the remaining part of the tumour is cut away. Next, the cavity of the uterus or the cervical canal is cauterised with a ten per cent. solution of carbolic acid, in order to destroy any infectious germs that may be present. . . . The denuded surfaces of the stump are first united in the depth near to the mucous membrane of the uterus; these sutures are covered up by several rows of other sutures, uniting the walls of the stump; finally, the peritoneum is pulled over the stump, and attached to it and to the peritoneum of the other side by a line of closely-placed stitches. On the sides of the stump at the spots on which the large blood-vessels have been divided, and on which the peritoneum covers the stump only loosely, the tissues are firmly fastened to the stump by a separate deep suture. After removal of the India-rubber ligature, the stump is seen with a smooth covering of the peritoneum united by a neat row of sutures. At each side of the stump, the divided, but not stitched, broad ligaments are visible; in front we have the ligatured round ligaments, and towards the pelvic wall, the ligatured spermatic artery, &c. There is no dragging on the tissue whatever around the stump, and the peritoneal covering is perfectly smooth. Any hæmorrhage occurring after removal of the India-rubber ligature is easily stopped by putting a few more stitches at the spots whence it comes.

"The difficulties of the case become very numerous when we have to remove a fibroid developed at the lower part of the uterus and extending into the cellular tissue of the pelvis. The uterus is sometimes dragged upwards on one side so far that it is impossible to reach the os with the finger. In such cases I again ligature the appendages as explained above, and I then enucleate the tumour out of the pelvic cellular tissue. This

latter manipulation is generally very easy. Tumours firmly located in the pelvis are thus made free from the surrounding tissue, and appear attached only to the cervix. The India-rubber ligature is then applied around the cervix, the tumour is cut off above it, and the stump stitched up, according to the principles described above. There remains, however, a cavity out of which the tumour has been enucleated. This can be treated in different ways. If I do not expect a very abundant secretion from it, I leave the walls of the cavity simply to close upon each other, and drop the whole into the abdomen. In other cases, I insert a drainage tube from the cavity into the vagina, and close the wound towards the abdominal cavity by stitching the peritoneum over it."

Schroeder then speaks of the occasional necessity of dissecting the bladder from the tumour, and further describes an operation for removing a fibroid situated low down in the posterior lip. At the time of writing, Schroeder's mortality was 30 per cent.; just before he died, it was said to have diminished to about 15 per cent. This death-rate is too high; and probably the exact following of Schroeder's method of operation has died with him.

With Schroeder's description we may profitably compare the following descriptions of operations by Keith.*

The first case was that of an unmarried woman aged 28. "The first incision measured twelve inches: it terminated four inches above the pubes, so as to avoid the bladder, which was known to be elevated on the tumour. On the right side, the broad ligament rose as high as the crest of the ilium. The left broad ligament was largely spread over the half of the tumour as high up as the ribs. The opening was then enlarged to 22 inches, and, by dint of hard pushing and patience, the huge mass was slowly moved forwards as far as its connections on the left side would permit. The right ovary was easily seen. On searching for the left, it was found to be transformed into a long, tense, umbilical-like cord, seven or eight inches in length. Here

* Cases vii. and xxxvii. in *Hysterectomy for Fibrous Tumours of the Uterus*. Edinburgh, 1885.

and there along this tense band were several small cysts. It was so embedded in the tumour that it could never have been removed. The right broad ligament was transfixed by soft iron wires, secured, and divided; all bleeding from the tumour side was prevented by a series of strong locking forceps. The fibroid was now more easily dealt with. It was drawn forwards, so as to put on the stretch its enormous connection on the left side. About a dozen locking forceps, 10 inches in length, were now applied to the broad ligament, before and behind. The whole was then cut downwards, and the mass enucleated as low as possible. A strong soft iron ligature embraced the base, which was of great thickness. The tumour was then cut away, the stump showing a section of the cervix in the centre. The forceps were removed one by one, and all the bleeding vessels separately tied. Some of these were large, and one threw blood over the assistant's head. There was much trouble in finding some bleeding points among the cellular tissue of the huge gap now left. The hæmorrhage was mostly venous. All present could see that this condition was full of danger, and that secondary hæmorrhage into this loose tissue was not one of the smallest risks of this operation. When all oozing seemed to have ceased, the stump (the thickness of the leg) and the end of the right broad ligament were secured, with much tension, outside; a glass drainage tube was fixed in above the stump, and the wound closed by forty silk sutures. The operation lasted one hour and three-quarters. After much blood and serum had escaped from the tumour, its weight was 42 lbs." The patient recovered.

The second case selected was that of an unmarried woman aged 34. "The incision extended from five inches above the umbilicus to two inches above the pubes. When exposed, the tumour was deeply congested and very vascular. On introducing the hand, the tumour was found to extend very high up. It was in contact with the liver, pushing both it and the diaphragm upwards, and there were extensive adhesions above everywhere. The slightest touch of the hand on the diaphragm, in making this examination, caused respiration invariably to

stop at once. It was impossible to get out the tumour. The incision was then enlarged up as far as it would go. This exposed adherent omentum and some long broad adhesions coming from above, as well as some parietal adhesions. The tumour was fixed too high up under the sternum to be brought out in any way. It was then pulled out of the pelvis, and by placing several pairs of enormous locking forceps round the ligaments and base, the tumour was got out first from below. Then, by introducing two hands on either side the upper portion was suddenly dislodged, and it appeared with the whole of the stomach attached to its upper and back part. The omentum, containing enormous vessels, was spread over the upper third of the tumour all round, also a quantity of adherent mesentery and intestine. No one who had examined the case had the slightest idea of this mass: at least one-third of the whole tumour was concealed by the ribs. All these adhesions were separately tied as quickly as possible, a very large number of ligatures being left in. The part of the tumour which had felt like a large kidney before operation was entirely covered by adherent ascending colon, and was shelled out of its cellular attachments. This adhesion gave the most trouble. The worst bleeding, however, came from above, partly from the vascular wall and partly from the long adhesions that came down from the diaphragm under the sternum. In the upper part of the incision there were so many vessels to tie, that many carbolised silk ligatures were used. The wound was closed by thirty-one deep sutures, besides superficial ones. The incision above the umbilicus was longer than below it. Operation lasted one hour and five minutes. A drainage tube was left in. The upper part of the tumour was broader than the lower. It weighed 16 lbs." The patient recovered.

I venture to add one case from my own experience which has some points of special interest.

The patient was an unmarried woman of forty. The operation was in a sense exploratory, though on the whole the diagnosis was between ovarian cystoma and fibro-cyst of the uterus. It was a very soft fibroid, full of enormous vascular

channels, which made the tumour fluctuate. I had decided to remove the appendages, although the growth was perhaps too large to promise full benefit from this operation. The left ovary was pulled up with some difficulty, and with it came enormous coils of dilated veins which looked as large as the small intestine. A forceps placed on the pedicle of the ovary included parts of the walls of more than one of these veins; and they were so closely set that transfixion would have been impossible without wounding them. The right ovary could not be found; and though the whole uterus was removed and carefully examined, it was never found. In the meantime blood came welling out of the pelvis, and was found to originate from the veins grasped in the blades of the forceps. Several large locking forceps were placed on these veins below the bleeding point; but each grasp of the blades seemed to tear the friable tissue and cause more bleeding. The tumour was delivered, and the bleeding from the veins in the left broad ligament was more easily controlled when they were put on the stretch. Finally, a few ligatures were placed around them by an aneurism needle carefully pushed through the cellular tissue, and the broad ligament cut away from the uterus. The base of the bladder dipped down in a deep sulcus between the uterine body and a separate growth as large as the fist, and required to be carefully separated by dissection. The fibroid on the right side dipped down in a curious manner under the right ureter, and here enucleation had to be carried out with great care. This state of matters, combined with the absence of uterine appendages on the right side, suggested the possibility of there being some congenital malformation of the uterus—possibly it was unicorned. Below the overlapping fibroid was the only site suitable for applying the clamp, and this lay so low down that it seemed impossible to treat the pedicle extra-peritoneally. However, a wire clamp was applied and tightened, and the tumour was cut away above it, exposing the uterine cavity. As blood welled up rather freely from the pedicle, the clamp was tightened till considerable force was required to turn the screw. Still the blood flowed from the cut surface, and now the wire was crushing up the uterine fibres and deeply embedded. At the next

turn of the screw the clamp broke. (I purposely avoid naming the clamp used, as the fault lay with the instrument maker, and not with the inventor.) No forceps made could be of any use here. A very thick double silk ligature was rapidly cast round the pedicle, and tied as tightly as possible. Still bleeding went on. Then double transfixion ligatures were placed and tied; then the actual cautery was used; but still there was bleeding, though not so free. Finally, a silk ligature in three interlocking loops was carried through the whole pedicle and firmly tied: this left only very slight oozing. A drainage tube was inserted, and the abdomen closed over the pedicle. The operation lasted a little over an hour. Nearly half a pint of blood was removed by suction through the tube in the first twenty-four hours; at the end of a week, only a little bloody serum could be sucked out, and the tube was then removed. Three days later the temperature rose, and tympanites appeared. The abdomen was re-opened and washed out, and the drainage tube re-inserted. The pedicle sloughed and came away; and the patient recovered, with an opening between the vagina and the pubes through which matter discharged. After four months the fistula closed. By vaginal examination not a particle of uterine tissue can be detected.

The study of a few such cases as these—and many such have been recorded—is more instructive than much generalised description. They show that the surgeon who begins to remove a large uterine fibroid must be prepared to treat off-hand complications of the most difficult and even alarming character. Extensive adhesions may be found with any abdominal organ—even with the stomach and liver; they may even arise from the diaphragm. Enucleation may have to be made, not only from between the folds of the broad ligament, but from under the greater part of the pelvic and some portion of the abdominal peritoneum. Keith, in one case, left very little peritoneum behind on the parietes; the intestines in many places lay in contact with the bared muscles. And then the veins in the tumour capsule and in the broad ligaments may be so enormous and so thin-walled that ordinary surgical measures may be almost ineffectual to stop bleeding from them. The comfort of

a temporary elastic or rope compressor in these circumstances can scarcely be exaggerated.

A few special points may be summarised:

In cases where the growth of the tumour is mainly in the fundus and towards the abdominal cavity, and where the vessels in the broad ligament are neither large nor thin-walled, the wire clamp may be at once placed around the cervix, and the tumour cut away.

Where the whole uterus is enlarged and the uterine cornua, with the round ligaments, tubes, and ovaries, retain their normal relations, the broad ligaments being on the stretch between the pelvis and the tumour, it will be wise to divide the broad ligaments at some convenient point high up, and ligature them separately. This division frees the tumour and permits of its being drawn farther out of the abdominal cavity, so that the clamp may be placed lower down. Large or thin-walled vessels lying in the broad ligaments should be secured by ligature and not included in the wire of the serre-nœud. Hæmorrhage, occurring during the separation of the pedicle, frequently starts from these vessels. This fact alone would make me, in every case where the broad ligaments can be isolated and ligatured, treat them by intra-peritoneal deligation, while the pedicle proper is treated extra-peritoneally.

Where the tumour grows from the side or sides of the uterus, the folds of the broad ligament are opened up, the whole pelvic peritoneum may be elevated, and some portion of the abdominal peritoneum may be removed from the posterior wall. In such cases, extensive enucleation may be called for, and large raw surfaces, or rather cavities, may be left behind. The edges of the peritoneal wound need not be sutured—they will fall into apposition; but drainage must be efficient.

In every case where an adhesion is separated and tied, a locking forceps should be placed on the site of its attachment to the tumour. No wound of the capsule should be made until a compressing ligature has been carried around the base of the tumour. Hæmorrhage from the capsule of uterine myoma may be very free.

TREATMENT OF THE PEDICLE IN HYSTERECTOMY.

This, the most important detail in the operation, requires separate consideration.

There are three methods of treating the pedicle: intra-peritoneal; extra-peritoneal; and mixed, or partly intra-peritoneal, and partly extra-peritoneal.

Intra-peritoneal Treatment of the Pedicle.—All surgeons aim at complete intra-peritoneal treatment of the pedicle in hysterectomy for fibroids; and there are few surgeons of experience in the operation who have not tried it. It may at once be said that very few of those who have tried the intra-peritoneal treatment are satisfied with it—at least, as at present performed. Some cases are more suitable for this plan than others; in many, it is either impracticable or unsound. Excessive thickness of the parietes has, in one case, compelled me to adopt the intra-peritoneal method.

The advantages of this mode of treating the pedicle are self-evident. The disadvantages are: the large size of the pedicle, its vascularity, its tendency to shrink, and its liability to undergo sloughing.

In 1874 Kaltenbach proposed intra-peritoneal treatment for small pedicles, with suture of the edges of the wound in the uterus and of the broad ligaments. Hegar* about the same time employed this plan with success. In 1877 Kleeberg† suggested the elastic ligature, and proved its harmlessness in the abdominal cavity by experiments. In 1878 Czerny‡ put this idea into practice by leaving the elastic ligature surrounding the pedicle inside the abdomen. Wells, Koeberlé, Péan, and others about this time recorded cases of intra-peritoneal treatment of the pedicle chiefly by multiple ligatures, but with no very encouraging success. Olshausen, Fritsch, and Leopold had fair results with the elastic ligature; but Martin, Tauffer, and a few others somewhat discredited this method by showing

* *Operat. Gynäk.*, Stuttgart, 1880. † *St. Petersburg med. Woch.*, 1877 and 1879.
‡ *Centralbl. f. Gynäk.*, 1879, p. 519.

that it sometimes caused sloughing of the pedicle, or suppuration and septicæmia.

By far the most important systematic attempt to arrive at a trustworthy intra-peritoneal treatment of the pedicle was made by Schroeder.* Schroeder's plan, already described, is essentially multiple ligature of bleeding points, and deep and superficial suture of the wound in the uterus. He began by the application of a temporary elastic ligature near the neck of the uterus, then separately ligatured the vessels in the broad ligament which supply the uterus, and finally dealt with the uterine wound. Martin advocates Schroeder's plan, with the substitution of silk for catgut as material for ligature. To the mucous membrane of the exposed cavity carbolic acid, or corrosive sublimate, or the actual cautery, is applied to cause disinfection. Leopold, von Antal, Thiriar, Olshausen, Fischer, Marey, and many others, have introduced unimportant modifications.

The outcome of the recorded experience of the intra-peritoneal treatment of the pedicle may be shortly summarised as follows. The elastic ligature overdoes compression, tending to cause suppuration, sloughing, or even septicæmia. All modes of ligation in mass with non-elastic material are unsafe, on account of the shrinkage of the uterine fibre. Multiple ligation, or ligation in detail of vessels in the broad ligaments and in the stump, is less dangerous, but still not satisfactory.

This plan is made more safe by superadding deep and superficial suturing of the uterine wound. As additional precautions against hæmorrhage, the stump has been seared with the actual cautery, and it has been soaked with powerful hæmostatics; but the results have even then not been fully satisfactory.

Extra-peritoneal Treatment of the Pedicle.—This is the original plan of Kimball, Wells, and Koeberlé; and it still remains the best. Kimball used the actual cautery, with fixation in the inferior angle of the wound. Wells transfixed the pedicle with two strong needles; below these he placed a ligature, and fixed

* *Zeitschr. f. Geb. und, Gynäk.*, 1881, p. 213, and 1883, p. 204; and *Brit. Med. Journ., loc. cit.*

the stump in the parietal wound. In 1864 Koeberlé introduced his wire clamp for the treatment of the pedicle; and this instrument, with unimportant modifications, and his plan, still continue in favour. Many other varieties of extra-peritoneal treatment have been invented, and many instruments have been introduced. In this connection the names of Péan and Cintrat deserve mention for their wire clamps; and those of Baker Brown, Keith, Kiwisch, and Wells, for their special unyielding clamps.

Avoiding detailed historical description, we may confine our attention to the three most important modes of extra-peritoneal treatment of the pedicle at present in vogue: by the clamp; by the elastic ligature; and by the wire constrictor.

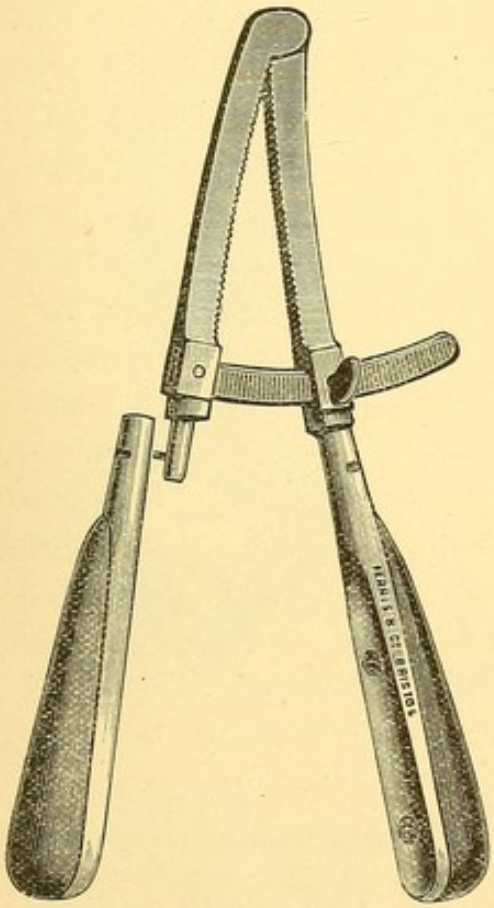

FIG. 41.

Keith's Clamp for Hysterectomy. One-third size.

Keith, so far as I know, is the only highly successful operator who uses the *clamp*. It is a special instrument, made very large and thin. (Fig 41.) He says: "I have not found sloughing take place to the extent that it does when a single wire merely embraces the pedicle; the parts are more spread out in the clamp, and there is not nearly the amount of puckering of the soft parts that there is when a wire is used. A mass, as thick as the wrist, can be squeezed into a loop an inch, or three-quarters of an inch, in diameter; whereas, with a large clamp there is no great pressure on any one part below. The pressure of the wire does not act simply on the constricted portion, but exerts its influence to some distance below the constriction. . . . Before

applying the clamp, it is better to draw all the parts gently together by a thick silk ligature or by a soft wire. This prevents a too great spreading out of the parts between the blades, which would render the closing of the wound around the clamp somewhat troublesome." Keith applies freely to the stump a saturated solution of perchloride of iron in glycerine, and then dries it off; after this, plenty of iodoform and salicylic wool. The cervical canal is scraped out and disinfected.

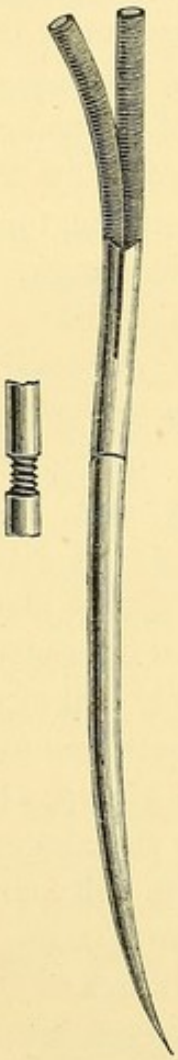

FIG. 42.

(HEGAR AND KALTENBACH.)

Needle for carrying elastic ligature through Pedicle.

The *elastic ligature* has many supporters; Olshausen, Martin, Sänger, and Hegar, being among the chief. It may be applied either as an encircling ligature, around the whole; or as a transfixing ligature, embracing the pedicle in halves; or as a double ligature, encircling and transfixing. For applying the ligature around the pedicle, the ingenious instrument of Pozzi (Fig. 40) will be found valuable. With it, any requisite amount of tension can readily and rapidly be applied, and the instrument automatically keeps up whatever tension

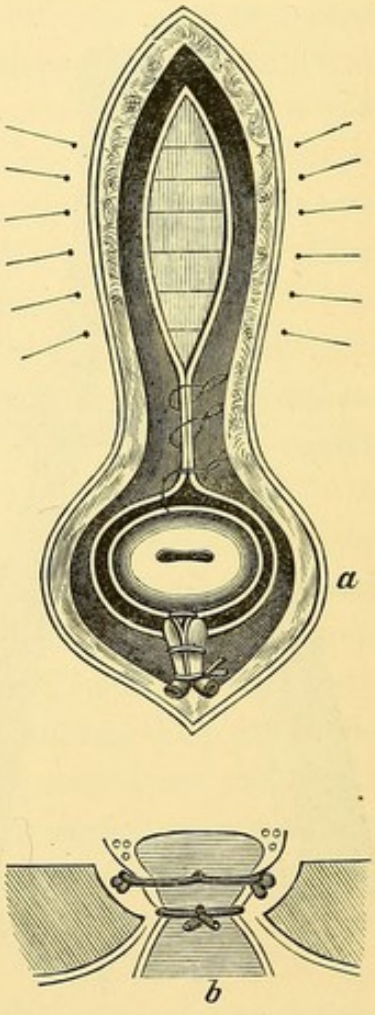

FIG. 43.

(HEGAR AND KALTENBACH.)

To show closure of Abdominal Wound (a); and treatment of Pedicle by elastic ligature (b).

is put on. For carrying the ligature through the pedicle Hegar has invented a transfixing needle. (Fig. 42.) It is composed of two parts—a sharp conical piercing point, which screws off; and a hollow tubular portion split along the side, into which the ligature is drawn in a loop. The knot made in the elastic ligature is, if necessary, finally secured by surrounding it with a strong silk ligature. Terrillon and Trélat have quite recently introduced ingenious instruments for the application of the elastic ligature. Hegar lays particular stress on the mode of closing the abdominal wound by peritoneal suture, and on the fixation of the pedicle in its lower angle. (Fig. 43.) To prevent retraction where the pedicle is short, pedicle needles should be pushed through it. The elastic ligatures are cut away about the eighth or tenth day.

The *wire-constrictor* remains the favourite instrument with most operators; and Koeberlé's simple instrument, or some modification of it such as Tait's, is generally acknowledged to be the best. Its application is exceedingly simple. In most cases, the wire is placed below a temporary constrictor of rope or elastic. With Tait's instrument the two ends of the wire are simply pulled tightly around the pedicle, and hooked into the claws on the sliding screw. With Koeberlé's original instrument, or rather with Bantock's modification of it, one end is looped on to a button on the screw, and the other is pulled over the same button and fixed there. The instrument, being left attached, is placed so that it lies flatly on the abdominal wall, pointing upwards and to one side. Koeberlé himself uses two of his instruments, each encircling half the pedicle. Strong pedicle needles (Fig. 44) are pushed through the pedicle above the level of the wire, their broad ends resting on the parietes. The needles should always be inserted before

FIG. 44.

Needle for Transfixing Pedicle in Hysterectomy. Half size.

the tumour is cut away, to prevent retraction of tissues afterwards.

In those cases where the pedicles of the broad ligaments are left inside—and such will form the majority—it may be necessary to pull together around the pedicle the detached peritoneum, so that the constricting wire shall at all points lie upon peritoneal membrane. In some cases it would be quite easy to apply the wire around the fibrous or tumour tissue alone, at the pedicle, without including the peritoneal investment at all; the peritoneum might then be used as a funnel to shut off the sloughing pedicle from the cavity, simply by fixing it to the parietal wound with a few stitches. But adhesions form so rapidly between parietal peritoneum and that covering the pedicle, that the cavity is usually completely shut off before sloughing has set in.

The part of the pedicle beyond the wire or the ligature is removed by pressure necrosis. A sort of dry gangrene which is not actively putrefactive, and which does not set loose foul discharges, is sought to be produced by various means. Soaking with strong perchloride of iron, or with tannin or alum, is used for this purpose. Bantock has found that the simple application of dry absorbent wool mummifies the tissues, and renders them almost as hard as wood: and I have been able in my own practice to confirm his experience. The process of separation is accelerated by a few turns of the screw every second or third day, and complete separation usually takes place in from seven to fourteen days. Little pieces of dry absorbent lint are packed round the pedicle to absorb all discharge as it appears, and to prevent its burrowing along the line of incision or trickling into the abdomen. These are changed as often as necessary. The abdominal wound, if properly shut off, need not be looked at for a week, when it will probably be found healed.

When the pedicle separates, a deep granulating hollow is left, which usually fills up and skins over at the end of two or three weeks. In a few cases the granulations are not perfectly covered with cuticle for months; and in such cases an occasional discharge of blood, coincidently with the menstrual periods, is observed.

The *combined intra- and extra-peritoneal* method of treating the pedicle is usually one of necessity, and not of choice. It is used in cases where the pedicle cannot be pulled outside the parietes without exerting dangerous tension on the parts.

The simplest method of "mixed" treatment of the pedicle is where it is secured by ligatures, and the ends of these ligatures are fixed in the inferior angle of the wound. The same treatment may be carried out where serre-nœud or elastic ligature is used. The margins of the pedicle are stitched to the parietal wound, and the pedicle, with its constricting apparatus, is dragged some little way inside the abdomen. Additional security against the escape of discharges into the cavity is got by stitching the parietal peritoneum to the side of the pedicle below the point of constriction. Various devices* have been invented to shut off the pedicle from the general cavity. One of these is, to surround it with macintosh sheeting or gutta-percha tissue, as in a funnel.

The mixed treatment, at its best, is suspension and inter-parietal fixation. Perfect drainage, frequent removal of discharges, and absolute rest may make it practically extra-peritoneal.

According to Vautrin, in supra-vaginal amputations the general mortality, with intra-peritoneal treatment of the pedicle, is 56.2 per cent.; with extra-peritoneal, 33.3 per cent. Although this death-rate is far in excess of what may be termed the legitimate mortality,—that is to say, the mortality in the hands of the best operators,—it is more than probable that the proportionate mortality is the same all round. In other words, the dangers of the intra-peritoneal treatment are nearly twice as great as the extra-peritoneal. At present, therefore, the extra-peritoneal treatment of the pedicle should be selected. No doubt the advancing surgery of the day will not rest till some intra-peritoneal method has been devised

* A very full account of these may be found in Vautrin's book, already referred to.

which will excel all others: in the meantime, our present knowledge and experience are in favour of the extra-peritoneal method.

After-treatment.—The general after-treatment requires no special description, being, to all intents and purposes, the same as after ovariotomy. There is usually more pain; and the bladder, having less room to expand, requires to be emptied more frequently than in ovariotomy. Pain is often relieved by emptying the bladder.

The nurse must look sharply after the stump, to see that hæmorrhage does not take place; and she must be carefully instructed how to tighten the screw and check it. The tighter the wire is kept (short of cutting), the sooner the stump dries up.

When the pedicle is converted into a hard dry mass the serre-nœud may be removed, but the needles should not be disturbed. The pedicle usually sloughs for some distance behind the wire as well as in front of it; and if the needles are removed before the slough separates, the whole is retracted inside the cavity and gives some trouble in its removal. If the needles are removed at all, it should be in order that they be re-inserted lower down in the substance of the slough; then all the tissue above them should be cut away, except sufficient to hold by. Stimulating lotions promote the formation of granulations, and thereby accelerate the separation of the slough. Dry strips of boracic lint or other absorbent dressing should be laid around the slough, and changed frequently, so as to keep the pus from burrowing downwards.

SECTION V.

OPERATIONS ON THE GRAVID UTERUS, AND FOR ECTOPIC GESTATION.

To save life in cases where, from any cause, delivery cannot take place through the natural passages, at least five distinct operations have been recommended, besides a number of modifications of these. They are: Cæsarean section; Utero-ovarian amputation, or Porro's operation; Laparo-elytrotomy; Total extirpation of the uterus; and Symphysiotomy.

Two of these, the last, may be at once dismissed. Symphysiotomy, or section of the pubic symphysis for increasing the space of the pelvic cavity, was proposed in 1768 by Sigault, and successfully carried out by him nine years later. The operation has not, however, come into general use, most men believing that, in those cases where it is likely to be successful, other and less dangerous modes of delivery are possible.

The allied operations of Pelviotomy (Galbiati) and Pubiotomy (Stoltz) have also failed to secure the confidence of the profession.

Total extirpation of the pregnant uterus has been performed only during the co-existence of cancer, and then the operation has been rather the extirpation of a cancerous organ which happened to contain a fœtus, than one designed to save life endangered by obstruction to delivery. Bischoff* operated, in 1879, on a patient with cancer of the cervix in the thirty-fourth week of pregnancy. The patient died in eleven hours; and at the necropsy one ureter was found enclosed in the ligature. In 1881 Spencer Wells removed by abdominal section a cancerous uterus six months pregnant. The patient recovered from the operation; but the disease recurred not long afterwards. A case in which the writer removed a cancerous and pregnant uterus by the vagina during the second month of gestation can scarcely be included in this category. The patient recovered, and as yet, after a year, continues well.

Full consideration is given to three operations:

Cæsarean Section.
Porro's Operation.
Laparo-elytrotomy.

And, further, it will be necessary to describe separately the surgical treatment of

Rupture of the Uterus.
Extra-uterine Pregnancy.
Pregnancy in one horn of a Uterus bicornis.

With reference to Cæsarean section, Porro's operation, and Laparo-elytrotomy, the mortality, indications to operate, and appreciation, will be considered conjointly and, as far as possible, comparatively; so that, if such a practice be possible, there may be a selection of method according to the nature of the case.

* *Hegar und Kaltenbach. Operat. Gynäk.*, 2nd Ed., Stuttgart, 1881, p. 414.

SURGICAL ANATOMY OF THE GRAVID UTERUS.

The elaborate studies of Polk* on the relational anatomy of the gravid uterus are of great value. I have been able to supplement and confirm Polk's observations by two dissections specially made in view of surgical procedures. One was obtained from a patient in the ninth month of pregnancy, who died of acute chorea. The other, in which labour had advanced till the os uteri was dilated to the size of a crown-piece, was got from a patient who died from fracture of the spine, caused by a fall. Both dissections are now in the museum of the Bristol Infirmary.

During pregnancy changes take place in the relations of the peritoneum, the uterine and ovarian arteries, the uterine ligaments, and the ureters.

As the uterus rises out of the pelvis, it carries the peritoneum with it. The elevation of the pelvic peritoneum, near the end of pregnancy, is so great that the reflection from the parietes to the uterus takes place somewhere near the level of Poupart's ligament. At the same time the cellular tissue becomes lax and distensile, and the attachment of the peritoneum is much loosened. This elevation of peritoneum and laxity of cellular tissue is so marked, that if an abdominal section is made transversely at the level of the internal ring, and the uterus is pushed to the opposite side, the true pelvis may be entered without encountering peritoneum at all. Even if it bulges into the incision, it can easily be pushed upwards. This change in the relations of the peritoneum renders the operation of Laparo-elytrotomy possible.

The broad ligaments are lifted out of the pelvis altogether, and become triangular instead of being quadrangular. The inner border, descending from the cornu to the internal os, is much broadened: its layers are separated and loosely attached, especially the anterior layer passing over the front of the uterus. The superior border, running between cornu and pelvic brim, is

* *New York Med. Journ.*, 1884.

almost perpendicular. The lower border, partaking of the general elevation of the pelvic brim, now occupies the level of the upper border in the non-pregnant state, running straight across from pelvic brim to uterus. The outer border is obliterated. The uterus may, in fact, be considered as growing upwards between the folds of the broad ligaments, carrying these and the peritoneum continuous with it.

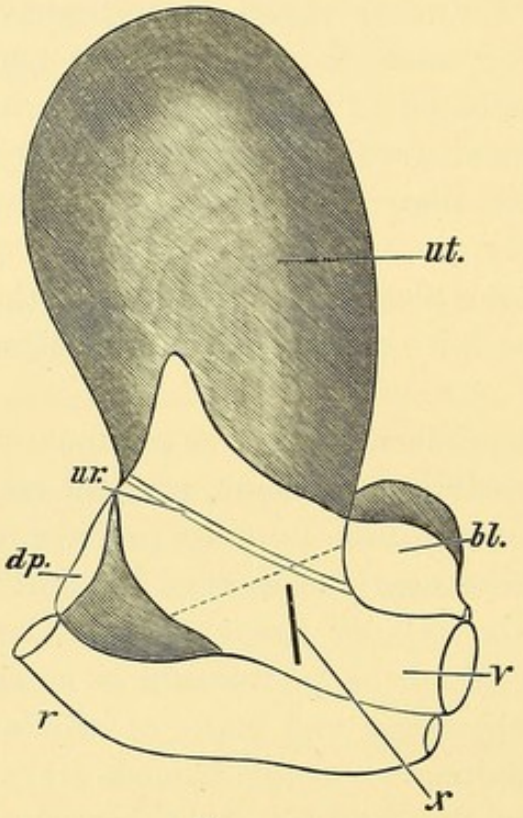

FIG. 45.

Outline drawing from dried preparation of uterus near termination of first stage of labour. (Bristol Infirmary Museum.)

ut., uterus; *v.*, vagina; *bl.*, bladder; *r.*, rectum; *d.p.*, Douglas' pouch; *ur.*, ureter; *dotted line* at level of external os; *x*, at line of incision through vagina in Laparo-Elytrotomy. Shading is placed on the areas closely invested by peritoneum.

The round ligaments, greatly enlarged and elongated, descend in the anterior folds of the broad ligaments in straight lines from their insertion at the cornua to the internal rings. Nowhere do they descend below the pelvic brim. They may be considered as instrumental in raising the peritoneum from the iliac fossæ.

The arteries are much enlarged—the ovarian more, in proportion, than the uterine. The uterine artery is straightened, and is elevated so that it is, in part, removed from the pelvic wall. Its relations to the ureter are not much changed. The ovarian artery, after it reaches the bifurcation of the iliac, runs upwards and forwards to the elevated cornu in the posterior border of the expanded upper portion of the broad ligament.

The relations of the ureters are, in one of these operations, exceedingly important. They are, at full term, detached from

the pelvic wall and elevated along with the vagina and bladder. They lie very closely to the vagina on its antero-lateral aspects, and strike the bladder about three-quarters of an inch below the cervico-vaginal junction. These relations are not much changed during labour. As the head descends and fills the parturient canal, the ureters are pushed apart. They now lie in close contact with the vaginal and uterine walls, amongst the plexus of vessels. The relation of ureter to external os at the end of the first stage of labour—that is to say, at the most important surgical period—is shown in the accompanying diagram, made from a special dissection. (Fig. 45.) In a full lateral view, the ureter crosses the line of the os uteri obliquely near the junction of its anterior with its middle third. In other words, at the level of the external os the space between ureter and rectum is twice as great as that between ureter and bladder. The importance of these relations in laparo-elytrotomy will be seen presently. The ureter leaves the uterus behind out of the range of danger in Porro's operation, unless the pedicle is constricted very low down.

Cæsarean Section. Puerperal Hysterotomy.

History.—The removal of a child from a mother who fails to deliver it is a very old operation. At first performed only when the mother was dead, the operation afterwards came into use while she was still alive. Whether or not we accept the interpretation given to the sentence in Pliny ("Auspicatius, enecata parente, gignuntur sicut Scipio Africanus prior natus, primusque Cæsarum a cæso matris utero dictus"), there is no doubt that the name Cæsarean was very early given to the operation; and many historical personages—among others, Manilius, Edward VI. of England, and Sanctus, King of Navarre—have been called Cæsars from their having been supposed to be cut out of their mother's womb. According to Heister,* the Greeks were acquainted with the operation of removing the child while the mother was alive, and named it "Hysterotomia." There is little doubt that it was practised among the Jews from very ancient times. In later times, the operation was done here and there; but full and authentic records of it are wanting. The first case recorded with anything like circumstantial minuteness is that done in 1500 by the Châtreur or sow-gelder of Seigerheusen, who operated on his own wife, as recorded by Gaspar Bauhin in his appendix to Roussetus's great work. The woman had been in labour for some days, and had been attended by thirteen midwives and several lithotomists. These the sow-gelder sent about their business, and extracted the infant with success to both mother and child. W. Simmons, surgeon to the Manchester Infirmary, who published a very able monograph on the subject in 1799, believes that this case was really one of extra-uterine fœtation. Whether this was so we cannot now decide; but the influence of this obscure operator was not felt till after the publication, in 1581, of the first elaborate work on the operation by Roussetus.† By a careful

* *System of Surgery*, 1750, vol. ii., p. 27.

† *Traité nouveau de l'Hysterotomotokie ou enfantement Césarien, qui est extraition de l' enfant par incision laterale du ventre et matrice de la femme*, &c.

record of seven cases, and an elaborate discussion of all the details of the operation, he sought to place it upon a scientific basis. Bauhin, in 1582, translated this work into Latin, and added an appendix. Guillemeau, Marchant (both Paris surgeons), and others, having utterly failed in the practice of the operation, unhesitatingly condemned it: to these Roussetus, in 1590, replied,* placing the operation on a more secure basis. In 1604 Scipio Mercurius, a Roman surgeon, in his work on *Midwifery*, published in Venice, advises hysterotomy in suitable cases. Soon after this, Schenkius; Roonhuisen, an Amsterdam surgeon; Sonnius, a physician of Bruges; Rudbeckius, a Swede; Bartholini; Renaud; Saviare, and others practised and wrote upon the operation. In 1695 Valerus† published a treatise on the operation. Ruleau, a surgeon of Xaintes, seems to have had a successful case about the beginning of the eighteenth century; and Dionis‡—who, however, is strongly against the proceeding—by investigations made subsequently on the spot, satisfied himself as to the authenticity of this operation. Sennertus, Hildanus, and Scultetus, may be quoted as favouring the operation; Paré, however, was distinctly against it.

A notable contribution both to the history and the science of the subject was made by M. Simon in the first volume of the Memoirs of the Royal Academy of Surgery, in which also various cases are recorded, with not very encouraging success. A similar want of success seems to have followed operation everywhere. In Vienna, Godson tells us, the operation was done for a hundred years without a single success; and in the Maternité, at Paris, a similar story was told. Chiara of Milan gathered 62 operations, with only three recoveries. In England an almost equally dismal record is given for the eighteenth and even part of the nineteenth centuries. Here and there a success is recorded—not always, however, by leaders in surgery, who, as a rule, were opposed to it. One such case is recorded by

* In *Dialogus pro Cæsareo partu*, &c., Paris, 1590.

† *Dissert. de partu Cæsareo*, Viteberga, 1695.

‡ *A Course of Chirurgical Operations*, Eng. Trans., Lond., 1733.

Mr. Duncan Stewart,* in which a midwife—who, seems, however, to have been a consultant among her class—operated successfully with a razor. Unlike most operators, she made her incision in the middle line; she closed the wound with tailors' needles and silk, used like hare-lip pins. The patient was seen afterwards quite well, but with a ventral hernia.

A good many examples of Cæsarean section performed by the patient herself are on record. Among the most remarkable of these is that recorded by von Guggenberg,† where the woman succeeded in removing the child; and all that was left for the surgeon to do was to close the openings. Another ‡—in which the patient, two hours after operating on herself, walked a kilometre, breakfasted with a sister, and then walked about for some time, had protrusion of intestines, and (with medical assistance) recovered—is even more remarkable.

The impetus recently given to abdominal surgery has spread to all operations for removing the fœtus, and not least powerfully to Cæsarean section. And, particularly within the last few years, the comparative want of success of Porro's operation in Germany and elsewhere has led to the devotion of increased attention to certain details in ordinary hysterotomy which place it in a position of rivalry with, if not of superiority to, hysterectomy.

THE OPERATION OF CÆSAREAN SECTION.

When it has been decided, in any given case, that puerperal hysterotomy is to be performed, the sooner it is carried out the better. The condition of the patient, already in all probability not very favourable, rapidly deteriorates; and the local effects of prolonged contraction of the uterine fibre, exhausting its vitality, are not conducive to subsequent healing. Therefore, though it is advisable to operate with a cleansed vagina, no time which delays operation is to be spent in doing this. Cleansing may be carried out after operation is over. The abdomen may be rapidly purified with carbolic or corrosive

* *Med. Essays and Observations*, Edin., vol. v., p. 361, 1752.
† *Lancet*, 1886, i., p. 90. ‡ *Lancet*, May 22nd, 1886.

sublimate lotion, and particular attention must be paid to the umbilicus. Shaving adds to the security. The general arrangements for operation are the same as those already described for abdominal operations in general (p. 68).

I should always use antiseptics in their fullest details. The instruments required are very few and simple. A scalpel, a pair of scissors, and a dozen pairs of locking forceps, with the necessary complement of needles, sutures, ligatures, and sponges, are all that are wanted. Two long flat sponges will be found very useful. In every case we ought to be provided with a clamp and other instruments necessary for a possible hysterectomy.

The Parietal Incision.—The abdominal opening, which used to be made to one side of the median line, is now always made along it, and in the same manner as for ovariotomy. But the primary incision is longer, and does not descend so low, while it rises higher. The elevation of the bladder renders it inadvisable to approach within a distance of two or two and a half inches from the pubes. Above this point an incision of five inches may be made. According to the size of the patient, the upper limit will reach to, or pass a varying distance beyond, the umbilicus. According to Sänger, a suitable incision will in most cases be one-third of its length above the umbilicus, and two-thirds below it. The cut may go straight through the umbilicus: but, for reasons given elsewhere, I think it is better that it should pass to the left of it. If, as some surgeons recommend, the uterus is to be turned out of the wound before opening it, then the incision must be made considerably longer. More will be said on this proceeding. The intention, in the operation to be described, is to give sufficient space—firstly, for removal of the child; and secondly, for suturing the wound in the uterus.

Opening the Uterus, Extraction of Fœtus.—In making the wound in the uterine walls, we have to bear in mind avoidance of hæmorrhage and the encouragement of subsequent union. If the incision is carried too low, the branches of the uterine artery

are endangered. The anterior reflection of the peritoneum from the uterus is a good guide. Here the peritoneum is loosely attached and somewhat freely movable. The lower limit of the incision may enter this region. So far as bleeding is concerned, the upper limits of the incision are unimportant. The position of the placenta might be supposed to have an important influence on the selection of the line for the uterine wound, but, practically, this would seem not to be so. Still, if it is possible to make out the site of the attachment of the placenta before incising the uterus (always difficult, often impossible according to most writers), the operation might be rendered easier by avoiding this area. No extraordinary trouble need be taken to avoid it, however. A vertical incision is recommended.

The line of incision being fixed upon, two long flat sponges are placed, one on each side of it, between the uterus and the parietes. An assistant, standing on the left side of the patient, opposite to the surgeon, places a hand deeply in each flank behind the uterus, and makes the uterus bulge forward into the parietal opening, firmly holding it there. By this manœuvre, and with the intervention of the flat sponges, the risks of escape of fluids into the abdomen are minimised. The uterus is so placed and fixed that the incision through its walls will correspond to the parietal incision.

As to the best mode of making the uterine incision, many opinions are held. Some recommend tearing; others, a combination of cutting and tearing; others, pure cutting. Some recommend a dissection deliberately carried out, each vessel being caught in forceps as it bleeds. To prevent bleeding, the placing of a temporary ligature around the neck of the uterus has been used by several surgeons; by others, equally trustworthy, it has been neglected. As a matter of fact, the bleeding is rarely severe; but should it chance to be alarming, a sponge may be packed into the wound to check it while the elastic ligature is slipped over the uterus to its neck and tightened. In the absence of a proper tourniquet, a simple knot may be cast and tightened; while it can easily be prevented from becoming undone by placing a catch forceps upon it. In every case it is

best to do without the use of a constricting ligature, if that is possible; every increase of traumatism adds to the danger.

I am in favour of a clean-cut incision. At the upper end of the projected incision, where the uterus is least vascular, an opening an inch in length is rapidly made by the scalpel. The opening need not completely perforate the uterine walls, but may be completed by pushing the finger through it. If the membranes are intact, a condition which is considered favourable, they need not now be divided; but it can matter little if they are divided by the finger. The incision is now rapidly completed downwards, by scissors cutting on the finger as a director. A few seconds suffice for this part of the proceeding. The scissors is now thrown aside, and the hand plunged through the opening catches the head of the child, the fingers clipping the neck. If the feet are conveniently near, the child may be extracted by grasping them; but as the uterine opening may contract round the following neck, it is better to extract by the head. If, during extraction by the feet, the head is caught in the uterine opening, the incision should be prolonged upwards to prevent downward laceration of the organ.

Uterine action will have been going on all this time, and gushes of amniotic fluid will have escaped from the uterus and run over the macintosh plastered round the abdominal opening. The assistant, meanwhile, will have carefully kept the uterus pressed forward on to the abdominal walls: if he is skilled and attentive, no fluids will enter the abdomen.

The umbilical cord is now divided between two pairs of locking forceps, and the child is handed over to an assistant. The surgeon then directs his attention to the detachment of the placenta, and the bleeding in the uterine wound.

If the uterus is contracting well, bleeding from the uterine sinuses soon ceases, and the placenta becomes spontaneously detached. At least one surgeon seems to have been able to increase the vigour of uterine contraction by the application of electricity, and this hint is well worthy of attention. A hypodermic injection of ergotine is advisable at this stage. If the condition of the patient permits of it, it is always best to wait

for spontaneous detachment of the placenta. During this period it is easy enough to control bleeding from the uterine sinuses by compression by sponges, or, if necessary, by forceps. If, after a timely delay, the placenta is not detached, we may encourage detachment with the fingers; but if the uterus still refuses to contract, and if bleeding continues free from the uterine incision, then we ought to proceed to hysterectomy by Porro's method. The secret of success in simple hysterotomy is efficient contraction of the uterus; if this fails us, the next best proceeding is hysterectomy.

In the great majority of cases, operated upon sufficiently early, the uterus contracts, the placenta is spontaneously detached, and the hæmorrhage from the uterine sinuses spontaneously ceases, or becomes unimportant. Careful attention is bestowed on the complete and thorough removal of the secundines. When the uterus is empty, it may be advisable to push a drainage tube or probang through the cervix and vagina, and leave it there to act as a drain. In any case, permeability towards the vagina will have been ascertained before closure of the uterine wound is begun. There is little use in mopping out the uterine cavity; it soon refills. Generally speaking, the less manipulation the better: the process of parturition physiologically looks after itself; meddlesome interference means, in many cases, harmful traumatism.

If the uterus has contracted well, and seems to be small enough easily to be pushed by the assistant through the parietal opening, there is no strong objection to this being done. It prevents the escape of blood into the cavity during the extraction of the placenta, and facilitates the insertion of sutures. Most surgeons would, however, dread the risks from additional traumatism thus induced.

Closure of the Uterine Wound.—There is a very general consensus of opinion that on this detail, more than on any other, depends the success of Cæsarean section. No doubt this is so. But many cases of recovery are on record in which no closure has been attempted; the wound has been left to close by uterine

contraction. On the other hand, it would seem that if uterine contraction fails, mere suturing is not always efficient. Accurate suturing, *plus* uterine contraction, give the best results.

The problem is complicated. The natural involution of the uterus induces an atrophy of uterine fibres, which is degenerative and attended with the free discharge of fluids. This process is, in wounds of uterine tissue proper, strongly prejudicial to union by adhesive inflammation. Uterine contractions going on after delivery, mean that a condition of unrest exists in the uterine wound. This is another bar to union. And this unrest and the delayed union permit of the escape of intra-uterine fluids through the wound into the peritoneum—a contingency which is full of danger.

The methods of suturing the uterine wound are very numerous. Lebas, in 1769, first introduced sutures. Polin of Kentucky in 1852 first introduced the silver suture; and this has always been a favourite material. Hemp, catgut, silk, and other materials, have been used; and the sutures have been placed in a great number of ways—deep, superficial, continuous, interrupted, singly, and in combinations. Wells, in a successful case, used a continuous silk suture, one end of which he carried through the vagina, subsequently removing it by traction. But the success after any method was not encouraging.

Within the past few years special attention has been devoted by several German surgeons to the mode of suturing the uterine wound, and with a success which is remarkable and striking. The extraordinary capacity of serous surfaces to become quickly glued together by inflammatory adhesions had been fully proved in abdominal surgery. In gastrostomy, enterotomy, and enterectomy, it had been shown that apposition of serous surfaces, with fixation by suitable and numerous sutures, was followed by agglutination so intimate and strong that escape of fluids or gases was impossible. The danger in Cæsarean section arose from gaping of the uterine wound, which took place from the natural shrinkage of the uterine fibre. As the fibres shrank the sutures became loose; and they might even act as setons, encouraging the escape of uterine secretions. The principle of

the new improvement was, to look to the peritoneum for the perfect closure of the uterine wound towards the abdomen.

Though Van Aubel is said to have suggested this method in 1862, Sänger, who published his ideas in 1882,* deserves the chief merit of having introduced it. Leopold was the first actually to carry it out. Beumer, Obermann, Münster, Credé, and others soon followed; and the combined results of these operators, in the short time during which they have been working, have already placed the improved mode of Cæsarean section by the conservative Sänger or Sänger-Leopold method ahead of all others.

Many variations in detail have been given. Sänger at first recommended resection of a wedge-shaped strip of muscular fibre under the peritoneal covering, so as to permit of the infolding of a greater amount of serous surface. This was found to be unnecessary, and sometimes even harmful. It is usually possible, without resection of muscular tissue, to fold inwards sufficient breadth of serous surface. It is unnecessary to recapitulate every variety of suture which has been employed; I select one which seems the best.

A double row of sutures is used, deep and superficial. (Fig. 46.) The peritoneal covering is detached from the muscular fibre for a little distance along the margins of the wound: in this way, it is possible to turn inwards a greater surface of peritoneum. Then the deep sutures are placed. They are made to enter at about half an inch from the edge of the wound, passed obliquely through uterine tissue, and made to emerge near to the bottom of the cut surface. No suture should enter the uterine cavity. These deep sutures should be placed about three-quarters of an inch apart; and they should be carried, converging a little, beyond the ends of the incision.

Then the superficial sutures are placed, two between each deep suture. The needle first pierces peritoneum and muscle, coming out a little below the lip of the wound; then it picks up the free edge of the peritoneum on its own side, and finally pursues the same course in opposite direction with the other

* *Der Kaiserschnitt*, &c., Leipzig, 1882.

side. The diagram, after Sänger, shows this more clearly than any description. The sutures are placed with great care, and they are carried a little way beyond the extremities of the wound.

The superficial sutures are first tied, bringing into accurate apposition two strips of peritoneum. Then the deep sutures are tied, causing still further incurvation of serous surfaces, and closing up and strengthening the whole. Finally, if apposition does not seem to be perfect, a simple continuous suture may be inserted over the whole.

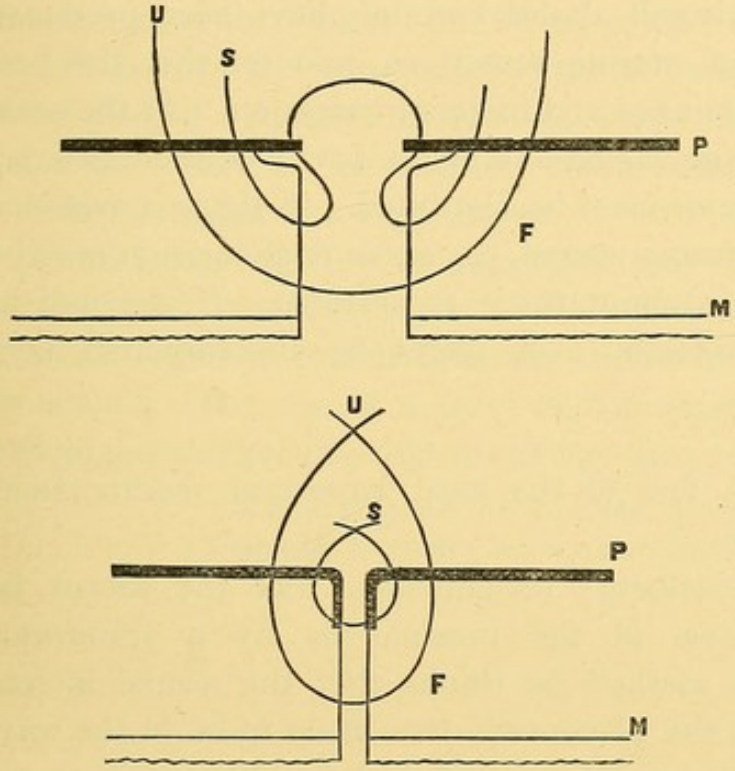

FIG. 46.

Diagrams to show the placing of Sutures in the Uterine Wound after Cæsarean Section.

P, Peritoneum; F, Uterine Fibre; M, Mucous or Decidual Layer; U, Deep Uterine Suture; S, Superficial Serous Suture.

In every case where future pregnancies may take place this should be prevented by excising with scissors a small portion of each Fallopian tube.

While the sutures are being inserted, a few sponges placed in Douglas's pouch and around the uterus will absorb any fluids that may have escaped. These are now removed, and the whole cavity cleansed.

The wound in the parietes is sutured in the ordinary manner.

The question of drainage is not without importance. In most cases it will be useless; but in some, by giving timely warning of the escape of uterine fluids, it may prove in-

valuable. At the worst it is harmless, and therefore I should always insert a drainage tube. It need not go deeply into the pelvis. A piece of rubber tubing, cut obliquely, laid over the uterine wound, and fixed by a stitch into the lower angle of the parietal incision, will suffice. At the end of a day or two it may be removed, should it not be required.

If the patient survives the shock of the operation, the chief subsequent danger is from peritonitis. This is treated according to ordinary principles by turpentine enemas and saline purges. But such peritonitis will almost certainly have been produced by extravasation of uterine secretions, and for this the best treatment is free drainage and frequent irrigation. At the same time cleansing of the vagina and of the cavity of the uterus by warm antiseptic fluids must be instituted. If there is evidence of gaping of the uterine wound, the abdominal incision may be re-opened, and an attempt made to close it. If the patient will bear it, hysterectomy even might be contemplated as a last resourse.

Modifications.—A few of the most important modifications may be referred to.

Kehrer of Heidelberg* recommends that the uterus be opened at the level of the internal os by a transverse incision. By this method he thinks that the wound is less liable to gape, that the placenta is less likely to be in the way, that the head is more easily reached, and that the peritoneum, being here loosely attached to the uterus, is more easily sutured separately. He recommends vaginal as well as abdominal drainage. He lost three cases in seven operations, and his plan has not secured followers. Obvious objections are: danger of hæmorrhage, the wound being in the region of large vessels; difficulty in controlling it by temporary ligature, should it occur; and risk of circular tearing in extracting the child.

Cohnstein† recommended that the whole uterus should be turned out of the abdominal wound, and that the opening should be made on its posterior aspect while the aorta is being

* *Archiv. für Gynäk.*, bd. xix., heft. 2. † *Centralbl. f. Gynäk.*, bd. v., heft. 12.

compressed. He advised drainage through Douglas's pouch, and complete closure of the abdominal wound. He rests the advantages of his plan on the facts, that the uterine tissue is thickest behind, and therefore less likely to gape; and that the posterior opening and dependent drainage are the best safeguards against septic peritonitis. His plan has not been adopted.

Sänger* himself recommended the long abdominal incision, and delivery of the uterus before extracting the fœtus. A few sutures are at once placed in the upper end of the incision, to prevent extrusion of bowels, while the abdominal cavity is shut off by placing a sheet of caoutchouc under the uterus over the abdominal wall. The evident disadvantages of this plan probably outweigh the advantages.

Frank† has ingeniously suggested that the vesico-uterine pouch should be closed as far as possible by stitching the round ligaments together, and draining the hollow thus formed through the wound. The use of a short rubber tube in the manner I have suggested, secures this advantage by a simpler method.

* *Archiv. f. Gynäk.*, bd. xix., heft. 3, s. 397.
† *Centralbl. f. Gynäk.*, bd. v., heft. 25, s. 598.

Porro's Operation. Puerperal Hysterectomy.

History.—Removal of the uterus, as a sequel to Cæsarean section, was first deliberately planned and carried out by Porro, in the Maternity Hospital of Pavia, in 1876. His patient was a woman deformed by rickets; and, although puerperal fever was then prevalent in the hospital, an excellent recovery followed. The idea was suggested by the success of hysterectomy for fibroids, and was strengthened by the results of experiments upon animals. Since then the operation has been known by Porro's name.

According to Godson,* the possibility of removing the gravid uterus from animals was first proved, in 1768, by Cavallini in Florence. In 1828 Blundell of Guy's Hospital performed the same operation on four bitches, with three successes, and suggested that hysterectomy might be a wise practice after Cæsarean section, or when a patient is evidently sinking after rupture of the womb. Michaëlis of Marbourg, in 1809, made a like suggestion; and other workers added to the experimental proofs of the possibility of operating with success.

The first case of actual removal of the gravid uterus in a woman was in the hands of Horatio Storer of Boston in 1869. He performed hysterectomy to avoid death from incontrollable hæmorrhage in Cæsarean section. The patient died in sixty-eight hours. After Porro's own operation, the next success was secured by Späth of Vienna, in 1877. Since then the operation has been performed more than 200 times, with a percentage of women saved of something between 40 and 50.

THE OPERATION.

Porro's operation may be defined as Cæsarean section, followed by removal of the uterus at the cervical junction, along with the ovaries and oviducts. It has been variously

* *Brit. Med. Journ.*, Jan. 26th, 1884.

named—Cæsarean hystero-oöphorectomy, Cæsarean hystero-ovariotomy, puerperal hysterectomy: Porro himself described it as "Utero-ovarian amputation, as a mode of completing the Cæsarean section." A true Porro's operation is therefore always preceded by Cæsarean section. In his proceeding also the fœtus is supposed to be viable. But puerperal hysterectomy may be performed for ruptured uterus, and for abnormal conditions which exist before the end of pregnancy: it is necessary to separate these from true Porro operations. Godson, in his valuable paper, very properly tabulates the operations into:

1. True Porro operations.
2. Utero-ovarian amputations performed during pregnancy, but before the fœtus was viable.
3. Operations for removal of the fœtus from the abdominal cavity by laparotomy, followed by amputation of ruptured uterus with ovaries.

For each of these proceedings the operative details are, in their main features, identical. Some special remarks will, however, be necessary in describing the operation for ruptured uterus.

The Parietal Incision is the same as for simple Cæsarean section. If anything, it ought to be lower, because the stump of the amputated uterus has to be brought out at its lower end. A modification introduced by Müller in 1878, whereby the whole uterus is turned out of the abdomen before it is opened, necessitates a very long incision. The advantages claimed for this method are, that it avoids the risk of escape of uterine fluids into the abdomen (a real advantage if, as in his case, the fœtus is putrid), and that it renders easy the application of a temporary constrictor to prevent hæmorrhage. The evident disadvantages are, however, so great that Müller's modification has not received much support.

The Uterine Opening may be made by incision or by tearing, and may be directed transversely or longitudinally. As the uterus is to be amputated, and the uterine wound is not to be

closed, the mode of opening is not so important in Porro's operation as it is in true Cæsarean section. The selection of a site for making the opening may, within certain limits, be guided by the position of the placenta.

Godson favours a transverse opening low down, made by tearing. Most operators, however, prefer a vertical opening, made by cutting; and this method seems, on the whole, to be the best. The incision may be rapidly made by scissors, in the manner recommended for Cæsarean section.

Other details as to the placing of sponges, pressing forwards the uterus and delivering the child, are the same as for that operation. The cord is divided between compression forceps, and the child handed over to an assistant.

Management of the Placenta.—The placenta may or may not be removed before amputating the uterus. The only advantage of so removing it is, that the uterus is thereby diminished in size; the disadvantages are, waste of time and risk of bleeding. Experience has proved that it is, at least, unnecessary; practically, therefore, it may be left attached.

Control of Hæmorrhage from the uterus may be effected by temporary constriction round the neck, by the hand inserted into the abdominal cavity, or by an elastic ligature, or by an instrument such as Tait's rope constrictor. Large T-shaped compression forceps applied to the edges of the uterine wound would quickly and efficiently serve the same purpose. But, with moderate uterine contraction and due rapidity of operation, bleeding from the uterine wound may be ignored—at least, till the uterus is turned out of the abdomen.

The uterus is delivered by hooking the forefinger of each hand into the ends of the incision and dragging it forwards. The abdominal cavity is shut off by placing large sponges in the opening.

Amputation of Uterus. Treatment of Pedicle.—Thus far experience has declared strongly in favour of the extra-peritoneal treatment of the pedicle. According to Godson's tables, of fifteen cases treated by intra-peritoneal methods, eleven died.

Though the verdict thus given cannot be regarded as final, it may be safely concluded that, with the practical methods at present in vogue, the likelihood of success is greater with the extra-peritoneal than with the intra-peritoneal method.

Numerous methods of constricting the pedicle have been employed. Various forms of wire constrictors and chain ecraseurs; the wire ligature, singly or in sections; steel clamps; and the elastic ligature, have been used. Constriction by a wire which can be tightened has been most favoured, and has given the best results. Cintrat's constrictor has most often been employed; but Koeberlé's simpler and smaller instrument is gradually displacing it. Tait's recent modification of Koeberlé's serre-nœud (Fig. 38) is as nearly perfect as such an instrument can be; and this instrument I consider the most suitable for securing the pedicle in puerperal hysterectomy.

The instruction generally given is, to place the wire round the neck of the uterus at the level of the internal os. But the position of the internal os will vary according to the stage of labour and the subsequent degree of uterine contraction. It will generally be safe to place the wire immediately below the bulge of the uterine walls, which marks the lowest descent of the fœtus. In the later stages of labour this will be very near to the level of the external os. In cases necessitating operation, there will be some obstruction to the descent of the fœtus, and as the uterus contracts the os is of necessity dragged up over the fœtus. The ureters can scarcely be endangered. If a temporary constrictor has been put on, the wire is placed below it, if this does not involve too low a situation; but there is no strong reason why the wire should not be placed in the groove of the temporary constrictor, or even above it. The single wire is quite sufficient: extra ligatures of silk or other material are useless, and may act simply as traps for filth. The instrument is fixed so that the handle shall be at right angles to the wound, or turned a little upwards towards the umbilicus. In this position it is least in the way of catheterism, or dressing of wound or pedicle.

To fix the pedicle in the wound, and to prevent its retraction,

one or two round steel pins are passed through it above the site of constriction. The pins are identical with those used in hysterectomy for fibroids, and their ends are protected in the same way.

The uterus being cut off at a distance of about three-quarters of an inch above the wire, the pedicle is carefully placed in the bottom of the abdominal incision. Before doing so, the vesico-uterine cul-de-sac is cleaned with a sponge, and the peritoneum around the pedicle and covering Douglas's pouch is also cleansed. Some surgeons, with a view to getting as rapid and complete closure of the peritoneum around the pedicle as possible, recommend that the parietal peritoneum at the lower extremity of the wound should be fixed to the peritoneum surrounding the pedicle. If this is not done, it would certainly be worth while to pull the peritoneum on the abdominal wall outwards over the cut surfaces, and fix it there by a suture just above the pedicle. However observed, the golden rule of peritoneum to peritoneum ought never to be neglected.

The lowest suture in the abdominal wound is so placed that it brings the cut edges in close apposition to the pedicle, but not with undue tension. Tension will cause suppuration around the suture, an event specially to be guarded against. The rest of the sutures are placed in the ordinary way.

Except in very special cases, drainage is not called for.

The pedicle is now finally trimmed and dressed. With scissors any superfluous tissue is cut off, leaving a circular convex surface, even all round. The mucous membrane in the centre, being prone to decompose, is scraped out, and the cavity cleansed. To mummify the tissue destined to slough beyond the constricting wire, perchloride of iron is rubbed into the raw surface, either solid or in a concentrated solution in glycerine. While this is being done pieces of lint are carefully packed around its base, so that no discharges shall get inside the abdominal cavity.

The dressing of the wound is most conveniently carried out in two parts. The upper part, the parietal wound, is dressed as if for primary union, with a dressing that need not be dis-

turbed for a week. The position in which the pedicle lies is so covered that a discharge of blood will be at once visible, and the screw of the clamp reached without disturbing the upper dressing. Further, the pedicle, undergoing decomposition, ought to be kept apart from the healing wound, and constantly under the influence of active antiseptics. With the help of Listerism, it sometimes happens that from beginning to end the pedicle is kept sweet, even if it does not continue dry: this is an advantage that cannot always be counted upon, however. All around the root of the pedicle small pledgets of boracic lint or absorbent gauze are packed, and removed as often as may be necessary.

The wire of the serre-nœud is tightened a little every day or every few days, as may seem expedient. At the end of a week or a fortnight, it will come away with the strangulated tissue above it.

The *after-treatment* requires no special comment. Peritonitis, simple or septic, is the chief cause of death, accounting for half the mortality. To obviate this an empty state of the bowels is the best treatment. Turpentine enemas, and, as soon as the patient will bear it, a saline aperient, ought to be given. Marked symptoms of peritonitis ought to be promptly met by abdominal drainage and irrigation through the wound above the pedicle. Rectal alimentation and free stimulation will be necessary, particularly if there is sickness.

Laparo-Elytrotomy.

By this operation (λαπάρα—flank; ἔλυτρον—vagina) is meant removal of a fœtus through incisions in the abdominal wall and in the vagina, without opening the peritoneum or wounding the uterus. It is also known as Gastro-elytrotomy and as Thomas's operation.

History.—This operation is as much the property of Gaillard Thomas of New York, as is the operation just described of Porro. Like the latter operation, laparo-elytrotomy had been proposed and even carried out, after a fashion, years before Thomas re-introduced it. According to Mangiagalli,* Joerg† in 1806 suggested the plausibility of reaching the uterus through an abdomino-vaginal incision; but there is no evidence that he ever operated. In 1820, Ritgen,‡ on hearing of the plan of ligating the external iliac without entering the peritoneum, devised gastro-elytrotomy for removal of the fœtus from the uterus. He operated in 1821; but the bleeding was so free that he had to conclude with an ordinary Cæsarean section. The patient died of vaginal hæmorrhage. Baudelocque (1823) seems to have devised no fewer than six methods, of which he tried two, both without success. Physick (1824) proposed a somewhat similar proceeding, reaching the uterus by a horizontal incision over the top of the bladder and under the peritoneum; but he never put it into practice. Sir Charles Bell (1837) discussed the method of sub-peritoneal hysterotomy, and suggested digital laceration of the vagina to avoid hæmorrhage; but it is doubtful if his proposal was original.

The operation owes its revival, and indeed its present existence, to Thomas. His proceeding, that of Ritgen and Bell combined, was carried out by him in March, 1870, on a living, or rather a dying, woman.§ The patient was at the end of the

* "Le piu recenti Mod. del Taglio Cesareo," *Am. Journ. Med. Sec.*, July, 1884.

† *Handbuch der Geburtshülfe*, 1807. Garrigues.

‡ *Heidelberg Klinische Annalen*, vol. i., 1825, p. 226.

§ *Am. Journ. Obstet.*, May, 1870.

seventh month of gestation, and was *in articulo mortis* from pneumonia; the operation was undertaken solely in the interests of the child. This case proved the feasibility of the operation. Dr. Skene* and others took it up, and have secured to it a promising degree of success.

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THE OPERATION.

Dr. H. J. Garrigues, of New York, has devoted special study to the history and technique of the operation, and has minutely described the anatomy of the parts.† To him and to Harris of Philadelphia, as well as to Thomas himself, I am mainly indebted for the following description.

Preliminary Steps.—The patient is prepared in the ordinary way by clearing the primæ viæ; the parts are thoroughly cleansed, the pubes shaved, and the vagina and vulva purified. The pelvis is elevated by a hard cushion, and the thighs are extended as much as possible. The os uteri, if not fully dilated, is now dilated artificially by means of Barnes's bags, or, if necessary, by the fingers.

As the vagina communicates with the wound, complete asepticism is impossible; therefore, the antiseptic spray may be dispensed with.

Assistance.—Four assistants are desirable. The operator stands on the right of the patient. One assistant is placed on the left side; his duty is to pull the fundus backwards and towards the left, so tilting the lower end of the uterus forwards and towards the right, and making tense the skin in the right groin. A second assistant, standing on the right side and to the operator's left, keeps open the wound in the groin by pressing his hand into its upper edge, and drags the peritoneum and bowels upwards. A third assistant passes a catheter into the bladder, and manipulates it according to direction. The

* *Am. Journ. Obstet.*, Oct., 1877.

† *New York Med. Journ.*, Oct. and Nov., 1878.

fourth assistant helps in various ways, chiefly in pushing the vagina into the wound, and in manipulating the thermo-cautery should it be called for.

The Parietal Incision is made in the right inguinal region, which has a slight advantage over the left in being more remote from the rectum. It is slightly curved, concavity upwards, and runs parallel with Poupart's ligament, about an inch above it. It begins an inch and three-quarters above and to the outside of the spine of the pubes, and ends an inch above the anterior superior spine of the ilium. The incision thus escapes the internal epigastric artery and the round ligament on the inside; it divides the external epigastric. The external oblique muscle is divided through its aponeurosis, except just above the iliac spine, where muscular fibres are met with. The fibres of the internal oblique being parallel to the incision, are simply separated; the fibres of the transversalis descending a little, require division. The transversalis fascia is now reached and carefully divided, after being pinched up between forceps. The fingers now push upwards the peritoneum and sub-peritoneal fat, and slowly work downwards towards the vagina, which is meanwhile tilted upwards and to the right by the assistant manipulating the fundus. The circumflex iliac is below the incision and out of the way. The elevated and loosely attached peritoneum is easily pushed aside and kept out of the way by the assistant behind the operator, using the palms of his hands covered by linen rags wrung out of warm carbolic lotion. A straight silver catheter is now passed into the bladder by the third assistant, and its tip made to bulge at the vesico-vaginal junction on the right side, so as to mark the proximity of bladder and ureter.

The Vaginal Opening.—At the end of pregnancy, in cases of narrowed diameter, the whole of the uterus will lie above the brim; and during labour, as the head cannot descend, the vagina will be dragged upwards. Near the utero-vaginal junction vessels are most abundant; it is therefore advisable to make the opening in the vagina as low down as possible. The

vaginal branch of the uterine artery at the side of the vagina, and the ureters and base of the bladder in front, leave the antero-lateral aspect of the vagina as the most eligible site for making the opening. The ureter and base of the bladder lie most dangerously near, almost in the field of operation. Roughly speaking, the ureter enters the bladder an inch below the level of the external os in the later stages of pregnancy; and during labour in the normal state, shown in the dissection which I have made (Fig. 45), the relations are not much disturbed. From its entrance into the base of the bladder, a position which may be demonstrated by the catheter, the ureter crosses over the vagina obliquely upwards and backwards. The site of election ought to be at least an inch and a half below the level of the tip of the catheter, lower if possible, and a clear inch from the lateral margin of the bladder.

The vagina may be pushed into the wound in various ways. Garrigues recommends for this purpose a blunt wooden instrument, something like the obturator of a cylindrical speculum; and he directs that the incision should be made on this instrument as low down as possible, away from the uterus, and parallel to the catheter in the bladder. Thomas, in his first case, used a steel sound; in his second case, the finger of an assistant pushed up the vagina. Skene used his own finger.

The advantage of using the wooden obturator is, that the parts may be divided on it by the cautery; the disadvantage is, that the division is made without the diagnostic aid of touch. Probably as good a plan as any would be that the operator should push the vagina into the wound by the first and second fingers of the right hand, and with the left hand push a Lister's sinus forceps through the vagina between them. Dilating the blades sufficiently to admit the two fingers of the right hand, the surgeon may enlarge the opening by tearing with the fingers inside and outside the vagina. The direction which the rent tends to pursue must be observed; as far as possible, it is guided downwards and backwards, away from bladder and ureter. It is not, however, at this stage that these parts are in most danger; but later, during the extraction of the child.

Delivery of the Child.—The catheter is withdrawn, and steps are now taken to extract the fœtus. The finger is hooked into the os uteri, pulling it towards the wound. If dilatation is not sufficiently advanced, this is artificially encouraged by the fingers. The membranes are ruptured; the long axis of the uterus, by combined depression of the fundus and elevation of the cervix, is brought as far as possible in a line with the opening in the flank; and the child is delivered by forceps, or turning, as seems at the time most suitable. The placenta is expelled by pressure.

The child is handed to an assistant, and attention directed to the wound. Firstly, all bleeding must be checked. The edges of the vaginal rent are examined carefully, and ligatures placed on bleeding points. A large sponge placed high up in the vagina may be of service in pushing the parts into the wound. Thornton's T-shaped forceps may be found of value in checking oozing over considerable areas. Temporary forci-pressure may be found of conspicuous advantage. The application of the actual cautery through a vaginal speculum may be required. As a last resource, sponge packing from vagina and from wound with firm pressure by bandages may be used.

Finally, the safety of bladder and ureter must be ascertained. If the ureter cannot be seen, it is probably intact. A rent in the bladder may easily be overlooked; the best way to detect it is to inject coloured fluid through the urethra.

Cleansing, Suturing, and Dressing.—The wounds are thoroughly cleansed by irrigation and sponging; iodoform powder is blown into the deep parts, and one or two large drainage tubes are passed through the vaginal opening into the wound in the loin, and out to the abdominal surface.

The parietal wound is closed in the ordinary way. If the abdomen is compressed by a binder the peritoneum will fall down into its natural position, and the gaping wound will fall together. If necessary, irrigation may be carried out through the drainage tubes.

The dressings over the flank may be of any antiseptic and

absorbent material. On the vaginal aspect most scrupulous cleanliness must be observed. Packing the vagina with dressings is irritating to the patient, and liable to cause disturbance of parts. Dressings packed between the labia and around the external parts will be found efficient. The urine should be drawn at each dressing, three or four times daily; the external parts ought then to be cleansed most thoroughly, and smeared with an antiseptic material, such as boro-glyceride; and a fresh dressing applied, and retained by a T bandage. A large drainage tube in the vagina will facilitate the outflow of the discharges.

Comparative Survey of the Cæsarean, Porro's and Thomas's Operations.

It will be of advantage to consider in conjunction certain facts and theories which are common to these modes of operative delivery. Though I believe that, in some degree, each operation has special indications, yet in most cases the choice, *quâ* operation, is evenly balanced; that is to say, a surgeon would be fully justified in selecting any one of them.

INDICATIONS TO OPERATE.

In a general way the indications to Cæsarean section are the indications to Porro's and to Thomas's operations.

The most frequent indication is deformity of the pelvis, with contraction of its diameters. The operation is said to be justifiable when the contraction is so great that we cannot expect to deliver the fœtus *per vias naturales*, with or without embryotomy, and save the mother. The degree of contraction is generally stated as 1½ inch and below. But cases in which much distortion exists may have an upward limit of 2 inches.

Tumours of various sorts may so block the pelvic outlet that delivery is impossible. Ovarian and uterine growths of all sorts—enchondromatous and other tumours springing from the pelvic bones, and even tumours springing from the abdominal organs, as the kidney or liver—may cause the obstruction.

Malignant disease of the cervix, if far advanced, may be an indication for operation. Before the child is viable, removal of the whole uterus may be instituted; but this proceeding comes under a different category.

Impaction of the fœtus transversely across the pelvic brim may, under special conditions, be considered an indication. According to Harris,* seven out of eleven cases of Cæsarean section for impaction were saved.

* *Internat. Cyc. Surg.*, vol. vi., p. 762.

MORTALITY STATISTICS.

Simple Cæsarean.—To get at trustworthy statistics of the results of the old Cæsarean operation is impossible. Mayer's statistics of the results in England, Germany, France, Belgium, Italy, and America give 1605 operations, with 54 per cent. of recoveries. The infant recoveries are between 50 and 60 per cent. Radford's table of operations in Great Britain gives 131 cases, with only 23 recoveries. In America, Harris gives 124 operations, with 53 recoveries; and other writers give a per-centage of recoveries, in America, of about 42 per cent. Against these statistics we must place the authorised statements that in certain hospitals in Paris, Berlin, and Vienna, not a single success had been scored for many years. Too ready deductions have been made from such statements: the operation is not uniformly fatal; or fatal in anything like 99 per cent. of all cases. The greatest success has always attended the operation in country districts. But on the other hand, it is certain that the general statistics of results are too favourable. A fair estimate would probably be between 75 and 80 per cent. of deaths in all cases operated on by the old Cæsarean method.

The Improved Cæsarean.—A sufficient number of cases has not yet been recorded to enable us finally to judge of the risks of this operation. So far they are highly favourable—more than sufficiently so to displace the old Cæsarean. Credé records 23 cases, with 4 deaths. Ten operations in the Dresden Institution had only one death, and all the children were saved; six at the Leipzig clinic were all successful. In 1886 there were 22 operations, with 4 deaths. Altogether, about 60 operations have been performed, with a mortality a little under 30 per cent.

Porro's Operation.—The most complete Porro-Cæsarean statistics are published in the *American Journal of the Medical Sciences* of April, 1885. They continue Godson's table, and include other cases. The total is 164; Porro's method, unmodified, was employed in 109 of these, and 46 patients recovered. The Porro-

Müller modification was employed in 41 cases, with 21 recoveries. Veit's intra-peritoneal method of treating the stump was followed in 14 cases, with 4 recoveries. Excluding moribund cases, and including only such as may be legitimately described as Porro-Cæsarean, we have a total of 147 operations, with 65 recoveries—a per-centage of women saved of 44. In special institutions and in the hands of special operators better results are got. Braun in 12 cases had 8 recoveries. Fehling had 1 death in 4 cases; he puts the general mortality of the Porro-Cæsarean operation at 55.8 per cent. And at this point it seems to remain, getting worse rather than better. A death rate of about 60 per cent. over all cases, and in all hands, may be expected from this operation.

Laparo-Elytrotomy.—So far as I can discover, only 14 of these operations have been performed, with 7 maternal recoveries. Of these, Skene of Brooklyn has had 4 cases, with 3 recoveries. From this small number no conclusions can be drawn. It should be noted, however, that nearly all the deaths were in very unfavourable cases. On the other hand, one of the successes was secured by Dr. Mc Kim,* under circumstances almost as unfavourable as it is possible to conceive.

In every case it must be remembered that delay in operation is one of the most potent factors in causing failure. Statistics show this very markedly. Operation at full term before labour has set in cannot fairly be compared with operation at the end of an exhausting labour, complicated perhaps with instrumental proceedings.

PECULIARITIES AND RESULTS OF EACH OPERATION.

In seeking to form a fair comparison of the relative values of these operations, many circumstances must be taken into consideration. Among these the most important are: the facility of the operation; the nature of the immediate risks as to shock, bleeding, and peritonitis; and the character of the remote effects.

* *N.Y. Med. Journ.*, Dec. 10th, 1887.

The Operation.—From the nature of the case, many operations have to be suddenly performed by practitioners not specially trained, with an inadequate supply of instruments, and at a distance from skilled assistance. In such cases the classical Cæsarean operation will almost certainly be selected. In every case, however, the improved suturing of the uterine wound ought to be carried out.

In other circumstances, where the full advantages of trained assistance, suitable instruments, and some experience, are available, it is not easy to decide, from the operator's standpoint, which is the most promising.

Of laparo-elytrotomy, all who have performed the operation say that it is easier than Cæsarean section, that it presents no special difficulties, and requires no special instruments. From the fact that Skene was able to finish one operation in fifteen minutes, and another in ten, it is evident that the technique is not elaborate or difficult. The greatest risk is rupture of the bladder; this happened in five of the cases, but the rent healed spontaneously in all. Bleeding has given little trouble. Pelvic cellulitis is to be apprehended from the extensive opening up of fibrous layers and bruising of parts; and a somewhat prolonged suppuration is to be expected. The immediate dangers are over when the vaginal hæmorrhage has been controlled. The bladder is liable to be abnormally placed in these cases; and if its situation can be diagnosed before operation, the side opposite to that where its chief bulk lies should be selected for operation. It is of great assistance to have the os uteri fully dilated before operation. Indeed, a hard contracted os is a contra-indication if the patient's condition is so bad that time cannot be safely given to make dilatation.

It may be true that laparo-elytrotomy is easier than Cæsarean section; but on the face of it this does not seem to be the case. The wound in the groin seems a formidable and somewhat difficult proceeding; and the division of the vaginal wall looks delicate, if not difficult; while the amount of laceration by the forthcoming child is uncertain and may be hazardous. It

is more than likely that the difficulties are apparent rather than real; it is certain that the appearance of difficulty has deterred many from operating.

In Cæsarean section there is no real difficulty. Bleeding from the uterine wound may be momentarily alarming. Adroitness is necessary to prevent escape of uterine fluids into the peritoneum. Patience and accuracy are desirable in closing the uterine wound. As compared with many abdominal operations, simple Cæsarean section is easy and straightforward.

Porro's operation, as a piece of surgical work, is also easy. The difficulties are mainly in the management of the pedicle. A skilled surgeon may with perfect confidence dispense with temporary constriction, and will at the first attempt accurately place the wire of the serre-nœud. When this has been done, the other steps are simple enough. The case is not completed, however, till the constrictor has been removed, and accidents are to be apprehended while it remains attached.

From the operative standpoint, therefore, there is little to weigh in favour of any one proceeding.

Shock.—The condition of the patient at the time of operation is the main factor in influencing results. If the patient is exhausted by a prolonged and futile labour, an operation which of necessity is prolonged or is attended with great shock is forbidden. In respect of shock immediately produced, Porro's operation must come first; so far as time spent over the operation can influence the result, Thomas's operation, in which it may be necessary to dilate a rigid os uteri, is worst. In average cases, the facts that Thomas's operation may be finished in ten minutes, that it does not expose the peritoneum, wounds only cutaneous or unimportant structures, and that the child is extracted from the womb in the natural way, tell strongly in its favour. As productive of collapse, the Porro-Müller modification is most to be deprecated. Cæsarean section would seem to hold a middle position.

Hæmorrhage.—The danger from hæmorrhage, both immediate and remote, is greatest in Porro's operation. In a good many cases, wire or chain constrictors have been found inefficient in checking bleeding from the pedicle, and other extraordinary means have had to be adopted. In ordinary Cæsarean section, hæmorrhage has not infrequently proved fatal; one of the earliest hysterectomies had to be performed on account of bleeding. If the placenta is wounded, the danger is increased. If the uterus contracts well, bleeding is not likely to be dangerous; if it does not contract, it would probably be wise to finish by hysterectomy. In Thomas's operation, the risks of bleeding are small; the drawback is, if it does occur, that it may be difficult to control. The vaginal rent may be indefinitely increased by the withdrawing of the fœtus, and bleeding may go on at the extreme ends of the tear. But the torn vessels are not of large size, and simple means will compress them.

Peritonitis.—The large proportion of deaths from inflammations of the peritoneum, usually septic, following Cæsarean section was one of the strongest reasons adduced by Porro for the introduction of hysterectomy. But his operation has not done away with this danger; in spite of all precautions, peritonitis kills 16 per cent. of all cases operated on by Porro's method. In laparo-elytrotomy peritonitis has only once appeared among the causes of death, and with proper care its occurrence ought to be rare.

Occurrence of future Pregnancies.—Too much has been made of the fact that in Porro's operation the possibility of future pregnancies has been done away with. In the face of other and simpler means, it is a ridiculous overdoing of surgery to amputate the whole uterus and ovaries to prevent the possibility of conception. In Cæsarean section, it is a very simple matter to carry out the suggestion that Blundell made many years ago, to cut out two little pieces of the Fallopian tubes: this would put the Cæsarean section, in that respect, on a level with Porro's operation. In Thomas's operation, the possibility of future pregnancies is in no way interfered with.

The final word has yet to be spoken as to the relative values of these operations. It may here be said that the results of Porro's operation have not been up to expectation; that the improved Cæsarean section has been successful beyond expectation; and that Thomas's operation has made out for itself an extremely good position, warranting further trial. Beyond this, it may be permissible to go in the direction of pointing out special indications and contra-indications for each of the operations.

SPECIAL INDICATIONS AND CONTRA-INDICATIONS.

Laparo-elytrotomy.—Garrigues has mentioned, as contra-indications to this operation—

(1) The impossibility of repeating the operation on the same side.
(2) Impaction of the head in the pelvis.
(3) The presence of a large tumour in the vagina.
(4) An obstruction in the womb itself (as, malignant disease of the cervix).
(5) Atresia or considerable narrowing of the vagina.

Stadfelt of Copenhagen has added another objection to the operation; namely, a tumour arising from the anterior wall of the pelvis, and pushing the vagina backwards.

It would be considered an unfavourable condition if the thighs were bent and anchylosed, or so distorted that they obstruct the site of operation in the groin. Cicatrices in the groin or pelvis, indicating old or deep-seated suppuration, are unfavourable, but not strongly so.

The indications may be considered favourable if, with an absence of the above conditions, there is present a fully dilated or readily dilatable os uteri; if the vagina is capacious and free from heat or congestion, and has not been bruised or injured by previous manipulations; and if the patient is in a fair condition of general health. Profound exhaustion from the labour is against Porro's operation, and, according to most writers, would tell less against laparo-elytrotomy than against the Cæsarean section.

Porro's Operation.—Hysterectomy is indicated in cases of uterine fibroid complicating labour. It is further specially indicated in cases where the Cæsarean cannot be completed: such are, free bleeding from the uterine wound; inertia of the uterus, with bleeding from the site of the placenta; difficulty in detaching the placenta; tendency to inversion of the uterus. In great and incurable atresia vaginæ, Porro's operation is to be advised, because the uterine discharges after Cæsarean section have not free exit. Putridity of the uterine contents is an indication for Porro's operation.

It is contra-indicated in cases of great exhaustion, where the shock of hysterectomy would endanger the patient's life. In cancer of the uterus, Porro's operation ought, if possible, to be converted into complete hysterectomy; otherwise, Cæsarean section is perhaps preferable.

Cæsarean Section.—In all cases of tumour occupying the body of the uterus, Cæsarean section is inadvisable. Otherwise, there is scarcely a condition in which operative delivery may be called for where this operation is not feasible. It has the widest primary applicability of the three. But during the progress of the operation certain conditions—as, uterine inertia, hæmorrhage, abnormal adhesion of the placenta—may be met with which render it advisable to complete the operation by Porro's method. Other conditions discovered during operation —such, for instance, as disease of the uterine appendages— may suggest completion of the proceeding by hysterectomy. A wound in the uterus which does not promise to be easily or satisfactorily sutured is a contra-indication to the simple Cæsarean conclusion.

It is, in fact, one great advantage of operating by median abdominal section, that the surgeon can finish by the improved Cæsarean method or by Porro's, as seems at the time most suitable.

Abdominal Section for Rupture of the Uterus. Puerperal Laparotomy.

ANATOMICAL CONDITIONS.

Rupture of the pregnant uterus may take place at any period of gestation from the third month onwards. It may arise spontaneously, or at least without apparent cause; also after violent strains or falls, or exhausting occupation; but in most cases rupture takes place at full term, and on the advent of labour. Here we need not discuss the somewhat unsettled question as to its exact etiology.

Barnes* gives the following classification of the varieties of rupture.

"1. *Rupture or bursting* occurs when, under strong tension of the uterus upon its unyielding contents, its walls burst more or less suddenly in the body or cervix.

"2. *Lacertion or rent* occurs when a breach begins at the edge of the os uteri, and extends.

"3. *Grinding or crushing* occurs when the uterus is subjected to long compression between the child's head and the pelvic wall.

"4. *Perforation or boring through* occurs when tissues give way from disease or long compression at one point, or from penetration by a spike of bone or by instruments.

"5. *Avulsion.*—The uterus has been torn away by manual force."

In *rupture or bursting* at full term, either during labour or before labour has properly set in, we usually find that the whole ovum, membranes and all, is thrown bodily into the abdominal cavity. The os may be undilated. The rent rarely takes place through the body or fundus, but almost always near the cervix or in the lower segment.

* *Obstet. Med. and Surg.*, vol. ii., p. 312.

Laceration in the great majority of cases is associated with some obstruction to labour. The liquor amnii has usually escaped, and the uterus is closely contracted on the child. The uterine tissue may be torn away from its attachment to the cervix, and the laceration is then transverse. Complete annular divulsion of the cervix may, under these circumstances, be observed. Another mode of laceration is produced when the cervix will not dilate over the descending head, and is torn through longitudinally, the rent extending upwards into the uterine tissue.

Grinding or crushing is found at that part of the uterus which lies in contact with the bony prominences, and is specially prone to occur when these prominences are unduly marked. Openings made in this way have jagged edges, much bruised, and perhaps broken into shreds; their direction is transverse to the uterine axis. *Perforation* or boring through at a point of the uterus weakened by disease, or thinned and bruised by compression, is practically the same as crushing.

Complete detachment of the uterus may take place by annular lacerations through the cervix, or the vagina; and the organ may be bodily torn away from its attachments, after delivery by manual force.

SYMPTOMS AND DIAGNOSIS.

Surgical treatment is rarely called for until there are symptoms that the fœtus has been extruded through the rent into the abdominal cavity. But in many cases it is possible to diagnose the condition with a fair degree of certainty before this catastrophe has taken place, and more particularly when the fœtus has only partially escaped.

The following description of the symptoms of rupture is from Barnes's pen :* "Sudden acute pain, with a sense of rending in the belly, sometimes attended with an audible snap, it is said; quick collapse, marked by pallor, fainting, extinction of pulse; vomiting; some hæmorrhage externally, and the signs of anæmia

* *Op. cit.*, p. 342.

from greater loss internally; cessation of uterine contraction. If the child be thrust wholly or partly out of the womb, the abdomen flattens somewhat; there is retreat of the presenting part of the child from the os uteri; occasionally, prolapse of the intestine in the vagina, or beyond the vulva; great pain, especially on palpation of the abdomen, where irregular hard projections are felt, which may be identified as parts of the fœtus. If the effusion of blood be great, there is increased and distressing tension of the abdominal walls. Cramp-like or spasmodic pains follow. The flushed face becomes suddenly deadly pale; the eyes lose their brilliancy; the whole surface is covered with a clammy sweat; trembling of the limbs or repeated faintings announce a profuse internal hæmorrhage. Presently, when reaction comes, the patient complains of feeling a warm fluid pouring out in the neighbourhood of the groins and loins. She sometimes feels the movements of the child when it has escaped into the abdomen. But usually the child dies quickly.

"It has, however, often been observed that the symptoms are not so strongly marked. Sometimes very little is complained of at the time when it was presumed that the injury took place. The collapse creeps on gradually. The woman may be even capable of walking about for some time. . . .

"But, sooner or later, almost always within two or three hours, collapse becomes pronounced and pain is severe." In such case we may infer that the process of tearing has been gradual.

In many cases the acute symptoms are preceded by signs of obstruction to delivery. Boring through of the uterine tissue may be going on, while the patient's symptoms are simply those of exhaustion or irritation under long-continued labour. The completion of the tearing is shown by the onset of the violent symptoms just described.

When the fœtus has been extruded into the abdominal cavity, the diagnosis is completed by passing the hand into the uterine cavity, and detecting the rent. Intestine may be felt passing into the uterine cavity, or even into the vagina.

OPERATIVE TREATMENT OF RUPTURE OF THE UTERUS.

The treatment recommended for all cases is abdominal section, removal of the fœtus and its membranes, cleansing the cavity, and either suture of the rent or removal of the uterus.

Not in all cases will it be advisable to suture the uterine tear. The wound will be, in all probability, an irregular one with ragged and bruised edges; it will usually lie low down either behind, or in some position not conveniently situated for suturing; and, most important of all, uterine contractions will probably be absent or very feeble. If the rare combination is met with of a moderately clean straight wound, a convenient situation, and a contracting uterus, simple closure of the wound may be had recourse to. But in the absence of this combination, it will be wise to finish by hysterectomy.

The operation is begun exactly as for Cæsarean section. The child and placenta are extracted; blood-clots are removed, and the abdomen is thoroughly cleansed by irrigation and sponging. To discover the rent, it may be necessary to turn the uterus out of the wound. Cases are recorded where recovery has ensued when the rent has been left unclosed. But the chances of success are greatest with a perfectly closed uterine wound. The method of suturing recommended for ordinary Cæsarean section is the best. If the edges of the rent are much bruised or lacerated, then hysterectomy is recommended. Drainage by the vagina, if the opening is on the posterior surface, may be used with advantage.

The per-centage of recoveries after this operation has been variously placed at 68 (Jolly), 86 (Trask), and, in the United States, at 53 (Harris). It is certainly more favourable than might be expected—perhaps, than it ought to be. The worst cases are permitted to die: if more cases were operated on, more lives would be saved, but the statistics would not be so favourable.

Puerperal hysterectomy for rupture of the uterus differs in no

important particulars from the operation as performed for other reasons. The incision is made in the ordinary way. If the ovum is intact, an attempt may be made to remove it bodily; but this cannot often succeed. Much time may be saved by removing as much of the amniotic fluid as possible by tapping before removing the ovum from the cavity. In every case the whole ovum—membranes, fœtus, and placenta—will be removed bodily, and as far as possible intact. No particle of tissue is to be left behind.

If the fœtus alone is extruded, and the placenta and membranes remain inside the uterus, the fœtus is removed, and the cord divided and compressed or tied. Then the collapsed uterus is turned out through the wound, to be clamped and removed. If the fœtus is only partially extruded, it is quickly pulled through the rent; and as soon as it is removed a temporary constrictor or the hand is passed round the uterus, as low down as possible, to prevent hæmorrhage.

The uterus being turned out on the abdomen, and the situation of the rupture having been ascertained, several large sponges are packed into the abdominal cavity. Before putting on the clamp, the finger should be passed to the inside of the uterus, to make sure that the whole of the torn tissue, inside as well as outside, is above the level fixed for applying the wire.

The pedicle is then clamped, fixed in the wound, and treated exactly as in Porro's operation.

Attention is now paid to cleansing of the abdomen, which must be as thorough as possible consistent with rapidity. The large sponges, soaked with blood and amniotic fluid, are removed. The cavity is thoroughly washed out with aseptic fluid, at 99° temperature, by means of an irrigator with a large tube, while the intestines are freely moved about by the fingers inside the cavity. When the fluid returns clear, fresh sponges are placed in the pelvis and in the hollows of the loins, to soak up what remains. Too much time must not be wasted in endeavouring to get the cavity perfectly dry.

Drainage will be called for in a proportion of cases greater than in ordinary Porro's operations, because of the extravasation

before operation. Indeed, the insertion of a drainage tube can scarcely ever, in this operation, be other than good practice.

The further procedures as regards closure of wound, management of pedicle, and treatment of patient, are in no way different from those described under the head of Porro's operation.

Operations for Ectopic Gestation.

Under this head are discussed the operative proceedings which may be employed for extra-uterine pregnancy properly so called, and for those cases of misplaced uterine pregnancy in which spontaneous delivery cannot take place. The latter condition has its type in cases of pregnancy in one horn of a uterus bicornis, and is often, from its most marked clinical feature, spoken of as "missed labour." This name is, however, occasionally applicable to all forms of ectopic gestation.

History.—Heister,* in naming the indications for abdominal section, places first this one—"when the fœtus is contained in the Fallopian tube, the ovary, or the cavity of the abdomen." Simon,† in his elaborate review of the Cæsarean operation, speaks of abdominal gestation as an indication for operation. In reviewing the history of actual operations, it is difficult to decide as to their real nature. The earliest operations were probably performed after a suppurating sac had shown signs of bursting, and were little more than the opening of an abscess. Christopher Bain's case, in 1540, was little more than the opening of an abscess. The well-known cases of Noierus in 1591, and of Cyprian in 1694, were almost certainly of this nature. The first genuine laparotomy for extra-uterine fœtation was probably that of Primerose in 1594, who successfully operated on Noierus's patient when she again became pregnant. Several other successes were about this time reported from the Continent. In 1764 Mr. John Bard, a New York surgeon, first operated in America; he was followed by Baynham, Mc Knight, Wishart, Stevens, and others (nearly all country practitioners), and a considerable number of successes were registered. These operations extend to about 1850, the beginning of the era of ovariotomy. Up to the end of 1875, Dr. Parry, for his classical work on *Extra-uterine Pregnancy*, had collected a list of 62

* *Op. cit.*, vol. ii., p. 28. † *Mem. de l'Acad. de Chirurg., Paris*, vol. ii.

operations for the removal of extra-uterine children, with the encouraging result of 30 successes and 32 failures.

But as anatomical and clinical knowledge extended, so did the sphere of operation. For rupture of the sac in the early stages, little or nothing was done till recent times. In 1849 Dr. Harbert, an American surgeon, first suggested operative treatment for this terrible accident; but little attention was paid to his proposal till 1866 and 1867, when Dr. Stephen Rogers of New York wrote and urged operation.* Moreau,† curiously enough, while strongly urging abdominal section for rupture of the sac during spurious labour, condemns it for rupture in the early stages. The operation made no headway till Tait, in recent years, took it up, and, by a remarkable series of successes, placed it in the front of major life-saving operations. Up to Oct. 26th, 1887,‡ Tait had operated for early ruptured pregnancy 35 times, with 2 deaths.

PATHOLOGICAL ANATOMY.

The actual origin of extra-uterine fœtation ought to include a consideration of its causation. Of this little is known. Suffice it to say that it specially occurs in women who have shown an "inaptitude for conception," who have for abnormally long periods been sterile; and in women who have some malformation of the uterus, congenital or acquired. More definitely, catarrh of the Fallopian tube has been laid down as a cause. When the ciliated epithelium is shed in any part of the tube, the ovum cannot be passed along it; it rests in the denuded space. Here the spermatozoa, endowed with independent powers of motion, reach it and impregnate it; and here it develops. Obstructive catarrh of the Fallopian tube, blocking the canal sufficiently to prevent passage of the large ovum, but not enough to prevent the passage of the small spermatozoa; adhesions on the outside; simple derangement of the physio-

* *New York Med. Rec.*, 1867, vol. ii., p. 22.

† *Traité Pratique des Accouchements*, ii., 367; Paris, 1841.

‡ *Brit. Med. Journ.*, Nov. 12th, 1887.

logical functions of the tube—spasm, or paralysis, or irregular action—have all been assigned as causes.

The elaborate classification of the varieties of misplaced conception, as given by the earlier writers (Dezemeris gives ten varieties), has now been reduced to one or two. Parry limits the species to three—Tubal, Ovarian, and Abdominal; these he subdivides into eight varieties. The simple theory of Tait, held by Gaillard Thomas and other prominent gynæcologists, explains all varieties. He holds that all extra-uterine conceptions are at first tubal, and that all further varieties are produced after rupture of the primary tubal sac and escape of the ovum. Interstitial pregnancy is simply a variety of tubal, where the tube enters the uterus; ovarian pregnancy is tubal among the fimbriæ. If the rupture takes place on the under surface of the tube where it is embraced by the broad ligaments, the ovum may develop in the enclosed cellular tissue, and be extra-peritoneal. If the rupture takes place on the free surface of the tube, the ovum escapes into the abdominal cavity, and may develop there.

The dismissal of ovarian pregnancy cannot, however, be made in a word. It is just conceivable that the ovum may not escape from a ruptured follicle, and that spermatozoa may enter the follicle and fertilise it. Putting aside the older cases, we cannot utterly ignore the accurately recorded cases of Kammerer* and Porter.† Lusk, Spiegelberg, Werth, and other competent modern authorities admit the validity of the evidence in favour of the possibility of this variety. Most cases of so-called ovarian pregnancy are undoubtedly instances where the sac has developed among the fimbriæ of the tube, and become intimately adherent to the ovary; and it is just possible that all are to be so explained.

Interstitial pregnancy is simply development of the ovum in that part of the tube which passes into the uterine cornu; and not in the uterine tissue, as Breschet, Meyer, and others, supposed.

The possibility of primary abdominal pregnancy cannot be

* *New York Med. Journ.*, 1865, p. 141. † *Amer. Journ. of Med. Sc.*, Jan., 1853.

denied, in the face of such evidence as is afforded by cases of impregnation through abnormal orifices in the uterus. Two such are recorded by Lecluyse* and by Kœberlé†—one through an opening unclosed after Cæsarean section, the other through the canal left after hysterectomy for myoma. As a pathological curiosity, we may note the occurrence of pregnancy in tubo-ovarian cysts. Paltauf‡ has minutely described such a case; and refers to two other similar cases, though with some doubt as to their reality.

Practically, we may admit the general, if not the absolute, truth of the following propositions:

(1) Every extra-uterine pregnancy is at first tubal. Occurring where the tube is close to or passing through the uterine tissue, it may be called Interstitial; where it is broken up into fimbriæ at the infundibulum, it has been called Tubo-ovarian; elsewhere in the tube, it is simply named Fallopian.

(2) When rupture of the sac takes place, the ovum may escape into the abdominal cavity or into the cellular tissue between the layers of the broad ligament. The former is known as intra-peritoneal, and is at once the most common and the most dangerous; the latter is less dangerous, naturally, and more easily dealt with practically.

The state of parts varies according to the duration and position and behaviour of the pregnancy.

In the early stages, while the fœtal sac lies unruptured in the tube, few opportunities of examination have been afforded. We may expect to find increased vascularity of the tube and its annexa, general thickening and perhaps tortuosity of the whole duct, with a boggy, cystic, and vascular tumour in one part of it. In the described cases, the mucous membrane has been found enormously thickened; in fact, the normal decidua would seem to have formed in the tube.

After rupture of the sac in the early stages, opportunities of examination are far too frequent. It would seem that rupture

* *Bull. de l'Acad. de Méd. de Belgique*, 1869.

† Related by Keller, *Des Grossesses Extra-uterines*, Paris, 1872.

‡ *Arch. f. Gynäk.*, 1887, xxx., iii.; *Lond. Med. Rec.*, July 15th, 1887.

takes place, as a rule, through the seat of the placenta, which might be expected to be the weakest part. In such cases death is usually produced by hæmorrhage, which, considering the size of the rent, is often enormous in amount. As much as two gallons of blood have been found in the abdomen after death from rupture, and two or three pints is not an unusual quantity. The amount of blood lost has no relation to the size of the tear in the sac.

The ovum, with its placenta, may escape entire through the rent; or the ovum and its membranes may escape, while the placenta remains attached; or the whole ovum may remain undetached. In the mass of blood-clot, the escaped ovum may easily be missed; in most cases, even if the fœtus cannot be found, the placenta, or the cord, or parts of the membranes, are found in or near the tubal sac.

The structure of the walls of the sac will depend on the position of the ovum. In the middle of the tube, they will consist simply of its mucous, muscular, and serous layers. If the sac lies in the uterine portion of the tube, it will be surrounded by a capsule of proper uterine muscle, varying in thickness and amount according to the depth at which it is placed. At the fimbriated extremity, the sac may be only partially covered by tubal structure, and the chorionic villi may protrude into the abdominal cavity. There is no true decidua into which the villi of the chorion are inserted; but decidual membranes are formed inside the uterus, as if there were a normal pregnancy.

Kussmaul holds that many cases of so-called tubal fœtation are really instances of gestation in the rudimentary horn of a bicorned uterus. He collected thirteen cases of this sort, all of which died of rupture between the fourth and six months. Parry and others consider that Kussmaul overestimates the frequency of cornual gestation; and even if it were more common than is generally supposed, it need not result in rupture. Missed labour is a more frequent result of such pregnancies.

If rupture of the sac do not prove fatal before the fourth month, the pregnancy in most cases goes on to full term. If

the ovum remains in the tube, the tubal walls are greatly thickened, and the muscular layers much hypertrophied. This muscular envelopment is much greater if the ovum lies partly inside the uterus. In some cases a part of the ovum may be within the uterine cavity: thus, the placenta has been found inside the uterus, while the fœtus lay in the tube; or part of the child may be intra-uterine and part intra-tubal; or the placenta may be wholly situated in the tube, while the child is inside the uterus.

Should the placenta, after rupture of the cyst and escape of the fœtus, retain its attachment, we may have the fœtus covered with its envelopes developing in the abdominal cavity, while the placenta in the tube supplies it with nourishment. The envelopes may be wanting, and the fœtus is then surrounded by an adventitious cyst composed of organised inflammatory material. Should the placenta be extruded with the fœtus, it may adhere to any contiguous organ; omentum, stomach, large and small intestine, abdominal wall, and an infinite variety of combinations of these, have been found serving as placental sites. The sigmoid flexure of the colon is, as might be expected, a favourite situation. In a general way we may expect the ovum to fall somewhere into Douglas's pouch, matting together whatever structures may be encountered there. Thus it happens that the posterior surface of the uterus is frequently involved. As the ovum grows, the uterus is usually elevated and pushed forwards; it is always enlarged, generally to a size corresponding to the third or fourth month of gestation, and may or may not contain decidua.

As regards the extra-peritoneal variety, where the fœtus grows between the layers of the broad ligament, a most important study has recently been made by Berry Hart and J. T. Carter of Edinburgh,* from frozen sections of two specimens. One of the specimens was a four and a half months' gestation *in situ* in the bony pelvis; the other an entire cadaver with advanced abdominal gestation. The latter showed a Fallopian pregnancy developing to an extraordinary extent between the

* *Edin. Med. Journ.*, Oct. 1887.

layers of the broad ligament, continuing this mode of growth till it had stripped off the peritoneum from the uterus, bladder, and pelvic floor, until it became in great part surrounded by a peritoneal capsule derived from these organs. The growth was, in fact, entirely extra-peritoneal; the extra-peritoneal tissue, with its blood-vessels, was practically the material part of the placenta. The authors hold that the following varieties of extra-uterine gestation, or rather development, have been demonstrated: Tubal; Tubo-ovarian; Sub-peritoneo-pelvic; Sub-peritoneo-abdominal. The last two varieties may be later developments of the first.

If the mother survives the death of the child at term, certain changes take place in the retained fœtus which vitally influence the progress of the case. In the first place, the child may remain quiescent in its envelope, the liquor amnii being absorbed, and the cyst-wall contracted around it. Certain atrophic or heteromorphic changes may now take place. The whole ovum may become cartilaginous, or it may become infiltrated with calcareous matter (when it is known as a lithopædion); or it may undergo transformation into the peculiar material known as adipocere. In any of these conditions it may remain for long periods, sometimes for many years. This is the most favourable termination.

On the other hand, decomposition may take place, and suppuration is set up in the sac. Here the termination is the ordinary one for all abscesses—rupture. The rupture rarely takes place into the abdominal cavity; but usually, after formation of adhesions, into one or other of the contiguous hollow viscera, bowel or bladder, or through the abdominal wall.

SYMPTOMS AND DIAGNOSIS.

Following Parry, we may best study the symptoms in three stages: the first, up to the period of probable rupture of the sac —that is, to the end of the fourth month; the second, to the period of spurious labour; the third, from the end of the labour and the death of the child onwards.

During the first month or six weeks the symptoms may be those of ordinary pregnancy, but more than usually variable and indefinite. At the end of this time signs, often urgent and unmistakable, appear to warn the patient that all is not right. A sudden attack of violent colicky pain in the hypogastrium, accompanied by profound prostration or even syncope, is usually the first sign of evil import; this may last for a few hours or even days. The pain disappears as suddenly as it came on, and the patient regains her usual health. In a few days or weeks, however, similar symptoms recur, and they continue intermittently till the third or fourth month.

Such attacks usually come on after severe exertion, and are probably due to contractions in the wall of the sac, or to its straining against over-distension. Peritonitis is curiously absent, as proved by the rapidity with which recovery takes place.

During this stage a frequent occurrence is the discharge of dark clotted blood from the uterus. This takes place at irregular intervals, lasts for uncertain periods, and disappears as capriciously as it comes. Sometimes pieces of the decidua are found in the discharge.

A vaginal examination at this period reveals some enlargement of the uterus, with displacement, usually forwards, and great tenderness in the pelvis. The enlargement is not so great as we should expect in a normal gestation of the same standing; but this sign is not trustworthy, because it is so difficult to decide as to the duration of extra-uterine pregnancy. In the region of the greatest tenderness, usually behind the uterus, we may expect to find the tumour. To make a satisfactory examination, an anæsthetic is usually necessary. A rounded, soft, boggy or fluctuating mass, of size corresponding to the period of gestation, is usually all that can be made out. In this stage the sign of ballottement cannot be elicited.

When quickening has taken place, the symptoms undergo a marked change. The attacks of colic diminish or disappear.

Metrorrhagia either disappears or becomes unimportant. Fœtal movements are now detected, often exaggerated and usually on one side. The abdomen perceptibly enlarges, more on one side than the other. The uterine displacement becomes more marked, and is attended with elevation and fixation. Often the fundus uteri can be felt through the abdominal wall, over the pubes and to one side.

Through the vagina the tumour will now readily be felt, rounded, fluctuating, and containing a hard body in the midst of its fluid. Frequently the cyst-wall is so thin that the outlines of the fœtus can be made out with great accuracy. Passing the catheter, by telling the position of the bladder, may be of assistance: the uterine sound is not to be used, except in cases of urgency. Symptoms of irritation of the bladder are frequently present. Irritation of the rectum is more common, because the sac is often adherent to its walls; physical obstruction to the passage of fæces may be caused by the bulk of the tumour.

The end of this period is signalised, at the full term, by a spurious labour. The pains are almost identical with those characteristic of the first stage of normal parturition, and may deceive physician as well as patient. They differ from those of natural labour in that they do not steadily increase in severity, but have irregular aggravations, with remissions and intermissions. Finally they pass off altogether, after continuing over many hours or even days.

Concomitantly with the fruitless labour there goes on a discharge of blood from the vagina. If the decidual membranes have not previously been expelled, they are expelled now. When the sanguineous discharge ceases, another comes on which is analogous to the lochia.

It would seem that the uterus is mainly to be credited with the causation of these pains. Only tubal sacs have muscular fibres; but labour comes on all the same if the gestation is ventral. Mr. Scott,* during laparotomy in a case, found the uterus contracting strongly and regularly, as in normal labour.

* *Lond. Obstet. Soc. Trans.*, 1873, vol. xiv., p. 370.

The false labour also seems to have little influence on the sac; at least, it rarely ruptures or becomes inflamed. A few cases of rupture, with escape of the child into abdomen, rectum, or vagina, are recorded.

A curious sequence to this labour is death of the child. Just before it dies it frequently struggles violently for some time, causing great distress to the mother. When the child dies the abdomen diminishes in size, from absorption of the amniotic fluid. If the child is to remain quiescent, or undergoes atrophic changes, the diminution remains, and becomes more marked; if decomposition takes place, the sac refills, and its distension is accompanied with signs of internal suppuration, often of a very acute nature. Special symptoms may be referred to special organs through which the abscess is preparing to discharge its contents. In the rectum, tenesmus, with a feeling of weight and diarrhœa; in the bladder, irritability, with frequent micturition and signs of catarrh; in the vagina, fulness, pain, heat, and a leucorrhœal discharge, indicate the site of election for bursting. One case, at least, has burst into the stomach. Sometimes the opening is double—as, for instance, through rectum and abdominal wall.

Signs of Rupture of the Cyst.—In about one-half of the cases rupture of the sac takes place before completion of the full term. This is attended with symptoms of a most serious and alarming nature. Premonitory attacks of griping pain in the lower abdomen are followed by a sudden seizure of agonising pain, often with a sense as of something having given way; and this is rapidly followed by prostration and collapse. During this period of "abdominal collapse" one fainting fit follows another; and the patient either dies very soon, or slowly rallies to an attack of peritonitis. Frequently, considerable quantities of blood are effused; in these cases, the peritonitis is late in coming on, and is not very acute.

The special symptoms of pregnancy in a hernial sac, and of twin fœtation—one inside the uterus and one outside, or both outside,—being simply cumulative of individual symptoms, need not be discussed.

INDICATIONS TO OPERATE.

Extra-uterine pregnancy may be regarded as among the most deadly of diseases. Nearly three-fourths of all cases die; and more than one half of these deaths is from rupture of the cyst. Parry writes: "Recovery is so rare after rupture, that the physician has no right to allow the fact that it *may* occur to influence him in deciding upon a plan of treatment."

For such a disease, therefore, no half-hearted or tentative measures are to be tolerated. In some of its aspects it is as dangerous as hæmorrhage from an artery of the second magnitude; in others, it may rank with strangulated hernia; while under its most favourable conditions, it is fraught with an instability which at any moment may develop into acute danger.

Parry's statistics of 500 cases of extra-uterine fœtation give a mortality of 67.2 per cent. In 336 cases the causes of death were mentioned. The most important are:

Rupture of Sac	174
Exhaustion	54
Peritonitis	24
Pregnancy	16
Intestinal Obstruction	8

To these Lusk* has added 103 cases, occurring between 1875 and 1886, excluding cases of rupture in the early stages. Of 29 cases of abdominal pregnancy terminating in fistulous openings, 9 died. These, it must be remembered, are often regarded as examples of spontaneous cure; and if to the actual high mortality is added the probable continued impairment of health or comfort, it will be evident that spontaneous discharge of the fœtus is not a termination to be hopefully anticipated. Eight cases died before fistula had formed, at periods varying from 8 months to 1½ year. Of 52 cases of laparotomy performed at varying periods after death of the fœtus, 37 recovered

* *Brit. Med. Journ.*, Dec. 4th, 1886.

and 15 died. Of the fatal cases, only three—all cases of free hæmorrhage—could be attributed to the operation. In all the others, the cases were almost hopeless at the time of operation; as Lusk remarks, "the resources of surgery are rarely successful when practiced on the dying."

Harris of Philadelphia has investigated the mortality of primary laparotomy in cases of extra-uterine pregnancy. Primary operations he reckons as those performed, not only while the fœtus is living, but after it has reached a viable period of gestation—thus adopting the ordinarily accepted meaning of the term "primary." Of 25 cases collected, 23 mothers died and 18 children: 12 mothers died of hæmorrhage; and this hæmorrhage may occur during the separation of the placenta, as late as a fortnight after, as in Joseph Price's case. It is clear that if this class of operation is to be performed, some extra-ordinary means of controlling hæmorrhage must be adopted. Harris* recommends ligature of the vessels supplying the placenta, and its removal with the cyst if possible: if this is impossible, he recommends careful antiseptic treatment of the placenta, to prevent its decomposition.

Before setting down the indications for the major operation, it will be necessary shortly to estimate the value of certain minor proceedings.

Evacuation of the Liquor Amnii.—Sir James Simpson,† in 1864, treated a case by puncturing the cyst through the vagina. The child was not killed, and the mother died in three days. Braxton Hicks,‡ in 1865, by a similar method succeeded in killing the child, but the mother died of hæmorrhage. Two years later, and quite independently, Greenhalgh§ was able to record a success. Dr. James of Philadelphia in 1867 had a success, which was near being a failure. A few successes and more failures have since then been recorded, and the plan has now been practically abandoned.

* *Annals of Surgery*, July, 1887. † *Ed. Med. Journ.*, March, 1864, p. 865.
‡ *Lond. Obstet. Soc. Trans.*, 1866, vol. vii., p. 95.
§ *Lancet*, March 23rd, 1867.

Injection of Lethal Substances into the Fœtus and surrounding Fluids.—Joulin, in 1863, is credited with the invention of this plan; but Friedrich, in 1864, was the first to put it into practice. Morphia was used, and the case was successful; but it is doubtful if it was one of ectopic gestation at all. Koeberlé followed with a success, and others are recorded. Matthews Duncan has combined the plan with electricity; but, in spite of most persevering, skilful, and painstaking efforts, without success. At best this plan is uncertain, and it is dangerous.

Elytrotomy.—A good many cases have been recorded of operation by the vagina. Parry records 15 such operations, with six recoveries. King of Georgia, in 1817, was probably the first to remove an extra-uterine fœtus by vaginal incision. Bandl, in 1874, operated in the same way, but without success. Gaillard Thomas used the galvano-cautery for division of the tissues, and the patient narrowly escaped with her life. Herman* collected 33 cases of operation by vagina, and from his consideration of these drew certain conclusions which are worthy of being quoted: 1. The operation of opening an extra-uterine gestation sac by the vagina early in pregnancy, before rupture has taken place, by the cautery knife or otherwise, is a dangerous and unscientific proceeding. Abdominal section ought always to be preferred to this. 2. Soon after rupture has taken place, when interference is called for to arrest hæmorrhage, abdominal section is more likely to succeed than vaginal. 3. When rupture has taken place, and the effusion of blood is followed by pyrexia, the indications for incision of the vagina are the same as those in hæmatocele from any other cause. 4. At, or soon after full term, before suppuration has taken place, there might be conditions which indicate delivery by the vagina as preferable to abdominal section. These are: (*a*) When the fœtus is presenting with the head, breech, or feet, so that it can be extracted without altering its position; (*b*) when it is quite certain, from the thinness of the structures separating the presenting part from the vaginal canal, that the placenta is not implanted on this part of the sac, and it is not certain that the placenta is not

* *Brit. Med. Journ.*, Dec. 3rd, 1887.

implanted on the anterior abdominal wall. 5. If the child cannot be delivered by the vagina without being turned, abdominal section should be performed. 6. No attempt should be made to remove the placenta; the sac should frequently be washed out.

Broadly speaking, vaginal section may properly be performed under the above conditions when the state of parts—a thin sac and a presenting fœtus—invites the proceeding; or when nature is showing a disposition to make an opening through the vagina.

Robertson* of Oldham has successfully operated by dividing the perineum, and separating the walls of the vagina and rectum.

The Application of the Electric Current.—Voillemier is said to have first suggested electricity; Cazeaux, after him, certainly did so. Bachetti of Pisa, in 1853, was the first actually to use electricity to kill the fœtus, and he was successful. Braxton Hicks in 1866,† Allen of Philadelphia,‡ and others, by various methods of discharge, sought the same end. Gaillard Thomas, in particular, has paid much attention to this plan of killing the ovum, and has done much to improve and to simplify its application. He records several striking cases of success. Dr. Blackwood of Philadelphia,§ who has paid a good deal of attention to this subject, strongly recommends Faradism, because it is controllable and acts with greater energy on the embryo. Believing that it acts by "tetanization" of the whole mass of the embryo, he would give the maximum dose at one sitting, prolonged for an hour or more. Galvano-puncture he considers waste of time. As now employed, electricity is usually applied by means of an induction apparatus; one electrode being placed on the most prominent part of the swelling in the vagina, and the other on the opposite side of the tumour over the parietes. Several applications are usually necessary.

* *Brit. Med. Journ.*, Feb. 13th, 1886.

† *Lond. Obstet. Soc. Trans.*, vol. vii., p. 96. ‡ *Amer. Journ. Obstet.*, May, 1872.

§ *Phila. Med. and Surg. Rep.*, Sept. 3rd, 1887.

The position that electricity at present holds as a plan of treatment in extra-uterine fœtation is, that it is suitable only in the early stages, where it is not dangerous and is followed by an encouraging degree of success. It must be noted, that in these early stages diagnosis is uncertain; that the stimulation of an electric discharge may induce to rupture; and that danger is not over when the fœtus is killed. It may not destroy the vitality of the placenta. Leopold's experiments† with the fœtus in pregnant rabbits would seem to show that the presence of a dead embryo in the abdominal cavity is a condition by no means free from danger; and actual results in the human female show the same thing.

Electricity is the best of all minor plans of operation; but it is not quite free from danger, it is not always successful, and in its limited application it enters into competition with laparotomy in the same field where laparotomy is most successful in primary results, and has also secondary results which are absolutely perfect.

A dispassionate consideration of the natural terminations of the disease, and of the effects of minor modes of treatment, almost drives one to the conclusion that, at all stages and under all circumstances (excluding the exceptional cases wherein elytrotomy is permissible), abdominal section is the best treatment. In the early stages and before rupture, abdominal section ought to be a very simple and successful proceeding. Even during the alarming state produced by rupture, one surgeon (Tait) can show a record of 35 operations with two deaths. Between the fourth and ninth months the dangers to the patient are least; the next period of danger comes on at term. But if the risk to the patient during those five months is stationary, the danger of operation is weekly added to. The size of the fœtus increases the magnitude of the operation: if, as is likely, operation will be called for at the end of nine months, why wait for that time, when the dangers are so much greater? As a result of operation, a living mother and a living child can be credited only to two surgeons—Jessop of Leeds, and A. Martin of Berlin. The

† *Archiv. für Gyn.* and *Med. Times and Gaz.*, 1882, vol. i., p. 41.

wise practice is, that the less important life shall give way to the more important; that where sacrifice is called for, the child must give way to the mother. It happens that the period which is least dangerous to the mother is most dangerous for operation—speaking of the whole period as one. But there is great difference in risk between an operation performed in the fifth month, and one in the ninth. To the latter operation, where the child is living and viable, the name "Primary" has been given; the operation after full term, when the child is dead, has been called "Secondary." This nomenclature is misleading.

A Primary operation is performed at the worst possible period, as regards the safety of the mother. The results, so far, have been 25 operations with 23 deaths. One of the successes was Jessop's famous case, where both mother and child were saved. Martin of Berlin had the other success; the child, however, was deformed and moribund. Indeed, if the child is viable, or even if the case has passed the sixth month, it is very doubtful whether it would not be better practice to wait till the period of false labour has passed by, and operate when the child is dead and the placental circulation has ceased. Of course, the case must be carefully watched, and any indication of change promptly met.

I would summarise the indications for operation by abdominal section, in extra-uterine fœtation, as follows:

I. In all cases before the period of expected tubal rupture ($2\frac{3}{4}$ to $3\frac{3}{4}$ months), in fact, as soon as the condition has been discovered, should electricity fail to kill the ovum.

II. In all cases of tubal rupture, as soon as possible after the condition has been diagnosed.

III. In all cases up to the fourth month in which the fœtus continues to live. Between the fourth month and the period of false labour, operation is not advisable.

IV. In all cases after false labour when the child is dead and the amnion absorbed. If suppuration takes place, operation is imperative; if the fœtus is quiescent, operation, though advisable in the view of preventing further trouble, is not

urgent. Absorption of amnion is waited for, because this indicates cessation of circulation in the placenta.

V. In all cases where the condition endangers the life of the mother.

Speaking broadly, operation ought not to be left as a last resort: it ought to be ranked as a mode of treatment. The natural course of the gestation being intelligently foreseen, the best treatment ought to be available at all times, and not only when a catastrophe has taken place. The following case* points its own moral: "In October, 1875, three prominent Philadelphia obstetricians met daily in consultation for sixteen days over the case of a lady who was suffering the pains of false labour. . . . As they could not promise the husband that an operation would probably save the life of his wife, they waited for the time to come when they could do this; but, while doing so, and when the lady appeared to be getting better, she was suddenly seized with agonising pains, followed at once by a state of collapse, and died in thirty minutes."

THE OPERATION.

Laparotomy for ectopic gestation may be conveniently described as five varieties of procedure:

I. Removal of the sac in the early months.
II. Operation on account of hæmorrhage from tubal rupture.
III. Operation while the child is alive, between the fourth month and the full term.
IV. Operation for rupture of the sac after false labour.
V. Operation with a dead or decomposing fœtus.

Removal of the Sac before the Fourth Month.—This operation—"Laparo-cystectomy," as it has been called—is of the simplest possible nature. It is essentially half the operation of Removal of the Uterine Appendages—or even less than this, for the ovary need not necessarily be removed.

* Harris, *Internat. Cyclop. Surg.*, vol. vi., p. 784.

The abdomen being opened, the situation and connections of the cyst are made out by two fingers passed into the cavity. The tumour is gently, and without unduly compressing it, drawn to the surface. A suitable site for a pedicle is selected, with or without the ovary included, according to the situation of that organ; ligatures are placed around it, and the tumour is cut away. In most cases the Staffordshire knot will be found perfectly efficient. If the pedicle is very broad, two Staffordshire knots, or a chain ligature, may be substituted.

Operation for Hæmorrhage from Rupture of Tubal Gestation.—The primary object of operation here is, to check hæmorrhage: with this we associate removal of extravasated blood from the abdominal cavity, extraction of the ovum, and also removal of the gestation-sac. The operation is performed while the patient is suffering from acute anæmia, possibly from profound collapse.

When the abdomen is opened, there will probably be an escape of blood, and the pelvis will be found more or less completely filled with blood-clot. Through the clot the fingers are pushed to the fundus uteri, and passed along each broad ligament embracing the Fallopian tubes. The site of gestation will be made out as a soft boggy enlargement of varying size and consistency, according as the ovum remains *in situ* or not. This is brought to the surface, and examined for a rent. A pedicle is fixed upon, ligatures are placed and tied in a suitable manner, and the whole sac is cut away. It is a better as well as a speedier plan to cut away the whole sac, than to endeavour tc stem bleeding from the rent. Rarely does the complete ovum remain in the sac. Sometimes the placenta is found, while the fœtus has escaped; and frequently the entire ovum is extruded, and lies amidst the blood-clots.

The extravasated blood is removed, at first, by the fingers or hand; then, by irrigation with a hot aseptic fluid; and finally, by sponging. These manipulations may demand prolongation of the parietal incision. When the cavity is dry, the wound is closed in the ordinary manner.

In many cases the indication to operate is simply an alarm-

ing pelvic hæmorrhage, and the diagnosis is frequently made only after operation. This is of no consequence in respect of treatment. The first indication of extra-uterine pregnancy may be this alarming hæmorrhage, following rupture of the sac: an intra-peritoneal hæmorrhage is most frequently of this nature, and we must promptly act on this presumption. No patient should be permitted to die while we wait for the evolution of diagnostic signs.

Operation between the Fourth Month and the full Term, while the Child is Alive.—Although the operative details are essentially the same between the end of the fourth and the end of the ninth month, the operative results, so far as the mother is concerned, are very different. Apart from the shock of the operation, which is naturally greater after removal of a large fœtus than of a small one, the chief danger—hæmorrhage—is increased with the age, and consequently the size, of the placenta. As already remarked, the primary operation, so called, for delivery of a viable fœtus is not to be recommended, unless urgent symptoms on the mother's part call for it. And, generally speaking, the condition of the mother, before the child is viable, is the call to operate. Diarrhœa, rectal or vesical tenesmus, irritation or inflammation, repeated attacks of pain, increasing weakness and such symptoms, will usually be present in patients submitted to the operation here described.

The leading features of the operation are: incision of the sac (if there is one), removal of the fœtus, cleansing the cavity of the sac, stitching its edges to the abdominal opening, and leaving the placenta to be separated by natural processes. But an endless variety in detail may be expected, demanding the exhibition of skill, dexterity, and tact on the part of the surgeon.

Thus, intestine may be found closely adherent to the sac at the site where it is most desirable to lay it open. Or, the placenta may be placed so that it is impossible to enter the sac from the front without passing through its substance. The surgeon must do his best to aim at a minimum of traumatic

disturbance, with efficient technical completion of the steps of the operation.

Supposing, as in Jessop's case, that there is no sac, the operation is of the simplest nature. The fœtus is removed, the cord is divided and tied, a drainage tube is placed with its extremity near to the attachment of the placenta, and the end of the cord is left hanging out of the wound. The subsequent treatment is most important. The abdomen is kept dry by repeatedly sucking out extravasated fluids through the tube; and, if necessary, abdominal irrigation is employed. The placental *débris* are thus removed: should the placenta, or portions of it, slough, it may be wise to enlarge the abdominal opening, to permit of its removal or facilitate its escape.

Should it seem feasible to remove the placenta without greatly adding to the risk, this may be done. Martin, in his successful case, did so. But in most cases, and particularly if the sac can be shut off from the general cavity, this is not advisable. If there is no sac, to remove the placenta will rarely be possible, and still more rarely proper.

Intestine adherent to the sac at the point elected for opening must be separated with great care and delicacy. This is best done by peeling it off with sponges; if a cutting instrument must be used, and it is difficult to follow the line of attachment, it is wiser to borrow extra tissue from the sac than from the bowel. Indeed, it may be a good plan to cut out the adherent portion of sac and leave it attached to the bowel, using the opening so made for delivery of the fœtus.

"The golden rule for the operation is," says Tait, "to avoid touching the placenta." The site of placental attachment is not usually obscure in these cases. Dark coloration of the sac-wall, with the ordinary signs of abundant vascularisation, and, not infrequently, intimate adhesions to contiguous structures, mark the placental site. Every legitimate effort must be made to avoid it; but if it cannot be avoided, it must be cut through. As soon as it is cut, its edges must be grasped in large T-shaped compressing forceps; and hæmorrhage may be permanently checked by carrying a shoemaker's or chain suture around the

opening, and including both placenta and sac. When the ends are pulled tight, this form of suture will cause puckering of the gap to any extent desired, when its edges may be conveniently fixed in the wound.

If there is much fluid in the sac, this may be removed, by tapping or aspiration, before the incision is made, so as to save future sponging. The incision in the sac is made preferably in the direction of the abdominal wound. But if avoidance of placenta or adherent intestine is gained by making the incision in another direction, this direction may be followed. When the fœtus is extracted the sac collapses, and there is no difficulty in bringing its cut margins to the surface.

During extraction of the fœtus the edges of the opening in the sac are pulled forwards by forceps, so as to guide the fluids over the parietes. The cavity is cleansed and mopped out, and the cord is left hanging out of the wound. The edges of the opening in the sac are carefully stitched to the skin at the bottom of the wound, leaving an opening large enough to admit the largest size of drainage tube, and along side of it the umbilical cord. It would be good practice to surround the cord with a roll of gutta-percha tissue. The abdominal incision is finally closed down to the attachment of the sac.

Sponging and sponge-packing will have been employed at every step where necessary, to soak up fluid or protect abdominal organs.

Supposing the sac is covered by peritoneum—that is, supposing the ovum has developed between the layers of the broad ligament—we may expect to find the whole pelvic peritoneum elevated, thickened, and vascular. Instead of the thin fibrous tissue, traversed by large vascular trunks, met with in adventitious sacs, we here have to deal with thick, succulent, cellular tissue, abundantly supplied with minute vessels. Hæmorrhage is therefore likely to be troublesome, on making the incision; but it may be controlled in the way recommended. In such cases, delivery by vagina may be substituted with least disadvantage.

Free drainage, combined with irrigation, and, if necessary,

dilatation of the opening, to permit escape of the separated placenta, include the subsequent details of treatment.

Rarely is it advisable to attempt complete removal of the sac. In the early stages of ventral gestation, while the sac is small and its connections neither intimate nor numerous, it may be possible to shell the whole out. In such proceedings, however, bleeding may be difficult to control, either because its source lies deeply in the pelvis, or because it arises from numerous points of adhesion to intestine or other important viscus.

Operation for Rupture during Spurious Labour.—Here the plan of operation is decided for us. The fœtus being removed, and the extravasated blood and other fluids having been mopped up, the rent in the sac is examined for bleeding points. Locking forceps are placed on these, and left attached. A deliberate examination of the state of parts is now instituted. If the rent is in front, the operation is concluded as if it had been intentionally made there, by suturing its edge to the parietal wound. If it is behind, or so situated that its lips cannot be brought to the surface, a variety of methods are possible. It is inadvisable to permit the discharges from the sac to escape into the abdominal cavity; therefore, the rent should, if possible, be closed, and an opening made in front, below the parietal wound. This opening need not be so large as if the fœtus had to be delivered through it; sufficient space to admit the drainage tube and the umbilical cord is all that is wanted. Through this opening measures may be adopted to close the rent, either temporarily by T-shaped pressure forceps, or permanently by a continuous suture through the infolded edges. The sac is then treated as if it had not been ruptured. It will always be advisable to place a drainage tube in the abdominal cavity, and retain it there for a day or two, until there is evidence that there is no leakage from the rent.

Operation with a Dead or Decomposing Fœtus.—This proceeding is usually called for after the period of false labour, when symptoms arise which indicate danger to the mother. The conditions

which give rise to these symptoms are very varied, and the details of the operation will be similarly varied. In fact, to describe the average course of one operation, in the midst of the endless varieties met with, would be impossible. From removal of a gangrenous sac containing a putrid ovum, with perhaps resection of bowel, down to simple opening and drainage of an abscess, we must be prepared for almost any contingency.

Thornton* succeeded, after much difficulty, in removing the whole gestation-sac as well as fœtus. The cyst-wall was rotten, and, during the manipulation necessary for separating the abundant intestinal adhesions, rupture took place, and clotted blood, followed by a withered fœtus, escaped.

Notta† records a case on which M. Boilly operated, and in which intestinal obstruction was present. The fœtus had been carried for eight years, and the cyst was very intimately adherent. A loop of intestine was found strangulated, and the constriction was divided. The patient died; and after death a second strangulation was found. A preparation in the Bristol Infirmary museum shows strangulation of a double loop of bowel by adhesions around a gestation-sac.

In Galabin's‡ case of extra-uterine and intra-uterine gestation combined, the sac was so friable that it could not be stitched to the abdominal wall; and death was probably caused by the uterus, in the premature expulsion of its own fœtus, contracting away from the extra-uterine placenta which was attached to its surface, and so causing hæmorrhage.

Breudel§ operated successfully on a case where there was absolute constipation for four weeks. In this case the fœtus was not decomposed, the placenta was almost separated, and the operation presented no serious difficulties.

Spanton‖ operated successfully on a case in which symptoms of peritonitis had existed for two months. A macerated fœtus and putrid purulent fluid were found in the sac, and very exten-

* *Obstet. Trans.*, vol. xxiv., 1882, p. 81.

† *Prog. Méd.*, 1884, xii., p. 196. ‡ *Obstet. Trans.*, 1882, vol. xxiv., p. 81.

§ *Centralbl. f. Gyn.* Oct. 13th, 1883, p. 649.

‖ *Brit. Med. Journ.*, Jan. 12th, 1884.

sive intestinal adhesions were present. Drainage of the abdomen as well as of the sac, and daily irrigation, were employed.

One of the most remarkable of these cases was operated upon with success by the late Dr. Angus Macdonald.* The woman at the end of the sixth month was seized with dysuria and pain in the lower abdomen; three weeks later a sanious vaginal discharge appeared, with œdema of the left leg. Hectic supervened, and the patient was brought to a very low ebb. At the operation it was found that the cyst had opened into the intestine; and the fœtus lay, surrounded with fæculent fluids, in a sac, part of whose wall was formed by intestine. Resection of the semi-gangrenous gut was at once carried out, and the abdomen closed after being thoroughly cleansed. The patient made an excellent recovery.

While these sheets were passing through the press, I had to operate on a patient in the Bristol Infirmary, with an extra-uterine fœtation, about five months after the period of spurious labour. The fœtus lay in its membranes quite free in the abdominal cavity; but adherent to bowel, intestines, and parietes. The adhesions were broken down with great ease, not a vessel had to be tied, and the operation was concluded without any difficulty whatever. The membranes were quite intact, lying closely over the limbs and trunk of the child. The head was putrefying. The placenta was firmly attached over the fundus of the bladder and was not disturbed. There was not a trace of fœtal sac. The fœtus appeared to be one of about the seventh month.

No two cases are alike, and no general rules can be laid down for their treatment. Litzmann has collected 33 cases, 24 occurring between 1870 and 1880; there were 19 recoveries.

Before laying open a sac which may contain very putrid material, the aspirating needle should be used, to draw off sufficient fluid to cause relaxation of the sac-walls, and to permit of the site elected for opening being drawn to the surface by forceps. Sponge-packing around the sac should always be employed; and thorough cleansing of the abdominal cavity

* *Ed. Med. Journ.*, Feb., 1884, p. 697.

ought to be carried out. When the sac is empty, the fingers should be carried around it everywhere, to make certain that there is no strangulation of intestine. The placenta, unless it is loose or partially detached, ought not to be disturbed.

If there is a suspicion of general peritonitis, or if any of the fluids have escaped from the sac, abdominal drainage ought to be used, as well as drainage of the sac. Irrigation of the sac with antiseptic fluids is useful, both as helping to remove placental *débris*, and as protecting from septic absorption.

It is a great advantage in these cases to find that the placental circulation has ceased, because then that body can be removed without risk of causing hæmorrhage or laying open the maternal sinuses to the danger of septic infection. Unfortunately there are no means of ascertaining beforehand when the placental circulation has ceased. Experience is no guide; for, while Schroeder in one case found obliteration of the vessels three weeks after the death of the fœtus, Depaul, in another case in which fœtal death had occurred four months previously, found the placental circulation still going on, and lost his patient from hæmorrhage. After the child is dead, if there is no urgency we may wait; every week that passes adds to the probability that obliteration of the placental vessels has taken place. On the earliest appearance of troublesome symptoms, operation should be performed.

These operations, properly conducted, are not so fatal as might be expected. Thus, Gaillard Thomas saved four cases on which he operated; Tait has lost only one out of seven; and individual examples of most difficult and unpromising operations conducted to success are daily becoming more numerous.

OPERATION FOR "MISSED LABOUR." PREGNANCY IN ONE HORN OF A BICORNED UTERUS.

Only a very few examples of this condition have been recorded, and still fewer operations. Some of the cases might be read as so-called interstitial pregnancies; that is to say, as pregnancies in that part of the tube which passes through the

uterus. Others might have been true extra-uterine pregnancies, which had forced their way by ulceration into some part of the genital tract. But a sufficient number of cases have been recorded by competent observers to prove beyond a doubt that pregnancy may proceed to full term in one horn of a bicorned uterus, and that when labour comes on at term it may not result in discharge of the fœtus. Angus Macdonald held that all examples of "missed labour" are probably cases of uni-cornual pregnancy. Whether this be so or not, it is certain that the anatomical and physiological peculiarities of pregnancy in one horn of a bicorned uterus will explain most cases of missed labour. If this is not a proved fact, it is certainly a good working hypothesis.

Anatomical Conditions.—In the cases of uni-cornual pregnancy which have resulted in missed labour, there has always been found either complete absence of communication with the general cavity, or only a small opening incapable of being dilated. The pregnancy takes place in an offshoot or diverticulum of the uterine cavity, so to speak; the ovum is completely surrounded by uterine muscular fibre; at no part is there tissue like the cervix, which will soften and dilate, and uterine contractions simply result in compression of the ovum. The fibres around the opening contract as much as the fibres at the fundus; and their contractions effectually bar the way against delivery. In fact, the balance of muscular force is away from the genital canal; for the sac is usually thickest below, the reverse of what exists in normal gestation. In two of the published cases no communication was discovered with the general cavity.

The shape, attachment, and relations of the tumour are easily understood. It is not completely globular, but bluntly conical. Somewhere on the side opposite its uterine attachment, and elevated as in normal pregnancy, are the uterine appendages, ovary, and Fallopian tube; and the round ligament may also be observed, elevated and thickened. The uterine appendages of the opposite side are found low down, attached to the unaffected cornu. The tumour does not lie symmetrically, but towards the side from which it originates.

The contents of the sac are—the dead, and perhaps macerated, fœtus; and fluids of varying character, according as to whether decomposition has advanced.

Diagnosis.—The history of a pregnancy advancing to full term; a fruitless labour, followed by symptoms of death of the child; an obliquely-placed abdominal tumour, rounded, smooth, and movable, with a uterine cavity little or not all increased in depth, ought to suggest uni-cornual pregnancy, with missed labour. Occasionally there is a discharge of decidua from the unimpregnated horn at term, and menstruation may occur regularly from the time of labour.

A physical examination reveals a normal cervix; a uterus of normal depth, closely attached to the tumour, and pushed to the opposite side; and a tumour with the characters just described. The presence of a fœtus is to be looked for by the ordinary means. In Litzmann's case, the fœtal head was found resting on the pelvic brim. Finally, the uterus may be dilated, and an opening looked for in its interior. In Litzmann's case, putrid fluid flowed continuously from a very small opening.

Operative Treatment.—In all cases the only treatment is by operation; and the best operation is laparotomy, with complete removal of the sac and its contents. I know of only five cases of operation, the operators being Salin of Stockholm, Litzmann, Sänger, Wiener, and Macdonald. The last operator has given a particularly clear and full account of his case;* and has, at the same time, summarised and reviewed other cases. The operation was practically identical in each case, and four of the five cases recovered. Wiener's case† occurred in the end of 1884, and was not known to Macdonald. He treated the stump by the intra-peritoneal method, and got a favourable result. Prof. Schultze of Jena‡ has amputated one half of a bicorned uterus in which the placenta was retained. The child was born at the seventh month. The midwife had torn away the cord in her efforts to remove the adherent placenta. The patient recovered.

The operation is of the simplest possible nature. The tumour

* *Ed. Med. Journ.*, April, 1885. † *Archiv. f. Gynäk.*, bd. xxxvi., heft. 2.
‡ *Deutsche med. Woch.*, Nov. 4th, 1886.

is delivered through the incision, clamped by a wire serre-nœud at its neck, and cut away. The pedicle is trimmed and dressed exactly as in Porro's operation.

As the fluids in the cyst may be putrid, the tumour should, if possible, be delivered without being tapped. But if the cyst is very large, there is no objection to the removal of fluid by tapping, provided the site of puncture is carefully guarded. In every case, to prevent the sudden emptying of the sac over the abdomen as it is cut off above the clamp, a second clamp should be placed above the first, and the pedicle divided between them.

SECTION VI.

OPERATIONS ON THE STOMACH.

A CONSIDERABLE number of operations are now performed on the digestive organs. Most of these are undertaken on account of some obstruction to the passage of aliment or excrement; and are chiefly of the nature of resections of new growths, removal of various causes of obstruction or strangulation, and the establishment of fistulæ below constrictions which prevent the ingestion of food, or above constrictions which prevent the discharge of excrement.

For the performance of these operations, the surgeon must be familiar with a number of special technical manipulations, some of them of great delicacy. It is essential also that he should have an acquaintance with the topography of the viscera, not only anatomical, such as may be acquired in dissecting rooms, but also practical, such as may be picked up in the deadhouse. The fingers, inserted through openings made in the

parietes, are made to explore the cavity in all directions, giving a practical and tactile acquaintance with the position of the viscera, as well as with their consistency, shape, distance from the surface, and many other peculiarities. I would strongly urge the importance of this post-mortem study of the abdominal viscera by touch. There is no substitute for it but great practice in operating; and the experience so gained is liable to be costly to the patients. Every operation ought first to be performed on the cadaver.

I believe it is not generally appreciated how much of the abdominal cavity may be explored by a single finger inserted through an opening an inch in length. In a subject of average size, through an opening midway between the pubes and the umbilicus we may examine the whole of the true pelvis, and the abdominal cavity as high as the kidneys laterally, and the greater curvature of the stomach in the middle line. With two fingers a greater distance may be reached. The topography of the abdomen, from a surgical point of view, is best learnt in this way. Anatomical knowledge tells us where to make an incision in order to reach a certain organ; but the educated fingers inserted through this incision must recognise the organ, and bring it within reach of the operator. The hollow viscera are not always to be found in their anatomical positions. Indeed, when there is occasion to operate on any part of the intestinal tract, the disease which necessitates operation will usually be found to have been a cause of displacement. This is another reason for the cultivation of diagnosis by touch.

The characters of the tissues themselves are peculiar and unique, from a surgical point of view. To deal with any part of some twenty odd feet of hollow tube containing septic material, and lying in a closed cavity which is perfectly aseptic but peculiarly amenable to septic influences, is a problem in practical surgery which it is not easy to solve. And in dealing with the walls of this tube, the material we have to work upon is not the most satisfactory for surgical manipulations.

In every operation involving a solution of continuity of the digestive apparatus, special precautions have to be taken to

prevent the escape of their contents into the peritoneal cavity. Its blood-supply is conveyed in a delicate meshwork which is easily torn across, and gangrene of portions of the bowel may be induced by injury to mesentery or omentum and, in certain situations, even to parietal peritoneum. Lastly, in the closure of wounds, we have to deal, on the one hand, with the thin serous and muscular coats, which are readily torn through by needles or sutures; and, on the other, with mucous membrane which secretes fluids inimical to the vitality of the uniting media.

Topographical and Surgical Anatomy of the Stomach.—The position of the stomach as ordinarily described in text-books is not consistent with that laid down by the accurate researches of Luschka, Braune, Warner, Lesshaft, and others. Nor are these more recent descriptions perfectly harmonious on all points. The stomach is a movable organ, varying its position within considerable and not very definite limits; and these changes of position are usually most marked under circumstances such as demand operation.

It is only when the stomach is empty that its surfaces are directed forwards and backwards, and its borders upwards and downwards. Leuf describes the stomach, when fully contracted, as being "tubular." Its external measurement is then no larger than a moderately distended jejunum; the mucous membrane is corrugated into deep folds, and the muscular coat greatly thickened. In this empty state of the stomach the pylorus is frequently found open, so that water poured into it may at once run into the duodenum. As it fills, the lower border not only descends in the abdomen, but also rotates forward around the long axis of the viscus, thus bringing the anterior surface superior, and the posterior surface inferior. In some cases this rotation may be so considerable as to bring the lower border fully to the front, while the upper border is behind.

About five-sixths of the stomach lie on the left of the middle line, one-sixth or less being on the right. During distension the cardiac extremity rises upwards under the diaphragm, increasing the size of the pouch, but causing little increase of the projection towards the left. The bulk of the organ lies directly

behind the cartilages of the fifth and sixth ribs; the rest, with the pylorus, is situated in the epigastrium. Most observers place the pylorus exactly in the middle line; sometimes it lies a little to the right.

The anterior surface of the stomach is in relation with the diaphragm, with the under aspect of the left lobe of the liver, with the internal surfaces of the fifth, sixth, seventh, eighth, and ninth left ribs and their cartilages, and with the anterior abdominal wall. It is accessible on the anterior surface, where it is in contact with the parietes. The accessible area is in a triangular space bounded by the ribs, the edge of the liver, and a line, nearly transverse, which moves upwards or downwards according as the stomach is empty or full. When moderately distended, the lower limits of the stomach may be on a level with the tip of the tenth rib-cartilage; when empty, the stomach may disappear from this triangular area, and be completely retracted behind the bony margins of the upper abdomen. Tillaux points out that the tip of the ninth rib-cartilage is prominent and movable, being attached to the eighth cartilage by a short ligament. It is known by its prominence, and by a sense of grating which it gives when it is rubbed on the upper cartilage. He would make the tip of the ninth rib a landmark for making out the lower limit of the stomach, and recommends it as a fixed point to reckon from in gastric surgery.

In many cases of distension of the stomach, the limits of the organ may be accurately mapped out by percussion; and other modes of assisting diagnosis, by artificially distending the cavity with gas or fluid, are employed.

The connections and vascularisation of the stomach are of surgical importance. The gastro-splenic ligament has more bearing on the surgery of the spleen than of the stomach. The lesser omentum, passing between the upper border of the stomach and the under surface of the liver, requires fuller notice. It contains in its folds the gastric artery, which is the chief source of blood-supply to the stomach; and the hepatic artery, coursing along the front border of the foramen of Winslow, which gives off the important pyloric, gastro-duodenal, and right

gastro-epiploic branches. The importance of these, both as supplying blood to the stomach, and as being in the region of certain surgical operations on the pylorus, is self-evident. The portal vein and the common bile duct also lie in the lesser omentum.

The neighbourhood to the pylorus of the vena portæ, the pancreas, the splenic vein, and the neck of the gall-bladder, must be borne in mind during surgical manipulations.

The attachment of the great omentum to the greater curvature of the stomach is also of surgical importance. It requires division in circular resections of parts of the stomach, and in such operations as may be performed on the posterior surface of that organ. The transverse meso-colon itself is not beyond the reach of danger in operations on the pylorus; and as it contains between its layers the vessels which supply the transverse colon, any wound of it is fraught with risk to the vitality of that bowel. This, however, is not likely to take place unless adhesions exist, binding the parts together, and the pylorus is displaced downwards. In no fewer than five cases has gangrene of the colon resulted from injury to the meso-colon.

The vascular anastomosis around the stomach is so free that gangrene of portions of its walls need not be counted among the risks of operation. It may be as well, where a choice is given, to make any incision along the course of the chief branches—that is, transversely to the long axis; but this is not of great importance.

The operations performed on the stomach are the following:—Gastrostomy, or the artificial formation of a fistula for the introduction of food; Gastrotomy, incision of the walls of the stomach for the removal of foreign bodies or tumours; Gastrorraphy, or operative closure of a fistula, or ulcer, or wound; and Pylorectomy, partial gastrectomy, or excision of portions of the stomach for new growth. Besides these, various operations are performed for pyloric obstruction; such as, operative dilation of the pylorus, and the formation of fistulæ between stomach and intestines, and between intestines and the parietes: and these will here be considered.

Gastrostomy.

Gastrostomy (γαστήρ—stomach, and στόμα—mouth) is the establishment, by operation, of a fistula through the abdominal and gastric walls for the purpose of introducing nourishment.

History.—In 1837 Egebert (or Egeberg), a surgeon in the Norwegian military service, read a paper before a medical society in Christiania in which he strongly recommended the practice of this operation for stricture of the œsophagus. He based his recommendation on the frequently successful results of the treatment of wounds in the stomach, and on the proved compatibility of gastric fistula with healthy existence. He described the operation with great minuteness, and with a scientific foreknowledge which leaves little to be added to the modern descriptions of it. He even advised preliminary suturing of the stomach to the abdominal wall (since called Howse's method), so that adhesions might form before the opening was made. This, however, was then a recognised procedure in the opening of cysts of the liver and other organs. Egebert's paper was not published till 1841.*

About this time Blondlot, in his investigations on the process of digestion, had succeeded in forming gastric fistulæ in the lower animals. A little later, Watson, reasoning on the same lines as Egebert, sought to justify gastrostomy in insuperable contractions of the œsophagus. All this was speculation: no one had as yet performed the operation.

To Sédillot, who, in 1846, came forward in strong advocacy of the procedure, is due the merit of having first performed the operation on a human being. He gave it the name "gastrostomy." His writings exhibit the practical knowledge of the trained surgeon and anatomist, and they are brimful of earnest

* *Norsk Magazin for Lægevidenskaben.*

enthusiasm. The indications for operation he considered to be so straightforward and so favourable, that he expressed surprise that no one before him had suggested it. Apparently, therefore, Sédillot was ignorant of Egebert's proposal. In his indications for operation he includes a wide range of diseases. Besides stricture, he includes congenital absence of the œsophagus; tumours in the neighbourhood of the œsophagus and pressing upon it; tumours of its walls; and even wounds, ulcers, and inflammatory softenings, where the result to be attained was merely temporary rest. In one of his papers he records, in support of the operation, successful experiments upon animals. Individual surgeons, and on one occasion the united opinion of a whole society, were, however, against him. In 1839 he had performed his first operation on a man far gone with cancerous stricture, with a fatal result in twenty-five hours. In 1853 he again operated with fatal result after ten days. A third case, also fatal, is recorded in his work on *Operative Surgery*. In spite of these failures and of much opposition, Sédillot maintained the propriety of the operation.

Streubel, while objecting to the operation for cancerous stricture, considered that it might be justifiable in cicatricial contraction; but he did not operate. In 1853 Fenger, quite originally, and after careful preparation, operated with fatal result after fifty-eight hours. Nélaton, in his work on *Surgical Pathology*, speaking of the operation, advises that it should be performed in two stages, and that it should be limited to cases of uncomplicated cicatricial contraction of the œsophagus in young subjects.

The operation continued to languish. In 1858 Cooper Forster of Guy's Hospital operated for the first time in England, but without success. In 1859 he again operated, with like result; and one or two isolated cases occurred in the next few years. Among those who favoured the operation, the opinion was very generally held, that it ought to be restricted to cases of cicatricial contraction. Günther and Gross, in particular, identified themselves with this view. In 1866 Bryant and Curling operated, both without success. Indeed, with the

exception of a partial success by Küster of Berlin, no satisfactory result was achieved till 1874, when Sydney Jones of St. Thomas's Hospital performed his third operation.

From this time the operation rapidly advanced in success and repute. The improved results arose partly, no doubt, from earlier operation; but chiefly from a better understanding of the technics of abdominal surgery. What influence the general modern practice of operating in two stages, as originally suggested by Egebert, advised by Nélaton, and independently re-introduced by Howse, may have had upon the operation, it is difficult to say. Zesas,* whose monograph on Gastrostomy is one of the most important which has yet appeared, is not in favour of the operation in two stages. He considers that it interferes with success, by unnecessarily prolonging the starvation and weakening the patient: the improved results he attributes to antiseptics. However performed, there is no doubt that the operation has now an assured foothold among legitimate measures of surgical relief.

THE AIM OF THE OPERATION.

The immediate purpose of gastrostomy is, to establish a fistula, which traverses the walls of the stomach and the abdomen, between the cavity of the stomach and the outer air. The remote and permanent purpose is, to carry nourishment into the stomach through this fistula. The reason for the operation exists in some insuperable obstruction in the digestive tract above the stomach which prevents the introduction of food, or in some condition of the tract which renders the introduction of food dangerous to life. The whole motive is, therefore, to prevent death by starvation. In some cases the prevention of death may be nothing more than a prolonging of life, as in those cases where life is already doomed on account of malignant disease. In other cases, the operation may have results synonymous with permanent cure.

* "Die Gastrostomie und ihre Resultate." *Archiv. f. Klin. Chir.*, 1885, bd. xxxii.; heft. 1.

Conditions for which the Operation may be Performed.—The actual conditions for which the operation may be performed are the following:

1. Cancerous stricture of the œsophagus.
2. Cicatricial contraction of the œsophagus.
3. Obstruction by the pressure of growths outside the œsophagus.
4. Malignant disease in the pharynx or the mouth.
5. Ulcerative, chemical, or traumatic destruction of the walls of the œsophagus.
6. Congenital closure of the œsophagus.

Cancerous Stricture of the œsophagus is nearly always of the epitheliomatous variety. Of 57 cases collected by Butlin, 53 were epitheliomatous, 2 were scirrhous, 1 was encephaloid, and 1 was colloid. It is most common in males after middle life. It would appear (though this has been disputed) that it is most frequently situated in the lower half of the tube. Out of 20 cases, it was found in the lower and middle portions of the gullet in 14, in the middle in 4, and in the upper third in 2. Professor Harrison Allen,* from an analysis of a considerable number of cases, concludes that the parts most liable to stenosis lie behind the cricoid cartilage and the left bronchus. Morell Mackenzie found, out of 100 cases, that in 44 the disease lay in the upper third.† Butlin‡ says that while the disease is unusual in the middle portion, it occurs with almost equal frequency in the upper and lower halves. Scirrhus may extend into the œsophagus from the stomach.

The narrowing is caused partly by the ingrowth of the epitheliomatous nodules, but it is more of the nature of a want of distensibility than of actual constriction. The new growth infiltrates the tissues as they lie normally undilated, and prevents their becoming dilated by the passing food. Spasmodic contraction, with hypertrophy of the muscular tissue, increases the difficulty. The growth of the tumour is so irregular that the

* Agnew's *Surgery*, vol. ii., p. 1019. † *Dis. of Throat and Nose*, vol. ii., p. 88.
‡ *Operat. Surg. of Malig. Dis.*, p. 207.

open passage is usually very devious. At parts there is ulceration, extending sometimes completely through the tube and causing perforation. Indeed, perforation is one natural termination of the disease; though starvation and hæmorrhage, perhaps, are more frequently the immediate causes of death. Not a few cases have died from perforation produced by the passage of bougies; the aorta, the left bronchus, and the pleura, have in this way been entered.

Fibrous or Organic Stricture, also known as cicatricial contraction, is usually a sequence of ulceration caused by the swallowing of caustic fluids or very hot water. It may follow other forms of ulceration, particularly the syphilitic. Constant traumatic irritation or injury, as in sword-swallowing, may also produce non-malignant stricture.

The stricture following the swallowing of caustic substances usually begins high up in the gullet, and extends a considerable way downwards. It is very rarely annular. The mucous membrane is replaced by a grey or bluish-grey tissue of a peculiarly hard and resisting nature. The muscular layer is rarely involved. Stenosis after syphilitic ulceration is usually high up, and presents characters very similar to those following traumatism.

The passage through the stricture is devious, but not to such an extent as in epithelioma. Before stenosis is extreme, a bougie passes down it with increasing difficulty as more of its length is engaged. Sacculation in this, as in the previous form, is often found in the gullet above the constriction.

Tumours outside the Gullet may press upon it to such an extent as to cause almost insuperable obstruction to deglutition. Such are: growths in the neck or thorax, aneurisms of the aorta or the innominate artery, and some diseases of the larynx. Dislocation backwards of the sternal end of the clavicle is said by Sir Astley Cooper to have been a cause of extreme dysphagia; and I have seen a malignant growth, apparently springing from the sterno-clavicular articulation, produce great difficulty in swallowing. Most of these and similar cases are, however, usually amenable to other forms of treatment than gastrostomy.

Tumours in the walls of the œsophagus, other than cancer, are extremely rare. Fibroma, sarcoma, and lipoma are found both sessile and pedunculated. Polypoid growths are most common. A foreign body, becoming impacted and surrounded by inflammatory adhesions, may cause obstruction, but is best treated by other means.

Malignant Disease in the Pharynx or the Mouth is very rarely an obstruction to swallowing. Mr. Whitehead of Manchester has performed successfully the operation of gastrostomy for cancer recurring in the mouth and pharynx after removal of the tongue; and a few operations have been performed for primary malignant disease in the mouth and pharynx.

Ulceration of the Œsophagus which refuses to heal in spite of prolonged treatment may justify the operation, on the ground of setting the parts at rest. An extensive destruction of the mucous membrane, as a consequence of swallowing corroding fluids, may do away with the power of deglutition, or may render the performance of the act dangerous to life. In such a case, if the patient suffers from inanition in spite of rectal alimentation, operation may be indicated. In syphilitic and other forms of ulceration the operation may, on similar grounds, be called for.

Congenital Absence or Closure of the Œsophagus is sometimes described as an indication to operation. The condition is however so rare, and the chances of its being discovered in time are so remote, that, for this end, the operation is not likely to be frequently performed.

DIAGNOSIS OF ŒSOPHAGEAL OBSTRUCTION.

The subjective signs of stricture of the gullet are chiefly those of difficulty of swallowing. At first, with solid food, there is a sense of some impediment to deglutition, with uneasiness referred to the neck or chest. It is gradually found that comfort is attained only by swallowing small morsels. Soon discomfort merges into difficulty, and difficulty advances to impossibility as far as solid foods are concerned. Then

liquid foods only can be swallowed. With these also difficulties arise. They are swallowed only in small amount, and quantities are returned after repeated and prolonged attempts at deglutition. A feeling of nausea, sometimes culminating in vomiting, is often present. At times there is considerable suffering, perhaps amounting to a sort of anguish, with palpitation and a sense of suffocation. All these symptoms go on increasing till absolute inability to swallow food of any sort is produced, and death from inanition stares the patient in the face.

Pain in the part affected, and radiating towards the stomach and the mouth, is frequently complained of. The pain is increased by spasmodic contraction of the parts during the attempts at swallowing. Tenderness on pressure may be present; and this tenderness is usually more marked if there is thickening of the outlying tissues.

In the intervals there is a regurgitation of mucus, mixed in some cases with pus or blood. Such discharges are frequently most offensive: in advanced cases the fœtor is simply horrible. Signs of digestive disturbance, such as flatulence, colic, constipation, or diarrhœa, are always present.

With the progress of the disease, the patient rapidly and surely loses ground. He becomes thin, wan, and anxious; his strength leaves him, so that he cannot make the slightest exertion without feeling exhausted; his limbs swell when he stands, or even when he sits; and he dies of starvation, in a state of physical prostration and mental gloom which is most painful to witness. Nutrient enemas, even when selected and administered with the utmost judgment and care, seem only to prolong the agony.

The objective signs are obtained by the passage of bougies and by auscultation of the œsophagus.

Obstruction to the passage of the bougie is the final confirmation of stricture or narrowing of the gullet. The instrument must be soft and flexible, and it must be passed with great delicacy. Several varieties of suitable instruments are in use; none are superior to the soft French bougie *à boule*.

I believe that passage of the œsophageal bougie, in cases of stricture, is not always regarded with the gravity which it demands. I was present when a patient dropped dead off a chair while a distinguished surgeon was passing the œsophageal bougie: an aneurism of the aorta was found ruptured. I have known of two others where death resulted from perforation of the pleura at the hands of skilled surgeons. The slightest force is therefore to be strongly condemned.

Some idea of the nature of the stricture may be derived from the passage of the instrument. Its position in the gullet may be deduced from the distance which the instrument traverses without being checked, as measured from the teeth. If the stricture is cancerous, blood or pus, or even small shreds of tissue, may be found on the instrument when withdrawn; if it is simply fibrous, the instrument is covered with mucus only. In fibrous constriction, the bougie is grasped with increasing tightness as it is passed along; in malignant disease, the obstruction is suddenly met, and, once passed, does not produce increasing difficulty.

Further assistance in diagnosing the nature of the obstruction is derived from the history. In all cases this must be carefully gone into. The interpretations are obvious, and need not be particularised. Spasmodic contraction of the gullet as found in young hysterical females need only be mentioned as a possible, but improbable, source of error.

As a supplementary aid to passage of the bougie, we may employ the method of auscultation of the œsophagus as introduced by Hamburger in 1867.* Morell Mackenzie,† Clifford Allbutt,‡ Zenker,§ and others, have employed and favourably commented upon this method. Though its inventor claimed too much for it, there need be no dispute that by auscultation over the spine we can detect the existence of an obstruction to deglutition, and, within somewhat uncertain limits, fix upon its site. Familiarity with the normal sounds of deglutition must

* *Klinik der Œsophagus-Krankheiten*, 1871.

† *Lancet*, May 30th, 1874. ‡ *Brit. Med. Journ.*, Oct. 2nd, 1875.

§ Ziemssen's *Cyclopædia*, vol. viii., p. 12.

first be acquired in healthy subjects. The whole length of the gullet, from the fifth cervical to the ninth dorsal vertebra, must be examined with the stethoscope over the spine during successive acts of deglutition of the same substance, liquid or solid. The character of the sound it is impossible to describe: it is said to resemble the word "glou-glou" pronounced in a loud whisper. An obstruction to the descent of the food in the gullet is inferred if there is marked diminution or cessation of the sound at any part; if there are prolonged gurgling or clucking sounds; or if the sound, arrested at a given spot, passes upwards again as the material is regurgitated. After special training, diagnosis by auscultation may be satisfactory and final; with most, it is merely a confirmation of other methods. Probably most clinicians would agree with the opinion recently expressed by Ogston, that the value of auscultation is chiefly in showing delay in the downward passage of the material swallowed.

The œsophagoscope is not of much practical value; its mirrors are obscured by the mucus, which is abundantly secreted when the instrument is passed.

MORTALITY AND APPRECIATION.

Gross* and Zesas† have collected elaborate statistics of the results of gastrostomy. Gross has gathered together 207 operations: Zesas gives the results of 162 cases, and provides at the same time a short description of each case.

Zesas, who lays great stress upon antiseptics, divides the operative period into two eras—the pre-antiseptic and the antiseptic. Of his 162 cases, 31 belonged to the former period; and only one, at the end, was successful. In the antiseptic era there were 131 operations—104 for cancerous stricture, and 27 for cicatricial stricture. Of the first class, 87 died and 17 recovered—a mortality of nearly 84 per cent. Of the second class, 16 died and 11 recovered—a mortality of about 60 per cent. The chief causes of death were: exhaustion in 36, peritonitis in 20, and pneumonia in 10. The periods of dying

* *Trans. Amer. Surg. Association*, vol. ii., p. 363. † *Loc. cit.*

are divided as follows: under 24 hours, 17 cases; under 30 hours, 69; between 1 and 12 months, 19; between 12 and 18 months, 1.

Gross gives for his 207 cases 61 deaths only, or a mortality of 29.47 per cent. At the date of the last reports, he reckons that these operations had prolonged life for an average of 82 days in each case. For cancer, 167 operations were performed, with 49 deaths (29.34 per cent. mortality); for cicatricial stricture, 37 operations, with 11 deaths (29.72 per cent.). Peritonitis, pneumonia, and shock, were the chief causes of death. This shows results apparently much more favourable than Zesas quoted. Gross adds of cancerous stricture: "Of the entire number, 117 died in one month; 4 were living, but how long cannot be determined; and 46 survived longer than one month—the average duration of life, after the stomach was opened, being 33 days." Speaking of cicatricial stricture, he says: "Of the entire number, 20 died within one month, and 17 survived upwards of one month—the average duration of life, after the stomach was opened, having been 295 days."

An examination of these figures, apparently irreconcilable, will show how difficult a thing it is to say what is, and what is not, a death from operation. To fix an arbitrary period up to which the operation is said to cause death, and beyond which the disease is blamed, is simply impossible; and nothing short of this would render statistics trustworthy. We are dealing with imponderable quantities. Death from peritonitis at the end of a week in a moderately well-nourished young patient with cicatricial stricture, is a very different thing from death in the same way in an old patient in the last stage of exhaustion with cancerous stricture. They cannot be classed together for comparison.

Statistics seem to prove little in the way of results, beyond the fact that the operation is systematically delayed too long. It would probably be no exaggeration to affirm that, at the present day, a skilled surgeon could operate on suitable cases with a mortality under 10 per cent. Looked at practically, the question is something like this: What is best for the patient—

early operation, a ten per cent. risk, a certain avoidance of death from starvation, and a probably considerable prolongation of life; late operation, and a risk rising up to or even beyond fifty per cent.; or no operation at all, with the certainty of death from starvation if he escape certain accidents?

The answer is widely different, according as the disease is malignant or non-malignant. In the case of simple stricture, successful gastrostomy saves life, and adds indefinitely to the span of healthy existence. In this sense the operation is as justifiable as any which receives the sanction of the profession. When other measures fail, gastrostomy gives the only chance of life: if it saved only ten per cent. of the cases, it would still be justifiable, as much as ligature of the very largest arteries if the patient is bleeding from them. I conceive, therefore, that in every case of cicatricial stricture of the œsophagus, as soon as it becomes evident that minor measures are ceasing to be efficient, we ought to perform gastrostomy. And, further, the operation ought not to be delayed beyond the time when the health begins palpably to suffer. If the necessity for operation becomes apparent, the patient ought not to be deprived of the best chances of success.

In cancerous stricture the case is very different. Here gastrostomy is a procedure of the nature of colotomy for malignant stricture of the rectum, intended merely to prolong life and to render it less uncomfortable. Theoretically, it ought to have a smaller mortality than simple stricture. While gastrostomy for simple stricture would be justifiable with a large death-rate, the same operation for malignant stricture would not be recommended if the mortality were excessive. What, in actual figures, would constitute an excessive mortality it is impossible to say. Indeed, to lay down any hard and fast line up to which the proceeding is justifiable, and beyond which it is not justifiable, would be absurd. It must be left to the judgment of the surgeon. In such a case, I am of opinion that considerable weight ought to be given to the desires of the patient, after an honest and impartial statement of the possible and probable results have been put before him. My experience

is, that he elects not to be operated upon. If he can swallow even a little, he is loth to believe that he will not improve, and he puts off operation from day to day, till it is too late; when the power of swallowing has passed, and he is being fed entirely on enemas, he has already got so near to the inevitable end, that he desires nothing more than that it should not be much longer postponed. In some the love of life is strong, and it may be difficult for the surgeon to withstand entreaties to operate in a case where the prospects are all but hopeless. To dictate advice is impossible; the action of the surgeon will follow the leadings of his conscience.

The question of removal of the cancerous stricture (œsophagectomy) may be introduced as an alternative. Of the five cases of this operation collected by Gross, to which Butlin* has added a sixth, three died of the operation, and the others soon died of recurrence of the disease. Butlin concludes, in my opinion, rightly, that the operation has at present no *locus standi*, and that there is little prospect of our being able to perform it except in very exceptional instances.

It is necessary to state that certain surgeons of repute consider that gastrostomy ought never to be performed for cancer of the œsophagus. Gunther and Gallard consider the existence of cancer as an absolute contra-indication. Lagrange† thinks the operation ought to be limited to certain favourable cases. He argues that, when complete obstruction by cancer has taken place, the neighbouring viscera will have been involved—a statement which is manifestly too sweeping.

The operation has suffered in two ways. It has too often been performed by unskilled operators, and it has been delayed too long in the large majority of instances. A fuller knowledge of the conditions surrounding the operation will no doubt partly remove these objections; more judgment will be exercised in the selection of cases, and more skill will be exhibited in the technics of the operation.

For syphilitic disease the operation has been performed at least twice, in neither case with success; and twice for obstruc-

* *Op. cit.*, p. 210. † *Revue de Chirurgie*, 1885, No. 7

tion produced by enlarged bronchial glands, with one success and one failure.

In cicatricial stricture in children, dilatation is particularly difficult, and operation is called for at an early period. The success too, immediate and remote, is naturally greater.

THE OPERATION.

Any preparatory proceedings will depend on the method selected and on the condition of the patient. It simplifies the operative details to have the stomach distended. In cases where the patient can swallow, some bland, innocent drink may be given before operation. The employment of any of the numerous artificial methods of dilating the stomach, such as may be used in gastrotomy, is not advisable in this operation, except in certain cases of cicatricial stricture. The operation must be done with as little worry and disturbance to the patient as possible, and quickly as well: artificial dilatation, either before or during anæsthesia, is objectionable on both these grounds. Besides, the advantage of it is doubtful. We desire to place the sutures in the stomach where there will be least traction, and this may not be where the dilated stomach presents. If the stomach is full at the operation, it will be empty very soon afterwards. By placing the sutures when the stomach is empty, we see and know the worst that its contraction can do. The increased difficulty in operating refers only to the finding of the stomach; and, if the operator has that amount of tactile skill in the abdominal cavity which he ought to have, this difficulty is very small indeed. I should not, therefore, in the slightest degree add to the patient's discomfort by trying to dilate the stomach.

Before operation it will be wise to administer a specially stimulating enema with an ounce or two of brandy.

The operation is conveniently described under three heads: (1) Making the parietal incision; (2) Suturing the stomach-wall to the opening; and (3) Opening the stomach.

The Parietal Incision.—Many forms of incision have been recommended and adopted. Sédillot used a cross incision below the xiphoid process. Fenger's incision, next introduced, made parallel, and near, to the left costal margins, is the one now most generally used. Sydney Jones made an almost vertical incision in a line drawn from the left nipple to the spine of the pubes. Küster incised the linea alba. Maury used a curved incision, with its convexity towards the middle line. Cooper Forster employed a vertical incision through the top of the linea semilunaris, and many English surgeons have adopted his plan. Howse recommends a vertical incision through the outer edge of the rectus—a method which has the advantage of surrounding the fistula by muscular fibres, which in their contraction tend to close it.

The actual line of incision followed would not seem to be of supreme importance. It must be as short as possible. A long incision unnecessarily weakens the abdominal wall, and has a tendency to permit subsequent protrusion of the stomach. It must not be too close to the ribs, as their movements during respiration disturb the wound and weaken or tear or stretch the peritoneal adhesions. Unless at least an inch of space is left between the edge of the wound and the costal margin, the upper lip of the wound protrudes, and the lower lip is drawn inwards. This last objection does not apply to the vertical incision. Then, again, it must be so placed that the margin of the left lobe of the liver does not press upon the sutures fixing the stomach to the abdominal wall. Now, the position of the margin of the left lobe varies. It may lie as high as the lower edge of the xiphoid process, or it may descend as low as the tip of the cartilage of the ninth rib. We may expect to find it lower than normal, as it falls downward on account of the hollow viscera being empty. In a case on which I operated the left lobe was greatly enlarged and its margin depressed through the presence of a shrivelled hydatid cyst in the right lobe.

The site of election must be as high up as possible, to avoid traction on the stomach; and it must be low enough down to be well clear of the margins of the ribs and the liver. The

situation is better decided by palpation and percussion, than by anatomical landmarks. The retiring angle between the ribs and the edge of the liver is marked out, and a site is fixed upon at least an inch distant from both. At this point the fistula should be established. The incision, therefore, ought to extend equally on both sides of this point—say, three-quarters of an inch on each side of it. (Fig. 47.)

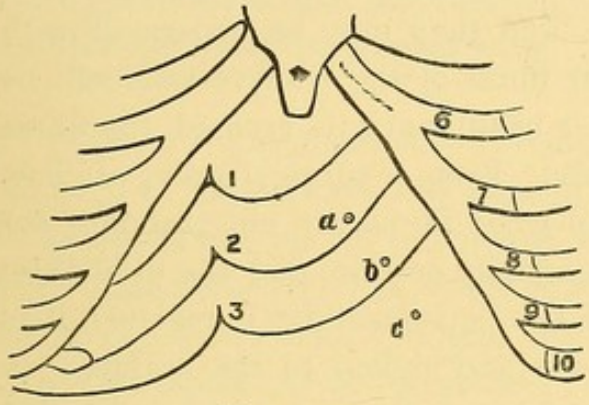

FIG. 47.

Diagram to show Site of Fistula in Gastrostomy.

The opening is made at *a*, *b*, or *c*, according as the liver margin corresponds to the lines 1, 2, or 3.

The vertical incision has many advantages, more especially after the fistula has been established. But the oblique incision is on the whole, perhaps, the better, and more particularly because it gives greater freedom during operation. Tillaux recommends, as an anatomical landmark, the tip of the cartilage of the ninth rib, which is separated a little way from the fixed cartilage above it, and can be diagnosed by the sensation of grating which is felt when it is rubbed on this cartilage. Landmarks taken from the linea semilunaris vary too much to be trustworthy. If the edge of the liver cannot be determined by palpation or percussion—a rare event—then the tip of the ninth rib-cartilage is, perhaps, the best landmark. But its position I have found, from repeated observations, to vary also. Frequently the line of incision will be found to lie equally on both sides of the linea semilunaris; more often, it will be on the outside of it. Occasionally it will be entirely to the inside of this line. The direction of the incision will always be parallel to the edges of the ribs, distant from them three-quarters of an inch, or a little more, if the abdominal walls are thick. It need not be longer than an inch and a half, or at most two inches—this is, sufficient to admit two fingers.

The skin and fascia being divided, the muscles are severed by successive cuts of the knife, pressure-forceps being placed on the bleeding points. The external oblique, thick and fleshy, will be divided almost transversely to the direction of its fibres. The thin fibres of the internal oblique lie nearly parallel with the direction of the wound, and they may be separated with the handle of the knife. The fibres of the transversalis will be cut transversely. If the linea semilunaris is crossed, the fibres of the rectus are cut obliquely. From a surgical point of view, it is a matter of no moment what fibres are cut through, nor how they are cut. Union is equally certain, and the difficulties are insignificant. When the sub-peritoneal fat is reached, it is pinched up with catch-forceps and pulled to the surface. A second pair of forceps is placed below the first, which is handed to an assistant, and the raised fold of peritoneum gently sawed through by the blade of the knife held horizontally.

The peritoneum being divided on the finger to the length of the wound, two retractors draw the edges of the incision apart, so as to permit a view of the presenting organ. If the stomach is distended, it may present at the wound, and this visible portion may at once be selected for the placing of the fixation sutures. Theoretical considerations as to the advisability of having the opening in a certain position of the stomach, preferably near the cardia and the lesser curvature, are of small weight, as compared with the importance of avoiding all traction on the stomach-wall.

In most cases, however, the stomach will be contracted, and situated high up under the diaphragm, while the colon or the omentum presents at the wound. It is quite possible to mistake the colon for the stomach: more than once the colon has been opened. To find the stomach, we may either pull it down by dragging on the omentum and the colon, or we may follow the suggestion of Legond, highly recommended by Faraboeuf, and use the under surface of the liver as a guide. The fingers are carried under the left lobe of the liver till they reach the vertebral column: they are then moved to the left, close to the diaphragm, when the lesser curvature will be felt. The stomach

is always the highest of the hollow viscera. When recognised, a fold of its anterior wall is pinched up between the two fingers and pulled to the surface of the wound. The part which seems best to fulfil the double purpose of avoiding traction and providing a suitable spot for forming a fistula is then fixed upon, and the next step proceeded with.

Fixation of the Stomach.—The mode of fixing the wall of the stomach to the parietes will depend on whether the opening is to be made at once, or postponed for several days until adhesions have formed. The usual practice is now, in all cases, to follow the latter plan. Where the patient can afford to wait, this is no doubt the better method; but it is by no means certain that it is always the better method. A few continental surgeons of the highest repute advocate immediate opening of the stomach. They maintain that, the stomach being in most cases empty, the danger of extravasation is exaggerated; and that, if the sutures are properly placed, the danger of subsequent escape of fluids into the cavity is very small. Zesas and others have pointed out the great danger of withholding food from a half-starved patient upon whom has just been put the additional strain of a severe surgical operation. Exhaustion is the most common cause of death; and exhaustion is best combated by stomach feeding. The low vitality of the patient is against the rapid formation of strong adhesions. Kocher points out the risks of traction on an empty stomach, through interference with its circulation: this risk is obviated by immediate feeding.

I take it that we cannot lay down a rule which will apply to all cases: the mode of opening, and therefore of suturing, must be decided for each case. The advantage of having even a little fresh lymph between the serous surfaces is evident: this can be secured by waiting for a few hours. In the worst cases, we can spare ten or twenty-four hours: this time may nearly always be given to the formation of adhesions. In cases where the power of swallowing exists, or where weakness is not excessive, or where (as sometimes happens) power to swallow returns after

operation, we may wait as long as possible, and open the stomach only when the strength is beginning to fail. We must not let the patient die while we wait for surgical perfection in the wound; nor, on the other hand, need we be in haste to establish the fistula if the patient's strength holds out well.

The proceeding to be adopted, if we intend to postpone the opening of the stomach for a week or so, may be much simpler than if we desire to make immediate opening. Sédillot, in his second case, sought to cause adhesion of the stomach to the parietes, and at the same time to make the opening in the stomach by necrosis, by attaching a forceps to the stomach and leaving it there. This plan he did not like, and he proposed to transfix the stomach-wall by an ivory pin. Following a suggestion of Macnamara, Boyce Barrow and others have adopted this plan, employing harelip pins; and there is probably none better. Other plans of forming adhesions, by caustics, acupuncture and rows of needles, have been recommended and adopted; but none of them seem trustworthy. Howse is said to use clamp forceps padded with India-rubber; and his results are excellent.

In cases, therefore, where the opening of the stomach is to be postponed for some days, sutures need not be inserted. Mere apposition of the surfaces will result in the formation of sufficiently strong adhesions. To secure this end, the use of two thick harelip pins is by far the simplest plan, and perfectly satisfactory. The points of the pins should be rounded and smooth, and not cutting. They are carefully inserted under the serous and muscular coats of the stomach, in lines transversely to the direction of the wound; and they enclose a square area of stomach-wall, whose sides measure about three-quarters of an inch. In the centre of this square the opening is subsequently to be made. The ends of the pins are stuck into pieces of India-rubber, to prevent them from chafing the skin on which they rest. If the abdominal walls are thick, the pins may be bent downwards in the middle; in fact, a little downward curve will always be advantageous. If the pins are not removed, it may be possible to open the stomach after four or five days, so perfect is the apposition which they give. Macnamara has supplemented

this plan by the insertion of a piece of thick silver wire into a fold of the stomach, which was fixed to the skin of the chest.

If it is decided to open the stomach within three or four days, it will be wise to make use of sutures. Chavasse, in a successful case, used only four sutures. Two or three sutures in addition to pins would be as good a plan as any to adopt, if the stomach is to be opened between the third and the fifth day. For late opening the suturing has been overdone. In one case I used a deep continuous silver suture and four superficial silk sutures, with success. In another, four deep and four superficial sutures gave perfect apposition. Many similar plans have been successfully used—most of them, like mine, erring on the side of doing too much.

When the stomach has to be opened at once, or after a few hours, the method of suturing must be more elaborate. It must secure accurate apposition from the beginning all around, without inflicting too much injury on the stomach, and without involving too large an area of its walls. Many plans are in vogue: the following is, perhaps, as good as any. By it, stomach-wall is kept in accurate apposition with parietal peritoneum in a continuous circle, and not at interrupted points. Firstly, following Bryant's excellent suggestion, insert two loops of silver wire near the spot where the opening is to be made. By these the stomach is manipulated during the process of suturing, and they serve to fix it when the opening is made. Then, with a round needle threaded with thick soft silk about a foot long, pass a continuous suture, in a circle of about two inches in diameter, under the peritoneal and muscular coats of the stomach. At every third quarter of an inch in the circle, the needle is taken out and re-inserted; so that six or eight free loops, about an inch and a half in length, are left protruding on the serous surface. (Fig. 48.) Then, at corresponding situations in the abdominal wall, a handled needle with a recurved hook instead of an eye (Fig. 50) is pushed through, and catches up the loops one after the other. As each loop is drawn through, a piece of rubber tubing is slipped under it. The loops are pulled with moderate tightness over the rubber tubing from each end of

the incision. Finally, the ends of the silver sutures are hooked under the tubing, and serve to keep the exposed portion of stomach well up in the gaping wound. (Fig. 49.) A suture at each end of the wound may be necessary.

It will be seen that this mode of fixing the stomach is easily and rapidly carried out; that it provides accurate apposition under elastic pressure; and that it does not draw the stomach too much outwards, and so increase the risk of having a dribbling fistula to deal with.

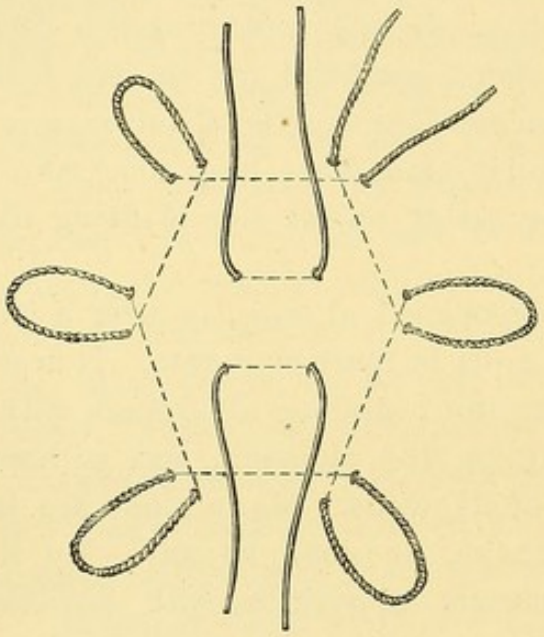

FIG. 48.

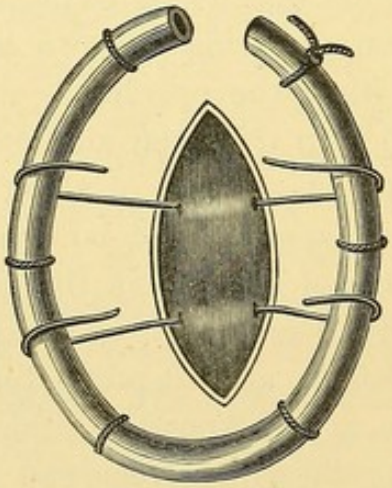

FIG. 49.

Figs. 48 & 49.—*Diagrams to show Fixation of Stomach to Parietes for Immediate Opening in Gastrostomy.*

Opening the Stomach.—This is a very simple proceeding. It is quite painless, and requires no anæsthetic. Consequently, as adhesive material is very rapidly thrown out between serous surfaces,—they may be glued together in four or five hours,—the opening need not be

FIG. 50.

Eyeless Needle for Inserting Sutures as it is withdrawn. One-third size.

made till the patient has fully recovered from the anæsthetic, when also the stomach is more likely to be tolerant of food.

It is important to follow Bryant's wise advice, and make the opening as small as possible, to prevent dribbling of the gastric contents. The opening may be made by gently inserting the fine point of a curved bistoury under the muscular and serous coats, and cutting outwards. Through this minute opening, a Lister's sinus forceps is insinuated through the mucosa, its blades are separated, and a small French gum-elastic catheter is passed into the stomach between them. The divergent blades of the sinus forceps pull the stomach outwards while the catheter is being passed inwards, and the whole operation is easily concluded without any disturbance of parts.

Fluid food in small quantity—about six ounces of warm peptonised milk is perhaps the best—is slowly passed into the stomach through the catheter. After feeding, the catheter may either be removed or left in place, as seems most desirable. Both plans have their advantages and disadvantages. If it is removed, the small opening is completely closed by the mucous membrane acting as a plug; but a little difficulty may be experienced in re-introducing it: if it is left, this difficulty is obviated; but fluid is liable to find its way along the side of the catheter. Such fluid, acid gastric juice, has an irritating effect on the wound, seeming to dissolve up the recent and delicate adhesions. To collect any juice that may escape, the wound should be kept covered by some highly absorbent unirritating material, which is to be frequently changed.

When the opening is made a few days after operation, the procedure is complicated by the presence of a layer of lymph filling up the cavity between the lips of the wound. This may bleed if it is removed by forceps. In this case, it is not so easy to judge of the depth of the puncture to be made by the knife, and more disturbance of the parts may be caused than in immediate opening. But this matters little, for adhesions are likely to be firm. And if the plan of fixation by pins be adopted, the opening is a very simple affair. The insertion of a catheter is conducted as above recommended; and it may be left in, with a

plug to close it. It is fixed by a thread to pieces of strapping on the skin of the abdomen.

When the opening of the stomach is delayed, and the patient cannot swallow, feeding by the rectum must be instituted. This is a proceeding of great importance, requiring care both in the preparing and in the administering of the enema. Rectal feeding has received much attention of recent years, and many valuable preparations may be had. I believe that we do not always remember, in rectal feeding, that a certain quantity of fluid is an essential ingredient of all foods. The concentrated meat capsules and suppositories now frequently used should be supplemented by an injection once or twice daily of a pint of tepid water. A good enema for such cases I have found to be the following: an egg beaten up in ten ounces of milk, with two or three teaspoonfuls of meat jelly, peptonised in the ordinary way, and administered warm, with or without the addition of brandy, every five or six hours. If the enema is passed in very slowly, it will usually be retained without difficulty. A large enema of tepid water to cleanse the rectum is necessary every day, or every other day. If some of it is absorbed, it will do good: starvation is robbed of half its terrors if plenty of fluid is given. Zesas and others who have spoken of nourishing enemas in such cases are inclined to put very little value upon them. Under the best form of rectal alimentation yet devised, the patient steadily and surely loses ground. But the opinion that they help, if they are not all-sufficient, is too general to be delusive. In every case, rectal feeding must be used where feeding by the mouth is impossible; only we must remember that it is at best an inefficient substitute for feeding by the stomach, and that opening must not be unduly delayed.

The mode of feeding by the fistula is of some importance. The food must at first be small in quantity, and of a nature to be readily absorbed, so as to cause the least possible physical and physiological disturbance. Peptonised milk, or beef tea, or beef peptonoids, are readily absorbed and nourishing. Starchy and fatty foods, which undergo digestion chiefly in the intestine, may be administered alternately with the more stimulating

fleshy materials. "Often and little" has been the adice given; but, as previously remarked, not too often nor too little. Too frequent feeding may irritate the stomach as well as the fistula, and too little will fail to support the patient's strength. Half a pint, slowly administered every four hours, would be an average quantity and frequency.

All foods introduced into the stomach should be of the temperature of the body. When the patient has got over the dangers of the operation, the food may be administered only at the ordinary meal times. It has been recommended that solid food should be masticated before being passed into the funnel which leads to the stomach. If there is a sympathy between the mouth and the stomach, causing the stomach to undergo certain physiological changes preparatory to the reception of food, this recommendation has a meaning beyond the gustatory. Cases are recorded where, by the help of ingenious contrivances, the patient has sat at table, masticated food, and passed it into the stomach-tube without shocking the susceptibilities of his companions. The patient will soon learn what apparatus is best for feeding; and how, in the intervals, the fistula may be most perfectly kept closed and protected. Feeding by gravitation is usually the mode selected, and a pad of clean linen will, in most cases, efficiently guard the wound.

Gastrotomy.

Gastrotomy (γαστήρ—stomach, and τομή—incision) is here used in the limited sense of meaning the operation of making an incision into the stomach, and more particularly with the view of removing foreign bodies lodged in that viscus. Gastrotomy may have to be performed for other purposes, as for dilatation of the pylorus or the œsophagus, or for the removal of foreign bodies in the gullet; but in these cases the operation is subsidiary. As a synonym for abdominal section, the word Gastrotomy is in frequent use at the present time; in this sense its employment is confusing.

GASTROTOMY FOR THE REMOVAL OF FOREIGN BODIES IN THE STOMACH.

This is a very old operation. One Crolius is said to have removed a knife from the stomach in 1602, and Guenther is credited with a similar operation in 1613. In 1635 Shoval* successfully removed a knife six inches long, and in the same year Schwaben had a like success.† Considering the early and striking success of gastrotomy, and the undoubted frequency of the necessity for it, it is remarkable that the operation was performed so few times in the following century. Successful cases are reported by Hubner in 1720, by Cayroches in 1819, by Bell in 1860, by Labbe in 1874, and by others.‡ It is perhaps even more remarkable that in the modern era of abdominal surgery the operation should have been so rarely performed. Gross§ quotes only twenty cases, three of which were fatal. The more accurate tables of Credé|| and Richardson¶ and

* Cheelius's *Surgery*, vol. ii., p. 391. † Hévin, *Mem. de l'Acad. de Chir. de Par.*

‡ See Poulet, *Foreign Bodies in Surgical Practice*, vol. i., p. 162.

§ *Trans. Amer. Surg. Assoc.*, vol. ii. || *Arch. f. klin. Chir.*, XXXIII., iii.

¶ *Boston Med. and Surg. Journ.*, Dec. 16th, 1886.

Bernays,* which exclude all doubtful or ill-authenticated cases, reduce the number to 13 or possibly 14. All recovered save two, and in these were specially troublesome complications. There can be no doubt, therefore, that gastrotomy is not a dangerous operation: under modern rules, it ought not to have a death-rate of more than eight or ten per cent.

Indications for Operation.—The conditions pointing to operation are twofold: (1) the presence of a foreign body in the stomach, of such a nature that we know it cannot be passed through the intestines, or can be passed only at great risk; and (2) the existence of serious and urgent symptoms in the patient.

The great majority of foreign bodies swallowed pass through the pylorus, and are voided in the stools. It is a common statement that anything which passes the cardiac opening will pass the pyloric. And so it will, as far as the smallest diameter of the body is concerned; but where long bodies are swallowed, such as knives, spoons, forks, pencils, bars of lead, or, as in Fournier's case, the hoop of a barrel fifteen inches long, we can scarcely expect that they will be passed through the pylorus and along the duodenum and the numerous coils of small intestine. As a matter of fact, long bodies rarely escape from the stomach at all.

Aggregations of small foreign bodies require removal, as much as long or large single bodies. They may become glued together by mucus, and form a mass whose diameter is considerably greater than that of the pyloric orifice. Thornton† and Schönborn‡ have successfully removed large masses of hair swallowed by their patients.

Apart from the remote risks attending the prolonged presence of a foreign body in the stomach, the subjective condition of the patient may be such as to demand operation. The patient is constantly nauseated; he has an indefinable sensation of distress and anxiety referred to the pit of the stomach; he complains of severe shifting pains in various situations, which

* *Phila. Med. News*, Jan. 1st, 1887. † *Lancet*, Jan. 9th, 1886.
‡ Langenbeck's *Archiv.*, 1883, vol. xxix., p. 609.

are sometimes distracting (in at least one case they drove the sufferer to suicide); and his combined sufferings often render life a prolonged agony. In other cases the symptoms are less urgent, but they are always more or less distressing. Frequently the ingestion of food relieves the pain; sometimes it aggravates it. The patient occasionally finds relief in special postures, and constantly assumes them. The slightest movement may aggravate the pain; the patient may have to tread with slowness and difficulty, and his breathing may be performed superficially or with effort. Soon the health fails; the patient becomes pale, thin and worn; he becomes liable to attacks of syncope, or even convulsions; vomiting sets in, sometimes with bleeding; wasting goes on to extreme degrees, and death takes place in the last stage of exhaustion.

Local conditions demanding operation may exist. These are produced when the foreign body shows signs of perforating the walls of the stomach, either immediately by cutting them through, or gradually by ulceration and the formation of abscess. Richardson* has collected 11 such cases occurring between 1602 and 1882, the foreign body in each case escaping either spontaneously or after a simple incision; and only one of these cases died. Perforation into the peritoneum, if untreated, is certainly fatal. The risks of perforation through the parietes when the stomach becomes adherent to them are evidently not so great, but they are sufficient to demand operation. Perforation in other directions—towards spleen, liver, lung, or heart—must be reckoned among the terminal casualties.

THE OPERATION.

To facilitate operation, various plans of distending the stomach have been suggested. Felizet of Paris† utilised the vapour of ether for this purpose, in an operation for the removal of a spoon. A piece of rubber tubing was passed into the stomach; the outer extremity of the tube was bifurcated—one of the ends communicating with a funnel, the other with an ether

* *Loc. cit.* † *Lancet*, vol. ii., 1882.

reservoir. The stomach was first washed out with a solution of bicarbonate of soda, poured in through the funnel. The ordinary incision was then made; when it was concluded, the ether reservoir was placed in hot water, and the vapour, passing along the tube into the stomach, distended it and forced it through the wound. Felizet, while the stomach was distended, sutured it to the wound before removing a spoon, and a gastric fistula was left. Schönborn,* in a case of gastrostomy, made use of a bladder attached to the end of a hollow sound, which he distended by blowing. Jacobi† and Fowler‡ have caused distension by pouring into the stomach measured quantities of acid and bicarbonate of soda. Other methods have been used or recommended.

It is very doubtful if the advantages of distending the stomach counterbalance the disadvantages. The advantages are, increased facility in finding the stomach, and the comparatively small size of the opening made while the walls are stretched. The chief disadvantages are, the trouble to the patient connected with the process of distension, the difficulty in preventing the distending agent from coming into contact with the peritoneum (even ether is not innocuous), and the increased difficulty of finding the foreign body in a distended cavity. Billroth, in one case, found this last difficulty a very troublesome one to overcome. The exigencies of the case would probably be met by a prior cleansing of the stomach with a dilute solution of bicarbonate of soda. There is no objection to the patient's swallowing, just before operation, eight or ten ounces of some innocuous fluid; this amount will be quite sufficient to throw the stomach into prominence, while it is not too large to be collected in sponges should it escape. On the whole, perhaps, it is best to operate upon an empty stomach, which has been previously cleansed by an alkaline solution.

The site of the incision is not of so much importance as in gastrostomy. It may be higher up; if the liver is in the way, it

* Langenbeck's *Archiv.*, xxii., p. 500.

† *New York Med. Journ.*, 1874, vol. xx., p. 142.

‡ *Ann. Anat. and Surg.*, vol. vi., p. 27. Brooklyn, 1882.

can easily be kept back by a retractor. No advantage is gained by getting close to the ribs; the flexibility of the parietes, which is useful in permitting manipulation and the introduction of sponges, is diminished by proximity to the fixed rib-cartilages. If, as occasionally happens, the foreign body can be felt, the incision through the parietes is best made directly over it. And if sign of perforation show at any part, this also guides to the site of incision. Labbe recommended an incision parallel to the left costal margins, the lower end of which did not descend below the level of the tip of the ninth cartilage. Bell and Neal made use of an incision extending from the umbilicus towards the left false ribs; Vidal de Cassis made his incision in the middle-line; and other incisions, too numerous to mention, have been employed.

If the foreign body is very large, as in Thornton's case, the incision is best made in the middle line. The linea semilunaris is, for most cases, too far outwards. Labbe's incision is probably as good as any for those cases where the site of election is not determined by the foreign body being felt. The incision, beginning at the level of the tip of the ninth rib cartilage, and about an inch and a half to the inner side, is carried upwards parallel to the costal margin for a distance of two and a half or three inches. The muscles are divided and the peritoneum opened in the same way as in gastrostomy.

Now that the competency of sutures in wounds of the hollow viscera to prevent escape of their contents has been abundantly proved, the old practice of fixing the stomach to the parietes need not be followed. The stomach may be opened, sutured, and returned to the abdominal cavity, with an assurance that, if the stitches have been properly placed, there will be no escape of gastric fluids.

When the peritoneal cavity is entered, two fingers are passed over the anterior surface of the stomach, to feel for the foreign body. Occasionally some difficulty in detecting the body is encountered. If, as is usually the case, the body is long, the end which lies most conveniently to the parietal wound is selected as the site of the stomachic incision. If the body is

sharp-pointed at one end (as a fork), the blunt end is chosen. Particular care must be taken that the gastric wall is not perforated by rough handling of a sharp-pointed foreign body. If the blunt end lies at considerable distance from the parietal incision, it will be wise policy to open the stomach over the sharp extremity. In the case of collections of hair, the stomach may be opened where it protrudes most. Each case must be judged on its merits as to site of opening.

When the spot for making the opening has been selected, the whole surface of the stomach around this spot is covered with flat sponges. Two silver or silk guiding loops are inserted through the muscular and serous coats at the sides of the proposed line of incision; the stomach is gently pulled to the surface by these loops, the ends of which are now entrusted to an assistant, who keeps the stomach pressed up against the sponges by means of them. The line of incision is best made parallel to the course of the vessels—that is, transversely to the curvatures, or in a line with the abdominal wound. An opening of sufficient size is made between the loops by knife or scissors, and the forefinger, inserted through it, feels the body and enables the surgeon to decide upon the best mode of extraction. The finger may be able to push the end of the body through the wound, when it may be caught; or it may be lifted out between the forefinger and a lithotomy scoop or similar instrument; or the end may be seized in suitable forceps, whereby it is dragged out of the wound. Sometimes the body is found embedded in granulations, which bleed freely on being disturbed; the greatest care must then be taken to avoid perforation of the stomach. During the manipulations, the assistant takes care that the sponges are well placed to absorb any escaping fluid.

When the foreign body has been removed, it may be wise, if there is much mucoid or purulent or bloody material in the stomach, to cleanse it by means of small sponges on sponge-holders. The less the stomach is irritated the better, however. Before beginning to place the sutures, a very soft suitably shaped flat sponge is inserted through the wound, with a long piece of

thick silk passed through it to draw it out by when the deep sutures have been inserted and before they are tied.

The best form of suture for the stomach wound is the Lembert (Fig. 51), or some simple modification of it. The best needle is a milliner's needle of medium size; the suture material should be fine Chinese twist. The sutures are most easily and rapidly inserted along folds of the stomach-wall raised by traction on quilt stitches placed about two inches apart, in the manner described and depicted further on for Enterorraphy. The needle passes through the serous, sub-serous, and muscular coats, piercing but not cutting the tissues, and does not enter the mucous coat. The accompanying diagram (Fig. 51) may be taken as representing on natural scale the mode of placing and the closeness of the sutures. When the sutures have been placed, their ends are gathered together in the blades of catch-forceps, the threads crossing the middle of the wound are teased apart, and the sponge is removed. The sutures are then systematically and carefully tied, beginning at one end and going on to the other. A second row of sutures, passing through peritoneum alone, is sometimes placed in alternation with the first row. These sutures are ordinarily interrupted, but very perfect apposition may be got by making them continuous. A double continuous row, where the sutures cross and the free ends are tied together at the end of the wound, may be used if the wound is small. Appolito's suture (see Enterectomy) would seem to be very suitable. Expansion and contraction takes place through a wider range in the stomach than

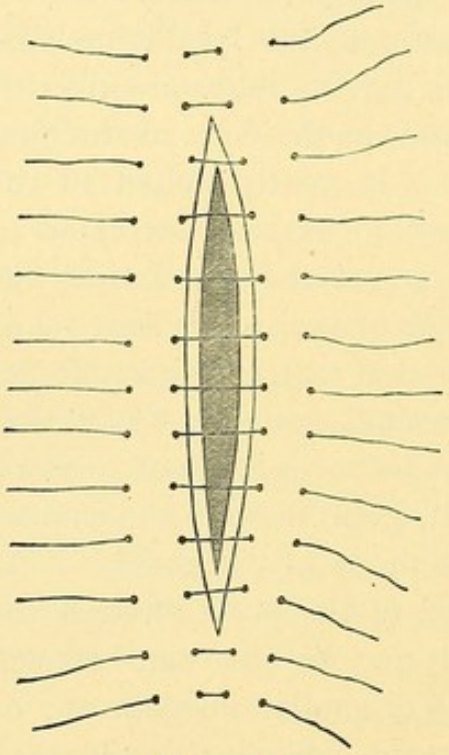

FIG. 51.

Lambert's Suture.

in the intestine. The continuous suture prevents stretching of the intervals, and subsequent escape of fluid when the stomach expands; if the stomach contracts, the continuous suture might get loosened. Unless the stomach is quite contracted, which is different from being empty, the interrupted suture is the safer.

When the stomach wound is perfectly closed, the sponges are removed from the abdominal cavity. A dry sponge is finally inserted on a sponge-holder, to make sure that no foreign matter is left behind. The parietal wound is then closed in the ordinary way.

The subsequent treatment consists in giving absolute rest to the stomach for three or four days, the patient being fed on enemas meanwhile. Very small quantities of peptonised milk, diluted with water, are given at stated intervals for two or three days more; and then beef peptonoids and thin broths may be added to the diet, while the intervals of feeding may be lengthened and the amounts of food increased. At the end of a fortnight, starchy foods may be given; and at the end of three weeks, ordinary light diet.

If vomiting takes place at any time, all food must be withheld till it has ceased. Separation of the lips of the wound is more likely to take place when the stomach contracts or is compressed over fluid contents, than when it is empty.

The chances of successful issue are very good. Mr. Thornton's case made an admirable recovery, in spite of his having to remove, on the day after the operation, a sponge which was inadvertently left inside the abdomen, and in spite also of suppurative inflammation of the parotid. In his case also the stomach wound was very large. When closed, it measured three inches. There is no other record of a foreign body of such dimensions having been removed from the stomach.

GASTROTOMY FOR REMOVAL OF FOREIGN BODIES IN THE ŒSOPHAGUS.

For foreign bodies impacted near the cardiac extremity of the œsophagus, when all attempts to remove them by the mouth have failed, gastrotomy may be performed with the view of removing them through the stomach.

Maurice H. Richardson of Harvard University, in 1866, introduced the operation by a very successful case. He succeeded, after introducing the whole hand through an opening in the stomach, in removing a denture of teeth impacted in the lower portion of the gullet. Since then he has made careful anatomical observations on the details of the operation, and studied its indications and possibilities.* In a series of cases he found that the average distance from the incisors to the diaphragm was 14½ inches: a foreign body arresting the point of the probang at a distance of 13 inches from the incisors would therefore be near to the cardia, and might be removed by gastrotomy. He found that all parts of the œsophagus were accessible to the finger, either by gastrotomy or external œsophagotomy. It is possible with the fingers of the left hand to reach three inches above the cardiac orifice.

Richardson recommends an oblique incision along the margins of the left ribs long enough to admit of the introduction of the whole hand. The vertical incision he considers best for the introduction of instruments. The stomach is pulled to the surface and carefully isolated with sponges. The lesser curvature is put on the stretch, so as to make a sulcus between the anterior and posterior surfaces, leading straight to the cardiac opening, and serving as a guide for the introduction of instruments. The site of the incision in the stomach is unimportant. It must be far enough to the right to allow of the passage of the instrument along the sulcus, as described. If the instrument is brought obliquely to this groove and passed upwards, all the time being pressed gently against the straightened lesser curvature, it will glide into the œsophagus every time with the greatest ease.

The assistant, standing on the patient's left, holds the stomach by the greater curvature in both hands, so that the whole viscus is flattened out. "The operator, standing on the right of the patient, holds the lesser curvature between the left thumb and forefinger, thereby making tense the lesser curvature, and assisting in the passage of the instrument. Before doing this it is best to introduce the hand into the peritoneal cavity,

* *Lancet*, Oct. 8th, 1887.

and examine the diaphragmatic opening externally. With the stomach held as described, the opening through its walls may be made anywhere on the flattened surface, so as to avoid the large vessels." In most cases the foreign body may be removed with a suitable instrument: if this fails, the stomachic incision must be enlarged, and the whole hand introduced. The opening in the stomach is closed by the Lembert suture in the ordinary way.

W. T. Bull of New York,* in recording an operation of this sort successfully performed by him, makes some novel and valuable observations. The patient was a boy of 16, and had swallowed a peach-stone, which was found firmly impacted in the œsophagus, at a distance of 13 inches from the incisors. After ineffectual attempts to dislodge it by the mouth, Bull, through a median vertical incision in the parietes, made a small opening in the stomach just large enough to admit the finger. After passing sponges into the abdominal cavity to collect any fluid that might escape, he placed four loops of thread in the wall of the stomach around the opening, and then, invaginating the anterior wall of the stomach while the finger plugged the opening, pushed the finger onwards to the end of the œsophagus. The peach-stone was felt, but could not be dislodged by finger or forceps. He then passed a fine bougie from below upwards past the stone into the mouth; attached a piece of sponge by a strong silk ligature to the end of the bougie, and pulled it through the mouth. The sponge passed by the foreign body; but a second and larger sponge, attached to the same string, pulled it into the mouth.

The patient made an excellent recovery. In this case very thin and lax parietes made the operation possible without passing the hand into the abdomen. In most cases it would probably be necessary to pass the hand inside the abdomen; but it need not always be necessary to make the large opening into the stomach.

It is too early to draw conclusions from these operations. There can be no doubt, however, that they present a valuable means of treating a peculiarly difficult, if uncommon, class of cases.

* *New York Med. Journ.*, Oct. 29th, 1887.

GASTROTOMY FOR REMOVING CANCEROUS GROWTHS IN THE STOMACH.

Augustus C. Bernays of St. Louis has recently* introduced to the profession a remarkable operation, whereby, after making an incision in the walls of the stomach, he removes, by curette or other suitable instrument, cancerous growths bulging into the stomachic cavity. He records two cases, and the results in each were so strikingly favourable as to warrant the conclusion that the operation he has introduced is worthy of a full trial in the hands of others.

As a result of extended study, he found that "one-half of all cancers of the stomach start near the pylorus, and that in nine-tenths of all cases they have a tendency to grow towards the lumen of the stomach. In the beginning the mucous membrane is the seat of the disease; the sub-mucous, loose connective tissue is next attacked; and only in the last stages are the muscular and serous coats invaded by the neoplasm." The muscular layer becomes soon hypertrophied, but it is last invaded; "cancer of the stomach originally grows inside the muscular layer, towards the lumen of the organ."

Reasoning from these facts, and from the analogy of results got after curetting similar cancers elsewhere, Bernays decided, as an alternative to other impossible or unsatisfactory operations, to give certain selected cases a trial by scraping or curetting. He first made an accurate examination of the parts from the outside of the stomach; then fixed a fold of the stomach to the parietal wound by numerous sutures. He then opened the stomach and carefully stitched the lips of the opening to the lips of the wound in the parietes. The stomachic cavity being thus completely shut off from the abdominal cavity, he proceeded with fingers and curettes to tear and scrape away masses of the growth. The bleeding was free, but soon ceased.

The stomach remaining attached to the parietes, the operation may be repeated without performing laparotomy when the

* *Annals of Surgery*, Dec., 1887.

renewed growth of the tumour calls for it. The gastric fistula may or may not be closed.

For a full account of the operation, and a history of the cases, I must refer the reader to Bernays' paper. As an alternative to such operations as gastro-enterotomy and pylorectomy, where these are impossible, the operation seems to me to have already assumed a justifiable position ; and, even in cases where these are possible, it seems likely that Bernays' operation will appear as a worthy competitor.

Gastrorraphy.

Gastrorraphy (γαστήρ—stomach, and ῥαφή—suture) is here used to mean the closure of a wound or opening in the stomach. In its old sense, as meaning suture of a wound in the abdominal parietes, the word may now be considered obsolete.

History.—According to Wölfler,* a Bavarian surgeon in 1521 first performed Gastrorraphy. So far as I know, Billroth† is the only living surgeon who has performed the operation. His case was one of gastric fistula, which he had failed to cure by plastic operation. Gastric fistula is not common: Murchison was able to find records of only twenty-five cases in a period extending over three centuries; therefore, operations for the cure of it must always be rare.

Conditions indicating Operation.—Cases of gastric fistula, in which the stomachic contents are constantly dribbling away, or in which the food taken by the mouth freely escapes, and which have resisted all other treatment to alleviate or cure, are legitimate subjects for gastrorraphy. Fistulæ arising from ulcerative destruction by malignant disease are, of course, unsuitable for operation. Perforating ulcer of the stomach, the most common non-traumatic cause of gastric fistula, may pass through the parietes by direct extension, or through an intervening abscess; in the latter case we may expect more inflammatory thickening than in the former, and the operation will be correspondingly difficult. The site of the fistula is, however, the most important consideration. If, as in St. Martin's case, it lies between the ribs, the operation would be complicated. If, as in Maillot's case, it lies close to the ensiform cartilage, the operation would be difficult. But, if it is well free of the bony parts, it need present no great obstacles to successful performance.

Cases of perforating ulcer of the stomach can, when perforation has taken place, be saved from certain death only by the

* *Ueber die . . . Resectionen des Carcinomatösen Pylorus.* Wien, 1881.

† *Wiener med. Wochenschrift*, 1877, No. 38.

performance of gastrorraphy. Two or three such operations have been performed; one, at least, with success. When, with a clear history of ulcer of the stomach, undeniable symptoms of perforation suddenly come on, abdominal section, cleansing of the cavity, and closing of the stomach-opening, give the patient the only chance of life. A very slight chance of success would justify the operation.

Traumatic wounds of the stomach, by bullets, knives, or other means, justify gastrorraphy or not, according to principles which will be discussed when the whole question of perforative wounds of the hollow viscera is considered.

THE OPERATION.

For *gastric fistula*, the operation is preceded by a thorough washing out of the stomach by an alkaline solution. If the fistula be large enough, several soft sponges, with long pieces of string attached, are passed into the stomach and pulled outwards against the opening by an assistant. These prevent the escape of mucus, steady the organ, and absorb any blood that may be lost during subsequent proceedings. They need not be removed till the first row of sutures is placed in the stomach-wall.

The parietal incision, about three inches in length, passes through the fistulous opening, and is made in any direction that seems most convenient. The peritoneum is divided at one extremity of the wound, so as to get beyond the adhesions which fix the stomach to the parietes. The finger inserted through this opening carefully separates the adhesions up to the fistulous opening, and as soon as possible sponges are packed into the abdominal cavity. The adhesions at the other extremity of the wound are separated in the same way with finger and finger-nail. When the stomach has been freed, the fistulous opening is drawn to the surface by means of the strings attached to the sponges inside the stomach. In most cases it will be wise to freshen the edges of the fistula in the stomach by means of scissors; and in doing so, as little of the tissue as possible will

be removed. The stitches are placed as in gastrotomy, the sponges being removed before they are tied. The fistulous tract in the abdominal wall is cut away. The subsequent steps are exactly as in gastrotomy, and the after-treatment is the same.

In *perforating ulcer of the stomach*, we have little experience to guide us. The oblique incision recommended for gastrostomy would probably satisfy all requirements. It might with advantage be half an inch further away from the ribs, and it might extend a little higher. If the perforation is in front, the stomachic contents will have escaped into the greater cavity of the peritoneum, and will be at once visible. If the perforation is behind, the contents may be confined to the lesser cavity of the peritoneum, and it may be necessary to tear through the anterior layers of the great omentum to get at the opening in the stomach.

Whenever the extravasated fluids are seen, wherever they be, the first thing to be done is rapidly to pass sponges into the cavity, so as to soak them up. If the opening in the stomach can be seen, the subsequent proceedings are now simple enough: to pare the edges of the ulcer, and suture the opening. If it is not seen, the stomach surface is carefully and systematically explored with the fingers, and by pulling it towards the abdominal opening for inspection. If, after most careful examination, no perforation is found on the anterior surface, the posterior surface must be explored. To do this, the anterior layers of the great omentum must be perforated. A convenient spot is selected midway between the transverse colon and the greater curvature of the stomach, and an opening large enough to admit the finger is teased out with forceps. This opening is enlarged by slow dilatation with the fingers; no vessels need be severed. Perforation of the posterior surface of the stomach will be shown by the escape of gastric contents through this opening, and then the finding of the site of perforation is merely a question of time and tactile sensibility. To bring it into view may not be easy. If the ulcer lies near the greater curvature, it can be rendered visible and brought within the reach of the fingers for manipulation. If the perforation lies high up behind,

it may be very difficult to bring it into view, and still more difficult to place sutures around it. By a properly arranged and sufficiently long incision, I have found, post-mortem, that it is always possible to render every part of the posterior surface of the stomach visible through an opening made in the great omentum, and that, with the help of sponges and retractors, sutures may be placed anywhere in the stomach walls.

If it is found very difficult to suture the perforation in the posterior surface, I would, rather than leave the operation unfinished, recommend incision of the stomach in front, pushing the perforated part through the incision by the forefinger placed behind, and suturing of the ulcerated opening from the mucous surface. To pinch up a fold of stomach on its mucous aspect and insert a few sutures, would give accurate peritoneal apposition. The incision in the stomach would then be closed as in gastrotomy for foreign bodies.

After any operation for perforating ulcer of the stomach, the abdominal cavity should be well washed out by a stream of warm aseptic fluid.

Operative Dilatation of the Orifices of the Stomach.

History.—Professor Loreta of Bologna introduced this operation; though Richter of Breslau first suggested it.* In September, 1882, Loreta performed his first operation,† a notice of which was first supplied to British readers by Mr. Holmes.‡ Up to March 15th, 1884, he had completed his ninth operation.§ A few other surgeons, chiefly Italian, have performed the operation. McBurney of New York has operated twice. The cases are too few, and the operations are too recent, for formulating any conclusion as to the permanent value of the proceeding. So far, the results have been most gratifying.

The Aim of the Operation.—The operation is intended only for cases of non-malignant character,—simple cicatricial or fibrous narrowing of the pylorus, or the cardia, or the lower end of the œsophagus. With such narrowing there is usually found considerable hypertrophy of the inorganic muscular fibre, and the stretching of this circle of muscle is an important element in the operation. Professor Loreta justly compares his operation with that of over-distension of fibrous stricture of the rectum, which is well known to be highly successful. As dealing with simple narrowing of the pylorus, the operation is intended to replace pylorectomy; for narrowing of the lower œsophagus and cardia, it takes the place of gastrostomy for simple stricture.

The *diagnosis* is important. In pyloric obstruction the patient is greatly emaciated, but the symptoms will have lasted so long as to exclude cancer. The stomach is much dilated, and the diagnosis is then between dilatation "due to pyloric obstruction from that due to idiopathic gastritis." In forming the diagnosis,

* *Deutsche med. Woch.*, 1882, p. 381.

† *Memoire dell' Accademia delle Scienze Instituo di Bologna*, ser. iv., vol. iv.

‡ *Brit. Med. Journ.*, Feb. 21st, 1885.

§ *Lancet*, April 26th, 1884.

Prof. Loreta places most value on the chemical and microscopical examination of the contents of the stomach. When positive results are got from the examination of matters rejected or extracted, we may conclude that the dilatation of the stomach is idiopathic; when the results are negative, we may infer dilatation from mechanical obstruction. In mechanical dilatation the gastric contents give an acid reaction, and no traces of albumen or peptones are found. In the other forms of dilatation the reaction is usually neutral or alkaline, rarely acid, and the albuminoid substances are found unchanged or nearly so. Other and more elaborate instructions for making a diagnosis are given by Prof. Loreta.*

The diagnosis, in simple stricture of the lower end of the œsophagus and beginning of the cardia, is more easy. In most cases there will be a history of the swallowing of caustic fluid; in all there will be an absence of the signs of cancer; and the ordinary signs, subjective and objective, of œsophageal obstruction will be present. In this case it is presumed that attempts to dilate the stricture by the mouth have failed, and that the so-called "tubation of the gullet" is either impracticable or devoid of result.

THE OPERATION.

For operating on the pylorus, Loreta at first made his parietal incision, about five inches in length, "on the right of the median line, the upper and inner end being about four centimètres below the xiphoid cartilage, the lower and outer end three centimètres from the cartilage of the ninth rib." He now makes the incision in the linea alba. The muscles and peritoneum are divided in the ordinary manner. The pylorus is felt for, and will be found thickened and hardened, and perhaps adherent to surrounding organs. The coats of the stomach, lifted out of the wound as far as necessary, are then pinched up into a fold, and divided by scissors midway between the two curvatures about an inch from the pylorus, or more if necessary. Any bleeding is

* See *Brit. Med. Journ.*, 1885, i., p. 373.

stopped by forci-pressure. (Loreta says nothing of placing sponges around the site of incision in the stomach, to protect the bowels and collect extravasated blood or gastric fluids.) The right forefinger, introduced through the opening in the stomach, is pushed into the pyloric opening, while the left forefinger steadies it. Considerable force and great patience may be required to overcome the powerful grip of the narrowed orifice. When the finger is passed through the opening, the pylorus may be hooked downwards towards the abdominal wound, and then the left forefinger is also insinuated through the stricture. Even with the fingers thus opposed, the resistance offered to dilatation may appear almost insuperable. After a time the muscle yields, and the dilatation is continued till a sensation is felt as if further distension would result in tearing. The fingers are kept in the opening thus dilated for a few minutes. In Loreta's first case the fingers were more than three inches apart as they lay in the opening.

The wound in the stomach is then sewn up, the stomach returned to its place, and the abdominal incision closed. The after-treatment is that of gastrotomy.

In operating upon stricture of the cardia and lower œsophagus, the parietal incision is the same, only on the opposite side. The difficulty of the operation is likely to be increased by the contracted condition of the stomach. When the viscus is drawn out of the opening as far as is safe, a longitudinal incision is made between the two curvatures as near to the cardia as possible. There may be some difficulty in finding the orifice of the gullet by exploring with the finger inside the stomach; if so, the left forefinger, carried between the lesser curvature and the under surface of the liver, will be of assistance by localising the situation of the gullet. The next step is to introduce the dilator, guided by the forefinger in the stomach. The dilator which Loreta used is made "something like that which Dupuytren introduced for lithotomy, only longer, measuring about eight inches from the joint to the end of the blades, and so constructed that the blades would not separate more than five centimètres." When the instrument is introduced the blades

are dilated to the full extent; thus dilated, the instrument is run up and down the œsophagus several times.

The subsequent steps of closure of the wounds in the stomach and parietes, and the after-treatment, require no description. It is curious that, in two cases operated upon, there appeared on the fourth day serious disturbances of the circulation and respiration, with abundant secretion of mucus from the trachea and bronchi; and these symptoms, in both cases, lasted over five days. This condition Loreta is inclined to attribute to an exudative hyperæmic process.

It is somewhat surprising that so few surgeons have adopted Loreta's operation. Forcible dilatation of the œsophagus by the mouth has not been attended with much success, and this may have deterred surgeons from imitating Loreta's proceeding through an incision in the stomach. But this objection does not hold with respect to pyloric dilatation. It is certain that many cases diagnosed during life as pyloric cancer turn out, post-mortem, to be nothing more than pyloric obstruction, mainly produced by enormous hypertrophy of the muscular tissue. In the last five years I have seen at least three such cases; and the facts were specially impressed upon me, because I had spent much time in examining with the microscope for the cancer which was supposed to be present, and found nothing but inorganic muscle. Such cases ought to be diagnosed; and if diagnosed, they are susceptible of great improvement, if not of permanent cure, by Loreta's operation. Pylorectomy has been performed for at least one case of cicatricial contraction: in the face of the proved success of forcible dilation, removal of the pylorus would seem to be doing too much.

Pylorectomy. Partial Gastrectomy.

By Pylorectomy is meant removal of the pylorus and so much of the duodenum and stomach as may be involved in the disease for which the operation is performed. The operation may thus be a partial Enterectomy as well as a partial Gastrectomy.

History.—According to Blum,* Merrein, in 1810, first conceived the idea of removing the pylorus. A little later Gunther practised the operation on dogs. Gussenbauer and v. Winiwater,† in 1876, demonstrated by experiments on animals that gastrectomy was a feasible operation. Kaiser, at Czerny's instigation,‡ repeated these operations with success; and Wehr§ further continued the experiments.

Péan,‖ in 1879, first performed the operation on a human being, but without success. Rydygier, in 1880, performed the second operation, also unsuccessfully. Billroth, who performed his first operation on Jan. 25th, 1881, is the chief exponent of the operation; and, through the writings of his assistant Wölfler, has been chiefly instrumental in bringing it before the profession.¶

Conditions for which the Operation may be Performed.—Thus far the operation has been performed almost entirely for cancer of the pylorus. It has five times been performed for ulcer of the stomach in the pyloric region, and once successfully, for cicatricial stenosis. Billroth, Czerny, and others strongly advocate it for non-malignant forms of pyloric obstruction, ulcerative or cicatricial, whether originating pathologically or after traumatism, as from swallowing corrosive liquids. Fenwick relates a case of cicatricial stenosis after injury, which might come under this category.

* *Arch. Gen. de Méd.*, vol. cl., 1882, p. 332.

† Langenbeck's *Archiv.*, bd. xix., p. 347.

‡ *Beitragen zur Operativen Chirurgie.* Stuttgart, 1878. § *Zeitschr. f. Chir.*, 1882, p. 93.

‖ *Gaz. des hôp.*, No. 60, 1879.

¶ *Ueber die von Herrn Professor Billroth Ausgefürhten Resectionen des Carcinomatösen Pylorus.* Vienna, 1881.

For non-malignant forms of pyloric obstruction most surgeons would probably prefer Loreta's operation of forcible dilatation —at least, as a primary proceeding. And for ulcer, unless it lies in the pylorus, a very limited gastrectomy might be considered more advisable. Still, if under any circumstances the operation is justifiable, it will continue to be so for certain cases of non-malignant stenosis or obstruction.

Certain cases of pyloric obstruction are produced by strong peritoneal adhesions compressing the bowel from the outside. These are peculiarly suitable for operative interference—not, however, by pyloric resection, but by dividing the adhesions. Obstruction caused by pressure from a tumour outside is remediable or not, according as the tumour is removable or not.

Cancer of the pylorus remains as the leading indication for pylorectomy. The majority of cases of cancer of the stomach are situated at or near the pylorus: according to Gussenbauer and v. Winiwarter, of 903 cases of gastric cancer, 542 were pyloric. In a surgical sense it is important to note that at death in 223 of these cases there were found no peritoneal deposits, and in 172 there were no adhesions. Rokitansky has observed that cancer of the pylorus scarcely ever extends into the duodenum.* There is always considerable hypertrophy of the muscular tissue surrounding the diseased area, and the obstruction may be due as much to the inability of this mass to contract as to the ingrowth of the tumour.

In making the physical *diagnosis*, it is recommended that the patient be anæsthetised. Special attention is paid to the range of mobility of the tumour, to its size, and to the nature of its surface—whether it is smooth or nodulated. If the tumour is freely movable, we may infer, with a high degree of probability, that there is no invasion of neighbouring organs. In one case the tumour was freely movable, yet the adhesions were so strong and so numerous that the operation had to be abandoned. On the other hand, fixation does not so certainly indicate extension of the disease. Mobility is an effect of dilatation of the stomach; if extensive dilatation does not exist, the pylorus may not have

* See Billroth's *Clinical Surgery*, New Syd. Soc., p. 494.

been disturbed from its natural situation. A greatly dilated stomach, with fixation of the pylorus in an abnormal situation, strongly suggests extension of the disease: if irregularity of the surface of the growth co-exists with these conditions, we may certainly infer that the disease has spread, and then operation is out of the question. Free mobility has been found associated with invasion of lymphatic glands; this can be discovered only after proceeding to operate.

There must be present unequivocal symptoms of pyloric obstruction. Dilatation of the stomach will usually be the most important symptom. If there is any doubt as to this condition, it will be advisable to verify it by the generation of carbonic acid gas in the stomach by drinking two solutions one after the other, which when mixed will evolve the gas. The history is important. From other species of pyloric obstruction, cancer differs in producing local pain and impairment of appetite. In cases not cancerous, pain is not a prominent symptom, and the appetite may be increased, often to voracity. More than one observer has noted that, in cases of cancer of the stomach, hydrochloric acid is not found in the gastric juice.

Mortality and Appreciation.—The operation is a very fatal one. Mikulicz of Cracow* collected 32 cases, of which only 8 recovered from the effects of the operation. Up to the end of 1887 Billroth† is reported to have operated 18 times, saving 8 patients for a longer or shorter time. One had lived five years. Winslow‡ has tabulated records of 61 cases, which he believes to be all the operations performed up to date of writing. Of these, 16 recovered and 44 died; in one case the result was unknown. Collapse was the chief cause of death, claiming 27 of all the cases. Peritonitis, pure and simple, is not a frequent termination—a fact which speaks volumes for the technical skill of the operators. Four of Winslow's cases died of gangrene of the colon, and a fifth case has since been recorded.§ In a large,

* *Wiener med. Woch.*, Nos. 23 and 24. † *Obstet. Gaz.* Cincin., Oct., 1887.

‡ *Amer. Journ. of Med. Sc.*, April, 1885.

§ Lauenstein, *Centralbl. für Chirurgie*, 1882, No. 9; March 28th, 1885; and Feb. 21st, 1885. Also, Rydygier, *Ibid.*, March 28th, 1885.

and as yet not fully reported, number of cases recurrence takes place a few months after operation. No case, according to Winslow, has lived longer than three years without signs of recurrence. Six cases of non-carcinomatous stricture have been recorded, with three recoveries. In these, of course, recurrence is not to be expected.

The most recent statistics are at once contradictory and unpromising. Mc Ardle* has collected records of 70 operations—8 for simple stricture, 62 for cancer. Of the former, 5 recovered and 3 died; of the latter, 21 died directly from the operation, 14 from peritonitis or septic absorption; "the remaining 27 made good recoveries, many of them being reported well four years after operation." It is a pity that, in this report, fuller details of the cases were not given; for then it might have been possible to explain the remarkable discrepancy with Butlin's painstaking studies,† which seem to demonstrate that, thus far, not one case of those which recovered from operation can be claimed to have been really cured of the disease.

With these results before us, we must admit that if pylorectomy is to be considered anything more than a mere "surgical exercise," it is to be contemplated only in a very carefully selected class of cases. If the patient is not in fairly good condition, if the stomach is greatly dilated, if the growth is large, fixed and displaced, the operation ought not to be contemplated. And, even when the obverse conditions are present, it is doubtful if it could ever be a surgeon's duty to advise the operation; he ought to undertake it only at the patient's urgent request, and after fully and honestly explaining to him the hazardous risk which he undergoes.

THE OPERATION.

Before operation, the stomach must be thoroughly cleansed by irrigation through a stomach-tube. If there is fermentation of the gastric contents, an antiseptic such as boro-glyceride should be used in the solution. A final cleansing should be

* *Dublin Journ. Med. Sc.*, June, 1887. † *Operat. Surg. of Malig. Dis.*, p. 221.

carried out not more than two hours before operation; and the whole of the fluid should be removed, so as to have the stomach empty at the operation. It is unwise to operate if the stomach is greatly distended, for an over-dilated stomach must be badly nourished and intolerant of operative interference. The amount of distension may be readily ascertained by percussion after a seidlitz powder has been administered in separate draughts—one draught containing the acid and the other the alkali.

The operation may be described in successive stages: the incision in the parietes; the isolation of the pylorus; its resection; and the closing of the wound in the stomach, and the uniting of the duodenum to it.

The Parietal Incision.—Various lines of incision have been recommended. Péan and Rydygier used vertical incisions—the former in the middle line, the latter a little to the right of it. Others have employed incisions more or less oblique, or almost transverse. Billroth and Wölfler made their incisions almost transverse, and most other surgeons have followed their example. It is evident that the greatest space for manipulation will be secured by an opening made in the line of the long axis of the stomach, and the pylorus ought to be very near the middle of this opening. If the pylorus has sunk low down in the abdomen, Wölfler recommends that it should be elevated before the incision is made. This would undoubtedly give the full benefit to the operator of the relaxation of parts which permits of the descent of the organ.

The first incision, made over the pylorus in the line of the long axis of the stomach, need be no more than two inches in length. Through this small opening the pylorus is thoroughly explored, and a decision is come to as to the possibility of removing it, and the best course in which to prolong the incision to accomplish removal. Before prolonging the incision (best done with scissors), a sponge is placed inside the abdomen to collect any blood that may escape. The bleeding may be somewhat free, but it is easily controlled by forci-pressure. The whole length of the incision will be from three to five inches. There is no objection to making a second incision at right angles to

the first, if the subsequent steps of the operation will thereby be facilitated.

Isolation of the Pylorus.—The stomach is lifted up to the wound, and the growth carefully examined, to determine the amount of tissue which has to be removed. The great omentum is first divided close to the greater curvature, and over as little area as is possible consistently with complete removal of the growth. The omentum is caught up in successive portions between pairs of pressure forceps, and divided between them. Ligatures are applied behind the forceps attached to the omentum, and the forceps are removed. Morris suggests that "double ligatures may be passed with an aneurism needle at short intervals through the portions of the omentum to be divided, and the section made after the ligatures are tightened." The same proceeding is carried out with the lesser omentum. Any enlarged lymphatic gland may now be removed. If the pylorus is low down and adherent, the danger of wounding the transverse meso-colon, and so causing gangrene of the bowel, must be borne in mind. To avoid this risk, Lauenstein has made a suggestion to peel the peritoneum off the posterior surface of the pylorus; but this is scarcely advisable in malignant disease.

When the portion to be removed has been freed from its connections, one or more large flat sponges are placed under it, so as to raise it up through the parietal opening. Other sponges are packed around, covering and protecting every portion of exposed peritoneum, and so rendering the operation as nearly extra-peritoneal as may be.

Resection of the Diseased Structures.—The walls of the stomach are best divided by successive cuts with a scissors. Bleeding vessels are ligatured as they are divided. The direction of the incision is guided by the shape of the growth; but the mode of its completion will depend on where it is intended to insert the duodenum into the divided end of the stomach. If there is much dilatation of the stomach, Wölfler's advice, to insert the duodenum close to the greater curvature, will be followed. In this case, the upper section of the stomach-walls may be at once sutured before completing the removal of the diseased

mass. In his later operations Billroth, in lessening the calibre of the divided end of the stomach so as to fit the small opening of the duodenum, does not divide the mucous membrane at the end of the incision, but removes a V-shaped flap composed only of peritoneum and muscular coat. The edges of this gap are brought together by stitches, which do not include the mucous membrane, this layer being bent inwards towards the cavity of the viscus. Threads placed in the peritoneal coats prior to complete division insure that there is no rotation of stomach or duodenum, and that they are united in their natural planes. No definite instructions applicable to every case can be laid down: the lines of division, the sites of apposition, and the mode of suturing, must be decided upon by the operator.

When the stomach is opened, any extravasated contents are at once absorbed by a sponge. A suitable sponge may be temporarily placed in the duodenum.

Suturing the Duodenum to the Stomach.—The opening of the stomach being larger than that of the duodenum, two sets of sutures will be necessary—one for uniting the duodenum to the stomach, the other for closing the opening in the stomach itself. Circumstances must determine at the time whether it is better first to suture the superfluous gap in the stomach, or first to insert the duodenum into the space retained for it. Probably, in most cases, part of each proceeding will be finished before concluding the whole of either.

Wölfler's suggestion, that as many sutures as possible be placed from the inside, is a valuable one. The lips of the incision are inverted, so as to bring peritoneal surfaces into contact, and the first rows of stitches are inserted and tied from the mucous aspect. As the openings are gradually closed, it will become less easy to place these inner sutures, and then the double row must be inserted from without. About a third or more of the suturing may be done partly from the inside and partly from the outside; the rest must be done entirely from the outside. However applied, the sutures are essentially the Czerny-Lembert. At the part where the transverse line of

sutures in the duodenum meets the longitudinal line in the stomach, a few extra stitches should be inserted.

Nearly all operators have used the simple interrupted suture. Inserting and tying a double row of these, which must be very numerous — from forty to sixty, — necessarily occupies a great deal of time. I can see no objection to the employment of the continuous suture, interrupted, as Pollock suggests, after every four or five stitches. For the inner row, if inserted from the mucous aspect, the continuous suture would seem to be particularly suitable.

Fine Chinese silk is the favourite suture-material: catgut has been used; but there is danger of its being absorbed before union is firm. The needles now proved to be most suitable for this and similar work on the intestines are straight, round milliner's needles, about an inch in length. For resection of the pylorus some thirty or forty needles should be provided.

Very much of the detail must be decided upon at the time of operation, and not a little of it will be regulated by the habits and manipulative peculiarities of the surgeon. Few surgeons would undertake the operation without having performed it several times on the dead subject, and tested the efficiency of the suturing by injecting fluid into the stomach. More may be learnt in this way than by a great deal of reading.

When the parts have been satisfactorily united, the sponges are removed, the peritoneum is carefully cleansed around the site of operation, and the incision in the parietes is closed over a sponge in the ordinary way.

After-treatment.—For the first day or two, or longer if the patient's strength will bear it, all food by the mouth is withheld, and strength is supported by nutrient enemas. The first nourishment ought to be peptonised milk or soup in small quantities. Meat has been given on the fifth day after operation; but if there is no urgency, it is wise not to incur any unnecessary risk by premature disturbance of the gastric wounds.

Gastro-enterostomy.

This operation is the establishment of a permanent fistula between the stomach and some part of the small intestine. Gastro-duodenostomy means, more specifically, the making of a fistula between stomach and duodenum; gastro-jejunostomy, between stomach and jejunum.

History.—Wölfler of Vienna first performed the operation on September 27th, 1881. He began with the intention of performing pylorectomy for cancer; and finding the operation impracticable on account of adhesions to the pancreas, he performed gastro-enterostomy. The patient lived four months. Billroth and Lauenstein followed, each with one case, in the same year.

Conditions for which the Operation may be Performed.—In its original conception, gastro-enterostomy was intended as a substitute for pylorectomy in cases where that operation was impracticable. In some cases, however, it appeared as a rival of the radical proceeding. Rydygier and Monastryski performed gastro-enterostomy for cicatricial stenosis, and here it may be considered as a substitute for divulsion.

Generally speaking, gastro-duodenostomy may he considered as an operation possible for any form of pyloric obstruction, malignant or non-malignant. In non-malignant stricture, it ought not to be performed until dilatation has failed. In malignant stricture it may be regarded both as a rival of, and as a substitute for, pylorectomy. As being a less serious operation than pylorectomy, and as being feasible in a greater number of cases, it has a wider field. Even in cases where pylorectomy is possible it may be argued that gastro-enterostomy, by giving a greater probable chance of immediate recovery and a not greatly diminished likelihood of prolongation of life, is the better operation for cancer of the pylorus.

Appreciation and Mortality.—We have not sufficient grounds on which to base conclusions as to the value of the operation.

So far the actual results have not been quite up to expectation. Winslow* collected 13 cases of operation, of which 9 died. Eight operations have been performed in Billroth's Clinic, with 5 deaths. The longest survival after operation for cancer up to date was in a case operated on by Barker of King's College, London, where the patient lived one year and one week. The latest statistics are those collected by Rockwitz,† in which 22 cases are collected. Complete cures were got in 2 cases of simple stricture; 5 were alive at periods between one and seven months; 4 recovered from the operation, but died in a few weeks; in the remaining 11 (50 per cent.) the operation greatly hastened the patient's death. Since Rockwitz wrote, Postempski of Rome‡ has had a success. The mortality is less over its first cases than was that of pylorectomy; but still, it is very large. Five died of collapse. Two died of kinking of the bowel at the site of junction to the stomach. Hæmorrhage, peritonitis, and exhaustion are among the other causes of death.

It is right to say that most of the operations have been performed under conditions less favourable than pylorectomy has had. Probably if the operation were performed earlier, it would have better results. As it offers less beneficent results than pylorectomy, it ought under similar conditions to be less fatal. Time alone will show whether it will be so.

THE OPERATION.

The parietal incision, in most of the cases, has been a transverse or slightly oblique one along the free margins of the right ribs. Barker, however,§ in his very successful case used a median incision from just below the ensiform cartilage to the left side of the umbilicus. The direction of the incision matters little, if sufficient room is provided for manipulation.

The stomach being exposed (it will have been previously cleansed and emptied), a suitable piece of intestine is fixed upon

* *Amer. Journ. Med. Sc.*, April, 1885.

† *Deutsche Zeit. f. Chir.*, June 22nd, 1887. ‡ *Sperimentale*, August, 1887.

§ *Brit. Med. Journ.*, Feb. 13th, 1886.

to attach to the stomach-wall. Prime regard is to be paid to the facility with which the bowel can be co-aptated to the stomach, and not so much to the physiological importance of having the junction made at as high a point in the bowel as possible. It will rarely be easy, without unduly dragging on the parts, to bring any part of the duodenum into contact with the stomach; and the same may be said of the first six inches or so of the jejunum. If the great omentum is torn through, apposition is more easily effected in the highest part of the bowel. But as two deaths already have occurred from kinking of the gut, bringing it through an artificially made opening in the omentum is not to be recommended. The whole omentum, with the transverse colon, might be turned upwards, and the posterior surface of the stomach thus exposed might be united to the end of the duodenum or the beginning of the jejunum. But this is not an easy proceeding. Barker's proceeding of carrying the bowel round the edge of the omentum seems on the whole to be the best—at least, where the omentum is not very large.

The omentum is pushed to the left, and the first part of the jejunum is caught in the fingers and drawn to the surface. The middle of the anterior wall of the stomach is also drawn out of the wound, and both are supported by packing warm carbolised sponges around. On the loop of intestine two spring clamp-forceps, such as Makins used for resection of the bowel, may now be placed about three inches apart, after all intestinal contents have been gently squeezed out between them. An assistant holds and manipulates the bowel by means of these. Barker used two pieces of rubber tubing carried through the mesentery for this purpose. The gut and stomach are now laid together at the points where the openings are to be made, and a longitudinal fold of the latter, with the empty bowel, is pinched up between the finger and thumb. An incision about an inch and a half long is made in the wall of the stomach, and a corresponding one in the approximated gut. This incision may be made complete through the walls of the viscera, or, according to Barker's excellent plan, only through the serous and

muscular coats. By this method the most important part of the suturing may be carried out before the stomach or bowel is opened. I quote his words: "Still holding the parts, as before, between finger and thumb, I now united the posterior edges of the wound by a continuous suture, the needle entering and emerging in each case between mucous and muscular coats, and the threads crossing the cut edges of the muscular and serous coats. In this way the serous surfaces were closely united from end to end before either viscus was opened. The row of stitches (which were about an eighth of an inch apart) was carried about a quarter of an inch beyond each end of the incision in the coats of the bowel. The moment had now come to open both the stomach and intestine completely; and this was done with a stroke of the scissors through the mucous coat in each case, special sponges being ready to receive any fluid which might escape. After careful cleansing, the anterior borders of both openings were now united by a row of interrupted fine silk sutures, introduced according to Czerny's method. When this was completed, the two openings were securely closed; but, as an extra precaution, the intestine was turned over, and the posterior suture was reinforced by a second row of interrupted sutures, placed about a quarter of an inch away from the first. The anterior row was then similarly reinforced by a row of continuous sutures, taking up, as before, only the serous and muscular tunics." This description I believe to represent the most perfect technique of the operation which has yet been carried out.

It would be wrong to conclude a description of the mode of performing this operation without referring to the results of the highly valuable experiments of Senn of Milwaukee. These show that the use of decalcified and perforated bone plates are of great value in the artificial formation of intestinal anastomosis, and suggest other improvements, which, in the absence of complete reports of his paper, I am unable to describe.

The abdomen is cleansed and the parietal wound closed in the ordinary way. The after-treatment need in no way differ from that of other operations upon the stomach.

Duodenostomy.—This is the establishment of a duodenal fistula through which nourishment is passed into the bowel. It is performed as a mode of relief in cases of pyloric stenosis, under circumstances similar to those for which gastro-enterostomy is carried out. The operation has not been done often. Langenbuch of Berlin performed the first operation, in 1879; and Robertson, Southam, and a few others have operated in recent years. None of the reported cases have recovered. Two of them have been performed for cicatricial stenosis, and would probably have been better treated by forcible dilatation.

The operation is found practically not to be so difficult as might be expected. In health, it would scarcely be possible to bring the duodenum up to the abdominal wound; but, in disease, the attachments of the duodenum are stretched, and the bowel is usually displaced downwards with the dilated stomach, so that it can without much difficulty be brought to the surface. Langenbuch and Southam performed the operation in two stages—postponing the opening of the bowel for seven and three days respectively. The principles of operation are essentially the same as in gastrostomy for stricture of the œsophagus, and need not be again repeated.

Jejunostomy.—This is the same proceeding as duodenostomy, carried out for a similar purpose, only a little lower down in the bowel, where it is less closely attached and more easily drawn to the surface. Pearce Gould, Golding-Bird, Ogston, and others have performed the operation in England. Ogston's case was very successful; the others were failures. A few scattered cases are recorded; but the operation is still in its infancy, and little can be said about it. It seems theoretically to be a better operation than duodenostomy, as regards facility of performance: as regards the worth of it, as offering an opening for the supply of food, there is probably little to choose between them.

If in any case in which pylorectomy was contemplated, and found, after making the parietal incision, to be impracticable, it is still considered advisable to give the patient a chance of

prolongation of life, then I believe that the choice lies between gastro-enterostomy and jejunostomy. If the patient is fairly strong and is bearing the operation well, gastro-enterostomy might be selected; if it appears advisable to shorten the proceeding as much as possible, jejunostomy is substituted.

The operation requires no special description. The jejunum may be found by pushing aside the omentum, and is drawn to the surface, sutured to the abdominal wall and opened, either at once or later on, as in gastrostomy. The value of peptonised foods in the subsequent treatment of the case is likely to be conspicuous.

Gastrectomy, or total extirpation of the stomach, was begun in 1883 by Connor of Cincinnati,* but was not completed, as the patient died on the table. He intended, after removing the stomach, to unite the cardia to some part of the small intestine. He says nothing as to how the vitality of the colon is to be provided for, and produces insufficient evidence to show that the operation is either feasible or proper.

Partial Gastrectomy, for cases where a malignant growth is situated in the walls of the stomach away from the pylorus or cardia, would seem to be a proceeding easier than pylorectomy, and likely to be followed by greater success. So far as I know, the operation has not yet been performed.

Intubation of the Pylorus, for stenosis, has been carried out by Hahn of Berlin. He performed gastrostomy, then carried a tube through the stenosed pylorus into the duodenum, and left it there. The patient lived three weeks. Forcible dilatation would now, in all probability, be preferably adopted.

* *Phila. Med. News*, Nov. 22nd, 1884.

SECTION VII.

OPERATIONS ON THE INTESTINES.

SURGICAL AND TOPOGRAPHICAL ANATOMY.

THERE is no definite topography of the small intestines, except at their extremities. Treves,* as a result of careful examinations in one hundred bodies, came to the conclusion that accurate localisation was quite impossible. In the majority of adult bodies the following arrangement was found: "The small intestine is disposed in an irregularly curved manner from left to right. The gut, starting from the duodenum, will first occupy the contiguous parts of the left side of the epigastric and umbilical regions; the coils then fill some part of the left hypochondriac and umbilical regions; they now commonly descend into the pelvis, reappear in the left iliac quarter, and then occupy in order the hypogastric, lower umbilical, right

* *The Anatomy of the Intestinal Canal and Peritoneum in Man.* Lond., 1885.

lumbar, and right iliac regions. Before reaching the latter situation they commonly descend again into the pelvis."

Special interest attaches to a knowledge of the parts of bowel which usually occupy the pelvis. It is not till some three or four years after birth that the pelvis begins to accommodate intestine. According to Treves, the parts usually found in the pelvis of an adult "belong to the terminal point of the ileum, and to that part of the intestine which has the longest mesentery—the part, namely, which extends between two points, respectively six and eleven feet from the end of the duodenum. It is not, therefore, uncommon to find loops lying together in contact with the pelvic floor that are in reality some twelve or fourteen feet apart."

An examination of some twenty bodies, with a view to fixing the topography of the bowels, convinced the writer that the variations were too great to be of value in practical surgery. The average disposition, as described by Treves, though for the majority of cases probably correct, is yet liable to so many variations in individuals, that rules of practice cannot with safety be based upon it.

The attachments of the mesentery have some surgical importance. (Fig. 52.) In localising a certain portion of bowel, and ascertaining the direction of it from duodenum to cæcum, it may be of assistance to remember that the right layer of the mesentery is also its upper layer, and the left layer the lower. The upper layer is continuous with the lower layer of the transverse meso-colon, and also with the peritoneum which invests the ascending colon. The lower layer is continued over the descending colon, forms the mesentery of the sigmoid flexure, and descends into the pelvis. When the abdomen is not distended, the length of the mesentery is such that any part of the small intestine can easily be raised up through an opening in the abdominal wall near the umbilicus. When the abdomen is distended, it may be impossible to bring certain portions of bowel through a median incision. Normally, according to Treves, the bowel cannot be dragged down below the level of the spine of the pubes. In elderly women with lax parietes the

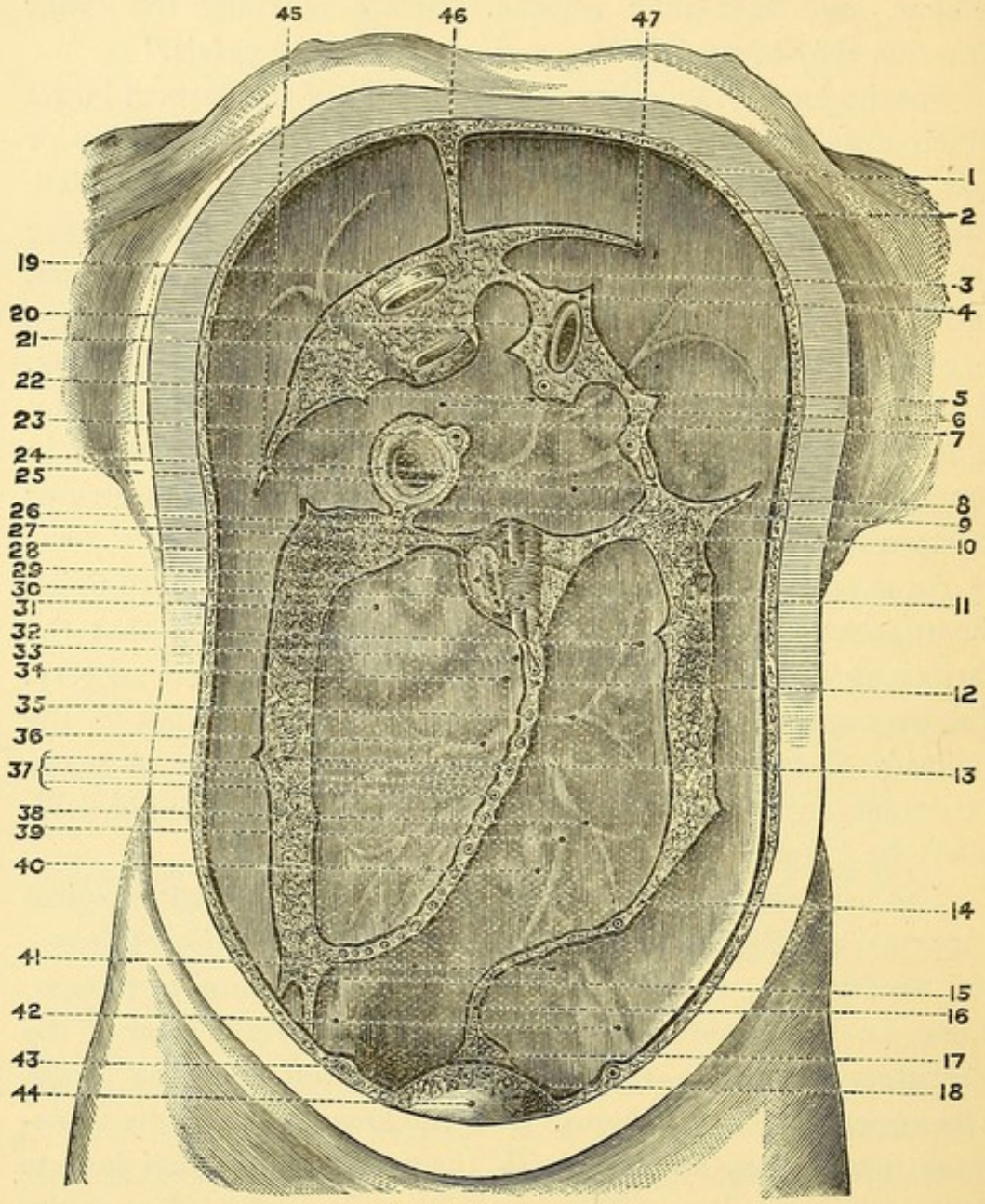

FIG. 52. (GRAY'S ANATOMY. 11th Ed.)

Diagram devised by Dr. Delépine to show the lines along which the Peritoneum leaves the Wall of the Abdomen to invest the Viscera.

1. Peritoneum. 2. Extra-peritoneal Tissue. 3. Diaphragmatic end of Gastro-hepatic Omentum. 4. Gastro-phrenic Ligament. 5. Gastro-splenic Omentum. 6. Foramen of Winslow. 7. Duodenum (1st part). 8. Costo-colic Ligament. 9. Dot between two Anterior Layers of Great Omentum. 10. Transverse Meso-colon. 11. Bare surface for Descending Colon. 12. The two Layers of the Mesentery Proper. 13. Bare surface for Ascending Colon. 14. Sigmoid Meso-colon. 15. Bare surface for Cæcum. 16. Meso-rectum. 17. Bare surface for 2nd part of Rectum. 18. Left Lateral False Ligament of Bladder. 19. Vena Cava Inferior. 20. Œsophagus. 21. Right Phrenic Artery. 22. Coronary Artery. 23. Hepatic Artery. 24. Splenic Artery. 25. Pancreas. 26. Inferior Pancreatico-duodenal Artery. 27. Colica Media. 28. Superior Mesenteric. 29. Duodenum (3rd part). 30. Aorta. 31. Duodenum (2nd part). 32. Right and Left Kidneys. 33. Superior Mesenteric. 34. Aorta. 35. Colica Sinistra. 36. Colica Dextra. 37. Vasa Intestini. 38. Sigmoid Artery. 39. Sup. Hæmorrhoidal Artery. 40. Common Iliac Artery. 41. Internal Iliac Artery. 42. External Iliac Artery. 43. Epigastric Artery. 44. Bladder. 45. Right Lateral Ligament of Liver. 46. Falciform Ligament of Liver. 47. Left Lateral Ligament of Liver.

mesentery is long, and the bowels are permitted greater freedom of range.

The topography of the large bowel is more definite. With respect to the cæcum, Treves's investigations have shown the existence of very general misconception.* It is generally held that the posterior surface of the cæcum is uncovered by peritoneum, and is attached by areolar tissue to the iliac fascia, thus bespeaking the existence of a meso-cæcum. Treves found, on the contrary, that the cæcum was always entirely enveloped by peritoneum, and lay free in the abdominal cavity; that there was no sign of a meso-cæcum; and that it usually lay upon the psoas muscle, so placed that its lowest point projected beyond the inner border of that muscle. In the great majority of instances, the apex of the cæcum will be found to correspond with a point a little to the inner side of the middle of Poupart's ligament. The lower limit of the reflexion of the peritoneum from the under surface of the cæcum to the posterior surface of the abdominal wall in other words, the lower border of the ascending meso-colon is a little below the level of the superior crest of the ilium.

The direction of the ascending and the descending colon is vertical, and the transverse colon lies almost horizontally between them. The splenic flexure is higher than the hepatic, and lies deeper in the abdomen. And the transverse colon very frequently takes a bend downwards. These bends sometimes descend a considerable distance, occasionally reaching the pubes; but they rarely get below the level of the crests of the ilia. They are sometimes quite acute, forming **V**-shaped curves.

Of much surgical importance is the disposition of the ascending and descending meso-colon. It is generally supposed that a meso-colon is more common on the right side than on the left, and this is often quoted as an argument in favour of left lumbar

* Although it has very recently been shown (Matas, in *New Orleans Med. and Surg. Journal*, Dec., 1887) that twenty-five years before Treves wrote, Bardeleben and Luschka insisted on the fact that the cæcum is completely surrounded by peritoneum, and several German anatomists maintained the same view, I have preferred to leave the text as it was printed in the first edition, if only to show, that so far as we in England have been instructed, Treves's studies deserve to be considered as discoveries.

colotomy. Treves found the reverse to be the case. "In fifty-two (out of a hundred) bodies there was neither an ascending nor a descending meso-colon. In twenty-two there was a descending meso-colon, but no trace of a corresponding fold on the other side. In fourteen subjects there was a meso-colon to both the ascending and the descending segments of the bowel; while, in the remaining twelve bodies, there was an ascending meso-colon, but no corresponding fold on the left side. It follows, therefore, that in performing lumbar colotomy a meso-colon may be expected upon the left side in 36 per cent. of all cases, and on the right side in 26 per cent."

It may perhaps be right to remark, that some indefiniteness must be admitted as to the existence or not of an ascending or descending meso-colon. A collapsed gut may have a well-marked meso-colon, when a distended gut would have none. As the bowel empties, the peritoneal layers fall together behind it; while, as it is filled, they are pushed apart, and the intestine becomes sessile. It will be found that a dilating colon borrows more of its investing peritoneum from behind, where the areolar tissue is lax, than from the front, where it is more firmly adherent.

The left meso-colon is usually attached along the outer border of the kidney, and is vertical. The right meso-colon is not quite vertical, but "crosses the lower end of the kidney from right to left, and then ascends along the inner border of the gland" (Treves).

In surgical operations on the intestines, it is impossible to ignore the great omentum. Rarely is it found conforming to the anatomical descriptions of it—spread out like an apron over the bowels. In many cases it is never seen, being placed high up, coiled or folded upon itself. In other cases it lies entirely on one side of the abdomen, usually the left. It may be twisted up like a rope, or spread out in one part and contracted in another; frequently it is adherent to bowel or parietes; sometimes it is partly embedded among the intestines. It may be thin and translucent or even cribriform, or it may be very thick and laden with fat.

The free anastomosis of the intestinal vessels in the peritoneum has as much surgical significance on the one hand, as their circular distribution in the intestinal walls on the other. Thus, though a piece of mesentery may be destroyed at a little distance from the bowel without impairing its vitality, the smallest portion of bowel left without its mesentery closely attached to it may, and probably will, die.

A word must be said on the sigmoid flexure of the colon. Treves has shown that the curve which this part of the bowel describes is more of the shape of the Greek Ω than the letter S. This omega-flexure has a well-marked mesentery. It usually lies wholly in the pelvis. When distended it rises out of the pelvis, reaching sometimes as high as the umbilicus, and, in cases of extreme distension, even to the liver. In this condition it is liable to become twisted upon itself, producing volvulus. Its more exact disposition does not here specially concern us.

As bearing upon all operations on the intestines, and especially on resection and suture, the anatomical structure of the intestinal coats and the mode of attachment of the tube to the mesentery are of supreme importance. The following statements are based upon the elaborate studies of William S. Halsted of New York;* also upon notes by Mr. Anderson of St. Thomas's Hospital,† and upon some observations made by myself. As they, in some respects, modify or contradict generally accepted views, they must be given with some degree of fulness.

Firstly, as to the structure of the internal coats. Fig. 53 is copied from Halsted's paper. It "is a diagram of the dog's intestine, and is intended to represent accurately the thickness of the several coats. The serosa is prolonged beyond the outer muscular coat to emphasise its thinness. Between the submucosa and the glands of Lieberkühn—in other words, between it and the lumen of the intestine—practically nothing intervenes; and, literally, nothing but the two layers of muscularis mucosæ and fibrosa mucosæ respectively. Fully two-thirds of the thickness of the wall of the intestine is mucous membrane. When

* *Internat. Journ. Med. Sc.*, Oct., 1887.

† MacCormac's *Abdominal Section*, 1887, p. 25.

the needle, therefore, has been passed through its outer third it must have entered the glands of Lieberkühn, and, hence, the lumen of the gut. It is an easy matter to isolate the sub-mucosa. The outer muscular coats strip from it readily, and the mucous membrane can be rapidly scraped off with a knife. Thus obtained, the sub-mucosa is found to be an exceedingly tough fibrous membrane. It is air-tight and water-tight, and is the 'skin' in which sausage-meat is stuffed. It is, moreover, the coat of the intestine from which 'catgut' is made.

"A needle, on being pushed vertically through the walls of the intestine, meets with considerable resistance when it reaches the sub-mucosa, and still greater resistance is encountered if it be attempted to pass the needle horizontally through its meshes. A delicate thread of this tissue is very much stronger and better able to hold a stitch than a coarse shred of the entire thickness of the muscular and serous coats." Practical experiments to test this point bore out these views. Halsted "soon discovered that, even to the sharpened end of a needle, sufficient resistance is offered by the sub-mucosa to be readily appreciable, and that it is possible and, with very little practice, not difficult to pick up at each stitch a thread-like piece of sub-mucosa without incurring the danger of passing into the lumen of the gut."

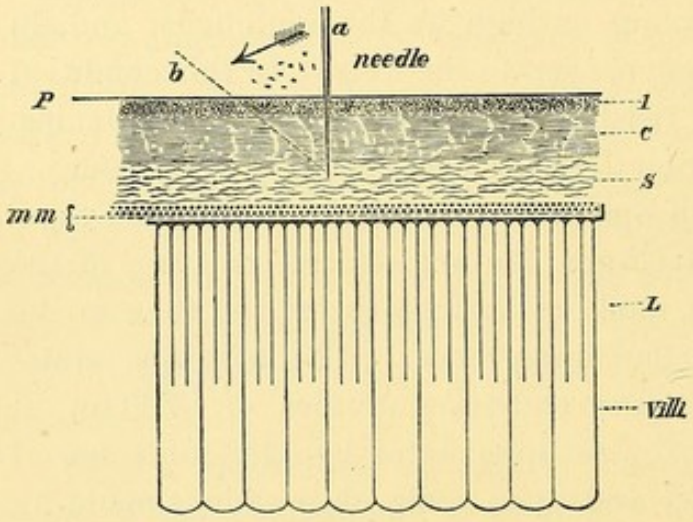

FIG. 53. (HALSTED.)

Diagram of Section of Dog's Intestine.

P, Peritoneum; L, Longitudinal Muscular Coat; C, Circular Muscular Coat; S, Sub-mucosa; mm, Muscularis mucosæ; L, Glands of Lieberkühn.

Practical advantage of the toughness of this sub-mucosa may further be taken by picking up portions of it in stitches, carefully

placed so as to pierce it at some distance apart, and making traction on the sutures. This raises a ridge on the serous aspect of the gut, which at once marks the line in which the co-aptating sutures should be placed, and, by raising the tissue to the needle, greatly facilitates the introduction of the individual sutures. I have endeavoured to show this in the diagram accompanying the description of enterorraphy.

As to the disposition of the mesentery around the gut, we must not forget that it is not a complete envelope, but leaves a portion of the lumen, averaging about five-sixteenths of an inch in width (Anderson), for which the outer covering is the muscular. The divergence of the layers of mesentery begins at a distance varying from two-thirds to three-fourths of an inch from the wall of the gut, and we thus get a triangular space, filled with fat, intestinal vessels and lymphatics, bounded by mesentery on two sides and bowel on the third. The arterial loops to supply the intestines lying in this space come to within a third of an inch of the gut, closer in the lower portion of the ileum than in the jejunum. From these loops are given off the straight vessels, which pass directly, on each side of the interspace, to supply the bowel. It is evident that the anastomosing loops should be injured as little as possible, if the vitality of the bowel is to be assured; triangular resection of the mesentery should therefore be, as far as possible, avoided. The layers of the mesentery at their attachment to the bowel are very lax and easily drawn together by purse-string sutures, so that they need not be in the way, even if they are left behind; while, as will be pointed out further on, they may be employed to give breadth and solidity to the intestinal union at a point where it has been found that it most frequently gives way.

Laparotomy for Intestinal Obstruction.

The relief of intestinal obstruction by Laparotomy is, in most cases, of the nature of a herniotomy. If we regard an ordinary hernial sac as an artificial diverticulum of the abdominal cavity, and if the sac is opened during operation, we may regard such as an abdominal section. In intestinal hernia we operate without full knowledge of the site and nature of the obstruction; it is not visible, very rarely tangible, and, in many cases, can only be inferred with a high degree of probability from rational symptoms.

History.—The question of operative treatment in intestinal obstruction has been discussed for centuries. It is doubtful if the Greeks or Romans performed the operation. Le Clerc, in his *History of Medicine*, tells us that Praxagoras advised laparotomy in cases of volvulus or intussusception (they were considered as synonymous); and even incision into the gut to allow the fæces to escape, when the gut should be sewn up and the abdominal wound closed. This is certainly very advanced treatment; but it is more than doubtful if it was ever carried out. Praxagoras was very fond of the use of emetics in intestinal obstruction: they did good, no doubt, by relieving the distended viscera of fluids and gas, just as Kussmaul's treatment does by the repeated use of the stomach-pump. The injection of air per anum had been in use since the days of Hippocrates. In later times bleeding was, of course, in constant requisition.

In more recent times, Bonet, who edited Barbette's work, writes a foot-note to his remarks on volvulus, that he has known an operation performed for volvulus with success. I find the note quoted by M. Hévin, in a paper on "Gastrotomy" in the *Transactions of the Royal Academy of Surgery of Paris*, vol. iv., 1768: "The Baroness de Lanti, of Chatillon-sur-Seine, was nearly dead of an iliac passion. A young surgeon who had served in the army for a long time came forward, and promised recovery

if the patient would submit to operation. He was allowed to operate. He pulled out a great deal of the intestine before he found the twist; he freed it, *nodos dissolvit*, and returned it to its place. He sewed up the abdomen, and the wound healed nicely, and the patient recovered." The Baroness very properly settled a pension on this daring young surgeon, but he did not live long to enjoy it. Hévin considers that this may have been a case of hernia; but it is difficult to see why he should have to undo twists, and stitch up the abdominal wall, for a herniotomy. No doubt can be cast on another case, recorded by Oesterdykins Schacht, in which Nuck was the counsellor of operation. In this case the exposed intestines were carefully covered by warm milk while the coils were unravelled, and the patient also recovered. Most authors of the seventeenth and eighteenth centuries, with the notable exceptions of Hoffman and Felix Platerus, condemn the operation. Van Sweiten has been quoted as being favourable to Barbette's operation, and other names might be added. No doubt the operation was many times performed in the last two centuries, but with almost uniform failure; and this may have prevented the operators, in the face of the very general condemnation which it received at the hands of the greatest men, from publishing their cases. M. Hévin himself, in the article quoted, is by no means in favour of operative proceeding.

In the surgery of the present century, up to comparatively recent times, the operation had no history. It was either condemned or ignored. And even at the present day, in spite of the great advances in abdominal surgery and the increased certitude of diagnosis, there are many medical men who would consider it no discredit to stand by with folded hands while a patient is dying of an unrelieved internal strangulation of the bowels.

CONDITIONS FOR WHICH OPERATION MAY BE PERFORMED.

A full account of these conditions involves a description of all the forms of intestinal obstruction, with their differential and general diagnosis. The limits set to this work demand that

such description be very short. And the need for it will not be felt by English readers, who have had provided for them the admirable manual by Treves on *Intestinal Obstruction*.

For clinical purposes, we may divide the forms of intestinal obstruction into Acute and Chronic: the one, where the symptoms come on suddenly in a patient who has shown no previous symptoms of disease; the other, where the onset is more or less slow, or where there have been previous signs of intestinal disease. Thus classified, the varieties are:

Acute.

I. Strangulation by bands or through apertures.
II. Volvulus.
III. Intussusception.

Chronic.

IV. Stricture from disease in the walls of the gut, cicatricial or neoplastic.
V. Obstruction in the lumen: neoplasms, gall-stones, enteroliths, fæces, and foreign bodies generally.
VI. Obstruction from compression outside by tumours, &c.

I. Strangulation by Bands or through Apertures bears a close resemblance to ordinary hernia, not only in symptoms and causation, but also in treatment. The bowel is snared in an unyielding opening, which obstructs its lumen and strangulates its vessels. The small gut is nearly always implicated.

Various forms of bands are described.

(1) *Isolated Bands of organised Inflammatory Material*—"peritoneal false ligaments," as they are called—are frequently the cause of strangulation. Such bands vary greatly in length, density, and thickness: sometimes they are round; often they are flat. Not infrequently several such bands exist, and cases are recorded where strangulation took place simultaneously under two false ligaments. The attachments of these bands present an almost endless variety. Frequently one end is attached to the mesentery, the other being inserted into any part of the peritoneum.

Strangulation takes place either by the bowel slipping under the band, in which case it must be comparatively short; or by the bowel being caught in a twist or loop of the band, when it must be long. Sometimes obstruction is caused by the band dragging on the bowel, and so causing kinking. The modes of constriction are so bewilderingly varied, that it is impossible to classify them.

(2) *Bands or Cords of Omentum* constitute another mode of constriction. The omentum becomes adherent to some spot in the peritoneum; the whole, or part of it, is rolled up or twisted into a cord, which constricts the bowel, just as peritoneal false ligaments do. Omental bands are usually thick and vascular. They are found attached to any site where omentum can reach; and that is, practically, anywhere. But they most frequently have an origin in some way connected with old herniæ. Multiple cords and multiple constrictions are more common with omental than with peritoneal bands. The greater length and mobility of omental adhesions render strangulation through noose or knot a more likely occurrence than with peritoneal bands.

(3) *Strangulation by Meckel's Diverticulum* is of the nature of the preceding. Constriction may take place either when the diverticulum is attached to the umbilicus, or when it has become adherent at some novel situation. In the former case, the tube may be wholly or partially obliterated. The diverticulum acts as a peritoneal or omental band by constricting gut which passes below it, or by forming loops in which the gut is snared. I have operated on a case where strangulation was caused by several coils of bowel passing between the abdominal wall and a partially obliterated Meckel's diverticulum. Mere dragging on the diverticulum, by causing kinking or setting up inflammation, may induce intestinal obstruction. False diverticula have not been found associated with the complaint.

(4) *Strangulation by Normal Structures which have become adherent* is also met with. Thus, the vermiform appendix, or the Fallopian tube, or the appendices epiploicæ, or even the bowel and the mesentery itself, may all be causes of intestinal strangulation. I have operated on a case where it was difficult to say

whether the obstruction was caused by kinking from dragging on an old adhesion to the parietes, or by compression of a portion of bowel which passed over it.

(5) Strangulation may take place through *slits or holes* in the mesentery, or the omentum, or even in such situations as the broad ligament of the uterus and the suspensory ligament of the liver. Strangulation by the gut becoming caught in the foramen of Winslow has been described. About fifty examples of retro-peritoneal or mesenteric hernia, from the bowel getting entangled in the fossa duodeno-jejunalis, have been described.

In the great majority of cases owning the above causes, the small bowel is the part involved, and in most of these the lower part of the ileum. The probability of site advances almost in geometrical progression from duodenum to cæcum. The length of intestine strangulated ranges from a mere nipping of part of the calibre, to a capture of several feet. The average length is a little over a foot; but the limits are so wide apart, that any average is misleading.

The mechanism of obstruction is essentially the same as in external hernia. Simple entanglement, followed by congestion and partial or complete obstruction, will explain many cases; others are completely strangulated from the outset; a few, after the bowel has been caught and held for some time, undergo strangulation by a sudden and final twist or contortion. Senn's recent experiments show that in circular constriction of the intestine the immediate cause of gangrene is due to obstruction of the venous circulation, and takes place at a point most remote from the cause of the obstruction.

II. Volvulus is the name given to occlusion caused by torsion of the bowel, or rotation round its axis of attachment. In some cases, simple twisting is the cause; in others, two suitable coils become mutually intertwined. Volvulus is found at the sigmoid flexure, in the cæcum and ascending colon, and in the small intestine.

(1) *Volvulus of the Sigmoid Flexure* about its mesenteric axis is the most common form; two-thirds of all cases are of this

nature. The Ω-shape of this part of the gut, the length and loose attachment of its mesentery, and its tendency to become overloaded and displaced by collections of fæces, explain its liability to volvulus. The bowel may be twisted once, or twice, or even three times around its axis. In another class of cases the sigmoid loop, acting as a pedunculated tumour, becomes intertwined with a loop of small bowel, and induces strangulation of both.

(2) *Volvulus of the Cæcum*, or of the cæcum and colon adjoining, is easily understood. Mere acute flexure of the cæcum may block its passage; in such cases, however, there is usually some congenital malformation. In rotation of the cæcum upon itself, the colon is liable to be implicated, more especially if there is a long meso-colon. As with the sigmoid flexure, so here obstruction may be caused by the intertwining of small intestine. Volvulus of the ascending colon is rare, and usually depends on anatomical abnormality. Volvulus of the cæcum may be subacute or chronic. I have treated with a medical colleague a case where, with only about half a rotation, there was enormous cæcal distension; the distended bowel occupied half the abdominal cavity.

(3) *Volvulus of the Small Intestine* is rare. It may arise from the simple twisting of one coil, or from the intertwining of two loops. An abnormally long mesentery, as from an old hernia, is a predisposing cause. The simple twist is usually through one complete circle, and is most frequently from left to right. Volvulus by the intertwining of two loops is very rare.

III. Intussusception or Invagination of the intestine means the prolapse of a part of bowel into the lumen of the part adjoining. It is the most frequent single cause of intestinal obstruction, constituting more than one-third of all cases. The pathological anatomy of intussusception is well understood, and need not be dwelt upon. One portion of bowel catches another portion just above it, grasps it as if it were food, and pushes it along, invaginating more and more of it. The portion pushed inside, consisting of an entering and a returning layer placed

peritoneum to peritoneum, is known as the intussusceptum. The sheath or containing bowel is known as the intussuscipiens. The neck is at the entrance of the invagination, where the sheath joins the returning layer. Rare varieties are met with where double or triple intussusceptions take place, where a second intussusception is invaginated in a first, or a third inside both. A retrograde invagination, where a descending invagination is associated with an ascending one, is described.

When invagination is complete, adhesions form between the opposed peritoneal surfaces of the entering and returning layers, and these after a time become so strong as to render reduction impossible. Mere invagination need not cause obstruction; it is only when the opening in the intussusception becomes incurved by the dragging of the mesentery, or the walls become swollen from congestion or inflammation, that obstruction takes place. The invaginated portion, as a rule, undergoes inflammatory changes, which end in adhesion of the intestinal cylinders, or have more pronounced results in rupture of vessels from intense congestion, causing discharge of blood by the rectum, or even terminate in gangrene. Sloughing, with separation of the sphacelated portion, is found chiefly in cases of acute intussusception, though it is not uncommon in chronic cases. This sloughing, according to Senn, is caused by obstruction to the return of venous blood by constriction at the neck of the intussuscipiens.

There is a curious connection between epithelioma and intussusception. Most probably the epithelioma was the originator. The indurated mass gets caught in the bowel, is passed on as the apex of an intussusception, and there it continues growing. It is, however, quite consistent with what we know of the origin of epithelioma that it should have started in the ulcerating areas of the chronic intussusception.

Into the extremely interesting questions of the origin and cause of intussusception, I cannot here enter. I believe that many of the cases of acute colic produced by eating indigestible substances are intussusceptions which right themselves. The frequency of intussusception of the dying is much greater than

is generally supposed; if carefully looked for, at least one body out of four will show it on the post-mortem table.

Intussusception may take place—(1) in the small bowel, (2) in the colon or rectum, or (3) in the ileo-cæcal region. In the small bowel, it is found most frequently in the lower jejunum; and next in frequency, though in the proportion of four to one, in the ileum. The narrow calibre of the small bowel prevents any considerable amount of invagination; rarely is more than a foot engaged.

Intussusception of the large bowel may occur at any part of its course. It is not common in this situation; and when it does occur it is small, particularly in the rectum.

The most common site of intussusception is in the ileo-cæcal region. Two varieties are here met with—the ileo-cæcal and the ileo-colic. In the former, the ileo-cæcal valve forms the apex of the intussusception, and passes up the colon, followed by the cæcum and the ileum. In the latter, the ileum, passing through the ileo-cæcal valve, is invaginated up the colon. A rare and complicated variety is, where a primary invagination of the end of the ileum is either passed through the valve into the colon, or invaginated into the colon along with the cæcum.

IV. Changes in the Substance of the Intestinal Wall may, by narrowing the lumen, be a cause of obstruction. Such changes may be of the nature of simple cicatricial stricture, or of new growths.

(1) *Simple Stricture* is produced by cicatricial contraction of organised inflammatory material replacing an old ulcer, or loss of substance, or following any chronic inflammation. Ulcers may originate in enteric fever, dysentery, or catarrh; peptic ulcer in the duodenum; syphilis or phthisis. As originating in chronic inflammation, stricture is seen in its most typical form in bowel that had been engaged in an old hernia. Any injury to the bowel may result in cicatricial stricture.

(2) Stricture may be caused by the development of *new growths*, malignant or benign. The malignant stricture is nearly always of the nature of epithelioma of the cylindrical variety;

scirrhus and encephaloid are almost unknown. Epithelioma typically appears as a hard band embedded in the wall of the intestine, and constricting its lumen as if by a tightly-drawn ligature. The constriction is not always annular; sometimes it is in broad and diffused areas over a considerable portion of the intestinal wall. Thickening of the peritoneal and muscular coats is always present. Epithelioma of the intestine is practically always single and localised, and the mesenteric glands are late in becoming affected. As existing in the rectum, within the reach of the exploring finger, and treated by a special operation —colotomy,—the disease will again come under review.

Sarcoma and lympho-sarcoma are rarely found as causes of obstruction.

New growths of benign nature—such as, adenomata, tumours of pure fibrous tissue, or of fibrous and muscular tissue combined; fatty and vascular growths; and growths of a cystic nature* have all been known to cause obstruction: but they are by no means common.

V. Obstruction by a Foreign Body blocking the lumen of the gut is sometimes found. In this class must be reckoned the accumulation of fæces. Foreign bodies swallowed and becoming aggregated, gall-stones, and intestinal calculi or enteroliths, are causes of intestinal obstruction. Some polypi or pedunculated adenomata cause obstruction by their bulk in the cavity of the bowel.

In such cases obstructed circulation and strangulation of the bowel do not occur, and the symptoms in consequence are not, at first, very urgent.

VI. Compression of the Gut by Tumours outside of it forms a separate class. Obstruction may be produced in the most varied ways. I have seen a case where alarming symptoms of intestinal obstruction were produced by retroversion of the gravid uterus, pressing probably on entangled loops of small

* See Janicke and Buchwald, *Deutsche med. Woch.*, 1887, xl. Also Abstract in *Lond. Med. Rec.*, Nov. 15th, 1887.

bowel. All sorts of growths—solid or cystic, or even abscesses in the peritoneal cavity—may press on the bowel and block its passage. Growths of the liver or pancreas may cause obstruction in the duodenum; tumours of the ovary, uterus, or pelvic bones, may compress the rectum; and the small bowel may be compressed by tumours in any part of the peritoneal cavity. Naturally, the less movable parts of intestine are most likely to suffer.

Usually such causes provide examples of chronic obstruction. The sudden displacement of a tumour may, however, produce sudden obstruction, with acute symptoms.

DIAGNOSIS OF INTESTINAL OBSTRUCTION.

In cases of acute obstruction, the onset is sudden; the symptoms from the beginning are urgent; and the result, after a rapid course, is almost uniformly fatal. Spontaneous recovery after volvulus is unknown; a very small proportion of cases of intussusception get well; and genuine examples of recovery after strangulation by bands or through apertures must be less common than in ordinary hernia, where the chance of recovery is practically considered as *nil*. In the case of the last, recovery takes place from gangrene of the gut, with the formation of false anus; in internal obstruction, gangrene is certain death. There is a variety of intussusception which is chronic, and is not reckoned among examples of acute strangulation.

The symptoms are those of strangulated hernia, aggravated. Severe abdominal pain, collapse, vomiting, constipation, and abdominal distension are the leading symptoms. The pain is always severe and often agonising. It is frequently intermittent, and liable to exacerbations—possibly, as Treves suggests, on account of the intermitting nature of the constriction. The character of the pain varies: sometimes it is of the nature of severe colic, pure and simple; at other times, a sensation is felt as if a band were drawn tightly round the abdomen. The site of the pain is not a trustworthy guide to the seat of obstruction.

Collapse, always marked, often alarming, attends every case of acute intestinal obstruction. We may expect to find the collapse most severe in cases where the onset is very sudden, and the patient is young and vigorous. Profound collapse suggests complete strangulation; but the degree of it is no guide to the amount of bowel involved.

Vomiting is always an early and well-marked symptom. The irritated bowels soon become filled to distension with secretions, fluid and gaseous; and, under increased abdominal pressure and the constant contractions of the intestinal muscle, these secretions escape by the only possible exit—the stomach. Anti-peristalsis, or Dr. Brinton's well-known explanation of the process by the production of an axial and a peripheral current, may account for this vomiting. But such explanations are no more necessary to explain the regurgitation of the intestinal contents in the living than in the dead. Mere gaseous distension and increased abdominal pressure force the contents out of the mouth after death; and these passive causes, in addition to the very active one of intestinal contractions, may do the same during life.

The vomiting may or may not be attended with retching. Sometimes the fluids are ejected in great gushes without much straining effort. The vomit at first consists of the natural contents of the bowel; then, of bile-stained fluids; then, of dark grumous material—"coffee-ground"; and finally, of fæcal matter, more or less diluted. That fæcal matter may be vomited, even if the constriction is well above the large bowel, there is no longer any dispute; but we should not expect fæcal vomiting if the constriction is not below the jejunum. At first the vomiting may be of the nature of a reflex nerve symptom; later on, it is mainly a mechanical discharge of accumulated secretion, and the existence and continuance of such vomiting affords relief to the patient.

Constipation, absolute and insuperable, is an important sign. Occasionally, at an early stage of the complaint, fæces are passed from the bowel below the seat of constriction; but when the disease is well established, neither fæces nor flatus pass.

Discharge of blood by the anus is found in a considerable number of cases of intussusception.

Abdominal distension, from the accumulation of gas and fluid, is an early and prominent symptom. It increases with the duration of the illness; and in marked examples the parietes may be tense, like a drum, and visibly white and glistening from being stretched. In such cases mechanical obstruction to respiration is present. Tympanitic resonance all over the abdomen, except perhaps in the flanks, is marked.

It need scarcely be added that, in making the diagnosis, all the usual sites of external hernia must be explored, and the rectum must be digitally examined.

The *Diagnosis from other Diseases* is not often difficult. A localised paralysis of the gut, from inflammation of its walls or from nerve disturbance, may produce symptoms very similar to those of intestinal obstruction. A bruise or crush of the bowel, inflammation after reduction of a strangulated hernia, are practically varieties of obstruction. Descending testicle becoming incarcerated or inflamed is well known to cause symptoms like those of obstruction. I have been called to treat a man aged 76 for urgent symptoms of obstruction, which were found to be produced by inflammation in a testicle, which lay undescended in the inguinal canal, and I have seen two similar cases in hospital practice.

Acute peritonitis may be mistaken for intestinal obstruction; in fact, the mistake has been made on not a few occasions. If peritonitis is caused by perforation, the symptoms may be most misleading. A few hours will, however, make the diagnosis clear. The temperature is no guide; the worst cases of peritonitis may have a normal, or even subnormal, temperature. The nature of the onset, the character of the vomiting, the quality of the pain, and, most important of all, the palpation of the abdomen, will also guide us. Lead colic, accompanied as it often is with obstinate constipation, and renal or hepatic colic, where pain, collapse, and vomiting may be present, might also be mistaken for intestinal obstruction.

The *Diagnosis of the Variety of Obstruction* may be attended with considerable difficulty. It is nearly always possible to say whether the case is one of acute or of chronic obstruction: the difficulties appear in the diagnosis of the individual variety.

A chronic case, in which the primary symptoms have been obscure, may suddenly become acute. The terminal symptoms of all cases of obstruction are very similar.

The *Symptoms of Acute Obstruction* are as follows: The patient, in ordinary health, is suddenly seized with severe abdominal pain of a griping character, with exacerbations. He is at once prostrated, suffers from shock, and his face indicates the patient's consciousness that he is seriously ill. Vomiting very soon follows the first attack of pain, and continues at irregular but short intervals. There is absolute constipation, and abdominal distension which goes on increasing with the duration of the malady.

It must be noted that acute symptoms occasionally supervene on chronic causes; and the reverse, to a more limited extent, holds true.

The diagnosis of the *Variety of Acute Obstruction* may often be successful.

Strangulation by Bands.—The patient is probably a young male adult, who will usually have a previous history of peritonitis. In a few cases a previous attack of obstruction, partial and mild, will be recorded. The disease will have attacked him suddenly, and without warning, in the midst of his ordinary pursuits. The pain, which from the beginning is severe, is continuous, with exacerbations, and is usually located in the region of the umbilicus. There is no tenderness on pressure. Vomiting soon comes on, and is frequent and copious. In more than half the cases, it becomes stercoraceous about the fourth or fifth day. From the first constipation is complete. No blood is discharged. Extreme prostration, or even profound collapse, may be present from the beginning; usually it is most marked at the onset, and becomes less marked afterwards. Abdominal distension is not at first a marked symptom. No tumour is felt on palpation.

Such cases die about the fifth or sixth day.

Volvulus of the Small Intestines presents symptoms very similar to the above. *Volvulus of the Colon*, nearly always at the sigmoid flexure, presents more distinctive symptoms. It is usually found in males, after the age of forty, who have suffered for some time from constipation. Pain comes on at once, but it is not so severe as in strangulation through bands, and it frequently intermits. Occasionally the pain is referred to the hypogastrium or the back. Tenderness on pressure comes on as the disease continues. Vomiting comes on late, or not at all, and is never very urgent. In only fifteen per cent. of the cases does it become fæculent. Prostration is never extreme. Constipation exists from the first.

A distinctive symptom is a rapid and excessive accumulation of gas, which soon causes great distension of the abdomen.

The average duration of life is about six days.

Acute Intussusception usually appears in children. Pain is a prominent symptom; it comes on in waves, reaching a point of great intensity, and then subsiding. Vomiting is a very variable symptom: sometimes it is present from the onset, and is copious and frequent; at other times it comes on late, and is never severe; a few have no vomiting at all. The most characteristic sign is the discharge of blood by the rectum, frequently attended with diarrhœa and tenesmus. A definite tumour is frequently palpated through the parietes; and, in intussusceptions affecting the large bowel, the apex of the invaginated bowel may be felt through the rectum. Abdominal distension is usually absent; occasionally the abdomen is retracted.

These cases may be fatal within twenty-four hours; or they may last for several days; or they may become chronic, lasting for weeks.

The Symptoms of Chronic Obstruction need not be detailed. They are simply those of acute obstruction in a milder form, and prolonged over a longer period.

Stricture of the Small Bowel may be taken as representative of a large class of cases whose symptoms are broadly as follows. In such there is usually some previous history of intestinal

trouble, followed at a considerable interval by attacks of obstruction, gradually increasing in gravity till the final attack which jeopardises the life of the patient. Pain comes on in paroxysms, and completely intermits: not infrequently it appears after eating. Vomiting is not an urgent symptom; it is late in coming on, is neither frequent nor copious, and rarely is fæculent. Constipation, not absolute, or alternating with diarrhœa, will be present. Before the final attack, the patient will have lost flesh and spirits. Abdominal distension is replaced by attacks of flatulence, more or less distressing; but never, except at the end, causing dyspnœa.

Such cases may last for a month or more. In most cases, however, more or less acute symptoms supervene on the chronic, with corresponding curtailment of the duration of life.

It is rarely possible, unless a distinct tumour is felt, to diagnose simple from malignant stricture. The history may be of some assistance, however. Anything which causes gradual obliteration of the bowel, tumours outside or inside, contracting adhesions, and all such conditions, may produce identical symptoms.

Stricture of the Large Bowel has most features in common with stricture of the small bowel. There are the same irregular beginnings, and the same exacerbations, with occasional intermissions. Vomiting is less frequent in stricture of the large bowel. Distension is, however, always a marked, and often a very troublesome, accompaniment; and tenesmus, with the discharge of blood, mucus, or pus, is often found.

As cancer of the rectum, malignant stricture is perhaps the best known of all causes of intestinal obstruction.

Fæcal Accumulations have some special features of their own. They occur chiefly in women who have passed the prime of life, and, more particularly, in lunatics. The symptoms are simply those of constipation, becoming more and more intractable. There is usually a palpable, or even visible, tumour having the characters of fæces. The abdomen becomes generally distended with gas or fæces, or both. Pain of a paroxysmal nature supervenes. Vomiting is late in appearing, and is long

in becoming fæculent. There may be a history of previous attacks.

This is about as far in differential diagnosis as our present knowledge will carry us. Individual variations of symptoms must be allowed to each case on a liberal scale. The differences between a cumulative and an instantaneous cause,—between strangulation and mere obstruction; between obstruction in the small bowel and obstruction in the large bowel,—theoretically marked enough, are found in practice to be very difficult of detection. But, by a careful summation of the concrete symptoms in each case, it will nearly always be possible to form a tolerably correct opinion as to the exact nature of the obstruction, and formulate, either at once or after waiting a few hours, a consistent and definite plan of treatment.

INDICATIONS FOR OPERATION.

The indications to operate in any given case depend, in the first place, upon the chance which the patient has of getting well without operation; and, in the second place, upon the degree of probability with which success will follow the operation.

To cases of acute obstruction there is practically but one termination—death. No case of volvulus, whether of large or small intestine, has as yet been known to recover under treatment purely medicinal. Spontaneous recovery, in the numerous class of cases of strangulation by bands, is not to be looked for. In the case of intussusception, where we have been accustomed to look for favourable results without operation, it seems to me that Treves has made out a clear case against expectant treatment. Looked at from the side of causation, or actual pathological condition, there is practically no expectation of recovery. Certainly ninety-five per cent. of all such cases die.

Here, then, the indication is clear enough—as clear as the indication to tie a bleeding carotid—operation. In the sense of avoiding the risk of death, the indication is more definite

than in external hernia; for in hernia there is a chance of recovery by gangrene. In the sense of promoting the chances of recovery, the indication is not so strong; for more cases of external herniotomy must always recover, than of internal. The risks are increased in the same way by waiting, and by handling or purgation—which are almost the same in evil effect. There is but one treatment—release of the strangulated bowel from the strangulating band.

From the pathological standpoint, it is easy enough to be definite; but not so from the diagnostic. We are too seldom certain of the diagnosis, to be always dogmatic as to the treatment. But if we are doubtful whether we can do good by operating, we may be certain there are many ways of doing harm by administering drugs. There never yet was a case of true intestinal strangulation in which purgatives did not do harm; and not one out of ten escapes purgation. Emetics may do good; even bleeding may not do harm; but certainly purgation is baneful. I say nothing about manipulation of the abdomen under an anæsthetic. The cases of success recorded certainly do not read like cases of acute obstruction. But manipulation early in the case ought to be less harmful than purgation.

At once, or within a few hours, we ought to make a definite diagnosis. If we are convinced that it is acute obstruction, then operation should be performed at once; if we are convinced that it is not, another treatment equally definite ought to be pursued. From the beginning a definite plan of treatment ought to be laid down, and this plan ought to be adhered to. Let it be either drugs or operation, and never that fatal compromise—operation when drugs fail.

The indications for operation in chronic and sub-acute cases are by no means fixed and definite. Generally speaking, when, in a chronic case, we find that in spite of careful dieting and treatment the attacks of obstruction become more numerous and more severe, and finally if one attack supervenes which is positively insuperable and is rapidly killing the patient, then operation is indicated. But, with this, some conception must be

formed as to the nature of the operation, and the probable ultimate effects of it. Thus, in the case of peritoneal cancer obstructing the gut, uncertainty as to the amount of bowel involved, and the certainty of early death in spite of operation, would make operation scarcely justifiable. Cases of fæcal accumulation sometimes recover after the patient is apparently *in extremis*, with obstruction lasting, perhaps, for weeks; and in such operation is rarely indicated. In chronic intussusception, the question of operation is very difficult to settle. It is true that cases may have gone on for weeks without the formation of strong adhesions, rendering reduction impossible; but this chance is not to be reckoned upon. If the invagination cannot be reduced, and the bowel involved cannot be removed, we have still the unsatisfactory resources of making an artificial anus above the intussusception, or of forming anastomosis with another piece of bowel below the intussusception.

In many cases of stricture the question of resection of the bowel will arise: this will be considered later. In the case of foreign bodies in the bowel, treatment must be guided by the urgency of symptoms pointing to obstruction, or to ulceration and inflammation, and the proved inefficacy of other means of treatment.

Some discussion has taken place as to whether it is advisable to perform laparotomy for intestinal obstruction if peritonitis is present. Such a discussion is of an arm-chair nature—a reasoning away from the facts. Peritonitis is present in every case of true intestinal obstruction: it may be local or wide-spread, and it may be serous, plastic, or purulent. It is an essential concomitant of the disease. In a marked case of intestinal obstruction, I doubt if the separate diagnosis of peritonitis is ever possible. In any case its presence can be no contra-indication to operation. On the contrary, if other circumstances do not forbid it, I would regard peritonitis as a positive indication. It would be just as valid to argue against the performance of herniotomy because there was fluid in the hernial sac, as against laparotomy for obstruction because there was fluid in the abdomen.

Mortality and Appreciation.—The death-rate of laparotomy for intestinal obstruction is high, probably more than 70 per cent. Even thus the operation would still be justifiable; for nearly every case which recovers may be reckoned as saved from death, and the deaths are only hastening of the natural termination. There can be no doubt that delay is the chief cause of mortality. We know how successful early herniotomy is: surely, in the face of recent exploits in abdominal surgery, early laparotomy for intestinal strangulation ought to be only a little less successful. Before abdominal distension has come on, before the bowel has become inflamed, and before the patient's strength is exhausted, I have no hesitation in affirming that, in competent hands, laparotomy for intestinal obstruction would not have a mortality above fifteen per cent.

THE OPERATION.

The details of the operation include what is common to all cases of obstruction, and what is special to each variety. Some of the special proceedings are comparatively trivial; these will be described in the general account: others are of great moment, and these will receive separate consideration.

These patients are rarely promising subjects for anæsthesia. The surgeon is usually called in late, when the patient's heart is very weak, and his stomach and intestines are full of fluid. Vomiting, liable to occur during the anæsthetic, is full of danger: I have lost one patient on the operating table from this cause. It is often a question whether the stomach should not be first emptied by the stomach-pump. The mere administration of an anæsthetic is often followed by alarming symptoms: in a few minutes, though the operation may not be severe or prolonged, the condition of the patient may be changed from one not very serious to one positively alarming. This fact has so strongly impressed me that, in a bad case, with distended abdomen, I should always operate without general anæsthesia; make the incision, a very short one, after a local injection of

cocaine; be content with a short exploration, and, if the cause were not found, make an artificial anus. The operation may subsequently be completed when the patient is out of danger. Enterotomy with local anæsthesia is a very simple affair; general anæsthesia with an exploratory laparotomy is a very serious matter in an exhausted patient whose hollow viscera are distended with fluid and gas.

In this operation we have specially to bear in mind that the prime object in surgery is, not merely to perform a scientific and technically complete operation, but to save our patient's life. An operation for intestinal obstruction is certainly not completed till the cause has been removed; but if the cause can be removed only after a prolonged and difficult operation at the expense of the life of the patient, then I maintain it is better to temporise, save the patient's life by enterotomy, and remove the constriction afterwards when the patient can bear it. In every *very* bad case I should begin by putting the patient out of immediate danger, by the performance of enterotomy without general anæsthesia: as soon as he can bear it the cause of strangulation may be sought for, and the operation completed.

The Incision.—As we are rarely certain of the site of obstruction, we must adopt a form of incision which will give the greatest range and freedom for exploration and operation. This is a median incision, about midway between umbilicus and pubes if the abdomen is much distended, and nearer to the umbilicus if there is little distension. This incision is adopted merely for its convenience in exploring; there is no strong anatomical reason against adopting any other site.

The incision is made long enough to admit two fingers. When the sub-peritoneal fat is reached it bulges into the wound, being pushed outwards by the distended bowels. Tait's plan of opening the peritoneum, by pulling it outwards between pairs of catch-forceps and dividing the raised fold between them, is the best. If the membrane is thin, I prefer to pinch it up between the finger and thumb, roll it about to see that no bowel is included, and make a small opening at the top of the fold

with the scalpel. The opening is enlarged by scissors, upwards and downwards, to the extent of the external wound—that is, to about two inches. Bleeding will have been checked in the ordinary way. If afterwards found necessary, the incision may be prolonged.

Finding and Relieving the Obstruction.—The plan usually recommended is as follows. The hand, inserted through the wound (for this purpose the incision must be longer than that recommended), is first carried to the cæcum. If it is found much distended, we may expect to find the cause lower down somewhere in the colon. The hand follows the course of the ascending, transverse, and descending colon to the sigmoid flexure, seeking the cause of obstruction on the way. If it is not in the colon, we seek for it in the small bowel; and for this purpose, we are told to find and follow up the collapsed bowel below the obstruction. Lastly, the region of the umbilicus and the promontory of the sacrum, as being likely spots, are explored.

Now, these are excellent directions, from the pathologist's point of view; and they would be easily enough carried out if the bowels were not distended, and the abdominal walls not hard and tense. To explore the whole length of the colon through tense parietes and over dilated bowels would require that the arm be inserted half way up to the elbow—particularly if, as is often the case, the transverse colon is pushed upwards under the diaphragm. And to follow up individual coils of the small bowel with the hand is no more easy: if it is possible at all, it is tedious and difficult in the extreme. The finding of collapsed bowel would be of assistance: but, as often as not, there is no part of the bowel collapsed; it is only less distended than another part. The passing of the bowel along inch by inch will certainly expose the constriction, but it will probably kill the patient.

I believe that the best means of reaching the seat of constriction will be by inspection of the bowel presenting at the wound. There is a high probability, wherever the cause lie,

that the most dilated coils will rise nearest to the surface; and, the greater amount of bowel being within three inches of the umbilicus, there is a further probability that the most dilated coils will be within sight. Very gently they may be moved first on one side, then on the other, as well as upwards and downwards. The most dilated portion, which will be also the most congested or not far off it, is fixed upon and followed in the direction of increasing distension and congestion, wherever that may lead. It will certainly lead to the stricture. The whole manipulation may be carried out with two fingers. If, now that the obstruction and the nature of it are discovered, it seems necessary to prolong the incision to relieve it, this can be done in the direction which is most convenient.

Should this method not succeed (it has failed only once in twelve cases on which I have operated), I should then recommend the insertion of the hand to explore. Should this also fail, I should recommend that the most distended portion of bowel be permitted to extrude under a large flat sponge, wrung out of warm antiseptic lotion. One end of the loop will extrude less readily than the other, and one end will appear to become increasingly congested; these characters are sure guides to the seat of obstruction. When the bowel begins to show that it is fixed inside the abdomen, or when the evidences of congestion are striking, the finger inserted along this portion of bowel will detect the origin of the mischief.

This protrusion of bowels has a purpose other than the providing of more space for discovering and treating the cause of obstruction. It will be called for only in cases of great intestinal distension; and excessive distension I believe to be a condition which requires relief almost as urgently as actual strangulation. This distension can be relieved only by puncture or incision when the bowel is extruded.

The plan of permitting bowels to protrude has been very generally and very heartily condemned. The condemnation, however, has been in the spirit of the peritoneal surgery of the last generation, rather than of the present. In the face of the actual practical work now successfully carried out, it is idle to

argue that extrusion of the bowels, properly managed, is a source of serious danger. Less damage is likely to be inflicted on bowels by a soft sponge or sponge-cloth lightly resting on them, than by a rough hand pushing them about under great pressure inside the abdomen. Since writing the above for the previous edition, I am glad to be able to quote a good many successful practical experiences in favour of my view, at the hands of other surgeons. The chief objection to protrusion of bowel is the supposed difficulty of returning it. If in any case it is proper to return it, it is not very difficult to do so. An assistant hooks a finger of each hand under the ends of the incision, and pulls the parietes forwards; the surgeon spreads both hands over the sponge which covers the bowels, and by steady gentle pressure forces their contents into the bowels inside the abdomen. When empty and collapsed, the extruded bowels are readily returned.

But it is not always proper to return distended intestine into the abdominal cavity. I hold, on the contrary, that no operation for intestinal obstruction is properly completed if the patient leaves the operating table with a greatly distended abdomen. The effects of distension are doubly deleterious—on the system generally, and on the bowels themselves. That dyspnœa, palpitation, and what may be called abdominal shock, follow great distension of the abdominal cavity is well enough known. That paralysis may, and does, follow over-distension of a viscus such as intestine, whose contraction depends on inorganic muscle in its walls, is also known. But it is not generally recognised that the mere presence of an excess of fluid or gas in the intestine is in itself an efficient cause of obstruction. When the intestine, confined by mesentery and by the limits of the abdominal cavity, is fully distended, it does not form gentle curves, but acute flexures; at these flexures the intestinal walls on the mesenteric side encroach on the lumen, so as to form valves which obstruct the passage of contents. Even when the intestines, artificially distended in the deadhouse, are removed from the cavity with the mesentery attached, and laid on a table, they do not empty themselves. The disappointing results of simple tapping of the

bowels are thus explained: the gut is emptied down to the second or third flexure, and no further.

Further considerations in support of this view may be brought forward in the practical benefits derived from Nélaton's operation of enterotomy and Kussmaul's treatment by artificial emesis. Many cases of cure by enterotomy, which is nothing more than drainage of intestinal contents, have been recorded. And already a considerable number of cures by drainage through the œsophageal tube (Kussmaul's plan) have accumulated.* The relief that vomiting affords is evident in every case of intestinal obstruction; and no one, experienced in abdominal surgery, can fail to have observed the dangers of distension, or to have appreciated the benefits of getting rid of intestinal fluids.

I would therefore, in every case of laparotomy for intestinal obstruction with distension, consider evacuation of the intestinal contents as an essential part of the proceeding.

To open the bowel, it is best to make an incision by a scalpel transversely to its axis at the point most distant from the mesentery. A trocar and cannula, large enough to permit outflow with sufficient rapidity, would make a ragged, bruised wound, not so suitable for being dealt with by suture, and not so likely to heal kindly, as a simple incision. The bowel, properly protected, is pulled a few inches away from the wound, and held over a vessel by both hands, while an assistant gently kneads the sides of the abdomen to force the fluids along the bowel and up to the opening. The first flow of gas and liquid rushes out with considerable force, and a notable diminution in the size of the abdomen will at once be apparent: artificial pressure, however, is wanted to empty the rest of the bowels. Of course, the bowel that had been constricted will have been carefully examined to see that there is no chance of its being ruptured in the manipulation. But the operation having, on the whole, an effect of relieving the bowels of tension, need not be regarded as endangering the continuity of the intestinal walls. When the bowel is sufficiently empty, the opening is carefully closed by a continuous catgut or silk suture, including only peritoneum

* See, in particular, Rehn, *Centralbl. f. Chir.*, July 23rd, 1887.

muscle and sub-muscular fibrous tissue, in the ordinary manner. In three cases on which I operated in this way I used a double continuous suture, simply repeating the process with the same thread in the opposite direction. Any peritoneal fluid is to be mopped out, and the case generally treated as an ordinary abdominal section.

Removal of the Cause of Obstruction.—The surgical proceeding for the relief of the constriction varies according to the cause of it. In most cases where laparotomy is performed, the removal of the cause will consist in the division of a band, the enlargement of an opening and release of the bowel, the untwisting of a volvulus, or the drawing out of an intussusception. In all it may, as already indicated, be advisable to incise the bowel and draw off its contents. But in some cases it may be necessary to resect a piece of gangrenous or diseased bowel—enterectomy. In others it will be advisable to leave an intestinal fistula—enterostomy or enterotomy. These, and other allied special proceedings, will receive separate consideration. Here we consider the special modes of proceeding with the individual forms of constriction.

In Volvulus.—The unravelling of a volvulus of the small intestine, especially if it is caused by the intertwining of two coils, must frequently be a matter of considerable difficulty. Volvulus of the sigmoid flexure is still more difficult to deal with. At an autopsy which I performed on a case of volvulus of the cæcum, I could not, though the incision extended from sternum to pubes, undo the twist. Mr. Treves has had a similar experience with volvulus of the sigmoid flexure during the life of the patient, and found much difficulty in righting matters after death. In another case on which I operated, I was able to reduce a volvulus of the cæcum, and, with the aid of enterotomy, to save the patient's life. The rapid distension of the gut in volvulus, the early occurrence of peritonitis, and the complications which frequently accompany the condition, sufficiently explain the difficulty met with in reducing it.

Such cases left to themselves are hopeless, and a strong effort

should be made to bring success to the operation. As soon as it is evident that it is impossible to reduce the twist, the distended intestine, pulled out through the incision, ought to be opened at the highest part of the curve, and emptied of its contents. After this, reduction ought again to be attempted. If it succeeds, the opening in the bowel may be sutured and the abdominal wound closed. If it does not succeed, an artificial anus must be made in the first convenient piece of bowel above the volvulus. Resection of the affected gut has been suggested; but such a proceeding can scarcely be contemplated unless the volvulus is small, in which case reduction is less likely to fail.

In Strangulation by Bands and through Apertures.—The removal of a constriction belonging to this class is not usually a difficult proceeding. A peritoneal adhesion may be readily tied in two places by suitable ligatures, and divided between them. They ought to be tied as close as possible to their sites of attachment; as, if they are left long, they may give trouble at a future period. The same treatment ought to be applied to omental cords: they ought to be tied close to their point of origin, and cut off short. If, as is sometimes the case, the cord is very thick, it may be tied by transfixion in two portions; it will rarely be necessary to tie individual vessels. Sometimes there exists a second band, causing strangulation; a good few cases are recorded where death was caused by an overlooked strangulation.

In dealing with a Meckel's diverticulum, we must ascertain whether we are dealing with bowel, or the still pervious rudiment that goes to the umbilicus, or a simple inflammatory band. The band is treated as are other bands. When we have to deal with a pervious tube, we may, according to its size, be content with mere division as low down as possible; or we may, at the end next the bowel, have to make the closure as carefully as we should for any other opening into the bowel. Though there is a remote danger in leaving a diverticulum, there may be a still greater immediate danger in removing one if it is large; and its removal involves the making of an opening of a considerable size. It ought to be removed at a point where it is perceptibly diminished in size. The best mode of closure would probably

be by pushing inwards the mucous membrane, and ligaturing the fibrous coat outside it. If the opening appears to be too large to be treated in this way, it may be closed by the Lembert suture, or any other plan most affected. In a case on which I operated with pervious diverticulum about as thick as a crow-quill, I was content with simple ligature and careful disinfection of the mucous membrane.

If the appendix is the cause of constriction, we should try, by division of the adhesions, to liberate the constricted bowel. If this be impossible, the appendix itself must be cut through, and closed by suturing the peritoneal surfaces after having doubled the tube inwards. It must not be forgotten that the mesentery (so called) of the appendix sometimes contains a goodly sized vessel.

The Fallopian tube, adherent, as a cause of strangulation, may be treated as a simple band, and divided as such with safety; though, as in other cases, it is better to try and limit the division to the inflammatory new tissue.

In all such cases, the gut will be carefully examined before the abdomen is closed. If it is much distended, it will be incised and emptied at some distance from the site of constriction; if it is gangrenous or on the point of becoming perforated, this part must be excised in a manner to be described.

In Intussusception.—In most cases diagnosed as intussusception, a full trial to insufflation, injection of fluids, or some such means, will have been instituted, before abdominal section is thought of. It seems, from Treves's investigations, that spontaneous cure by separation of the gangrenous intussusception is a very rare event indeed; and cure, after any plan not operative, would seem to take place with far less frequency than is popularly supposed. With early operation, laparotomy for intussusception, involving as it does nothing more than merely pulling out the intussusceptum, ought to be one of the most successful of abdominal operations: when postponed till adhesions have formed, and a large amount of gut has become invaginated, it may be impossible to reduce it. In 51 operations collected by Braun, attempts to reduce the intussuscepted gut

succeeded in 26, and failed in 25; and 16 of these 26 cases subsequently died. Operation should not be delayed beyond the second day. At an autopsy, it will be usually found that the bowel will give way before the intussusceptum is pulled out. I have failed at operation to reduce a very large intussusception of three days' standing in a child a year old.

For reduction, the entering bowel ought to be grasped as closely as possible to the invagination, and the other fixed point ought to be the bowel just beyond the end of the intussusceptum; with traction is associated a gentle process of kneading. To catch the edge of the intussuscipiens close to the entrance, would be to force it down on itself and cause compression of the intussusceptum, and thereby increase the difficulty of reduction. The reduced bowel must be scrutinised most carefully, to see that there is no laceration or gangrene.

If the intussusception cannot be reduced, three plans are open: firstly, resection of the whole with suturing of the divided bowels; secondly, resection, and the formation of an artificial anus; and thirdly, formation of an artificial anus, without resection. A fourth plan which has been recommended is to form an artificial anastomosis between two portions of bowel above and below the intussusception. The first can be done only where the intussusception is comparatively small, not involving more than three or four feet of bowel; the second, usually preferable to the first, is similarly limited in application; the third may be used, as a last chance, where neither resection nor reduction is possible. In an infant on whom I operated, where quite half of the small bowel lay inside the colon and could be felt through the anus, resection was, of course, out of the question. I made an artificial anus above, and fixed the bowel with catch-forceps, so that more might not be dragged into the wound. A better plan would perhaps have been to divide the gut, close the lower part, and leave it to its fate with the intussusception, while the upper end was taken out of the wound as an artificial anus. Such a proceeding, of course, would be advisable only if the invagination were low down. The prognosis after such proceedings must always be bad: all the greater necessity for early operation.

Prof. Braun of Jena* has classified 63 cases of operation for invagination. For disinvagination the operation was performed 51 times: of these, 11 were cured and 40 died; 30 were children, 21 were adults. Of 10 cases in which enterectomy was performed, all died. After disinvagination failed, resection was performed 12 times without a single success; enterotomy 9 times, also without a success. Disinvagination alone, therefore, would seem to offer hopes of success; and this must be attempted very early.

Intussusception of the rectum may be treated locally without the performance of abdominal section. Barker† has resected an adenoid epithelioma of the rectum successfully, after stitching the divided walls of the gut together. Verneuil and Hulenkamph‡ had previously done the same operation.

In Foreign Bodies.—It may be possible to pass these along when the abdomen is opened, so that opening of the gut may be unnecessary. If this cannot be done, the bowel must be opened, and the substance extracted. If the gut overlying the substance seems to be but slightly inflamed, it may be opened immediately over it, and the material extracted with ease. If the bowel is inflamed, as will usually be the case, it will be wise to make the opening a little above the site of the obstruction, in the dilated and healthy intestine. The opening must be of sufficient dimensions to permit of the extraction of the foreign body without causing laceration. By preference the line of incision would lie in the long axis of the bowel, at its free margin. If the body cannot easily be pushed up to the opening, the opening may be pushed down to the body. It may be of advantage to crush or compress the body before attempting to extract it. The intestinal contents may or may not, according as seems most convenient, be permitted to escape before removing the cause of obstruction. During the manipulations, scrupulous care will be observed to prevent the escape of fæces into the abdomen. If the bowel is seriously damaged by inflammation or ulceration, or looks gangrenous, the advisability of resection must be contemplated.

* *Archiv. f. Klin. Chir.*, Bd. xxxiii, Hft. 2. † *Lancet*, May 14th, 1887.
‡ *Internat. Journ. Med. Sc.*, Oct., 1887, p. 529.

Enterotomy.

The name Enterotomy is given to the operation of making, by peritoneal section, an opening in the bowel through which its contents may be discharged. The best name for this is obviously Enterostomy, but usage has justified the use of the former term.

Enterotomy, first performed on a patient of Trousseau's by Nélaton, and often known as Nélaton's operation, is most properly regarded as an inevitable and undesirable substitute for other and better proceedings. Nélaton advocated it as a plan of treating cases of intestinal obstruction which had lasted over six or eight days, in which there was great abdominal distension, and where there was fæculent vomiting. Other surgeons have performed the operation on Nélaton's principles, and with a gratifying measure of success—so far, at least, as immediate results are concerned. As it does not attack the cause of the illness, and is, consequently, rarely other than palliative, it ought never to be instituted, except in cases where other and more complete measures are unavailable. It should never be undertaken unless there is fairly conclusive evidence that the obstruction is either low down in the small bowel, or in some part of the large bowel that is beyond the reach of colotomy.

The operation is a very simple one. Entrance is effected in the right iliac or inguinal region, parallel to and a little above Poupart's ligament, between the anterior iliac spine and the epigastric artery. The incision need not be a long one; one and a half to two or three inches, according to the thickness of the abdominal walls, being sufficient. The nearest distended piece of bowel, usually some portion of the lower part of the ileum, is drawn into the wound, and fixed there by sutures. If the case is not urgent the bowel need not be opened at once, but left there for two or three days till adhesions have formed. It must not be forgotten that if fæces escape, they run into the peritoneal cavity; and seeing that delay in opening, even for a

few hours, might secure the formation of plastic lymph sufficient to close the opening, wherever it is possible such delay may advantageously be observed. If it is decided not to open the bowel at once, mere fixation by a couple of harelip pins, or by two silk or silver sutures, passing through the fibrous coats only, will be all that is required. Some recommend simply leaving the bowel in the wound, in the certainty that adhesions will soon take place without the insertion of any sutures. If it is decided to open the bowel at the time, we must secure very accurate co-aptation between the intestinal walls and the edges of the wound before making the opening. Here there is more abdominal movement than in colotomy, and the opening is into the peritoneal cavity, so that the danger of fæcal escape is greater. Two silver sutures, not thin enough to cut, are usually recommended as the main support; but two or four additional silk sutures should be inserted. It matters little how the apposition is obtained, provided it be accurate and abiding. On two occasions I got perfect union from the application of a continuous suture including skin, peritoneum, and outer coats of bowel. When sutured satisfactorily, the intestine is incised by a tenotomy knife, a very small opening being made.

In a few days the abdominal wound will probably have healed, and a fæcal fistula will have formed. It will depend upon the nature of the case whether we seek later on to cure this artificial anus. In cases of unremovable cancer, for which chiefly this proceeding is indicated, any further operation would not be contemplated. In cases of fæcal accumulation where enterotomy had been performed, the question of closure of the fistula would arise as soon as the tendency to accumulation had passed off. In some few cases, where enterotomy was performed to relieve the patient of very urgent symptoms when diagnosis was wrong or more perfect treatment was impossible, the subsidence of acute intestinal troubles and further information as to the cause of the disease might make us contemplate closure of the fistula. In most cases, however, it will remain as an artificial anus, prolonging life and relieving suffer-

ing, but not curing the disease. Dr. Malins* has twice performed laparo-enterotomy for obstruction by adhesions in the pelvis which he could not completely divide; and in each case the patient recovered, with a fæcal fistula.

When the first incision has been made in the middle line, and, after exploration, the cause of obstruction cannot be found or cannot be overcome, enterotomy may be performed at this situation. In fact, as a last resource after failure of other methods, enterotomy will most frequently fall to be performed in the middle line. In this case accurate suturing by a continuous suture to the skin, and immediate opening of the bowel, will be carried out. If the parietes are not very thick, the parietal peritoneum may be pulled outwards and fixed to the wound-margins. The continuous suture is placed in two portions, and their extremities tied together after being stitched into the parietal wound. In a successful case of enterotomy, I thought the insertion of a piece of drainage tubing into the opening in the bowel maintained accurate coaptation of the uniting surfaces, and helped to prevent contamination by fæces.

For the treatment of very bad cases of intestinal obstruction of long standing, I have urged the adoption of enterotomy performed under local anæsthesia by subcutaneous injection of cocaine at the site of incision. In this sense the operation is merely temporary or preliminary, intended to ward off death where the full operation to relieve the cause of obstruction could not be borne, and to permit the patient to recover strength sufficiently to bear the major operation.

* *Brit. Med. Journ.*, Feb. 1883, p. 581.

Colotomy.

By colotomy is meant the establishment of a fistula in the colon, ascending or descending, by an opening in that part of the bowel which is uncovered by peritoneum and lies in contact with the parietes.

History.—Colotomy was first proposed by Littré, in 1710.* His proceeding was, to open the sigmoid flexure of the colon by incision through the abdominal walls in the left inguinal region. It was suggested for imperforate anus in children. It is not probable that Littré ever actually performed the operation; and his suggestion was forgotten till 1776, when Pilloré of Rouen operated, but by a different method. He opened the cæcum by a parietal incision made in the right inguinal region. Twenty years later Callisen suggested an operation whereby the colon might be opened without entering the peritoneal cavity. He sought to expose the bowel where it was not covered by peritoneum by a vertical incision in the left lumbar region. He failed to do this on the dead subject, and he never attempted it on the living. Fine of Geneva, in 1797, made an opening in the transverse colon through an incision in the region of the umbilicus. Amussat, driven to think of it while he was attending the famous Broussais for cancer of the rectum, actually performed the retro-peritoneal operation. He operated on the right side by a transverse incision. In the two following years he operated six times, with five successes. In 1842 Ashmead of Philadelphia,† not aware of Callisen's proposal, performed a retro-peritoneal lumbar colotomy by a vertical incision on the left side.

The operation, as usually performed now, is a combination of the methods of Callisen and Amussat. Like Callisen's, it is done on the left side; and, like Amussat's, it is carried out

* *Mem. Acad. Sc. Paris*, vol. x., p. 36.

† *Trans. Coll. Phys., Phila.* vol. i., p. 99, 1842.

through an incision which is either transverse or obliquely transverse. The oblique incision, first recommended by Bryant,* is that now adopted by most surgeons.

CONDITIONS INDICATING OPERATION.

Colotomy may be performed for any condition which obstructs the passage of fæces along the colon, or under any circumstances in which it is advisable to place that bowel at rest. Obstruction may be produced by various causes; such as, cancer of the rectum or sigmoid flexure or any other part of the colon; tumours of the peritoneum or any abdominal organ, pressing on the bowel; volvulus of the sigmoid flexure or of the cæcum and ascending colon; and fæcal accumulations and collections of foreign matter which cannot be disturbed by other means. It may be called for in cases of incurable ulceration of the bowel, however induced, when we have reason to believe that irritation of fæces and unrest of the intestinal walls contribute to the continuance of the disease; and in cases of extreme dilatation, with atony of the colon, giving rise to frequent attacks of obstruction.

The operation may be considered from three points of view: (1) as a curative measure, (2) as a measure intended to ward off for a time impending death, (3) as a proceeding intended, in the absence of immediate danger to life, to add to the comfort of the patient and prolong his existence.

As a *curative measure*, colotomy may be performed in cases of ulceration of the rectum, simple or specific, when all other measures have failed; in excessive distension, with atony of the colon; in volvulus of the sigmoid flexure, and in recto-vesical fistula.

In ulceration of the rectum, the condition may be kept up or aggravated by the irritation of passing fæces and by the spasmodic contractions of the hyperæsthetic bowel. By making an artificial anus above the ulcerated part, the bowel is set at rest, and the fæces do not come into contact with

* *Trans. Med.-Chir. Soc.*, vol. xxxv., p. 99.

the ulcerated mucous membrane. In most cases it will be sufficient to operate on the left side; but if we suspect that the ulceration extends higher up than the sigmoid flexure, it will be better to operate on the right side.

In cases of excessive distension of the colon with atony of its walls, where, in spite of strong purgation and the administration of enemas, fæces accumulate and symptoms of obstruction frequently appear, right colotomy is indicated. By giving an exit to the fæces at the commencement of the colon, the bowel is kept empty, and has an opportunity of contracting and regaining its tone. From being a flaccid tube with no power of spontaneous contraction and an almost unlimited capacity for distension, it will, in the course of a few weeks' rest and freedom from distension, regain its functions as a contractile viscus of limited calibre.

For volvulus of the sigmoid flexure, Bryant recommends colotomy as a remedial measure. There is much to be said in favour of the proceeding for this condition. As compared with laparotomy, it is not theoretically so perfect; but we have already seen that laparotomy in volvulus is not likely to be practically successful in every sense, and that it will probably result in the formation of artificial anus. Whatever advantages accrue from the retro-peritoneal operation are in favour of colotomy: these are, probably less severity in the operation itself; avoidance of the risk of escape of fæces into the abdomen, which, with the enormous collections that are usually found in these cases, must be considerable; and greater facility in operating. But each case must be decided on its merits.

In cases of recto-vesical fistula which have lasted for some time, colotomy gives the only chance of cure short of resection. The fæces passing through the opening in the colon, no longer traverse the fistula, the rectum collapses, and the fistula spontaneously closes. The presence of severe cystitis, the frequency with which attacks of retention of urine appear, the condition of the patient, and various other circumstances, will in each case promote or restrain the advisability of operation.

As a measure *intended to ward off imminent death*, colotomy is called for in all cases of obstruction in the colon, from whatever cause arising. The great majority of such cases are examples of cancer of the rectum. The condition of the patient must in every case settle the justifiability of the operation. If the patient is evidently so near death from the disease that relief of the obstruction can prolong life only for a week or two at most, it will be wise to let nature have its way. The choice between a death from obstruction, and a death from exhaustion interrupted by the horrors of a serious operation, is a choice of evils nearly equal. But if the obstruction comes on in the earlier stages of the disease, when the patient is not greatly weakened, and when a successful result to the operation means not only escape of death from obstruction but prolongation of life, with increase of comfort, then the operation is clearly indicated.

The indications in other forms of obstruction from growths which are not removable—either in the gut itself, or invading or pressing upon it from the outside—are similar to those for cancer of the rectum.

It has been said that an operation which is not intended to cure the disease, and which places the patient in a condition which "must inevitably render him an object of disgust to himself and of loathing to everyone around," ought never to be performed. The inevitable result of the operation need not be revolting; properly managed, it need cause little more than discomfort. I have operated on a lady for cancer of the rectum, who was able for months, not only to dine at table, but to attend dinner parties. And even if the result were revolting, and the patients' sufferings were such that they would wish to die, it is still our duty, according to the highest ethics, to do all that we can to encourage them and to help them to live.

As an *Ameliorative Proceeding in cases of Malignant Disease* where there are no symptoms of obstruction, and where it is intended to give relief to the patient from the irritation produced by the passage of fæces over the growth, and to remove

from the growth itself this source of harm, colotomy is more open to discussion. The progress of cases for which the operation, under these conditions, has been performed is notoriously uncertain. I have operated on a case in which there were no signs of obstruction, and in whom a likelihood of prolonged life, with increased comfort, was predicted: the patient died suddenly, of hæmorrhage from the growth. In another, weaker constitutionally, and with a much larger growth, life was prolonged for more than a year, and the patient died of extension of the growth to the peritoneum. Cases, again, are recorded where decided improvement sets in, and continues for some time, where no operation has been performed.

Statistics give us no help in forming an estimate of the duration of life in such cases, with and without operation. I think it is doubtful if surgeons as a rule follow the outspoken advice of Bryant, to operate as soon as malignant disease is discovered; and much might be said in support of their practice — at all events, it cannot unreservedly be condemned. The patient ought to have an opportunity of deciding: in my experience, the decision is usually against operation.

For *Imperforate Anus*, the operation holds a special position. It is intended to ward off death, but it may or may not be regarded as a cure for the disease. In many cases, it is the first step in the process of cure. In every infant born with imperforate anus, an operation of a local nature is first attempted; if this fails, colotomy by some method is performed, to ward off death: later on, an attempt may be made to get the bowel to discharge through the anus.

Mortality. Appreciation. Choice of Method.—The most complete and elaborate statistics on colotomy which have as yet been published are those collected by Dr. W. R. Batt.* He records 351 operations; of these, 215 (62 per cent.) recovered,

* *Amer. Journ. Med. Sc.*, Oct., 1884.

and 132 (38 per cent.) died,—4 having unknown result. The mortality after the various methods was:

	Operations.	Recovered.	Died.	Unknown.
After Amussat's method	244	165 (68 °/₀)	77 (31.6 °/₀)	2
„ Littré's „	82	38 (47 °/₀)	43 (53.1 °/₀)	1
„ Callisen's „	10	2	7	1
In Linea Alba	4	4	—	—

These results tally in a remarkable manner with those found in another notable collection by Van Erckelens.* He brought forward 262 cases of colotomy, with 151 recoveries and 109 deaths.

	Operations.	Recovered.	Died.
Amussat's method ...	165	102 (62 °/₀)	63 (38 °/₀)
Littré's „ ...	84	45 (53 °/₀)	39 (46.4 °/₀)

If these statistics can be taken as trustworthy, they would seem to indicate an improvement in the mortality of something like ten per cent. in the five years preceding 1884.

Many facts of interest and importance which cannot be referred to here are worked out in Dr. Batt's paper. The mortality after all operations for malignant disease was found to be a little over 30 per cent. Amussat's method gave a mortality of just over 25 per cent.; Littré's gave 45 per cent. If it is proper to reason from the results of these old operations, there is therefore a 20 per cent. probability of success in favour of retro-peritoneal colotomy. Of 52 operations for imperforate anus, more than half died; and the chance of recovery is about equally balanced between the two methods. Of 20 operations for fistula, all recovered save two. Of 40 operations for obstruction, one half died; the best results being got from Amussat's operation. Of 72 for stricture, 43 per cent. died, also with better results by Amussat's method.

Of those cases which recovered from operations for malignant disease, 12 died within 6 months, 15 died between the 6th and 12th month; 10 died between the 1st and 2nd year; 8 died between the 2nd and 3rd years, and 1 died at the end of 4½ years.

* Langenbeck's *Archiv.*, 1879, p. 41.

It will thus be seen that, under every circumstance, favourable or otherwise, colotomy is not a very deadly operation. Mere statistics cannot, however, give a just estimate of the mortality. Many operations are performed when the patient is *in extremis;* and in these the result is tabulated as failure, even if the patient lives for ten days or a fortnight in comparative comfort. To class such cases with others in which the operation is performed while the patient is in fair condition, adds to the mortality of the operation unjustly. The conditions under which the operation is performed are so varied, and even divergent, that the comparison of figures is of little value, except as affording means of comparison between different operations.

The figures show distinctly a preponderating bias in favour of Amussat's method—or rather, the modern modification which goes by his name. Amussat's method, as now understood, is retro-peritoneal colotomy performed on the left side by an oblique incision between the ribs and the crest of the ilium. It is the combined proceeding of Amussat, Callisen, and Bryant. When the choice is given, this method, as affording the best chances of success, ought always to be selected.

For imperforate anus, Littré's method, of dividing the parietes in the left inguinal region and entering the peritoneum, has much in its favour. With imperforate anus are frequently found other malformations of the colon which would render colotomy impossible by the retro-peritoneal method. Indeed, to render the chances of success in completing colotomy most certain, it is doubtful whether the median incision would not be best of all. The distended bowel can be brought to the middle line either from the right or the left side: if the descending colon exists, it may be opened; if it does not exist, the ascending colon may be opened; and if, as sometimes happens, the distended rectum is median in position, the advantages of the median incision will be most conspicuous. Frequently the situation of the bowel may be located by percussion and palpation.

As the names given to the operation, following the proper names of individual surgeons, have already lost their signifi-

cance and have caused a good deal of confusion, it will be convenient to speak of the retro-peritoneal method as Lumbar colotomy; and of the methods in which the abdominal cavity is entered, as Laparo-colotomy.

THE OPERATION OF LUMBAR COLOTOMY.

By Lumbar Colotomy is meant the making of an opening in the colon, ascending or descending, on either side of the body, within that area where it is not covered by peritoneum, and where it is attached to the abdominal walls by cellular tissue. The opening is made through an incision in the lumbar region —that is, in the space bounded by the last rib above, and the crest of the ilium below, and lying within lines drawn vertically between the middle of the iliac crest and the last ribs in front, and the lumbar group of muscles behind. Dividing the space vertically is the edge of the quadratus lumborum and the fascia transversalis. At the bottom of the space lies the colon, in its upper part overlapping the kidney; in its lower part lying in contact with the abdominal wall, and attached to it by cellular tissue. (See Fig. 54, 8 & 18.) The area of contact varies in extent with the amount of distension of the bowel. In full distension the bowel glides under the peritoneum, displacing it laterally, so that the surface in contact with the parietes is broadened. When the bowel is contracted, the peritoneum enfolds it more or less completely according to the length of the mesentery. It is always possible to separate the collapsing peritoneal folds, even when the bowel is empty, and so reach the bowel without entering the peritoneal cavity. It must be noted that, according to Treves's investigations, there is more likelihood of a mesentery being found on the left than on the right side.

The best practical guide to the site of the bowel is that furnished by Allingham, as a result of numerous dissections. It will be found directly under a point marked on the skin about half an inch behind the middle of the crest of the ilium, as measured between its anterior and posterior spines. It has

been recommended that this point be marked on the skin in ink. But, as a matter of fact, when the muscles have been divided the forefinger is the best guide.

The oblique incision recommended by Bryant is the best. Its chief advantage is, that it gives more room for its length than do other incisions. Further claims in its favour are, that

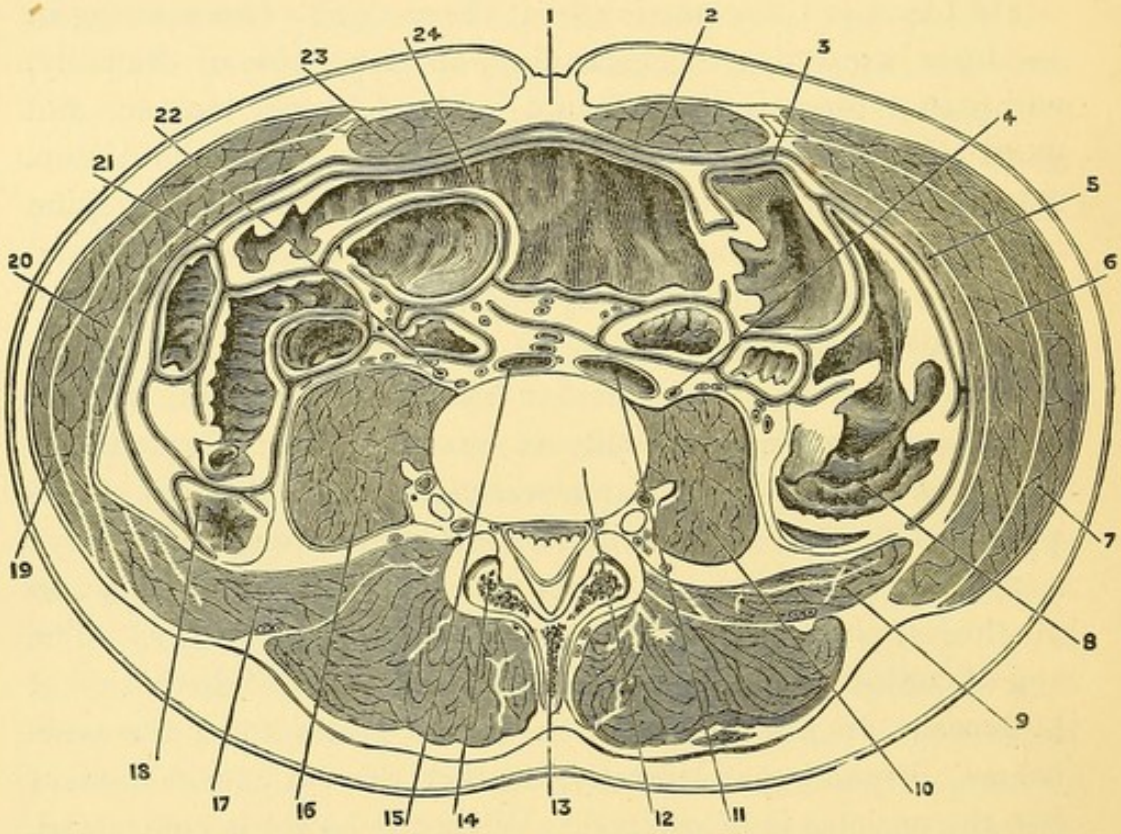

FIG. 54. (*After* BRAUNE.)

Transverse Section through the Navel to show the parts concerned in Colotomy.

1. Umbilicus. 2. Rectus Muscle. 3. Great Omentum. 4. Ureter. 5. Transversalis Muscle. 6. Internal Oblique. 7. Right External Oblique. 8. Ascending Colon. 9. Quadratus Lumborum. 10. Psoas Muscle. 11. Inferior Vena Cava. 12. Cartilage between 3rd and 4th Lumbar Vertebræ. 13. Spinous Process of 4th Lumbar Vertebra. 14. Lamina of 3rd Lumbar Vertebra. 15. Descending Aorta. 16. Psoas. 17. Quadratus Lumborum. 18. Descending Colon. 19. External Oblique. 20. Internal Oblique. 21. Omentum. 22. Ureter. 23. Rectus. 24. Transverse Colon.

it necessitates division of a smaller number of nerves and vessels than other methods; and that it facilitates coaptation by lying in the line of a natural fold, and helps to prevent prolapse of the bowel by lying almost transversely to its axis. In thin patients, and particularly in women, whose iliac crests are more

prominent than in men, there is a tendency for the upper lip of the wound to fall inwards, while the lower lip protrudes. This may be obviated by careful apposition, and by not bringing the line of the incision too close to the ilium.

The patient is laid on his side, or almost semiprone, and a hard round pillow is placed under the opposite loin, to separate the last rib from the ilium as much as possible, and make the site of operation prominent. The centre is at the point indicated —a little behind the centre of the crest of the ilium. Its length will vary according as the patient is fat or thin. Four or five inches is the length usually recommended; but this is the extreme. In a thin patient, two inches is ample; and I have found, in a very fat woman, three inches to give plenty of room. It will be found most convenient to have the bulk of the incision behind the point marked as the site of the bowel. The incision starts about an inch in front of and above this point, and passes obliquely upwards and backwards towards the angle formed by the spine and the last rib, for a distance varying according to the nature of the case. The various structures are divided by successive strokes of the knife or scissors, forceps being placed on the bleeding-points. The parts divided after the skin and superficial fascia are: some fibres of the latissimus dorsi, the posterior fibres of the external oblique, the internal oblique, and the lumbar fascia. The anterior edge of the quadratus lumborum will then appear in the wound, and may be divided or not, as seems convenient. The fibres of the transversalis may often be separated without division. When the transversalis fascia has been divided, the fat which underlies the colon will bulge into the wound. Each of these layers is divided to the whole extent of the cutaneous incision.

The sub-peritoneal adipose tissue is usually abundant, even in lean subjects. It is frequently found in well-defined strata, separated by layers of fascia. I have more than once seen these layers mistaken for bowel, and treated accordingly. Indeed, when in doubt as to a fascial fold being bowel or not, it is always best to treat it as if it were. An error is then harmless. The fat is teased aside by the fingers, a cutting instrument being

used as sparingly as possible. If it is very abundant it may be removed, to give additional space.

Various means of recognising the bowel have been described, such as its immobility, and the presence of bands on its surface. These would be valuable if the peritoneum were opened. In feeling for the bowel, the forefinger and thumb, or the first two fingers, are inserted into the wound, separating its margins. The bowel, if distended, will bulge outwards, and may be readily seized. If it is empty, it is sought for more deeply in the wound, keeping well backwards and separating the overlying tissues widely. If the peritoneum is pushed apart by the two fingers, only colon can be grasped between its layers. The existence of hard fæces inside the bowel is an infallible guide. The surgeon ought, from practice on the dead body, to be familiar with the sensation that colon gives when pinched up between the fingers through a lumbar incision; and this sensation is more trustworthy than any other guide, or any combination of guides.

In a very few cases * no colon has been found, on account of the existence of congenital abnormality. In others, the small intestine has been opened by mistake for the colon. We have it on the authority of Ball † of Dublin that one of the most experienced of living colotomists has candidly admitted that he opened the duodenum on the right side, believing it to be the colon.

If, during the manipulations, the peritoneum has been torn through, it must be closed at once. This may be done by catching the edges of the laceration in forceps, pulling it into the wound, and surrounding it with a ligature. This produces perfect closure, with apposition of serous surfaces. I have, on one occasion, seen this done, and no harm result. If the rent in the peritoneum is large, the bowels may prolapse into the wound. After reducing the bowels, advantage may be taken of the presence of the fingers in the cavity to search for the colon and make it bulge into the wound. A forceps may then be placed on its wall as a guide, and the rent in the peritoneum

* See Lockwood, *St. Bart.'s Hosp. Rep.*, vol. xix.

† *The Rectum and Anus*, Lond. 1887, p. 357.

closed. Thereafter the operation is proceeded with as if nothing had happened.

If the bowel is distended with fæces, the ends and deep parts of the parietal wound should be closed before opening it.

There is always some risk of burrowing suppuration; and accurate apposition of deep as well as superficial parts ought to be secured. The best way to do this is by continuous buried sutures of catgut carried from the deep parts of the wound to its surface; but deep silver button-sutures answer fairly well. A drainage-tube is placed deeply at the end of each half of the wound. To provide against the contact of fæces, the wound must be protected by lint soaked in some antiseptic material, of which there is nothing better than boro-glyceride.

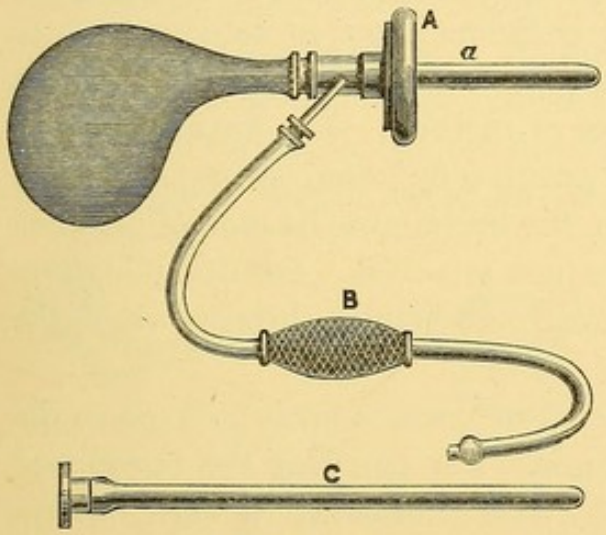

FIG. 55.

Lund's Insufflator.

A, Hollow Rubber Ring which is pressed against the Tissues around the Anus; *a*, Rectum Tube; C, Longer Rectum Tube; B, Ball-syringe attached to Instrument.

If there is much difficulty in seizing an undilated colon, a Lund's insufflator (Fig. 55) may be used, to cause its distension by air or fluid. Some surgeons recommend that the operation be begun by artificially distending the colon. If there is complete obstruction in the rectum, this is, of course, impossible; and, in any case, it need not be done till the necessity for it has become apparent.

The bowel may be at once opened and fixed to the edges of the wound; or, if there is no urgency, it may be fixed, and the opening delayed for a few days till the wound has united and the bowel has become adherent in its new situation. Delay in opening the bowel greatly diminishes the risk of unhealthy action in the wound, and permits the employment of antiseptic

treatment. On the other hand, if there is obstruction, the bowel must be opened at once, and the wound protected as well as possible by boracic ointment, or carbolised oil, or boro-glyceride. The experience of Davies-Colley in the operation *à deux temps* has shown that symptoms of intestinal strangulation may be induced by the retention of a loop of bowel in the wound. To obviate this objection he has devised a clamp which holds the bowel between ivory studs, while it does not strangulate it.

To fix the bowel in the wound, if opening is to be delayed, Howse's plan of fixation by forceps is the best. Two pairs of catch-forceps are made to grasp small folds of the muscular coats of the colon with just sufficient force to hold and not to cause sloughing. They are placed about half an inch apart, and at right angles to the line of incision. The forceps are laid flat on the skin, and kept in position by broad strips of plaster. At the end of a week, or less, the bowel may be incised between the points where the forceps are attached. Sutures placed in the bowel are liable to produce small fistulæ, through which the fæces escape.

If the bowel is to be opened at once, it must be fixed to the edges of the wound by sutures. For catching the bowel and drawing it out of the wound, Lund* has invented handled needles with points set at right angles to the shaft, and sharply curved. (Fig. 56.) Ordinary curved needles do very well. Two pieces of thick silk, with needles at each end, are inserted in the bowel at the four corners of an area about an inch square. While these stitches, grasped in the two hands of an assistant, are made to pull the bowel outwards, the surgeon makes a small opening with a tenotomy knife. A blunt hook passed through the opening pulls out

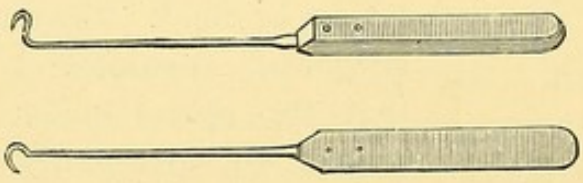

FIG. 56.

Lund's Hooks for picking up the Bowel in Colotomy.

* *Lancet*, vol. i., 1883.

the threads inside the bowel, which are cut in the middle, and thus make four points of support. Each suture is then carried through the skin at the margins of the wound by the needle attached, and there tied. Around the opening in the bowel there will thus be placed four sutures — two on each lip of the wound. Additional security will be afforded by placing two more stitches, each passing through the edges of the parietal incision, and hooking up the corner of the opening in the bowel. I prefer silk to silver as sutures, simply because, in the subsequent frequent cleansing of the wound, the ends of the silver sutures will catch in the wool or sponge and so far interfere with the manipulation.

In most cases there is an immediate discharge of fæces through the wound; but sometimes this discharge does not take place for hours, or even for days. If the fæculent matter is hard or in lumps, its escape may be impossible, or it may cause considerable pain. In this event Lund's forceps* (Fig. 57) will be found useful. If the discharge is frequent and abundant, very frequent dressings of the wound will be necessary. Large pads of absorbent antiseptic and deodorising material, kept in position by a square of mackintosh cloth, to each corner of which a piece of strapping has been fixed by a safety-pin, is a convenient form of dressing. Bandages carried round the body are clumsy and inefficient as a means of fixing the dressing. The piece of adhesive plaster at each corner of the square of mackintosh will be found efficient enough in most cases; if not, extra pieces may be pinned on along the borders.

FIG. 57.

Lund's Forceps for removing Hardened Fæces in Colotomy.

The position of the patient is not a matter of great importance. Comfort will be increased by changing the position slightly at each dressing.

Primary healing may be anticipated with considerable con-

* *Lancet*, vol. i., 1886.

fidence in every case, provided the wound is properly attended to. The disadvantages of suppuration in a wound constantly brought into contact with fæculent fluids and gases are evident enough.

When the wound is perfectly healed, and the artificial anus is established, an apparatus of some form or other must be worn, to collect any fæces that may escape. Ivory and rubber plugs attached to an abdominal belt are made for this purpose. I have used a soft rubber bag attached to a ring pessary of copper wire surrounded by rubber tubing, and fixed by tapes carried round the waist. After trying most of the apparatus recommended for this purpose, I have come to the conclusion that nothing is more efficient and more comfortable than clean linen rags nicely folded, and kept in position by a well made linen binder. Patients themselves often devise ingenious contrivances.

Occasionally fæces collect in the part of the bowel below the opening and give trouble. Bryant has seen symptoms of intestinal obstruction produced in this way, in spite of the presence of the opening in the bowel. To prevent the passage of fæces into the lower segment of gut, various means have been suggested and adopted. To increase the acuteness of the flexion of the bowel, sutures have been placed so as to take in the greater part of the calibre, or even (although this involves transfixion of the peritoneum) the whole circle. Mr. P. Jones* has succeeded in preventing the downward passage of fæces by turning inwards and suturing the mucous membrane around the prolapsing portion.

The most thoroughgoing proceeding of this sort is that of Madelung.† He recommends that the bowel be cut completely through, that the lower opening be closed and dropped inside, and the upper opening be sutured to the wound to form the artificial anus. The irritation of fæces on the cancerous rectum is thus done away with, and prolapse of the gut through the wound is less likely to take place. There is one risk attached to Madelung's proceeding which has not been pointed out; and that is, the accumulation of cancerous discharges above the

* *Brit. Med. Journ.*, 1886, i., p. 782. † *Centralbl. für Chir.*, No. 23, 1884.

stricture, which, unable to escape downwards, would certainly cause pelvic cellulitis. I have, in one case on which I had performed colotomy, seen sudden stoppage of all discharge by the anus, and appearance of it at the artificial opening. This alone would deter me from adopting Madelung's suggestion, even if the advantages to be secured were greater than he claims. Ball of Dublin has closed the divided lower segment of bowel after laparo-colotomy, and dropped it inside the abdomen, with good result.

LAPARO-COLOTOMY.

Here the colon is opened by an incision through the parietes, in the inguinal region usually. If performed on the left side, it is Littré's original operation. It may, however, be performed on either side—on the left, when it is desired to open the sigmoid flexure; on the right side, when it is desired to open the cæcum or ascending colon.

The operation is performed with the patient lying on his back. The incision is made parallel with Poupart's ligament, about an inch above it, and starts at the iliac crest, running inwards about two or three inches. The fingers, inserted through the wound, grasp the bowel and pull it to the surface. It may be sutured to the abdominal wound and opened at once, or fixed there by forceps and opened after a few days, according as the urgency of the case demands. Sutures must be placed with precision and accuracy. A double row of stitches—the outer passing through muscular and serous coats, and the inner transfixing the intestinal walls, as for colotomy—will more certainly provide against escape of fæces into the cavity than a single row.

There exist many modifications of the original operation, besides a change of side. Luke and Adams employed a vertical incision external to the epigastric artery. Various methods of exciting the growth of adhesions between intestine and parietes have been proposed. Professor Verneuil, who has for some time advocated the inguinal mode of performing colotomy, has introduced important modifications. To obviate the disadvantage

of having no spur or heel below the artificial anus to prevent the downward passage of fæces, and to provide against the contraction of the opening, are the main purposes of his operation. The incision, two inches in length, starts about two inches to the inside of the iliac spine, and is directed upwards to the umbilicus. He catches the edges of the abdominal opening in six pairs of hæmostatic forceps, to distend the wound and prevent the peritoneum from being peeled off. Enough intestine is pulled out to make a protuberance as large as a pigeon's egg; this is transfixed with two acupuncture needles, which lie on the parietes and keep the intestine in place. About fifteen metallic sutures are placed between intestine and abdominal wall, and the protruding piece of gut is resected. The thermo-cautery is used to check bleeding. The intestinal wall, bulging into the large opening, blocks the downward passage; the magnitude of the opening obviates the risk of stenosis; protrusion is prevented by the longitudinal direction of the parietal opening, and its comparatively small size.

Recent experience has made it necessary to review the position which extra-peritoneal colotomy holds, as compared with intra-peritoneal. Laparo-colotomy is steadily and surely coming into favour, and properly so. Ball* and Allingham (jun.),† in particular, are strongly in favour of the intra-peritoneal operation, and have devised important and ingenious improvements, which are worthy of special description.

Among the most important advantages of laparo-colotomy, the following may be mentioned. The large intestine can easily be found, and can scarcely be mistaken for any other portion of bowel. The operation permits thorough exploration and accurate diagnosis: thus, not only may it be possible to proceed to a radical operation by incision, but there is absolute certainty that the opening will be made above the stricture. The operation is a smaller affair altogether; may be performed through a short abdominal incision, and with more expedition and less

* *The Rectum and Anus.* Lond., 1887, p. 362.

† *Brit. Med. Journ.*, Oct. 22nd, 1887.

shock to the patient. The position of the wound renders it possible for the patient to dress and look after it. The only drawback is the necessary opening of the peritoneum; and this, now-a-days, is a very small one. As Ball points out, the peritoneum is opened in the lumbar operation by no means infrequently.

Ball's mode of operating may be given in his own words: "An incision about four inches long was made in the left linea semilunaris, this position being selected for the following reasons: it freely exposes the sigmoid flexure; it is made without cutting muscle; the parietes are thinner here than elsewhere; and no vessels of importance are wounded. The deep epigastric artery is quite safe from injury if the lowest limit of the incision does not pass below a line drawn from the umbilicus to the middle of Poupart's ligament. The upper limit of the cancer having been determined, the gut was emptied upwards by careful pressure, and a loop of bowel drawn out; a narrow-bladed clamp was now applied to the intestine, so as to prevent any fæces coming down, and a similar one applied to the distal extremity of the loop. In the present case, Ricord's phimosis forceps, covered with rubber tubing, and closed by means of elastic umbrella-rings, were used for clamps. (He has since had a clamp made, which has the advantage of allowing the blades to move quite parallel. By means of a screw the exact amount of pressure necessary to retain the loop of intestine in the grasp can be applied, and bending at a double angle permits of the blade portion lying easily within the peritoneal cavity.) The clamps being applied, a number of sutures were passed through the abdominal wall, including peritoneum, on one side, through the intestine *in front of the clamp*, and through the peritoneum and abdominal wall on the opposite side. Eleven sutures were in this way passed, five perforating each portion of intestine, and one passing through the meso-colon. The bowel was now opened between two aseptic sponges, and the interior carefully cleased of mucus and fæces. The loops of the sutures were hooked out from within the lumen of the bowel, cut, and the central ones tied on each side; the suture through

the meso-colon was also tied; the sutures through the angles of the abdominal wound and outer borders of the bowel alone remaining unclosed. A number of superficial sutures were now put in, so as to render the application of the mucous membrane to the skin extremely accurate all round, except at the angles where the handles of the clamps lay. The clamps were now withdrawn one by one, and the remaining sutures at either angle simultaneously closed, thus shutting off the opening into the peritoneal cavity at the moment that the clamps released the bowel. The single suture through the meso-colon is, I think, of use in ensuring a larger surface of peritoneum being in apposition to the abdominal wound, and the second clamp on the distal extremity of the bowel, although not as essential as the other, facilitates the operation considerably."

In Allingham's operation the bowel is kept forward in the wound by a suture passed behind the gut and through the mesentery, and fixed in the edges of the parietal wound. He makes the parietal incision, two inches in length, about one inch inside the anterior superior spine of the ilium, and parallel with Poupart's ligament. The divided peritoneal margins he at once sutures to the skin. The sigmoid flexure is then searched for with the fingers, and the intestine pulled to the surface. A piece with long mesentery is then fixed upon, and "a needle threaded with carbolised silk is passed through the mesentery, close to the intestine on both sides, then through the abdominal wall on both sides, nearer to the lower than the upper angle of the wound, and these are tied tight." The bowel is, in fact, hung up over the silk thread. The protruding bowel is then carefully sutured to the parietal opening all round. Antiseptic dressings are applied, and the wound is not disturbed for a few days.

At the end of two or three days the dressings are removed, the whole exposed bowel being found covered with lymph, and the opening made. To open the gut he uses scissors, "cutting the intestine from above downwards to the extent of about an inch and a half; through the incision can be seen two orifices separated by a well-formed spur, the upper opening being the larger, the lower the smaller," on account of the supporting

thread being placed nearer to the lower than the upper end of the wound. The superfluous gut by the edges of the wound may be cut away. Such operations on the gut are quite painless, and require no anæsthetic.

Allingham's method of operating is clearly a valuable one. He supports its recommendation by records of six very successful operations. I would suggest that the supporting thread passed under the gut should not be tied close to the edge of the wound, but should be carried through the parietes under the skin for a distance of two or three inches, and the ends fixed in buttons. The risk of contamination of peritoneum through the suture-holes would thereby be done away with. He does not recommend it for cases in which immediate opening of the gut is necessary. As regards the mere opening of the gut, I think he unnecessarily restricts its applicability; but in cases where the bowel is greatly distended with fæces, and there would be difficulty or danger in placing the thread under it, then his restriction should be enforced. For enterotomy the proceeding seems equally well adapted.

Resection of Intestine.

Enterectomy; Colectomy; Cæcectomy.

Removal of a piece of small intestine is known as enterectomy; the same operation applied to the large intestine is called colectomy. Cæcectomy, or excision of the cæcum, usually involves the removal of part of the ileum and part of the ascending colon as well. The operations may be considered conjointly.

History.—It would seem that this is by no means a novel proceeding. According to Dr. E. J. Ill,* Randohr, in 1727, successfully removed two feet of gangrenous intestine from a hernia. Up to 1836, the same writer tells us the operation had been performed at least ten times by French, German, and English surgeons. Of these cases, 5 were cured, 2 were left with artificial anus, and 3 died. Such operations, however, were rather timorous removals of sloughs, than deliberate resections of bowel. Such a case is one where Mr. Cookesley,† a surgeon of Crediton, in 1731, removed six inches of gangrenous bowel in a case of strangulated hernia, and the patient completely recovered.‡

* *New York Med. Rec.*, Sept. 22nd, 1883.

† *Med. Essays and Observations*, Edinburgh, 1752, p. 357.

‡ The following interesting record is from Cheselden's *Anatomy*, p. 151. Lond., 1730:—

"Thomas Brayn of Yeaton, in the parish of Baschurch, and county of Salop, a doctor for cattle, maketh oath, that about ten or twelve years agone, he was sent for by a farmer or husbandman, who lived near the village called Maesbrooks, and very near to the river Verney, in the said county of Salop, to have his advice about an ox he had, which was then sick by reason he could not dung; he had been drenched by several beast doctors before this deponent came to him. This deponent seeing this ox in the condition he was in, told the owner, that if he would venture his ox, he would do him what service he could, in the curing of him; which the owner consented to, and thereupon this deponent opened the ox in the flank, and took great part of his bowels, upon searching which he found there was a perfect stoppage in the guts; and the gut was about the stoppage putrified for about three-quarters

The removal of a diseased portion of colon was first suggested by Littré, in 1710; but it was not till 1833 that the first operation was performed. According to Marshall,* Reybard of Lyons, who made claim to having performed the first colectomy, presented his paper to the French Academy of Medicine in 1844; but it was rejected for publication in the *Memoirs* of that body, on account of some want of definiteness in the record. It seems almost certain, however, that he did excise a tumour from the sigmoid flexure, along with some portion of bowel; that he sutured and returned the divided gut; and that the patient lived for ten months afterwards, passing fæces per anum. The next operation is credited to Gussenbauer of Liege in 1877. In his case, a primary median incision was supplemented by a transverse one: his patient died in 15 hours. In 1879 he attempted another operation, but had to finish it as a lumbar colotomy. In 1878 Baum of Dantzic supplemented a vertical incision for enterectomy by a transverse one, and removed a growth in the ascending colon, with some inches of bowel above and below. Fæces escaped through the wound, and the patient died on the seventh day. In 1879 Martin of Hamburg had a brilliant success after a most difficult operation, in which he removed a large growth with a portion of the sigmoid flexure and some glands. In 1880 Czerny had a partial success after a difficult operation, the patient dying seven months afterwards from a recurrence of the disease. In 1881 Bryant finished a lumbar colotomy by removing the diseased bowel; and in 1882 Marshall unsuccessfully removed a growth from the descending colon by

of a yard, whereupon this deponent cut off so much of the gut as was putrified, and took it quite away, and then drew the ends of the guts which remained sound after what was cut off, together upon a hollow keck, which was about three or four inches long, and sewed the said ends of the guts together upon the said keck, leaving the keck within the guts, and then sewed up the hole cut in the hide upon the flank of the said ox; and this deponent further saith, that within the space of one hour after this operation was performed, the ox dunged; and the piece of the keck which the said ends of the guts were sewn upon and left within the guts, came away from the ox with the dung, where upon the ox recovered, and lived to do the owner service several years."

* *Lancet*, May 13th, 1882.

lumbar incision, after having failed by median section. Since then a number of cases have been recorded.

Whitehead of Manchester* has resected the cæcum through an incision made along the side of the rectus muscle. The ileum was stitched to the lower part of the wound and the colon to the upper part, an artificial anus being left. The patient died.

Resection of the intestine did not, however, assume the position of a recognised operation till 1875, when Langenbeck revived it, to be followed in 1877 by Küster. Since then the proceeding has made rapid strides in public estimation, and is now regarded as one of the most successful of heroic operations.

Conditions for which Resection of Intestine may be Performed. Indications and Contra-indications.—Resection of bowel is usually called for in one or other of three distinct conditions; namely, gangrene, stricture, and artificial anus.

Gangrene is usually associated with some form of obstruction of the bowels. In this case resection is most often a necessary termination to an operation designed merely to relieve obstruction. It may require to be carried out at any of the ordinary sites of hernia, or through an abdominal incision.

In cases of stricture, simple or malignant, resection is practically the only means of cure. The formation of an artificial anus above the stricture is only a palliative measure, intended to tide the patient over danger of death from obstruction. Cancerous stricture is found almost uniformly in the large intestine. Of 35 cases of resection of cancerous bowel tabulated by Weir,† all save one involved the large bowel. Butlin,‡ after a critical examination of Weir's cases, eliminates two in which the operation was incomplete. To the 33 remaining he has added 4: of this total of 37, 32 were of the large intestine, 3 of the small intestine, and 2 uncertain. The parts of large intestine

* *Brit. Med. Journ.*, Jan. 24th, 1885. † *New York Med. Journ.*, Feb. 13th, 1886.
‡ *Oper. Surg. of Malig. Dis.*, p. 231.

involved were: cæcum, 7; ascending colon, 4; transverse colon, 3; descending colon, 7; sigmoid flexure, 9; "colon," 2. Simple stricture is most common in the small bowel.

It may occasionally happen that, in cases of obstruction produced by peritoneal adhesions, it is impossible to disentangle the coils. In such cases the choice lies between enterotomy as a palliative measure, and resection as a means of cure. The decision will be guided by the condition of the patient, and the length of intestine involved. Koeberlé* on one occasion did not hesitate to resect more than six feet of small bowel entangled in adhesions.

In cases of intestinal fistulæ where all minor modes of treatment have failed, and where the patient is steadily losing ground, resection may be called for.

In small irreducible intussusceptions, resection may be the best plan of treatment. Here the formation of an artificial anus, though it removes the dangers of obstruction, leaves untouched the equally dangerous condition of intussusception. Both risks are avoided by resection.

Removal of portions of bowel may be called for in cases of perforating ulcer arising from constriction by bands, or the presence of a foreign body, or in examples of multiple or lacerated wound which cannot be perfectly sutured.

The operation is contra-indicated according to ordinary surgical rules. Where the strength of the patient is so undermined that a prolonged operation would be likely to cause death, no operation is to be thought of. In malignant disease, symptoms of obstruction are considered by Schede to contra-indicate resection. I should be inclined rather to say that it contra-indicates intestinal suture, or, in more general terms, a greatly prolonged operation. The disease may be very quickly removed and the divided ends of bowel fixed in the wound, almost as speedily as the simple intestinal opening. Unfortunately, too many of the cases are complicated by symptoms of obstruction. In every case a minute examination of the parts should be made, to make certain that the whole of the disease can be removed.

* *Mem. de la Soc. de Chir. de Paris*, 1881, p. 99.

Mortality and Appreciation.—The most complete statistics of enterectomy have been furnished by Reichel.* Of 121 cases of resection of the bowel, with suturing of the divided ends, 58 died and 58 were cured, and 5 recovered with fæcal fistula. Ill collected 47 cases, with 25 deaths. The most frequent cause of death is peritonitis, started by some defect in the operation; more than one half of the deaths are so caused. The best results are got after the operation for artificial anus. From the elaborate tables of Makins,† which give many valuable facts for which I have not here space, we gather that of 39 cases of resection for artificial anus 15 died, 3 were left uncured, and the rest—21—were cured. Weir's statistics of 33 completed resections of cancerous intestine give a mortality of 51.5 per cent.

There would seem to be no doubt that, in cases of obstruction at least, the best results are got after the formation of artificial anus. This is as might be expected. But it is doubtful if the double mortality from the double operation would be much less than the simple mortality from the single operation. If the artificial anus is cured by measures short of resection, which can usually be done by methods to be described presently, then the mortality would be much smaller.

THE OPERATION.

Special names are given to the operation, as one or other part of bowel is involved. Colectomy means removal of portions of the colon; cæcectomy usually involves, not only removal of the cæcum, but parts of the ileum and colon as well; enterectomy, the best known term, is usually applied indiscriminately to any part of bowel, but it will be convenient to limit its meaning to resection of the small bowel.

In its main features, the operation is the same, whatever part of the bowel is involved, wherever the opening may be, and

* *Deutsche Zeitschrift für Chirurgie*, 1883, p. 230.

† *St. Thomas's Hosp. Rep.*, vol. xiii., 1884, p. 81.

whatever the disease. Special descriptions will be given where it is necessary to specify departures from the routine method.

The proceeding may be described in three stages: (1) Isolation of the bowel, (2) Resection, and (3) Suturing of the divided ends, or Enterorraphy.

Isolation of the Portion to be Resected.—In every case it is necessary to make a full and particular examination of the diseased part before proceeding to remove it.

In the case of gangrenous bowel protruding through a hernia, gentle traction is employed to bring healthy bowel into view, and to make certain that the healthy portion can be brought far enough outside to permit of its being resected and sutured. If simple traction will not suffice, on account of the smallness of the opening, or the presence of adhesions, or great distension of the abdominal portion of gut, then the simple herniotomy must be enlarged into abdominal section.

When the gangrenous bowel lies inside the abdominal cavity, we must carefully examine, and see that the healthy bowel beyond the gangrene is free and sufficiently movable to be brought to the surface. I have found a gangrenous portion of bowel under a peritoneal band so firmly adherent in the neighbourhood of the pancreas that resection was impossible.

In the case of malignant disease, not only are the upward and downward limits to be accurately noted, but the mesenteric folds in the neighbourhood must be explored to make sure that the glands are healthy. One or two glands in the area of mesentery attached to the bowel may be removed, and this need not contra-indicate operation; but if glands are infected beyond this area, the operation must be abandoned. Adhesions to neighbouring bowel ought, in my opinion, to contra-indicate resection.

In artificial anus, the mode of isolating the bowel is somewhat peculiar; and this, coupled with other peculiarities, will render necessary a special description.

The lines of resection being fixed upon, the portion of bowel to be removed is isolated as perfectly as possible from the

general peritoneal cavity. Soft sponges, of suitable size and shape, are packed all around the abdominal opening, for the double purpose of preventing unnecessary exposure of bowel, and excluding foreign matter which might escape from the divided intestine.

Resection of the Diseased Bowel.—I have already insisted on the importance of never closing an abdominal incision over distended bowels. If the case is one of obstruction, there will, of course, be accumulation of intestinal contents above the seat of obstruction; and in many cases of malignant disease there is an accumulation of fæces, though there is no obstruction in the proper sense of the word. In either case I should endeavour, as part of the proceeding of resection, to empty the bowel above as thoroughly as possible.

FIG. 58.

Makins' Clamp for Resection of Intestine.

This may be done easily enough in the case of gangrene. Two Makins' forceps-clamps (Fig. 58) are placed, one on each side of the site of resection, at the lower limit of the disease. The bowel is divided between them, and before doing anything else the lower portion of divided bowel is carefully cleansed. Then the gangrenous bowel is rapidly divided by scissors from its mesentery, catch-forceps being placed on bleeding points, for the whole distance contemplated. The gangrenous tube thus set free is used as a conduit to carry the fæces as far as possible away from the abdominal wound into a suitable receptacle. The escape of fluids may be encouraged by kneading the abdomen. When the flow ceases, a clamp is placed above the line of the upper incision, and the gangrenous bowel is removed by scissors.

If the disease is stricture, it will not be possible to make use of the partly resected tube to convey the fæces away from the

abdominal opening. Nevertheless, if there is much distension, I should make an effort to relieve it through the incised upper end of bowel. This may be safely done after careful packing with antiseptic cloths.

In the preceding description the gut is said to be closed, above and below the lines of resection, by clamps. There are several intestinal clamps, those of Treves* and Bishop† being best known. Dr. Abbe of New York has invented an excellent clamp in which the blades are covered by flannel, as being less likely to slip than rubber, and in which compression is maintained by elastic. Objection has been taken to these instruments, that they are cumbersome, interfering with facility of manipulation and suturing, and that their unyielding compression is likely to be injurious to the intestinal walls. Many surgeons content themselves with the soft dexterous fingers of an assistant; and if these can be trusted, nothing is better. The nearest approach to the fingers is the simple spring forceps-clamp recommended and used by Makins‡ (Fig. 58), and found perfectly efficient. It is made on the principle of Dieffenbach's spring catch-forceps, with the addition of a screw, and has blades long enough to compress the whole width of the bowel, while it may be applied without perforating the mesentery. The blades are covered with rubber tubing, to minimise the risk of injury to the intestinal coats. Four clamps are used, one being placed on each side of the lines of incision. Between each pair the bowel is divided by scissors. Two clamps will usually be quite sufficient; indeed, as already remarked, the operation may be performed without clamps at all.

The gut may be removed either with a triangular piece of mesentery or along the mesenteric border. To remove a wedge-shaped piece of mesentery, and stitch up the divided margins, gives a surgical finish to the operation which, I think, is of apparent rather than of real value. It involves less division of vessels, and so induces a smaller risk of subsequent gangrene, to leave as much mesentery as possible. It may be gathered

* *Med.-Chir. Trans.*, vol. lxvi., p. 53. † *Brit. Med. Journ.*, Nov. 3rd, 1883.
‡ *St. Thomas's Hosp. Rep.*, 1884, p. 81.

together in a continuous suture under the line of intestinal junction; and if a few superficial sutures are placed between the broad base so formed and the intestinal walls, it affords increased breadth and security of apposition. Especial care must be taken that no portion of bowel be left without attached mesentery. In experiments on animals, Rydygier and Madelung showed that gangrene was liable to occur in pieces of bowel protruding beyond the mesenteric attachment. Zesas,* continuing and extending these experiments, found that gangrene always followed separation of the mesentery close to the undivided bowel, but that no such result followed when the separation was made at a distance.

If the bowel is much congested, bleeding from the divided vessels is likely to be rather sharp. The use of a blunt scissors will lessen this. Forci-pressure must be used with discretion: the intestinal walls must not be crushed—only the bleeding point must be seized. Tait's sharp-pointed forceps are the best for this purpose.

If a triangular area of mesentery is removed, the gap must be carefully closed by suture. A good method of suturing is the continuous overlapping or over-edging stitch, applied over the cut ends while the peritoneal planes are held in apposition by the fingers. A double row of continuous sutures, in reversed order, will give additional security. Catgut would be quite efficient. Treves lays particular stress on the accurate suturing of the mesenteric gap, so as to prevent occlusion by kinking at the line of junction. For the same purpose, and also to minimise the risk of gangrene at the free edge of the bowel, MacCormac recommends an oblique division of the gut, more being removed from the free than from the mesenteric side.

Enterorraphy.—Attention is now turned to the suturing of the divided ends of bowel—Enterorraphy, as it is called. This is a proceeding as delicate and tedious as it is important. On the accuracy with which the suturing is completed depends, more than on any other detail, the success of the operation.

* *Arch. f. Klin. Chir.*, 1886, Bd. xxxiii., Heft 2.

Of modes of suturing there is quite a formidable variety. Bishop, in a valuable paper on Enterorraphy,* has collected no fewer than thirty-three distinct methods. Some of these are simply fantastic; many of them are obsolete; but not a few are brought forward with the authority of great names, and at least half a dozen are stamped with the imprimatur of success.

The most successful method will be in harmony with the pathological processes of union. Though it would be erroneous to deny to the muscular coat all power of exuding plastic lymph, there is no doubt that the serous coat provides adhesive material in far greater abundance and with greater rapidity. As a medium of union, the mucous coat may be ignored; but as a passive plug which, when it falls into apposition, prevents the escape of intestinal secretion, it may be of great use. Apposition of serous surfaces, as continuous as possible, and inclusion of the muscular coat, not only to strengthen the basis of attachment, but to prevent the retraction which takes place after division, are primary elements of success. More in detail, the essentials of an intestinal suture are: (1) That it shall secure and keep up perfect closure of the wound through its whole extent. The slightest imperfection in apposition will permit of extravasation of intestinal contents; every stitch, therefore, must be perfect. (2) That it shall be of material which is unirritating, and that it shall have a known and durable period of existence in the living tissues. Sutures that are not absolutely pure and unirritating will cause suppuration, as will tying them too tightly. Certain forms of prepared catgut, although durable enough, are not very pliable or very smooth; unprepared gut is liable to be too speedily absorbed. Fine Chinese twist is on all hands admitted to be the best suture-material for divided intestine. (3) No suture passing through the peritoneum must penetrate the mucous membrane. This would practically be to insert a seton, to be followed by a fistula between the cavity of the gut and the peritoneum. A suture involving the mucous membrane should always be tied on the inside of the gut; if it suppurates, the pus passes into the lumen of the gut, where it is harmless.

* *Med. Chronicle*, Sept., 1885.

(4) An intestinal suture should be capable of being rapidly inserted.

Several varieties of suture satisfy these requisites, and the most useful may be referred to. They are either continuous or interrupted, or mixed—that is, partly continuous and partly interrupted.

The *continuous suture* has its advocates, and much may be said in favour of it. It affords very perfect apposition, it is quickly applied, and it prevents distension of the bowel and so opening of the spaces between the stitches. The continuous suture has been objected to because it remains firm only so long as each stitch remains secure, and that, when it is cast off inside the bowel, a long thread remains to conduct septic material into the holes in which it still lies. The second objection does not hold if the suture is placed outside in the serous and muscular coats; and the first is not a strong one if the suture is properly placed.

The best continuous sutures are, in my opinion, those of Dupuytren (Fig. 59) and Appolito (Fig. 60), the latter modified as I suggest. Dupuytren's suture gives perfect apposition of serous surfaces, and is the most easily and quickly inserted of all. The suture of Appolito, modified as shown in the diagram to avoid the necessity of placing a body in the intestine to which the end of the ligature is attached, can also be inserted with great rapidity after a little practice, and gives wonderfully accurate apposition.

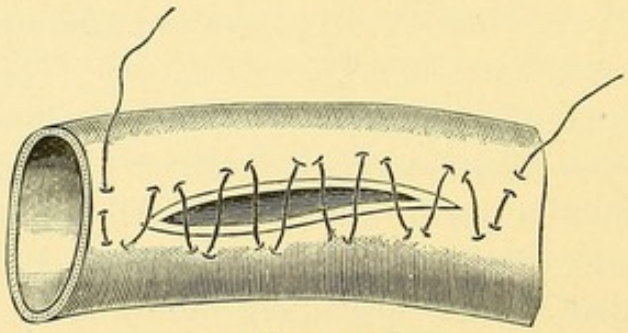

FIG. 59.

Dupuytren's Continuous Intestinal Suture.

There is one objection to the continuous suture, and that is, that, if the bowel contracts, it is loosened and may permit the wound to gape. As a sole means of closing the ends of completely divided bowel, the continuous suture must be condemned; but as an extra suture, applied over specially dangerous parts,

to give additional strength and security, it is of great value. Its chief virtues are, that it can be quickly applied, and that it prevents distension of the sutured gut and possible gaping between the interrupted sutures.

Of *interrupted sutures*, the best known are those of Lembert (Figs. 51 & 61), Czerny (Fig. 62), and Gussenbauer (Fig. 63).

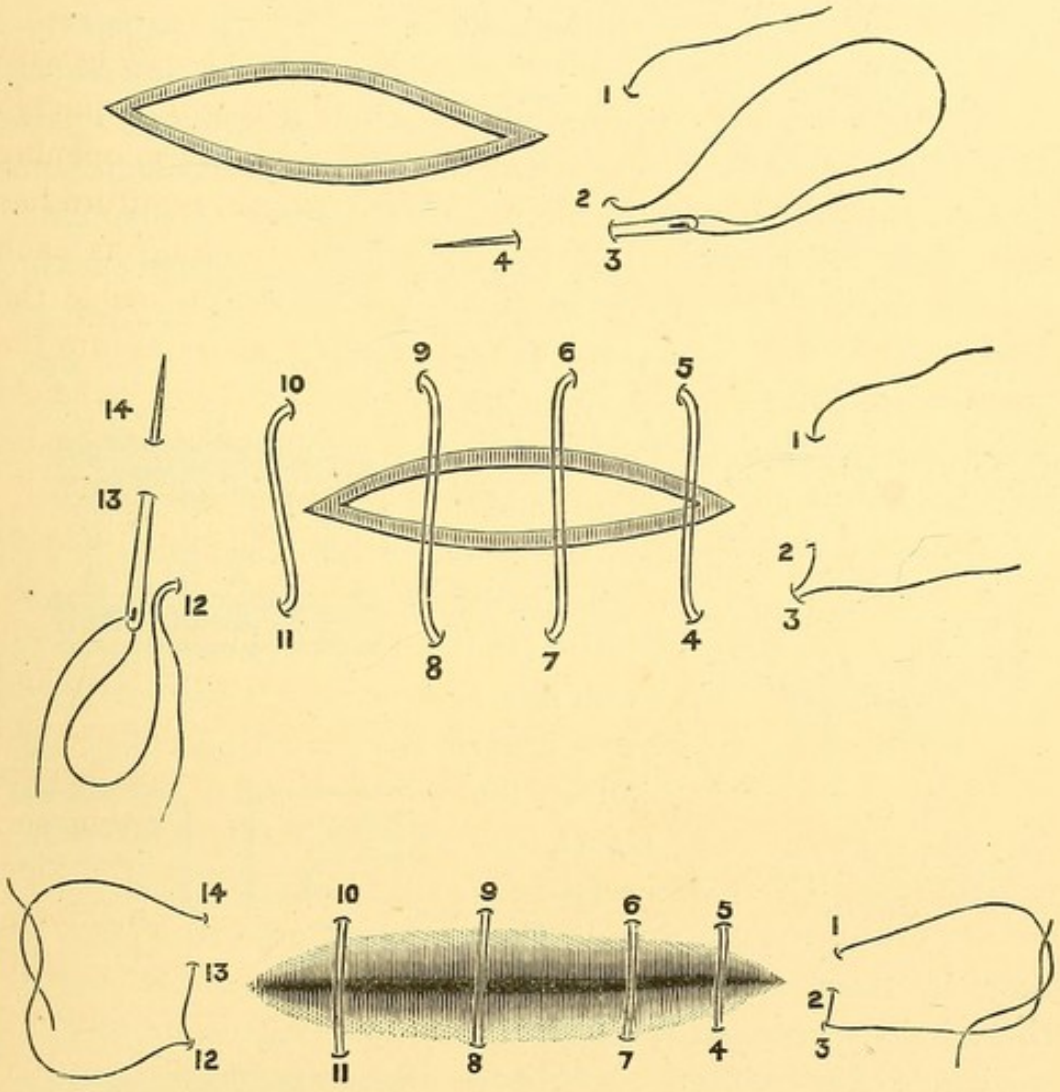

FIG. 60.

The Intestinal Suture of Appolito modified.

In Lembert's method, all the sutures are placed outside the bowel: this, always the favourite method, I believe to be still the best. Czerny's method combines Lembert's, with the addition of a second row passing through the whole thickness of

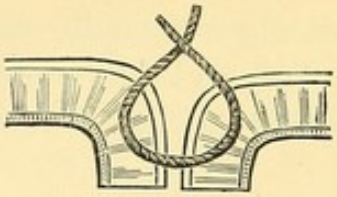

FIG. 61.

Lembert's Intestinal Suture.

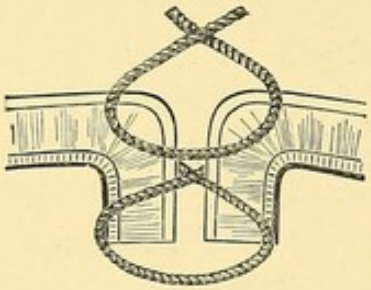

FIG. 62.

Czerny's Intestinal Suture.

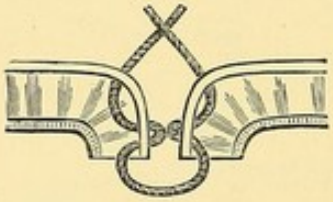

FIG. 63.

Gussenbauer's Intestinal Suture.

the gut and tied inside. Gussenbauer's method combines the Czerny and the Lembert in one suture, but does not, like the former, traverse the mucous membrane.

Bishop (Fig. 64) has introduced and successfully employed in the lower animals an ingenious and satisfactory suture. It is a sort of interrupted shoemaker's stitch introduced on the mucous aspect, each suture-loop being tied on alternate sides of the line of junction. It is not a rapid method of suturing, nor is it very easy of application; and it is open to the further objection, that the sutures are all on the mucous aspect, and that they, by their series of transverse constrictions, necessarily cause narrowing of the calibre. I believe that, as a subsidiary suture to be applied at weak parts, Bishop's is of great value; but as a complete suture for the whole, I think it might be excelled by others.

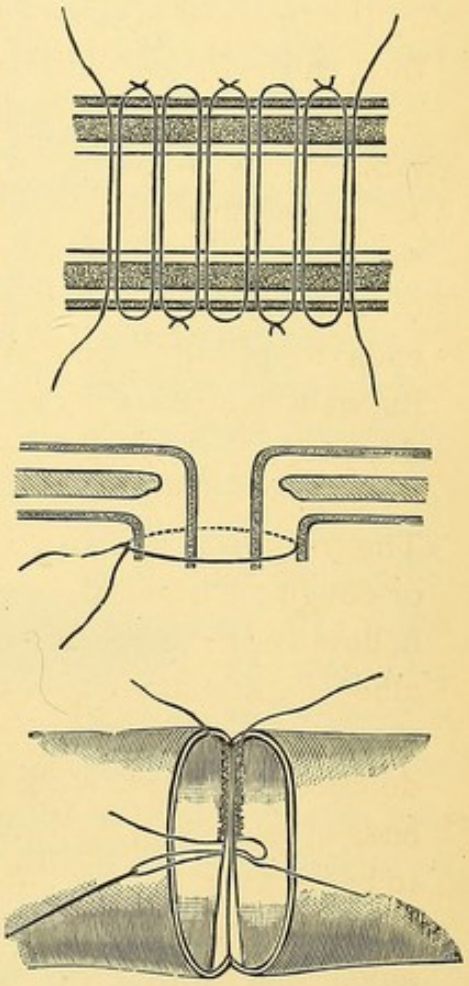

FIG. 64.

Bishop's Intestinal Suture.

Special mention must be made of the "quilt"-suture of

Halsted.* (Fig. 65.) In his numerous experiments he found it the best of all. It takes a very powerful hold of the tissues, and will bear a great strain without causing tearing; on this ground, I would advise its use in putting the parts on the stretch for the application of the Lembert suture, even where it is not employed throughout. The "plain-quilt stitches" do not produce such deep apposition as the "buried-knot half stitches." Although it has not yet been proved that they are as good as the Lembert for operations on the human subject, still there can be no doubt that they provide us with a very strong and easily applied method of suturing which may be employed to supplement other methods.

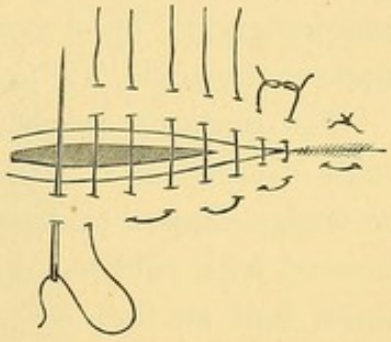

FIG. 65.

Halsted's Plain Quilt-Suture.

The suturing may be carried out either while one or other of the clamps mentioned is on the ends of intestine; or by the aid of the fingers alone, small sponges being placed in the open ends to prevent escape of the intestinal contents; or while its walls rest on a cylinder, over which the ends of bowel are drawn.

Of such cylinders a great variety has been suggested and used. The trachea of an animal; a cylinder of tallow, or cacao butter, or dough, or isinglass, or such liquefiable material; a decalcified hollow bone; a roll of oiled cardboard, and other materials of allied nature, have been mentioned or used. For this purpose the sausage-shaped soft rubber bag invented by Treves is undoubtedly the best. The bag, when empty, is placed in the open ends of the bowel and inflated; when the last stitches are about to be inserted the air is allowed to escape, and the bag is removed collapsed and empty. Most surgeons, however, Treves himself among the number, regard all such devices as unnecessary, and place the stitches without the introduction of any foreign body.

* *Internat. Journ. of Med. Sc.*, Oct., 1887.

Whilst endeavouring to do full justice to every good method of suturing the bowel, I may be permitted to describe in detail one method which, for ordinary cases of resection, is, in my opinion, the most perfect. This method will most easily be comprehended by a reference to the accompanying drawing, made to life-scale. (Fig. 66.) The Lembert suture is employed.

The diseased intestine has been cut away, the mesentery being divided as close to the bowel as is deemed desirable, and no wedge-shaped portion being removed. Two Makins' clamps, covered with rubber-tubing, have been applied, at a distance of about half an inch from the divided ends of bowel. A purse-string stitch has been so arranged along the divided margin of mesentery that it draws together the gap of cellular tissue and the attached margins of gut, while it leaves free small flaps of peritoneal membrane which may, if deemed desirable, be grafted on to the base of the line of union. Four quilt-sutures have been inserted on the opposite sides of the divided gut, in the exact line in which the Lembert sutures are to be placed; the two on each side are gathered together in the blades of catch-forceps, and gentle and steady traction made on them by an assistant. This raises a well-defined fold along the edge of the bowel; into this fold the sutures are inserted. The insertion of these quilt-stitches makes certain that equal distances of the bowel are arranged for suturing, and also by raising a fold makes the insertion of stitches more easy, and ensures their being placed in a straight line. The whole operation is carried out while the parts are resting on a warm sponge-cloth lying on the abdominal wall, and while several sponges packed into the cavity keep back the bowels. The assistant, with one hand, holds one pair of forceps, and steadies the clamps by their extremities; with the other he holds the other pair of forceps.

About a dozen ordinary milliner's needles are threaded with the fine silk selected for the purpose. Each needle carries sufficient silk to make three sutures—say, eighteen inches in length altogether. Three stitches may be placed as a continuous suture with one thread eighteen inches long; the loops are divided, and another threaded needle is taken up. If the needle

is not too sharp, the insertion of the sutures may be carried out with great practical facility and almost physiological precision. Halsted's statements as to the resisting nature of the strong

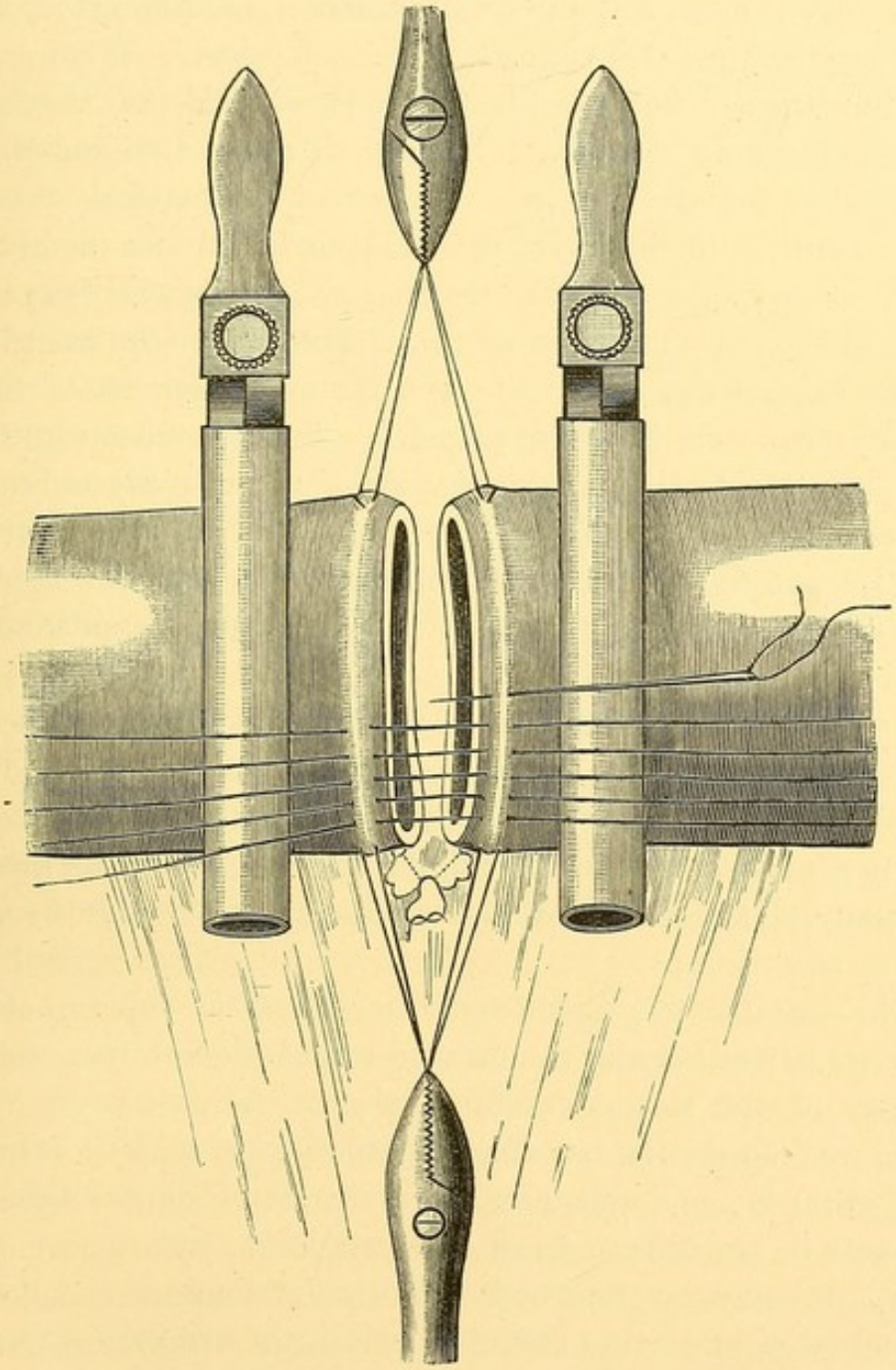

FIG. 66.

Drawing to show method of Intestinal Suture.

(For description see Text.)

fibrous coat are verified at every stitch: it is scarcely possible to ignore them. The needle passes readily through the serous and muscular coats, then it is checked; a rapid change from the vertical to the horizontal position picks up a few threads of the tough fibrous coat, and the needle emerges, to be inserted in the same way on the other side.

Thus the sutures are placed along one side of the bowel between the quilt-sutures. They are then gathered together in the hand of the assistant, as in closure of the parietal wound in abdominal section, and systematically tied from one end to the other. Finally the quilt-sutures are tied, the four threads being either tied in one knot or in two. The same process is now carried out on the other side, and the operation, so far as the bowel is concerned, is completed. The gathered-up layers of mesentery are finally inspected; and if there is any redundant tissue, this is raised as far as possible up the line of union on the intestine and fixed there by a suitable stitch. This will add to the strength and security at a point where experience has shown it to be specially wanted.

As the full reports of Senn's experiments on resection have not yet come to this country, I cannot describe his mode of using grafting or transplantation of the omentum. It is clearly a most valuable suggestion, and one which, as grafting especially, I should certainly employ where possible in every case of resection.

The clamps being removed, the intestinal contents above them are permitted and encouraged to pass downwards, and the security of the suture carefully tested. At any point which seems weak, a continuous Dupuytren's suture may be inserted. The bowel is finally cleansed by a stream of warm lotion, and may now be treated in one or other of three ways:

(1) It may be returned into the abdominal cavity, the abdominal wound being closed over it in the ordinary way.

(2) The bowel, carefully protected, may be left outside for a few hours till adhesive inflammation has sealed up the lines of incision. The sutures in the parietes are placed in position, but not tied till the bowel has been returned. Schede suggested this

plan; but the risks of distension of the extruded bowel, and of extrusion of more bowel, are so great, that it has not generally been adopted.

(3) The sutured bowel is returned, and fixed by a stitch or two to the parietal peritoneum. The abdominal wound is left open at the point of fixation, but closed above and below. A good many cases which have recovered have done so after fæces had burrowed an opening through the closed parietal wound; and some have died, apparently because free exit was not given to extravasated intestinal contents. There is no strong objection to this plan; if there is any doubt as to the perfection of the suturing, it ought to be followed.

When, however, there is no strong reason to the contrary, most surgeons prefer to completely return the sutured bowel into the cavity, and close the abdominal wound over it.

Where suture of the divided ends is rejected, on account of the great weakness of the patient forbidding prolongation of the proceeding, or on account of practical difficulties, an artificial anus is formed. This is done by bringing both ends of the bowel out through the abdominal wound at a convenient point, and suturing them to the wound-margin and to each other where they are in contact. Great accuracy must be observed in effecting closure of the openings into the abdomen; and when they are closed, they ought to be liberally smeared with some oleaginous antiseptic preparation.

In excision of the large bowel a few points demand special notice. It is rarely possible with complete satisfaction to remove a piece of ascending or descending colon through a median incision. In several cases where the median incision has been adopted, a supplementary transverse incision has been requisite. As it matters little where the abdominal incision is made, this ought to be always over the tumour. For purposes of diagnosis, where the tumour cannot be felt through the parietes, a small median incision a little below the umbilicus may be made for the insertion of the forefinger. When the site of the tumour is made out, a resection incision may be made at a suitable spot and the exploratory incision closed. The incision for lumbar

colotomy is not a satisfactory one for resection of colon. It is too deep and confined; the wound made is of very large dimensions, and through a lumbar wound it is not easy to delimit the amount of disease.

The *after-treatment* of these cases requires no special comment. The intestinal movements are subdued by the administration of opium. The patient is nourished by artificially digested foods, which are absorbed by the stomach and upper bowel, and which leave no residue. If the intestinal wound is high up, rectal feeding may be instituted. For the rest, the treatment is as in ordinary cases of abdominal section.

Operations for Artificial Anus and Fæcal Fistula.

The treatment of the artificial anus, which may result from any of the above operations, demands separate consideration. In those cases where the formation of artificial anus is all that was intended by way of prolonging life, all that can be done is to attend to the hygiene of the opening. In others, the formation of false anus was simply one step towards the permanent cure; and the cure of this fistula is attempted at the proper time. In other cases, a false anus, or rather a fæcal fistula, may result from the yielding of stitches after enterorraphy, and an operation to cure this fistula may be forced upon us.

A false anus may be described as an opening in the bowel which forms a communication, through the parietes, between the intestinal canal and the outer air. The bowel around this opening is adherent to the parietal peritoneum over a varying extent and by tissues of varying thickness and density, according to the amount of original inflammation and the standing of the case. The opening in the parietes to which the gut is adherent is of varying depth and size, according to the thickness of the parietes and the position where the bowel has become adherent. Its margins are puckered and depressed, and the skin around it is red and excoriated. Sometimes there are two such openings lying close to each other. The conditions of greatest practical importance are, the amount of bowel which has been lost, and the degree of flexure of the two intestinal tubes upon themselves. In cases where artificial anus has been made after resection of bowel for gangrene or disease, two pieces of intestinal tube lie parallel, and separated from each other by their double adherent walls. The end through which fæces pass will be dilated; the lower end will be collapsed, shrivelled, and empty. Between this condition of parallelism with destruction of bowel, and mere slight bending with a hole in the side of the

gut, there are many varieties. The accompanying diagrams (Fig. 67) give some idea of these varieties. In most cases, the continuity of the bowel above and below the fistula is interrupted by a spur or septum (*éperon* of Dupuytren), formed by the intestinal walls bent inwards. This spur varies in dimensions from a mere elevation or flap (Fig. 67, II.), to a complete barrier to the passage of fæces. (Fig. 67, III.) It increases in size with the duration of the case, being dragged down by the fæces and pushed over the lower collapsed bowel. The upper bowel itself, from its constant discharge of function, becomes increased in size and more vascular; while the lower portion may become shrivelled to the size of fœtal life. Hence, it is important that any operative procedures should be done early. The existence of this spur is the chief practical difference between false anus, which discharges the whole of the intestinal contents, leaving nothing to pass into the lower gut, and fæcal fistula, which may be a mere opening in the gut without flexure upon itself, and permitting extravasation of only part of the contents. In the cure of false anus, this spur is the chief obstacle: if fæcal

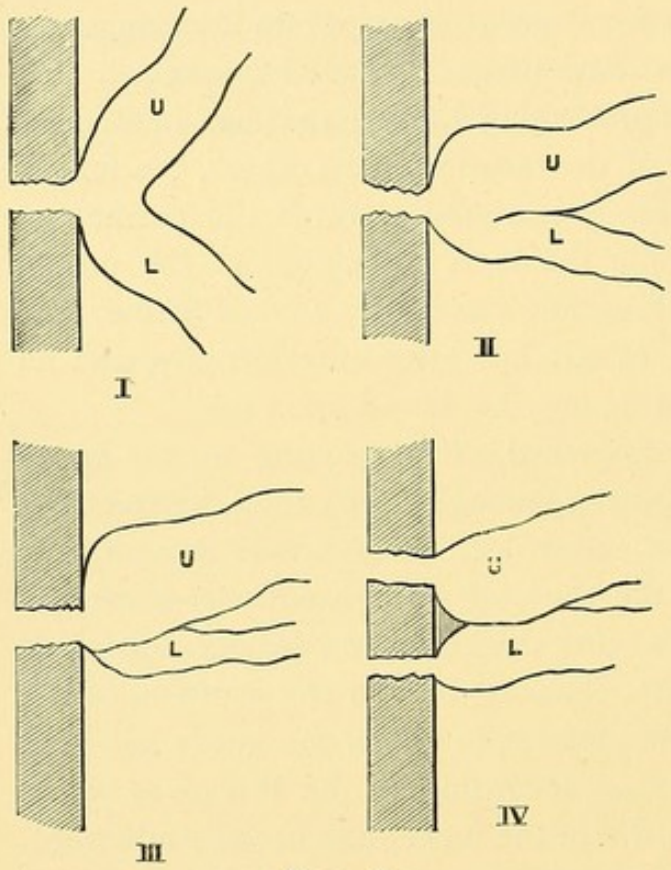

FIG. 67.

Diagrams to show varieties of Artificial Anus.

U. Upper Bowel. L. Lower Bowel. I. Fæcal Fistula, there being no Spur. II. Fæcal Fistula with Spur. III. False Anus with Spur, which completely shuts off the Upper from the Lower Bowel. IV. Double Fæcal Fistula.

fistula does not spontaneously cure, suturing or even resection of the bowel is necessary.

The *indications for operation* in fæcal fistula may be much stronger than a mere desire to get cured of a worrying or loathsome complaint. If the opening is high up in the bowel, rapid emaciation from escape of the chyle, and death from inanition, may be apprehended. The urgency of symptoms arising from escape of nourishment will depend upon the situation of the opening; but it seems to be a very general rule, that wasting is to be expected if the opening is anywhere in the jejunum or top part of the ileum. Besides this danger, patients with false anus are liable to prolapse of the bowel through the opening, or even to ordinary hernia.

Treatment.—The mode of treatment first adopted will depend upon the nature of the case; and the simpler methods, which promise a chance of cure, are put into use before the more severe plans. The modes hitherto recommended may be classified as—

(1) Plastic Closure, by pressure or plastic operation on the fæcal opening.
(2) Depression, division, or removal of the spur, to restore the patency of the canal.
(3) Resection of the fistulous portion of bowel, and suturing of the free ends.

(1) The mode of treatment by *closing the fæcal opening* is employed only in those cases where there is no spur, or where it has been removed, and where there is free communication between the upper and lower segments of bowel. It would be most suitable in cases of fæcal fistula.

Pressure exerted by an elastic truss, or strapping laced tightly over it, so arranged as to bring the granulations around the fistula into apposition and keep them apposed, has in some cases effected a cure. The use of the actual cautery, or of some caustic material, is occasionally effectual. Fixing the edges in apposition, after paring them, by harelip pins or silver

wire has been effectual. If all these fail, an attempt to close the opening by a plastic operation may be made. What form this plastic operatlon will take must depend on the nature of the opening to be closed; but I believe that the best plan, in most cases, would be by two flaps—one turned on its face over the opening, and the other laid by its raw surface over the surface of the first. The fistula should be drawn as closely together as possible by catgut sutures under the flaps, so as to prevent extravasation of fæces into the uniting portions; and the under flap should be fixed all round the opening, also by catgut sutures.

(2) *By removing the obstructing spur* caused by the infolding of the mesenteric aspect of the bowel, and so permitting the free passage of the intestinal contents, a spontaneous closure may take place. This may be done in various ways.

The simplest and perhaps the best method is by the insertion of a piece of thick rubber tubing into the two openings, which pushes downwards the spur by its continuous efforts to become straight. A string attached to it, and carried out of the opening, prevents its getting out of reach. Mitchell Banks has had several very gratifying successes by this method. It is evidently superior to the older methods, by tangle tents and such like. A silver tube has been used; but it may be very difficult of introduction, and may even produce some risk of perforation. The ends of the rubber tubing may be cut obliquely, to facilitate introduction and diminish irritation by its sharply cut ends. The method by rubber tubing is exceedingly simple, quite harmless, and, if employed early enough in the case, full of good promise.

Gradual division of the spur by ligature has been recommended and practised by several surgeons. A ligature is passed through the base of the spur, and made to cut its way through. As we cannot always be certain that peritoneal surfaces are in adhesion at the base of the spur, this thread may be carried into the peritoneal cavity and set up peritonitis. Dupuytren lost a patient through peritonitis, after the use of the scissors to

complete a cure by ligation, and he abandoned this method. It is not a plan to be recommended.

Destruction by the Enterotome.—Since the introduction of this instrument by Dupuytren, and the great success that followed its use, the mode of destroying the spur by slow crushing has enjoyed a considerable amount of favour. Dupuytren's well-known instrument has been modified and improved by Blasius, Delpech, Reybard, Gross, and others. Probably the best of these is Gross's enterotome, which not only divides the spur, but removes it. Its structure is simply that of a large torsion forceps, the points of which are transformed into two circular opposing rings. These are made to include the spur, and are left till the compression of the blades cuts their way through, removing the greater part of the spur between them. As the compressed portion sloughs away, protective inflammation is set up in the neighbouring peritoneum. In a very few cases, however, perforation has been caused by the enterotome, and death has resulted. This ought to make us careful in ascertaining that there is a spur with at least some amount of adhesion between its parts. The results of Dupuytren's method of operating are very favourable. Herman* has collected records of 84 cases, with a mortality of only 8.5 per cent., a complete cure in 50 cases, and in 26 considerable improvement. The mortality is so small, and the results (if trustworthy, which is just doubtful) so good, that the method of treatment ought to be adopted, where feasible before having recourse to more hazardous proceedings.

After any of the above proceedings it may be necessary to close up the opening by a plastic operation.

(3) *Resection and Suture of the Intestine* is a grave and difficult proceeding, to be adopted only when all other methods fail, and when the patient is losing ground from the effects of the complaint. It may be indicated in cases where there are several fæcal fistulæ, with several openings in the bowel which cannot be closed by the ordinary modes of treatment. In cases of large loss of substance of one side of the bowel, without flexure and

* *Lond. Med. Rec.*, 1883, p. 187.

without the existence of a spur, resection may from the first afford the only prospect of cure. Again, when there is extensive prolapse of the mucous membrane which cannot be controlled, and which is causing ulceration or inflammation of the bowel, resection may be indicated.

Mr. G. H. Makins* has made a laborious and complete list of all the recorded cases of enterectomy for artificial anus. Out of 39 cases where the operation was performed for this purpose, 15 (38.4 %) died of the operation. Of the fatal cases, 9 died of septic peritonitis—5 of which were from fæcal extravasation, in 3 cases from the mesenteric border. Of the 24 that recovered, 3 were left with artificial anus. These results are sufficiently encouraging, and more than justify the proceeding in cases such as those indicated.

The proceeding so carefully planned and so skilfully carried out by Makins, seems to me to fulfil, as far as possible, the best principles of surgery, and the following description is based on his account of his case:

Preliminary proceedings, to permit of operation with an empty bowel and a pure wound, will be instituted. For a couple of days or so before operation the patient is to be fed upon nutrient enemas, all food by the mouth being withheld. Just before the operation the bowel may be irrigated with warm water till the fluid returns clear. If it is possible to wash out the lower bowel as well as the upper, this had better be done. The fistula and the parts surrounding may be kept soaking for twenty-four hours or so before operation in carbolic lotion, as strong as can be borne without causing smarting—probably about 1–30. When the patient is anæsthetised, the surrounding skin is to be scrubbed, first with turpentine and then with 1–20 carbolic lotion, by means of a nail-brush. All granulations are to be scraped off or scrubbed off, and their site thoroughly purified. The spray may now be turned on, and the operation proceeded with, in the expectation of its being an aseptic one.

An incision, vertical by preference, is made through the abdominal walls for about an inch and a half on each side of the

* *St. Thos. Hosp. Rep.*, vol. xiii., 1884, p. 181.

fistula—more or less, as circumstances render expedient. The cavity being opened, the condition of the entering and returning bowel is inspected—their relations, the amount and nature of the adhesions present, and so forth. The ends are now carefully dissected away from their adhesions, liberated, and drawn through the wound. After the abdominal cavity is opened, the chance of extravasation of the intestinal contents may be prevented by the insertion of a sponge, or the placing of two clamp-forceps round the wound, or, perhaps best of all, by grasping the bowel around the opening by a Nélaton's or other suitable forceps and leaving it attached there. When the bowel is pulled out so far as to give freedom for the application of the sutures after it has been resected, the abdominal cavity is to be closed as far as possible by the packing in of sponges. A large sponge would with difficulty be inserted; but several strips of flat sponge, or several small sponges tied together, will serve the same purpose. When the opening is satisfactorily closed, the clamp-forceps are put on—one on each side of the two incisions—and the bowel, with the fistula in it, is cut away with scissors beyond the site of the old adhesions. The mesentery being united by a double row of continuous suture, if a triangular piece has been removed; or by a purse-string suture if no mesentery has been removed, the suturing of the divided ends is now proceeded with. If the two ends of bowel are of very different calibre, as is frequently the case, some difficulty in getting apposition may be apprehended. The lower opening may be gently dilated to a slight extent by the fingers, and this may suffice; but it may be necessary to cut the lower bowel obliquely away from its mesenteric attachment, so as to increase the area to be sutured. The suturing is carried out exactly as for ordinary enterectomy, already described.

If, after the bowel has been sutured, it is found impossible to bring together the edges of the fistulous opening, it may be wise to complete the closure of the abdominal wound by a plastic operation. As to dressing, nothing need be added to the accounts already given.

Section VIII.

OPERATIONS ON THE KIDNEYS.

The surgery of the kidneys might be arranged under the three heads of incision, removal, and fixation. Incision is performed for the evacuation of cystic and purulent collections, and for the removal of stone: the first class of operations is known by the name Nephrotomy (*νεφρός*—kidney, and *τομή*—incision); the second is specialised as Nephro-lithotomy (*νεφρός*, *λίθος*—stone, *τομή*). The kidney may be removed for any of the conditions which justify nephrotomy, and specially for solid new growths. The operation of excision of the kidney is named Nephrectomy. Operative fixation of a movable kidney is named Nephrorraphy (*νεφρός*, *ῥαφή*—suture). As, however, stitching is not an essential part of the operation for fixing a movable kidney, some other word, such as Nephropexis (*πήγνυμι*—fix), would be more exact. Nephrorraphy is properly applicable to the stitching up of wounds in the kidney.

SURGICAL ANATOMY OF THE KIDNEYS.

The size of the kidney in health is about 4 inches in length, 2½ inches in breadth, and between 1¼ and 1½ inch in thickness. The right kidney is a little shorter and broader than the left.

The kidneys lie deep in the lumbar regions, embedded in capsules of fatty tissue. Each kidney overlies portions of the diaphragm, the transversalis aponeurosis, and the psoas muscle. Vertically, the position of the kidneys is liable to some variation in health and in disease. Morris* says that "the upper edge of the kidney corresponds with the space between the eleventh and twelfth ribs, and the lower edge is nearly on a level with the middle of the third lumbar spine." This is probably correct: it certainly corresponds with a good many observations which I have made. Braune places them in similar position, the left being a little higher. Luschka's observations correspond, or place them about about half an inch higher still. The ordinary descriptions in the text-books place them about half a vertebra too low. The level of the hilum, the part which concerns us most, is practically that of the first lumbar vertebra; that is, just clear of the ribs behind, and overlapped by the floating ribs in front.

The long axis of the kidney is not accurately vertical, nor are its surfaces anterior and posterior. This will be best understood by saying that if the vertical axes were prolonged upwards, they would meet near the surface of the body behind at an angle of about forty degrees; while if the transverse axes were prolonged forwards, they would meet in front of the vertebral column at an angle of about sixty degrees. The upper end lies deeper and nearer to the spine than the lower. It might truthfully be said that the surface known as the anterior has just as much right to be known as the exterior.

The right kidney, on its upper and anterior aspect, is in contact with the under surface of the liver. This fact may explain its slightly lower position, and its greater tendency to become displaced. In direct contact with its anterior surface,

* *Surg. Dis. of Kidneys*, p. 2.

where they are uncovered by peritoneum, are the duodenum and the junction of the ascending with the transverse colon. The top of the left kidney touches the fundus of the stomach: the upper two-thirds of its external border is in relation with the spleen; in front, towards the inside, lies the pancreas; and crossing its anterior surface lower down, is the beginning of the descending colon. The position of the colon in relation to the kidney is of importance in diagnosis, as well as in operation. When the kidney becomes enlarged, the colon, bound down to it under the same peritoneum, is carried in front of it. Renal tumours, of necessity growing downwards, burrow under the colon and push it forwards. On the right side, the ascending colon is usually found to lie vertically on a renal growth; on the left side, the transverse and the descending colon pass obliquely in curvilinear direction from above downwards and outwards. In the layer of peritoneum which passes backwards from the colon to the mesentery lie the vessels which supply the colon; and any serious injury to these vessels, such as might be caused by peeling peritoneum off renal growth, is fraught with danger to the vitality of that portion of bowel. The peritoneum which passes from the colon over the tumour towards the abdominal wall may be divided without fear of injuring the vascular supply of the bowel.

The structures at the hilum (Fig. 68) of the kidney—the artery, the vein, and the ureter—are of special importance,

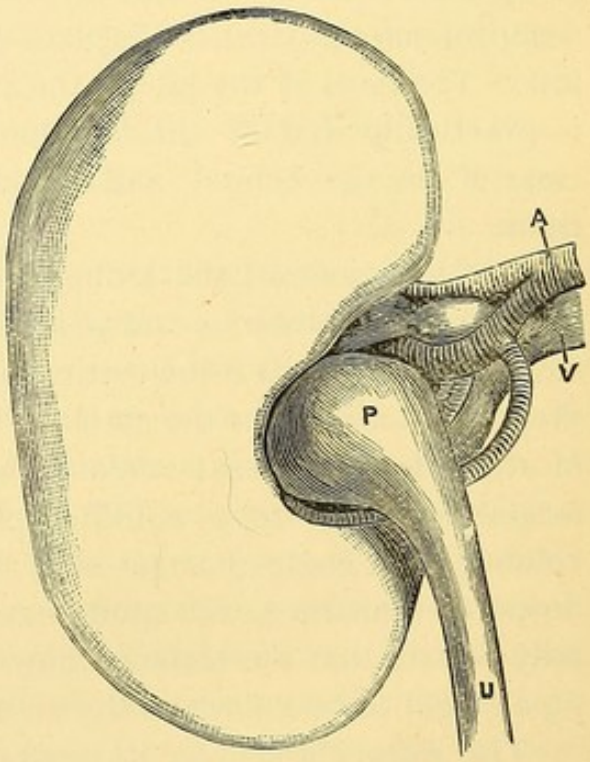

FIG. 68. (*After* WEISSE.)

Structures in the Hilum of the Left Kidney viewed from behind.

A, Artery; V, Vein; P, Pelvis; U, Ureter.

because they form the pedicle in cases of extirpation. The direction of the vessels from the aorta and the vena cava is practically transverse. The right artery ascends a little to its kidney, its origin from the aorta being a little lower down than the left; it is also longer than the left, owing to the position of the aorta to the left of the middle line. The right artery passes behind the vena cava. Just before entering the hilum, where the vein lies in front and the ureter behind, the artery breaks up into four or five branches, which are distributed to the renal tissue. These branches mostly, but not uniformly, retain their position behind their corresponding veins. Small branches are given off to the supra-renal body, the ureter, and the neighbouring connective tissue. The renal veins are a good deal larger than the arteries, and overlap them. The left vein is longer than the right, having to cross the aorta to enter the vena cava. Into this vein the left spermatic and the left inferior phrenic veins discharge themselves: both vessels are quite within reach of injury in dealing with the renal pedicle. At the hilum the veins branch quite as much as the arteries, and the subdivision extends farther towards the middle line. In the post-mortem room, in about twenty subjects examined on this point, I have been surprised at the frequency with which two or more trunks represent the renal vein, sometimes surrounding the artery. Variations in the artery are by no means rare. This want of uniformity in the renal vessels is against the possibility of ligaturing artery and vein separately. In scratching or cutting open the pelvis of the kidney, it is quite possible to wound a vein. Though the kidney is a very vascular organ, yet, as its vessels run in a straight course towards the convex border, and do not anastomose to any extent, an incision may be made from cortex towards hilum without causing dangerous bleeding.

At the lower border of the kidney the ureter begins to expand into the funnel-shaped sac known as the pelvis. In the hilum the pelvis gives off two or three short trunks, which in their turn subdivide and form the calyces or infundibula which open over and grasp the papillæ. Jordan Lloyd* has found that

* *Birm. Med. Rev.*, Dec., 1886.

many of the primary tubes are more than an inch in length, and no larger than a No. 10 catheter; while the secondary tubes run as fine as a knitting-needle. In such cases, it is evident that a finger inserted into any part of the pelvis could not possibly make a complete examination of the calyces; and, on the other hand, it may be added, that a stone impacted in one of the primary tubes could not be removed through a secondary tube opened up by an incision confined to the renal structure. The accompanying drawing (Fig. 69), which is more true to nature than any I have seen, shows clearly the truth of Mr. Lloyd's contention.

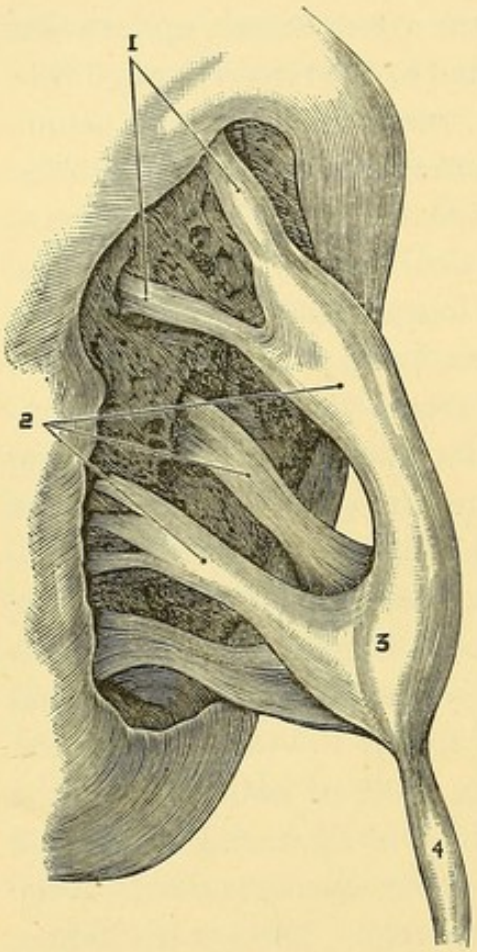

FIG. 69. (HEITZMANN.)

Pelvis and Calyces of the Kidney prepared out of the Renal Substance.

1. Minor Calyces. 2. Major Calyces. 3. Pelvis. 4. Ureter.

The pelvis passing downwards and inwards from the hilum, gradually contracts to form the ureter. The ureter is said to begin at the lower border of the kidney, and passes downwards and inwards behind the peritoneum to its insertion into the base of the bladder. From above downwards, it is in relation with the psoas muscle and the genito-crural nerve; at the brim of the pelvis, it crosses the external iliac vessels on the right side, and the common iliac vessels on the left; thence it passes in the fold forming the posterior false ligament of the bladder to its insertion. All through its course the ureter is very loosely attached to the cellular tissue in which it lies.

The kidney is kept in position by its thick packing of fatty cellular tissue, known as the tunica adiposa. This tissue varies

in amount in different individuals; but it is always of considerable thickness. In this elastic bed, the kidney enjoys some liberty of movement; when it is opened up, and the kidney is exposed, regular movements are seen to follow the respiratory acts. When the fat is partly absorbed, or its density is diminished, anatomical displacements may be produced.

In operations upon the kidney, the lowest limits of the pleura and its relations to the twelfth rib are of importance. Dumriecher of Vienna, in an operation upon an enlarged kidney, by misadventure opened the pleura. Holl of Vienna and Lange of New York have made studies on this point, which show that the last rib is frequently so short as to be overlooked, and that the pleura descends as low as if the twelfth rib were of normal length. (Fig. 70.) The lower edge of the pleura passes horizontally

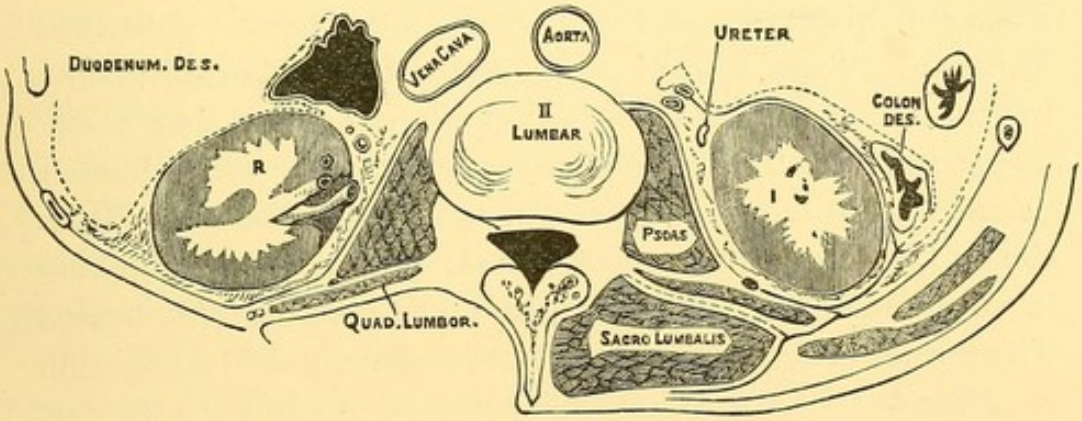

FIG. 70. (LANGE.)

Horizontal Section of Body between Second and Third Lumbar Vertebræ (surface of Upper Section seen from below, i.e., right side to left hand), showing relations of Kidneys to Peritoneum (marked by dotted lines) and Muscles.

between the lower boundary of the twelfth dorsal vertebra and the lower edge of the eleventh rib, whatever be the condition of the twelfth rib. It is peculiarly necessary, therefore, that the upper limits of incision should be marked rather by counting the ribs before operation, than by feeling the presence of the bony rim during operation.

Nephrorraphy.

By this operation is meant the fixation of a kidney that is movable. It need not be the replacement of a misplaced kidney; nor does the operation, as already remarked, of necessity involve the placing of sutures. With simple misplaced kidney, congenital or acquired, we have here nothing to do: the existence of such a condition is usually discovered for the first time in the post-mortem room. It is where there is not only displacement but want of fixation, and where this mobility begets troublesome symptoms, that the operation to be described may be called for.

Pathological Anatomy of Movable and Floating Kidney.—Two forms of displaced and not fixed kidneys are described—Movable Kidney and Floating Kidney. In Movable Kidney, the movements are entirely sub-peritoneal; they take place in a space artificially created in the areolar tissue which binds the peritoneum to the underlying muscles. In Floating Kidney, the movements are intra-abdominal; that is to say, the kidney is surrounded by peritoneum, and possesses a meso-nephron. The former is acquired; the latter is congenital.

Movable Kidney.—A certain amount of mobility, to the extent of an inch or an inch and a half, is not very uncommon, especially in women with flaccid abdominal walls who have borne a large number of children. Here the mobility of the kidneys is of a piece with want of stability in the position of other abdominal organs, and is of no practical moment. In greater degree the mobility may be associated with certain changes in the tissues which are in immediate relation with the kidneys, and in some instances with changes in the tissue of the organ itself.

The kidney moves behind the peritoneum in a loose bed, which, according to Newman, may be formed in various ways. The adipose tissue which closely envelops it may become loosened all round, and the kidney may move about in the

potential space so created. Or, the fatty tissue immediately surrounding the kidney may remain undisturbed, while the kidney with its fatty capsule may move in a space formed by the separation of peritoneum in front from muscle behind. Or, there may be a double mobility inside the capsule and behind the peritoneum. In every case there will probably be a notable diminution of circumrenal fat. In a considerable number of cases lengthening of the renal vessels has been found.

The amount of mobility varies from an inch or two, to the extreme distance which the double attachment of renal vessels and ureter will permit.

The movable kidney is usually perfectly healthy; but occasionally lesious are found in an association with mobility which can scarcely be regarded as other than one of cause and effect. Thus, Dickinson* has found pyelitis associated with movable kidney; and Fritz† relates a similar association, both in his own experience and in that of Urag. Landau‡ punctured many times a hydro-nephrosis in a movable kidney, which ultimately became purulent, and was successfully opened and drained. Hickinbotham had a case of death from pyelitis in a wandering kidney. Kehrer traces a connection between blocking of the ureter of a movable kidney by torsion or kinking, and hydro-nephrosis. In this category, as a probable cause of hydro-nephrosis, Dickinson places calculus or gravel, and further offers the suggestion that temporary dilations of the pelvis by an obstructing calculus, by increasing the size of the organ, may, when the swelling disappears, cause loosening of the kidney in its bed, and so start the mobility. Pyelitis may thus be a cause of mobility. In such cases peri-nephritis may be set up: occasionally this is so severe as to cause adhesion to neighbouring organs, and especially to the liver.

Tumours, cystic and malignant, have been found associated with mobility of the kidney. Menstruation has by several observers been noted as a possible cause of temporary increase in the size of the kidney. Sawyer, in particular, called atten-

* *Renal and Urinary Affections*, vol. iii., 1883. † *Archiv. Gén. de Méd.*, 1859, vol. ii.
‡ *Die Wanderniere der Frauen*, Berlin, 1881.

tion to this; and Newman found an aggravation of the symptoms in a movable kidney during menstruation, while he thought he also detected an increase in its size.

The condition usually appears during adult life or middle age, and is extremely rare in childhood and in old age. Of 290 cases collected by Newman, 81 per cent. occurred between the ages of 20 and 50. It is six or seven times more common in women than in men, according to the investigations of Newman, Roberts, Ebstein, and Dickinson. The right kidney is affected four times more frequently than the left; rarely are both affected at the same time.

From the fact that movable kidney is most frequently found in women who have borne children, it has been inferred that pregnancy is a cause. It would probably be more exact to say that laxity of abdominal walls, whether it follow pregnancy or not, favours the displacement. Absorption of circumrenal fat is another cause: such a case, a very marked one, appeared in the post-mortem room of the Bristol Infirmary three years ago. In this case cancer of the stomach was the cause of emaciation. Dickinson records cases in which accident or severe strain seemed to start the mobility.

Speaking generally, movable kidney is most likely to be induced by a combination of circumstances. The most telling combination would be found in a middle-aged woman, accustomed to severe manual labour, who has borne several children and who is losing flesh. When once the kidney is started from its bed, repeated movements or jerks increase the mobility. The influence of such jerks is cumulative: every inch gained adds to the ease with which another inch is gained, till its limits of mobility are reached, when it drags upon its own vessels and ureter.

Floating Kidney.—A floating kidney has been defined by Jenner* as one "that has a mesentery, a fold of peritoneum attaching it very loosely to the spine." It is, indeed, probable that this definition is too precise. The investigations recently carried out under the auspices of the Pathological Society of

* *Brit. Med. Journ.*, 1869, vol. i., p. 43.

London would seem to show that one variety of misplacement may merge into another, or rather that a movable kidney may so drag out its peritoneal covering as almost to cause the formation of a meso-nephron. To surgeons, as Morris very properly points out, the main consideration is, whether or not the kidney has a meso-nephron; that is, whether it can be reached by an extra-peritoneal operation from the loin.

Floating kidney is very rare. It is always congenital, and is frequently associated with other abnormalities in the disposition of the peritoneum. In at least two described cases, malformation of the large intestine has been found. The renal vessels have been found elongated. General laxity of the peritoneum has been found in more than one case of true floating kidney.

Symptoms.—The subjective signs of movable kidney range from mere discomfort to intense pain. The symptoms tend to vary according to the amount of mobility. Thus, slight degrees of mobility may be troublesome only after undue effort or exercise; extensive mobility rarely leaves the patient free from pain, and is often associated with positive agony.

The most common symptom is a dull, aching or dragging pain in the loin, shooting down the abdomen towards and along the thigh. This pain is increased by exertion of any sort, and particularly by long walks or rides. The pain is aggravated by constipation; and it is often increased during the menstrual period. Occasionally paroxysmal attacks of pain come on, not unlike nephritic colic. In these attacks are sometimes found symptoms of blocking of the renal artery or ureter: such are, suppression of urine, with headache, vomiting, foul tongue, and other symptoms of uræmia. Very frequently there is considerable intestinal or stomachic disturbance, shown by dyspepsia, flatulence, colic, sickness, anorexia, and diarrhœa. Frequency of micturition or even tenesmus may be present. All such symptoms are relieved by lying down. Pyelitis may show itself by the presence of pus in the urine. Œdema of one leg,* and jaundice from pressure upon the common duct,† have been

* Giraud, *Journ. Hebd. de Progrès des Sc. Méd.*, 1836, vol. iv., p. 445.

† *Brit. Med. Journ.*, Jan. 29th, 1876.

noted. Those symptoms which may be considered as suggesting renal strangulation are found associated with an increase in the size of the movable tumour.

The objective signs are: tumour in the upper abdomen, of the shape, size, and consistence of a normal kidney, which, upon manipulation, slips away from the examining finger, usually in the direction of its proper site in the loin. The patient will frequently draw attention to the tumour, and will explain that it changes its position. By comparison of the two loins, a want of resistance may be detected by the grasping fingers on the side to which the movable tumour tends to glide. The abdominal parietes being usually lax, this sign may be fairly definite: the laxity may be so great that the tumour may be bodily grasped in the fingers, replaced in the loin, and there palpated in comparison with the opposite side. When handled in this way, the kidney will show a tendency to slip away from its situation in the loin; and this tendency may be encouraged by making the patient turn to the opposite side or stand upright. Its range of mobility is characteristic. Between the umbilicus and the side of the abdomen laterally, and between the ribs and the crest of the ilium vertically, the movable kidney may be moved, in varying degree, almost anywhere; but beyond the middle line, or into the pelvis, it will not go. The renal artery has been felt pulsating on its concave inner edge; but this is unusual.

Percussion gives little help. As intestine overlies the tumour, the note may be of normal resonance, or but slightly muffled. Increased resonance, as compared with the opposite side, may be present in the loin.

During the physical examination, a subjective symptom of great value is elicited. This is a peculiar sickening and painful sensation, analogous to that experienced during compression of the testicle in man or the ovary in woman.

Diagnosis.—A movable kidney may be confounded with tumours of the omentum, the ovary, the parovarium, the gall-bladder, and the pylorus. It may be mistaken for impacted fæces in the colon. I have removed a hydro-salpinx which was

at first diagnosed by friends and by myself as a movable kidney. A growth in the pancreas I have known to be taken for misplaced and movable kidney. It is probably not necessary to do more than mention the fact that these and such growths may be taken for movable kidney.

The diagnosis of movable from floating kidney cannot be worked out with certainty. Excessive mobility may suggest a floating kidney; but it is just as likely to turn out to be a movable kidney with a wide range of mobility. Though it is practically of supreme importance that we should be able clinically to differentiate the one from the other, it has not yet been possible to do so.

Indications for Operation.—Many cases of movable kidney require no treatment beyond a properly fitted abdominal support. Others, in spite of such support and of other palliative measures, are attended with great discomfort, or serious derangement of health. In a third class there is positive danger to life. This last class would include those cases in which there is present, along with the mobility, some inflammatory or degenerative condition, such as has already been described.

The indication to operate is the urgency of the case. The operation to be chosen is nephrorraphy. Of 18 cases of this operation collected by Gross,* one died. The operation, therefore, cannot be considered as free from danger. It is to be undertaken only after a full and fair trial of all known palliative measures, and at the desire of the patient.

Nephrectomy has been performed at least 20 times for movable kidney. Of these, 13 recovered and 7 died. For simple movable kidney, the operation is to be condemned; it is altogether an overdoing of surgical proceeding. But not all of these extracted mobile kidneys were healthy: at least 7 of them were diseased. One was cystic, 2 contained calculi; these 3 recovered; the other 4—1 containing pus and cheesy material, 1 sarcomatous, 1 encephaloid, 1 fatty—all died. This leaves 3 deaths among 13 excisions of healthy movable kidneys—a mor-

* *Internat. Journ. Med. Sc.*, July, 1885.

tality of 23 per cent. It need scarcely be added, that nothing less than great danger to life, such as might occur from strangulation or diffuse suppuration, would justify the incurrence of such a grave risk.

In the case of floating kidney, when nephrorraphy may be impossible, the negation of nephrectomy need not be so emphatic. Still, in this case, only failure of a patient and skilful attempt at fixation, and the continuation of grave and alarming symptoms, would justify the adoption of the major operation.

THE OPERATION.

An unknown surgeon is said to have performed nephrorraphy prior to 1870 in Mobile, Alabama. The first recorded operation was performed by Dr. E. Hahn, of Berlin,* in April, 1881, and he gave it the name it bears. He exposed the capsule of the kidney by an incision in the loin between the ilium and the last rib, along the edge of the sacro-lumbalis muscle. The perinephric fat was drawn into the wound, and sutured to muscle and fascia by half a dozen catgut sutures. Having found that after this operation the kidney broke loose, he recommended a more thorough proceeding by placing the sutures in the incised capsule proper, and fixing them to the superficial tissues.

Many variations on this mode of operating have been described, nearly all of them successful. Carrying the sutures through fat alone, through both fat and fibrous capsule, and through fibrous capsule alone; simple closure, with ordinary drainage; drainage by a large tube laid along the convex surface (Newman), so as to get a considerable growth of granulation tissue; packing of the wound by gauze or lint (Morris), and making it granulate from the bottom, have all been brought forward with the recommendation of success. In a case of mistaken diagnosis, where I opened the abdomen and found a movable kidney, I succeeded in fixing it by scratching its capsule freely with a needle, while the hand inside the abdomen pressed it against the loin. Whatever detail in operating may

* *Centralbl. für Chir.*, July 23rd, 1881.

be favoured, there is no doubt that the best plan of fixation is by extra-peritoneal incision through the lumbar muscles.

The best incision is an oblique one, as recommended by Bryant for lumbar colotomy. More accurately, it may be described as being parallel to the colotomy incision, an inch or less behind it, and rising to the same height under the ribs. As this lumbo-renal incision will have to be frequently referred to, and as it is here performed under conditions most nearly approaching the normal, it may now be fully described.

The patient is placed on the side, resting on a hard round pillow, so as to increase to its utmost limits the costo-iliac space on the side of operation. The twelfth rib is located both by palpation and by counting. The top of the incision is fixed upon, at least half an inch below the last rib, and close to the outer border of the erector spinæ. It is continued downwards and forwards towards the crest of the ilium in a direction which the eye will suggest as the most convenient, according to the conformation of the body of the patient. The length ought not to be less than three inches. As the size and the shape of the ilio-costal interval vary greatly in different individuals, a fixed and definite line for the continuation of the incision cannot be laid down. Only the beginning of the incision can be fixed.

After dividing the skin and fat, the superficial fascia is exposed. A few cutaneous branches from the lumbar and the inter-costal arteries will be divided, and may require forci-pressure. The fascia being divided by the knife to the extent of the skin wound, the outer edge of the latissimus dorsi and the posterior border of the external oblique will be exposed. At this stage of the operation, I think it is best to lay the knife aside, and perform all further dissection by means of bent scissors. The latissimus dorsi being divided by cutting upwards and the external oblique by cutting downwards, the internal oblique and the transversalis will now be laid bare. The edge of the erector spinæ, to which is attached the fascia lumborum, need not be divided. The internal oblique and the transversalis aponeurosis are divided upwards and downwards by the scissors. Here

branches of the lumbar arteries may be divided, and require forci-pressure. The outer margin of the quadratus lumborum is now exposed. The breadth of this muscle, and consequently the extent to which it encroaches upon the field of operation, is very variable. If it cannot be retracted, the encroaching fibres ought to be divided by a stroke of the scissors. Finally, the deep layer of the lumbar aponeurosis, often a dense and well-marked structure, is divided from end to end of the incision. This exposes the circumrenal fat, which probably bulges into the wound.

The dissection will have been aided by the use of broad retractors in the hands of an assistant. The retractors are now made to gather up the whole of the divided tissues down to the fatty capsule, and the opening is stretched to its utmost dimensions. A second assistant pushes upwards and backwards the pendulous abdomen, and specially seeks to force the kidney towards the lumbar incision.

Two fingers, carried around the kidney and its capsule, now seek to diagnose the exact nature of the conditions associated with the mobility. If it is clear that the fatty tunic is closely adherent to the fibrous capsule, the former need not be opened. But if the kidney has space for movement inside its fatty capsule, then this ought to be widely opened along the renal border, and the finger, inserted through this opening, moved freely over the renal surface, so as to excite plastic inflammation. In every case of doubt as to the exact nature of the mobility—and most cases will be doubtful—the free border of the kidney will be exposed by division of the fatty capsule. Aseptic irritation, such as would be produced by the exploring finger, is not only not harmful, but positively beneficial, as setting up an inflammation which may result in plastic adhesion. To facilitate cure as well as diagnosis, most surgeons would expose the free border of the kidney by division of the surrounding fat.

Fixation of the kidney is secured by means of catgut sutures carried through its fibrous capsule and the margins of the incision. Local irritation, with drainage, is attained by means of a large rubber tube placed along the kidney border, and

doubled on itself at the extremities of the wound; the two ends being brought out through the incision. This piece of tubing is not to be removed till evidences of inflammation appear.

Newman found, in a case upon which he successfully operated, that catgut sutures became absorbed where they passed through renal tissue proper more quickly than anywhere else. Superficial stitches through the fibrous capsule would be quite efficient, and the chances of premature absorption are less. Morris, in his most recent operation, has carried several sutures through the renal tissues, and fixed them over the lumbar wound.

It is probable that permanency of cure would be more certainly secured by general adhesions all around the kidney, or by inflammatory condensation of its fatty surroundings, than by the temporary and local adhesion produced by sutures. Sutures are co-aptating, rather than uniting: they keep the tissues in contact while they may adhere; they only to a slight extent promote and secure adhesion. To the end of permanent fixation, I should lay much stress on the stirring up of circum-renal fat by finger or blunt instrument.

The closure of the wound and the after-treatment require no special description.

Nephro-lithotomy.

By Nephro-lithotomy is meant the removal by surgical operation of a stone situated in the substance or the calyces or the pelvis of the kidney. No better definition of the operation can be given than that of M. Hévin,* enunciated a hundred and thirty years ago: "La Nephrotomie, ou plutôt, suivant Schurrigius, la Nephro-lithotomie, est l'opération par laquelle on extrait une ou plusieurs pierres au moyen d'une incision qu'on fait à la région lombaire, et qui pénétre jusques dans la cavité du bassinet du rein."

History.—Up to a very recent date, all operations upon the kidney were performed for stone: nephrotomy was practically synonymous with nephro-lithotomy. But, in most, if not in all, cases of ancient operation, cutting for stone in the kidney was as much the evacuation of an abscess, as the extraction of a foreign body. Hippocrates himself recommends incision for the removal of renal calculus, "should the parts swell and become elevated;" that is, if there is an abscess pointing. Neither Celsus nor Galen refer to the operation; so that we may conclude that it had not an assured position among the ancients. Arabian authors have casually referred to it. Turner, in his *Art of Surgery*, published in London in 1727, quotes various writers to show that surgeons in very early times were familiar with lumbar nephrotomy. Avicen† says: "There are some who attempt to take the stone out of the kidneys by incision of the Ilea, but there is great danger therein." Cardan, lamenting over the number of lost operations that were common in the days of Hippocrates, mentions, among others, this one of removal of stones from the kidney. He quotes Albertus‡ as having met with a case where eighteen stones were removed from the loin of a woman who was long affected with nephritic illness. Caspar Bauhin reports the case of a girl who had an

* *Mem. Acad. Roy.*, &c., tom. iii., p. 238. Paris, 1757.

† *Canon.*, lib. iii. ‡ *De Varietat.* lib. viii., cap. 44.

induration and swelling in the loin, from which a surgeon, after incision, removed two stones.

All these were probably cases of evacuation of an abscess, caused by stone; certainly none of them were operations performed upon a kidney approximately healthy. The first case in which an operation is supposed to have been performed for the removal of stone from a kidney that was not suppurating is related by Mezerai, in his *Abrégé Chronologique de l'Histoire de France*. The doctors, says the historian, having learned that a certain archer of Meudon or Bagnolet, who had long been afflicted with stone in the kidney, had been condemned to death for his crimes, requested the magistrates to hand him over to them, that they might experiment and see if it were practicable to extract the stone without killing him. The experiment was successful, and the man is said to have lived for several years in excellent health. This occurred about 1680. Parè, Sabatier, and others discredit this operation; and we can scarcely give full credence to it. The mere record of it, however, shows that it was in men's minds, and regarded as within the bounds of possibility. Parè's unbelief or disapproval, it must be noted, is by no means disproof or condemnation: great as he was, he disbelieved in, or disapproved of, more than one operation which was both possible and sound.

The second case was the well-known one of Mr. Hobson, the English Consul at Venice, recorded in the *Philosophical Transactions* for 1696 by Dr. Bernard, to whom Mr. Hobson related his experiences ten years after operation. Some discredit has been cast upon this case also; but I think there can be no reasonable doubt that the operation was performed, though it is just possible that suppuration existed. The case, related by the patient himself, who was not a medical man, is too circumstantial to be purely fictitious. The scholarly and accurate M. Hévin,* in his historical and critical researches into Nephrotomy, says that he saw and examined the fistula in Mr. Hobson's side, and fully satisfied himself as to the reality of the operation. In Hévin's paper is given a full account of

* *Mem. Acad. Roy.*, &c., tom. iii., p. 238, 1757.

the life and work of the Marchettis of Milan, one of whom performed the operation. I have elsewhere quoted my opinion as to the reality of this operation; and Downes has recently contributed an able article to the same purpose.

The same amount of credence cannot be accorded to the case related by Joachim Camerarius,* in which a surgeon, at the urgent request of a nobleman who was suffering agonies, successfully extracted a stone that was plugging one of the ureters. Schurrigius,† using the case of a certain General de Birckholtz as a text, fully discusses the whole question under the name Nephro-lithotomy. In his case he would not operate, because he thought that the stones were blocking the ureter too low down to be within reach.

The practical outcome of these and other cases is fittingly summarised by M. Lafitte, in the second volume of the *Memoirs of the Royal Academy of Surgery*. He concludes that nephro-lithotomy is not to be reckoned as a justifiable surgical proceeding until abscess has formed. Rousselet and Riolan would remove a stone that could be felt. Nearly all subsequent writers admit the propriety of removing stones, provided abscess has formed; and there is almost equal unanimity in condemning the operation in the absence of abscess. In the first volume of *Medical Essays and Observations*, published in Edinburgh in 1752 (p. 186), Mr. John Douglas relates how he attempted, after death, to see whether it was possible to remove a stone that had been diagnosed to exist during life. He found that it was impossible. The depth of the incision was three and a half inches; and at this distance from the surface he found it impossible to reach the kidney substance. Such a record lends weight to the opinion that surgery, in some of its departments, has done nothing but retrograde for more than a thousand years; and that, in the last fifty years, we have done little more than pick up the clues that were lost when the Alexandrian Library was burnt.

There is no doubt that modern surgery is indebted to Mr. Henry Morris, of Middlesex Hospital, for the invention of the

* Schenck, *Observ. Med.*, lib. iii. † *Litholog. Hist. Med.*, cap. 13.

modern operation of nephro-lithotomy. He performed his first operation in 1880. Some hundreds of operations have been performed since then; but the operation of to-day practically continues as Mr. Morris left it.

RENAL CALCULUS.

Pathological Anatomy.—Renal calculus occurs chiefly before the age of fifteen and after fifty. According to Mr. Thomas Taylor, quoted by Morris, each age has its variety of calculus: "The nucleus of renal calculi formed in infancy is urate of ammonia; the nucleus of calculi formed in adult life is uric acid; whereas that of calculi formed after the fortieth year is oxalate of lime." Whatever its nature, and wherever it originates, the calculus usually arises to pathological and clinical importance in a calyx, or in the pelvis, or in the upper extremity of the ureter. One or both kidneys may be affected with lithiasis; and one or more stones may be found. The amount of mischief set up varies according to the size of the stone, the roughness or smoothness of its surface, and the position it occupies. A very rough stone, as one of oxalate of lime, may lie quietly in a calyx for years; while a small rounded smooth stone, which has not escaped from the secreting substance, may set up inflammation or suppuration. A small stone in the pelvis which just fits the orifice of the ureter may, by preventing the outflow of urine, cause most mischief of all.

Three types of nephro-lithiasis may be pathologically differentiated. The first is the small stone, with healthy renal tissue. The second is the large, perhaps branched, stone, coated with phosphates, and lying in an abscess-sac the walls of which are the thickened and suppurating calyces. The third is the small movable stone, blocking the ureteric orifice, and causing hydro- and pyo-nephrosis, with destruction of renal tissue. Each type has its special clinical features; and for each a variation in the operative procedure is called for. Strictly speaking, these types are different stages or casual developments of the same disease; but they are sufficiently marked to be worthy of differentiation.

(1) Gravel formed in the uriniferous tubules may either pass away in the current of urine without causing symptoms; or may, after increasing in size, be passed with difficulty along the ureter, producing symptoms of renal colic; or may remain embedded in the renal tissue, or imprisoned in a calyx. Here it may remain for long periods, setting up symptoms indicative of irritation rather than of inflammation, or pathological degeneration. Physically, it may cause bleeding, and set up attacks of renal congestion or inflammation, which spontaneously subside; physiologicaly, it begets a long train of symptoms, referable chiefly to the influence of nerve connection.

(2) In the calyces or the pelvis, a stone may set up catarrh or inflammation of the lining membrane, with secretion of pus, which passes into the bladder with the urine. As the stone grows the calyces are dilated, while their walls are thickened; accretion takes place in the areas where pressure is least, and the stone thus comes to be a cast of the dilated calyces which it occupies. The stream of urine flows along between the stone and the encircling sac; there is no urinary obstruction; and renal tissue is destroyed by continued suppurative inflammation, set up by the foreign body. In this way a renal calculus may attain to enormous dimensions, without causing marked symptoms. In the museum of the Bristol Infirmary is an enormous stone, which is a perfect cast of the calyces and lobules of a kidney enlarged to four times its normal dimensions: this stone was accidentally discovered at the post-mortem examination of a patient who died of lung inflammation, and who had presented no sign of renal calculus. Sometimes the calculus rolls about in an abscess sac of its own formation, and increases in size in the pelvis or calyces in the same manner as a vesical calculus. Suppurative inflammation spreads by continuity of tissue to the renal substance, and will ultimately cause its complete destruction. The further course of this process is towards the formation of peri-nephric abscess, which may burst through the loin, forming urinary fistula.

(3) When a comparatively small stone rolling about in the pelvis becomes engaged in the orifice of the ureter, acting as a

sort of ball-valve, the outflow of urine is checked, and, in addition to calculous pyelitis, there is set up an atrophic degeneration of the kidney, which may ultimately leave it as a loculated sac, containing very little healthy secreting substance. In the fully developed condition, numerous cavities are found containing brown putrid urine, with numerous calculi; and in the bottom of the pelvis, or lying in the orifice of the ureter, is found one stone which is presumably the source of the mischief. The renal tissue is not destroyed by advancing suppurative inflammation, but by compression and distension, brought on by obstruction to the flow of urine.*

Many varieties of calculus are formed in the kidney. The most common is uric acid; next in frequency comes oxalate of lime. Other varieties are composed of phosphate of lime, carbonate of lime, the triple phosphate, urate of ammonia, cystine, and xanthine. Occasionally the nucleus is formed of a blood-clot, or a fibrinous coagulum. Indigo has been found in the centre of a renal calculus; the uro-stealith, or "soap-stone," is very rare.

Symptoms and Diagnosis.—Both kidneys are about equally liable to calculus; in about a fifth of the cases, stone exists simultaneously in both organs. It is more common in males than in females, and is most frequently found to arise before middle age.

A stone in the kidney will probably first signify its presence by pain and hæmorrhage. Sometimes the symptoms are slight and transient; frequently they are exceedingly severe and persistent, so much so as almost to make life unbearable. Other symptoms associated with the pain and hæmaturia are gastric disturbances, retraction of the testes, irritability of the bladder, pus in the urine, and sometimes suppression of urine.

The pain is usually felt in the loin, over the kidney affected; though it may be felt in both loins, while one kidney is healthy.

* Jordan Lloyd *(Practitioner*, Sept., 1887) has brought his extensive experience and study to bear on the further elaboration of these types, mainly from the clinical and practical standpoints. To his paper I would refer my readers.

It is of a dull, heavy, dragging character, and may shoot downwards along the course of the ureter, and be referred to the testicle or even to the point of the penis. Sometimes it may shoot down the thigh, and be specially referred to the leg, the sole of the foot, or even the knee. Apart from the actual pain, there is sometimes a curious feeling of consciousness in the patient's mind as to the existence of a stone in the kidney. Some tenderness on pressure over the affected kidney is usually confessed to. The pain is intermittent, and is usually at its worst after active or jerking movements. Posture may affect it. Thus, a patient who suffers while sitting may be relieved by walking or lying down; pain which may be severe while the patient lies on one side, may be relieved by his turning on to the other; and various other positions, known from experience, may afford comfort.

Symptoms referred to the testicle of the diseased side, when they exist, are characteristic and valuable. Peculiar sensations, varying from tenderness to actual pain of a neuralgic character; some degree of swelling, and retraction of it within the scrotum, are the most common concomitants of calculus. In the female such pain may be referred to the labium, or the orifice of the urethra.

Symptoms derived from the bladder and urine are common. Vesical irritation is a common symptom of renal calculus. In fact, so common is it, that patients under close observation are usually sounded for stone before the diagnosis of renal calculus is made. There will be a constant desire to pass water, with frequent passing of it. Hæmaturia, remittent and not very profuse, is very frequently associated with the complaint. Occasionally it is absent throughout the disease. Sometimes it is present only after exercise; if it exists at other times, jarring motion is almost certain to aggravate it. As found in the urine, the blood is mixed less intimately than it is in other diseases of the kidney, and more intimately than in disease of the bladder or prostate. Casts of the ureter are occasionally found, and sometimes small rounded clots. Pus may be found in the urine from pyelitis that may have been set up. A pro-

bable guess as to the nature of the stone, its roughness or smoothness, may be made from the amount of the bleeding.

Symptoms referable to the stomach are not uncommon. There may be nausea, vomiting, and irregular attacks of indigestion, accompanied with flatulence and colicky pains.

A presumptive evidence of stone in the kidney is a previous history of renal colic, arising from the passage of stone along the ureter. If the kidney has formed a stone once, it may do so again. Such an attack once borne, is a memory for a lifetime. The acute agony of pain in the loins, shooting down the ureter into the testicle; the depressing nausea and ineffectual vomiting; the persistent vesical tenesmus, and the final exacerbation as the stone passes the narrowed channel before entering the bladder, make up a combination of suffering as intense, perhaps, as disease can create. If renal colic has existed, the patient is sure to know of it.

A stone has actually been felt in the kidney by the examining finger, and a sensation of grating has been communicated by the rubbing of several stones together. But such an aid to diagnosis is very rarely afforded. Strong pressure or a sharp squeeze, as causing an increase of pain of a pricking or stabbing character, may be of great diagnostic value.

As a result of extensive and carefully elaborated clinical experience, Bennett May* groups cases of stone in the kidney into three classes: (1) Where pain is the only prominent symptom—that is, where no help is given to the diagnosis by the physical examination of the urine or the patient, though constitutional symptoms may be present. (2) Where pus or blood, or both, are found in the urine. (3) Where, in addition to any of the above, there is a lumbar swelling or tumour in the region of the kidney. This, it will be seen, runs in some respects parallel with the division given above from the pathological point of view. In women, according to this authority, hæmaturia may be more misleading as a symptom of stone in the kidney than in men; a peculiarity which may depend on the fact, pointed out by Lloyd, that in women the primary and

* *Birm. Med. Rev.*, Jan., 1887.

secondary tubes are long and narrow, and therefore more likely to closely encircle the stone.

An element of confusion arises in the fact, first noted by Thornton and confirmed by others, that stone on one side may produce symptoms on the other. Godlee* relates a very interesting case where, after a stone had been removed from the right kidney, there was severe colicky pain on the left side, followed by the discharge of several small fragments of stone.

The differential diagnosis has to be made with malignant and villous growths of the bladder; purpura and hæmophilia; and malignant or inflammatory disease of the substance of the kidney. In addition to the symptoms already detailed, the profuse hæmorrhage of the first, with abundant clots and imperfect commingling of blood and urine, will help us. For the rest, the existence of the characteristic dyscrasiæ, and, in the case of tumours, the presence of a swelling in the renal region, will help us. Hæmatinuria will be recognised by its characteristic symptoms, borne out by a microscopic examination of the urine. The condition most likely to be mistaken for renal calculus is early strumous disease of the kidney. The presence of pain in calculus, and the absence of hæmaturia in strumous disease, are the chief signs relied upon for diagnosis. I have on two occasions (once with the assistance of my colleague, Dr. Shingleton Smith) diagnosed strumous kidney from the discovery of tubercle-bacilli in the urine.

An attempt to diagnose the actual pathological condition present ought to be made.

The small calculus with healthy kidney may be suspected when the symptoms are chiefly or entirely hæmaturia and pain.

The large calculus embedded in an abscess sac is suggested by pus in the urine, a tumour or increased resistance in the loin, and pain on pressure.

The hydro-nephrotic kidney, with small calculus blocking the ureter, is suggested by repeated attacks of lumbar pain, alkaline or putrid urine containing little pus, and a swelling in the loin, which is not very hard and not very painful on being pressed.

* *Practitioner*, Oct., 1887.

Indications for Operation.—Dickinson tells us, that of three individuals who have stone in the kidney, only one dies of it: the other two die of something else. The mere presence of stone in the kidney is not, therefore, an indication for operation. We must, in the first place, wait to see if the stone will be passed by the ureter; and, in the second place, come to a decision, either that the calculus is setting up mischief in the kidney which may endanger life, or that the subjective symptoms are so urgent that necessary work cannot be performed or health is being undermined. In every case, palliative treatment by rest, the exhibition of alkaline drugs, and careful dietary, will have been fully and fairly tried. Morris makes the wise suggestion that, when anuria follows symptoms of calculus in one or both kidneys, the kidney which has last become affected should be first explored.

A further reason for caution in proceeding to operate is the fact, that no fewer than twenty-five exploratory operations have been performed, and no stone found. This, of course, is no reproach to the operation itself; on the contrary, as all the patients recovered, it speaks in its favour. This more especially refers to operation where the kidney is comparatively healthy.

Where the kidney is diseased, the indication is to operate at once, provided the other kidney is diagnosed as healthy. In such a case, the operation may be little more than a simple nephrotomy, with drainage of an abscess. If advanced suppuration exists, the question of nephrectomy will arise, and must be decided on the same principles as would guide us in operating where there was no stone. In many cases of suppurative nephritis, stones are found which may have little connection with the origin of the disease. Barker points out that, in advanced calculous disease, both nephro-lithotomy and nephrectomy are about equally dangerous, as the patients are usually advanced in years and much pulled down in strength. Nephro-lithotomy, where the kidney is healthy, is a very safe operation: as yet, its mortality has not exceeded 10 per cent. Of 21 operations collected by Gross, 2 died—a mortality of 9.52 per cent.

THE OPERATION.

The instruments necessary, besides knife, scissors and catch-forceps, are: two large broad retractors; a fine conical needle, two and a half inches long, set in a handle, for exploring the kidney; and specially-designed sounds, probes, scoops, or forceps, for detecting the stone and removing it. Lucas's instruments seem to be admirably suited for this operation. An ordinary bladder-sound with short beak and of smallest size for children, will be found necessary, if the kidney is to be explored in the manner recommended by Jordan Lloyd.

The best incision is the oblique lumbar one recommended for nephrorraphy. Morris favours this incision: Howse made use of a vertical incision, supplemented by a transverse one; and other surgeons have variously modified it. The knife is entered close to the edge of the erector spinæ, half an inch or more from the lower border of the twelfth rib, and carried obliquely downwards and forwards towards the crest of the ilium for three or four inches, according to the size and shape of the costo-iliac space. If, in spite of the artificial enlargement of the costo-iliac space by the pillow placed under the opposite loin, the area for operation is very limited, the incision may be curved forwards, after being carried farther back than usual. Additional space may be got by dividing transversely the fibres of the quadratus lumborum. With the division of the deep lumbar aponeurosis and the exposure of the circumrenal fat, this preliminary stage of the operation is finished. All pressure forceps are now removed, vessels of considerable size being ligatured, and the wound is made to gape as much as possible by retractors in the hands of an assistant.

The fatty capsule is teased open with forceps, and the kidney surface is exposed. Morris says that, as the back of the kidney is approached, there may be noted differences in the character of the fat; that next the kidney being of fine texture, and of a delicate primrose colour. If there has been long-standing inflammation of the kidney, the surrounding tissues will be abnormally firm and coherent.

Through the opening thus made in the fat the finger is pushed, and the surface of the kidney systematically explored. During this examination, an assistant, pressing on the abdominal surface, forces the kidney as much as possible into the wound. The anterior surface may be explored while the kidney is lying on the psoas, against which firm surface it is pressed. To explore the posterior surface, the kidney is pulled forward and compressed against either a broad spatula or the fingers of the opposite hand. Lange's proposal, to examine the pelvis by tilting forward the whole organ, is well worthy of attention. (Fig. 71.) It is certainly easier to examine the kidney between the fingers when it is well pulled forwards out of its bed, than when it is lying far back in its normal situation. Every particle of renal tissue is rubbed and squeezed between the fingers, and any hard spot is noted. If the stone is small, and if it is overlapped by renal tissue, which may be increased in density from prolonged irritation, it may be impalpable. In one case of Morris's, after the kidney had been removed and placed on a table, it was found impossible by palpation with the finger to detect a stone which was embedded in a calyx. Of this fact there can be no doubt: a most painstaking examination with the finger may fail to detect a stone where it is present.

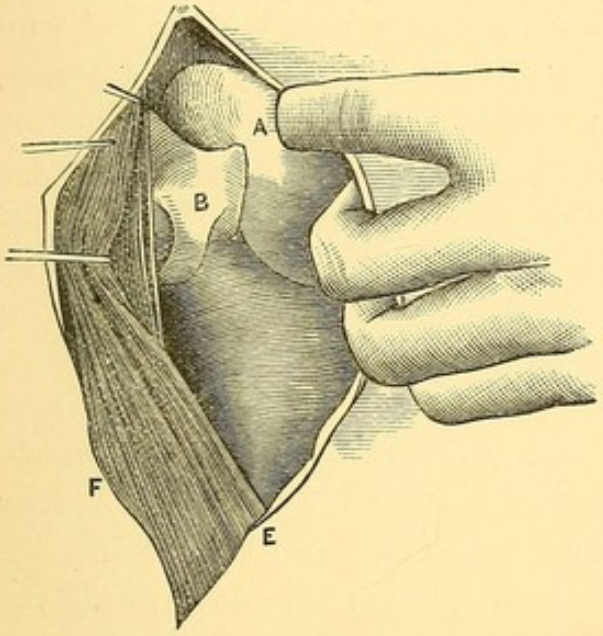

FIG. 71. (LANGE.)

Pelvis and Ureter exposed from behind after removal of Peri-nephric Fat.

A, Kidney; B, Pelvis of Kidney; E, F, Quadratus Lumborum.

Should a hard or elevated area be made out, the exploring needle is pushed into it, and the stone felt for.

Should no stone be felt, the plan recommended by Jordan Lloyd* should now be adopted. As a result of his anatomical studies (see above) and practical experience, he considers it infinitely more reliable and quite as easy to execute as the ordinary plan of needling. "The procedure is analogous to the method of detecting stone in the bladder, differing from it only in the one particular, that we reach the kidney's interior through an opening artificially made. When the kidney is exposed through a lumbar wound, I puncture its lower end with a long-bladed tenotome in a direction upwards and inwards, making for the lowest of the calyces. If the surgeon is observant and his knife is keen, he will readily appreciate the moment when a cavity is struck by the altered resistance offered to the puncturing instrument. . . . Into this opening I pass a child's bladder-sound, and systematically explore the whole interior of the pelvis. This sound should be of special construction, having a beak not more than one-third of an inch in length, a stem about seven inches, and the size of a No. 3 English catheter. It should be passed at once to the top of the kidney cavity, a distance of nearly four inches, and the exploration should be carried out systematically, from above downwards, the point being rotated in all directions so as to investigate both tubes and calyces as the instrument is withdrawn." He has succeeded by this plan, after needling and palpation have both failed.

Should this plan fail, a systematic examination with exploring needle may be carried out. This needle is a fine sharp steel probe, mounted on a wooden handle. It is so fine that it makes a very small wound; and, being only two and a half inches in length, it cannot, if pushed through the cortex, wound the large renal vessels. The exploratory punctures are made in a thoroughly systematic manner from one end to the other of the posterior border. While this is being done with the needle in one hand, the kidney is steadied and held upwards in the wound by the fingers of the other hand. Every thrust ought to be towards the hilum, so as to strike the position of the calyces.

* *Loc. cit.*

Should the needle strike a stone, a long thin-bladed knife is pushed alongside of it, till it also strikes the stone, and a vertical incision is then made in the renal tissue through which the stone may be extracted.

Supposing that no stone is discovered after complete exploration with the needle, the operation is not to be abandoned. The kidney may be unhesitatingly laid open by an incision along its posterior border, long enough to permit of digital examination of the calyces. As Morris remarks, "kidney wounds are known to heal readily, and whilst the risk of such an incision would not equal that of a nephrectomy, the subsequent condition of the kidney would be preferable to the possession of only one of these organs." Instead of the finger, a sound, such as that of Lloyd or Lucas or Bruce Clarke,* may be used. The latter surgeon made a series of careful experiments in the post-mortem room, to test how far it was possible to explore with a flexible sound the various recesses of the kidney. He found that with an ordinary bougie *à boule* with a porcelain tip it was possible to explore nearly every part of the pelvis and calyces.

Supposing a stone is felt in the pelvis of the kidney, it may become a question whether it would not be better directly to extract it by incising or tearing the pelvis, than to do so by incising the renal tissue. The pelvis should be opened from behind if possible, and the instrument used ought not to be sharp. After opening the pelvis, there is a risk of urinary fistula; therefore, wherever it seems feasible and proper, extraction should be made through an opening in the renal tissue.

The first incision down to the stone is made large enough to admit the forefinger. An attempt is made to raise up the stone on the finger-pulp, and this manœuvre may be assisted by a small scoop. The opening, if not large enough, is increased by tearing and dilating. Hæmorrhage is controlled by the finger, acting as a plug, and is rarely troublesome. It is always advisable to remove the stone entire, if this can be done without

* *Surgery of the Kidney.* London, 1886.

injuring the secreting substance; otherwise, it must be broken up. Bennett May has succeeded in removing entire from a kidney but slightly enlarged a stone an ounce in weight; and at least one heavier has been extracted.

The removal of a calculus blocking the orifice of the ureter may be an affair of extreme difficulty, taxing to the full the manual and mental resources of the surgeon. I have assisted at such an operation in which most skilful and persevering efforts on the part of one of our most brilliant operators only succeeded after an hour's trial in removing the stone.

Where the kidney is suppurating, and the stone lies in an abscess sac, the operation may be very easy. On the other hand, as in large branched calculi, it may be impossible to remove the stone until it has been broken into fragments. Each case must be managed on its own merits: a resourceful surgeon will at once decide upon the most favourable plan of removing the calculus.

A drainage-tube is placed in the bottom of the parietal wound, behind the kidney: the wound itself is closed in the ordinary way by deep and superficial sutures. For the first day or two nearly all the urine escapes by the drainage-tube: it soon diminishes, however; and after a few days or weeks, ceases altogether. To prevent contact of the urine with the wound, an attempt ought to be made to convey it into a reservoir. This may be done by using ordinary imperforated rubber tubing, making holes in it only for the distance it extends into the tissues, and carrying the external imperforated portion into a rubber bottle which lies at some distance from the patient. The tube should be fixed in the opening by a stitch including the tube and the skin. The wound is dressed with ordinary absorbent material: it usually heals with great rapidity.

Of special dangers following nephro-lithotomy we know little; for they have not yet appeared. If hæmorrhage is troublesome, a catgut suture may be carried through the renal tissue, so as to exert compression. Cellulitis, renal abscess, and renal fistula, are mentioned as possible results by Morris.

In cases of advanced calculous pyelitis, the dangers are practically those of nephrotomy or nephrectomy for the same condition. The question as to the advisability of combining abdominal section with lumbar section is but little different, in calculous disease, from that presented in non-calculous disease and need not specially be considered here.

Puncture of the Kidney, and Nephrotomy.

By nephrotomy is meant the operation of making an incision into the kidney, for the purpose of evacuating cystic or purulent collections of fluid. Puncture of the kidney is simply nephrotomy done without dissection, and not followed by drainage; nephrotomy is usually preceded by careful dissection through the loins, and is nearly always followed by drainage.

Puncture, nephrotomy, and nephrectomy overlap. Any one of them may be indicated for the same condition; and, indeed, all of them may properly be performed in succession for the cure of this condition. Thus, in a case of hydro-nephrosis, puncture failing to cure, nephrotomy with drainage may be tried; if this also fails, nephrectomy may be performed. Beginning at the other end, nephrectomy as a primary procedure has a more limited application. It is admissible where puncture and incision are inadmissible, only in the case of new growths; in every other condition, and especially in cyst and abscesses, it may properly follow a want of success in the minor operation of nephrotomy.

It is undoubtedly the case that for the same disease—scrofulous kidney, for example—nephrotomy or nephrectomy may be performed with equal propriety. But the actual stage or condition of the disease ought to be very different for each operation. It is impossible, therefore, to classify the indications for operation under the heads of the pathological condition for which the operation may be performed. It will serve our purpose of description better, and at the same time emphasise the best recognised practice, if under each operation we consider only such diseases as directly and specially call for it. For some of them, puncture ought first to be performed; if this fails, nephrotomy ought to follow; if this also fails, nephrectomy may be called for. In others, the first proceeding ought to be nephrotomy; if this fails, nephrectomy may be demanded. Nephrotomy also may sometimes be regarded as preparatory to

nephrectomy. In a third class, nephrectomy ought to be performed at first.

The following classification may be adopted as practically convenient:

Renal Puncture, indicated in—

(1) Simple cysts.
(2) Hydro-nephrosis.
(3) Hydatid cysts.

Nephrotomy, indicated in—

(1) Cases where puncture fails.
(2) Pyo-nephrosis.
(3) Suppurative nephritis and pyelo-nephritis.
(4) Scrofulous kidney.
(5) Calculous suppression of urine.

Nephrectomy, indicated in—

(1) Cases where nephrotomy fails, or would evidently be useless.
(2) Certain new growths of the kidney.
(3) Ureteral and renal fistulæ.
(4) Serious wounds of the kidney.
(5) Disease or degeneration of movable kidney.

Puncture of the Kidney.

CONDITIONS FOR WHICH THE OPERATION MAY BE PERFORMED.

Puncture of the kidney may be employed in any form of renal cystic enlargement; but it is primarily indicated as a curative measure only in simple and hydatid cysts, and in hydro-nephrosis.

Simple Cysts of the Kidney.—Here we are not concerned with those small cysts so frequently found in granular kidneys; nor with the rare general transformation into numerous cysts found congenitally or in adults. The former never attain to surgical dimensions; the latter, general cystic degeneration, being bilateral, is not amenable to surgical treatment.

Simple serous cysts are found as thin-walled globular tumours, of varying dimensions, springing from some part of the renal cortex. Their contents are not urinous, but a pale straw-coloured fluid, of low specific gravity, containing a considerable amount of albumen. Sometimes the cavity of the cyst communicates by an opening with one of the calyces; most frequently it is blind. The fluid often contains cholesterine, and occasionally blood. Rarely the contents are thick, or of the consistence of jelly.

These cysts are harmful only when they attain to large dimensions. They tend to distort, spread out, and cause atrophy of the proper renal tissue, as well as to interfere with health, from their bulk.

The symptoms are simply those of a slowly-growing cystic tumour, situated in the loin. There are no special signs available for diagnosis. Urinary symptoms are absent; and there is no pain, or pyrexia, or evidence of ill-health. Diagnosis can be made only by exclusion of other forms of cystic enlargement.

Para-nephric Cysts are rare developments of doubtful origin, which arise in the tissues immediately surrounding the kidney,

and sometimes form a connection with it. They may be congenital. Clinically, they are indistinguishable from simple cysts; practically, their recognition is unimportant, as the treatment is identical.

Hydatid Cysts of the Kidney.—Hydatids are found in the kidney six times less frequently than in the liver. In a considerable majority of cases, the left kidney is the organ affected: very rarely are both organs affected at once.

The cyst usually originates in the secreting substance; but occasionally develops in the cellular tissue underlying the capsule or surrounding the pelvis. The renal tissue is thinned out and atrophied, from pressure. As compared with hydatids of other organs, renal hydatids do not attain to very large dimensions: this is probably due to a tendency which they have to discharge a portion of their contents through the ureter. Of 63 cases of renal hydatids collected by Roberts, a history of vesicles passed in the urine occurred in 52. A renal hydatid cyst containing four pints of fluid would be considered a large one. It may burst into surrounding organs, as the intestine or lung; and it may undergo any of the inflammatory, degenerative, or atrophic changes which are found in hydatids elsewhere. Hydro-nephrosis has been caused by the impaction of a vesicle in the ureter.

The symptoms of renal hydatid disease are: the passage of hydatid vesicles in the urine, preceded by attacks of renal colic; and the existence of an abdominal tumour, fixed in the loin. Sometimes there is a discharge of hydatids, and no tumour; more rarely is there a tumour, and no hydatid escape. In only 18 of Roberts's 63 cases was a tumour discernible. Fluctuation is not always perceptible; and the hydatid fremitus is as rarely observed here as in the liver or elsewhere. The vesicles are found entire or ruptured; occasionally nothing is found in the urine but hooklets and shreds of membrane. Blood or pus may be discharged with the hydatids: these are specially frequent after attacks of renal colic. Retention of urine has been caused by blocking of the urethra; and, as already re-

marked, hydro-nephrosis may arise from blocking of the ureter. In the bladder, the vesicles may beget symptoms of irritation or tenesmus, or even inflammation : impacted in the ureter, the vesicles may set up the train of symptoms already described as characteristic of renal colic, from the passage of calculus.

Hydro-nephrosis.—This is a distension of the kidney with fluid, caused by an obstruction to the flow of urine. The obstruction may exist at any point in the urinary tract—urethra, bladder, ureter, or pelvis of the kidney. It may be congenital or acquired. According to Morris, about one-third of the cases have a congenital cause ; but in some cases this cause does not have its full effect in producing hydro-nephrosis till late in life. "Congenital nephrosis" must not be confounded with "hydro-nephrosis having a congenital cause."

Congenital causes of hydro-nephrosis are numerous and various. In the ureter, twists, kinks, reduplications or folds, stenosis, and complete obliteration, have all been described as causes. The junction of the ureter to the kidney or to the bladder may be faulty, obstructing the flow of urine. Compression of the ureter by abnormal arteries has been described as a cause of hydro-nephrosis.

Of acquired causes, the most important, from a surgical point of view, is impaction of a calculus in the ureter or pelvis of the kidney. In an elaborate investigation into the causes of 142 cases of marked hydro-nephrosis extracted from the post-mortem records of Middlesex Hospital, Morris found that 116 cases had cancer of the pelvic organs, uterus, vagina, bladder, or rectum ; 2 had cancer of the ovaries ; and the remaining 24 had, in about equal proportions, cystitis, vesical calculus, enlarged prostate, ovarian cyst, constriction of ureter, cancer of abdominal organs : in one there was a villous growth of the bladder ; in 4 the causes were unknown. Roberts found in 32 cases of hydro-nephrosis the causes to be—impaction of calculus in the ureter in 11, and probably in 3 more ; in 5, cicatricial stenosis of the ureter ; in 6, compression of the ureter by pelvic tumours ; and in 3, compression by inflammatory peritoneal

bands. Retroflexion of the uterus has been described as a cause; and Morris and James have explained how greatly increased frequency of micturition may produce hydro-nephrosis.

Hydro-nephrosis is about equally common in both kidneys; in about one-third of the cases it exists in both at the same time. It is found at all ages, and with equal frequency in both sexes. From an analysis of 69 cases of hydro-nephrosis and pyo-nephrosis, Dickinson concludes that death from one or other of these closely-allied complaints "is especially frequent during the first ten years of life, as the result of congenital lesions; as an acquired disease, largely due to stone, it produces its fatal issue with increasing frequency up to 50, beyond which age it is seldom delayed."

As to the actual lesion produced, it may affect the whole kidney, or only part of it; that is to say, the distension may involve the whole pelvis, or only a few of the calyces. A case has been recorded in which a tumour of considerable size was caused by the distension of one calyx. The mode of distension is easily understood. The pelvis is first converted into a globular sac; the calyces then become dilated; and lastly, the medullary and cortical portions are stretched out and thinned. In extreme cases, the secreting tissue may be represented by a thin layer underlying the capsule; or all traces of it may disappear, and the kidney is little more than a cyst with thin fibrous walls subdivided internally into secondary cysts or saccules by complete or incomplete septa. In most cases some trace of secreting tissue remains, with something of the kidney shape. In size the sac varies from that of the normal kidney, or less, to dimensions sufficient to fill the abdominal cavity. In only a small proportion of cases, however, does hydro-nephrosis attain to a size sufficient to cause perceptible tumefaction of the abdomen.

The fluid in the cyst is never pure urine; frequently it contains neither urea nor uric acid. It is usually a simple, clear, aqueous fluid, of low specific gravity, containing a little chloride of sodium and perhaps albumen. Occasionally the fluid is brown, from admixture with blood; rarely it is thick or colloidial; and sometimes it is putrid, ammoniacal, and turbid.

It has been pointed out that the obstruction in the most typical cases of hydro-nephrosis is not complete and not continuous. A complete obstruction to the urinary flow leads to atrophy, rather than to dilatation of the kidney; stricture, varying in narrowness, predisposes to dilatation. A calculus in the pelvis or the ureter, occasionally moving, causing at one time partial, at another time complete obstruction, while it sometimes moves out of the way altogether, provides the ideal cause of hydro-nephrosis, such as comes up for surgical treatment.

Symptoms of hydro-nephrosis, in the absence of a tumour, are usually wanting altogether; in the worst cases there may be symptoms of urinary suppression. In disease of both kidneys, uræmia sooner or later appears. Diagnosis is possible, or rather probable, only when a tumour is present. Such a tumour is rounded, often lobulated, usually fluctuating, and lies mainly in the loin. If the tumour is very large, it may occupy and distend the whole abdomen, on one side as much as on the other; in such a case, a history of its having once been one-sided, or of its having appeared in the costo-iliac interspace, will be of assistance. In every case, a history of its varying in size is of importance—almost pathognomonic, in fact. Morris has recorded eleven cases where the tumour completely intermitted; that is, where it was prominent at one time, and not distinguishable at another. Many others show temporary diminution without actually vanishing. If, with the diminution or disappearance of the tumour, there is observed an increased flow of urine of low specific gravity, we may almost certainly diagnose hydro-nephrosis.

As to subjective symptoms, records are extremely variable. Frequently there is no pain whatever; sometimes there is severe pain, occasionally amounting to agony. The amount of tension and the presence of a calculus would influence the production of pain.

The diagnosis of hydro-nephrosis is often difficult, sometimes impossible. It may be mistaken for any cystic abdominal tumour. Of renal cystic enlargements, it is most liable to be

confounded with simple or hydatid cyst, and with pyo-nephrosis. In hydatids the history gives most important aid. In pyo-nephrosis, elevation of temperature with continuous or occasional presence of pus in the urine, may be expected. Hydatids of liver or spleen may mislead. But, where the tumour is large, it is most frequently mistaken for ovarian cystoma; at least fifteen cases are on record in which hydro-nephrotic or simple renal cysts have been mistaken for ovarian tumour, and laparotomy performed on the erroneous diagnosis. (Morris.)

THE OPERATION OF PUNCTURING THE KIDNEY.

This operation may, with a fair promise of cure, be performed for any of the above conditions; viz., simple cyst, hydatid, and hydro-nephrosis. In the case of simple cysts, tapping may be repeated several times should the cyst refill. In hydatid disease, tapping may be successful, and should be tried; but incision, with drainage, is likely to be called for. If there is no discharge of vesicles by the urethra, Morris considers that the only proper treatment is nephrotomy. The first proceeding, in all cases of hydro-nephrosis calling for treatment, ought to be tapping. Friction and compression by the hands have caused several hydro-nephrotic tumours to disappear; but in few cases can manipulation be entirely free from risk, and in the great majority, from the nature of the obstruction, it must be useless. A single tapping is rarely curative in hydro-nephrosis; frequently the operation has had to be repeated many times. But if, after three or four tappings have been tried, a cure is not effected, most surgeons would proceed to incision and drainage. Repeated tapping is liable to beget suppuration.

Puncture and tapping of the kidney is best performed with the aspirator. The needle should be of large size, to lessen the chance of its becoming blocked with *débris*. The skin and the needle must be thoroughly aseptic; and the needle ought to be introduced full of an aseptic fluid, to prevent the introduction of air into the cyst. An air-bubble will rise into a sac of fluid out of the point of an aspirator needle, and filthy epidermic scales

may be carried in on the cutting point. An abundant experience of this very simple operation proves that it is too frequently allied to the experiment of introducing a germ-laden needle into the midst of a cultivation jelly.

The point at which puncture is to be made will vary according to the size of the tumour, its nature, and the side on which it lies. In every case the operation ought to be extra-peritoneal; the needle, therefore, must not be inserted too far forwards. Morris advises that "if there be any spot over the swelling which is thin, soft, prominent, or fluctuating, the trocar should be there inserted. A point which is not seldom indicated is midway between the umbilicus and the anterior superior spine of the ilium; or half an inch below, and an inch and a half to the side of the navel." One danger in puncturing too near to the middle line is, that the colon may be wounded.

Where the tumour is not large, or where no favourable spot presents itself, the site to be selected should be regulated by the anatomy. As a result of several experiments, Morris found that, to puncture the left kidney, the best point of entrance was one "just anterior to the last intercostal space." On the right side, puncture in this situation would probably traverse the liver; therefore, a lower point is selected half-way between the last rib and the crest of the ilium, from two to two and a half inches behind the anterior superior spine of the ilium. "This spot is on a level with the front of the bodies of the lumbar vertebræ, and a needle here passed horizontally inwards will be altogether in front of the normal kidney, and will either transfix or pass in front of the ascending colon when in its usual place. It may, however, with safety be conjectured that, in any case of hydro-nephrosis of the right side requiring to be tapped, if the trocar be inserted at the place I propose, and directed somewhat forwards, the peritoneum and colon will be sufficiently in front to escape injury; the liver will be safely out of reach above, and the kidney behind; while the dilated pelvis of the kidney will be tapped at its anterior and lower aspect." (Morris.)

As soon as the needle is embedded in the skin, the exhausting bottle should be connected; and the needle is then cautiously

pushed onwards till fluid is sucked out, when it should be pushed in no further. Thus the risk of wounding renal vessels is diminished. More than one case has died from extravasation of the cyst-contents into the peritoneal cavity. Wound of the margin of the liver may prove harmless. The risk of wounding the pleura has already been referred to.

Nephrotomy.

CONDITIONS FOR WHICH NEPHROTOMY MAY BE PERFORMED.

Pyo-nephrosis is simply hydro-nephrosis with suppurative inflammation of the lining membrane of the cyst. Between a simple catarrh with shedding of proliferative endothelial cells, and the formation of granulations with abundant discharge of pus, all degrees of inflammation are found. Mucus, blood, and urine are frequently found in the purulent fluid; occasionally it is very putrid. In certain cases, phosphates are found in sufficient amount to form with the pus a sort of paste.

Pyo-nephrosis may be the first effect of a calculus; or it may be an after-development of hydro-nephrosis, either spontaneously evolved, or as a result of surgical interference by tapping. It may originate in any of the conditions already mentioned as productive of hydro-nephrosis, and more particularly from renal calculus. Suppurative calculous pyelitis has already been described under nephro-lithotomy, and need not be further dwelt upon.

The symptoms are those of hydro-nephrosis *plus* suppuration. Elevation of temperature, with or without rigors; hectic; loss of appetite, with perhaps symptoms of uræmia or septicæmia, may be looked for. A tumour may be visible and palpable; but it rarely attains to the enormous dimensions sometimes observed in hydro-nephrosis. Dulness, if the tumour is large, may be interrupted towards the middle line by the colon passing over it. Fluctuation may or may not be detected. A lobulated outline on palpation may frequently be made out. Pain, cutaneous œdema or redness, and other local signs of suppuration, may be expected. An examination of the urine may reveal the presence of pus, and an estimation of its quantity may show a diminution in amount. Intermittence of the tumour has been found. Occasionally cystitis is set up, from contamination with purulent or putrid urine.

Suppurative Diseases of the Kidney.—There are various distinct forms of suppurative inflammation of the kidney. They may be described as: (1) simple circumscribed renal abscess; (2) general suppurative nephritis, pyelitis, and pyelo-nephritis; (3) scrofulous kidney. Such a classification is neither clinically nor pathologically perfect; it is, however, that usually followed, and may be conveniently adopted here.

(1) *Renal Abscess* has its typical origin in injury, as from a blow, or a calculus, or other foreign body: it may be secondary to peri-nephric suppuration; and it has been known to follow the administration of cantharides and turpentine. A single abscess may be formed by the fusion of many small ones; and there may be more than one abscess in the kidney.

Renal abscess is usually limited to one kidney. It may find its way into the pelvis, and thence empty itself into the bladder through the urethra; or it may burst through the capsule into the surrounding cellular tissue, causing peri-nephric abscess; or both events may occur. It is by no means rare to find more than one abscess in the renal tissue. In many cases the whole organ is transformed into an abscess, limited by pelvis and capsule, and partly subdivided by septa.

In acute cases, the symptoms are frequently ushered in with rigors, frequently repeated, and great elevation of temperature. In chronic cases there may be little or no fever at any stage of the disease. Pain in the region of the kidney is usually complained of. Pus may be found in the urine; if it is considerable in amount, and accompanied with decrease in the size of a lumbar tumour, the existence of renal abscess is almost certain. A sense of increased resistance in the loin to the examining fingers, œdema and redness of skin, and complaints of local pain on pressure, suggest renal abscess. The disease is always attended by great prostration, rapid emaciation, and complete loss of appetite.

(2) *Suppurative Nephritis* is usually described as secondary to some disease of the lower urinary tract. It may be confined to the pelvis, when it is known as pyelitis; or to the kidney, when it is described as nephritis; or it may involve the whole renal

organ, when it is known as pyelo-nephritis. In its typical development it is best known as "surgical kidney;" that is to say, it has its origin in any disease of the penis or bladder for which surgical treatment has been or may be instituted. As a matter of fact, the disease is more frequently caused by want of surgical treatment than by excessive or erroneous application of it.

From the nature of the disease, both kidneys are usually affected; and this fact is, in itself, sufficient to forbid a local operation of any magnitude. Suppurative nephritis is, in the great majority of cases, a rapidly fatal complaint; and surgical treatment offers little or no hope of cure.

(3) *Scrofulous Kidney*—or scrofulous pyelo-nephritis, as it is sometimes called—is an inflammation of the kidney, attended with the formation of the characteristic cheesy material. It is a constitutional disease. Of 95 cases reported by Dickinson in which death took place from scrofulous kidney, only 11 were free from similar disease in the other kidney or elsewhere. As these were all cases of death from scrofulous kidney, it is probable that the proportion of intercurrent disease would be higher than when the patient first came under observation. Still, in the view of operative proceeding, the undoubted frequency of outlying scrofulous mischief in cases of scrofulous kidney ought to teach caution.

The appearance of a typically scrofulous kidney is characteristic and unmistakable. The organ is enlarged as a whole—sometimes to three, four, or even six times the normal dimensions. On section, aggregations of the well known cheesy products are seen replacing, and more or less accurately following, the outlines of the individual lobules. These cheesy masses are partially divided from each other by incomplete septa, representing the divisions between the lobules, and containing remnants of the original secreting tissue. On these septa, and on the inner surfaces of the capsule and the pelvis, ragged œdematous granulations are exposed when the purulent material is removed. Sometimes the abscesses are large, while the septa between them are thin and short; in such

cases pyelitis will be superadded to nephritis. In other cases, the abscesses are small and the septa are very thick. The inflammation spreads from the pelvis down the ureter, which also becomes thickened in its walls and ulcerated on its surface. This thickening and ulceration of the ureter frequently descends as far as the bladder, and is one of the characteristic concomitants of such scrofulous kidneys as may be brought under operative treatment.

The symptoms of scrofulous disease of the kidney are often obscure or misleading. Occasionally there are no local signs, only vague general signs of ill health, with perhaps slight indications of urinary disorder. Usually there is continuous pain in the loins of a dull aching or dragging character. But this pain is often aggravated, occurring in paroxysms, as in renal colic, and due, in all probability, to blocking of the ureter by *débris*. Pus in the urine is a very constant sign of scrofulous kidney: its presence in the bladder may set up irritation, or even strangury, and lead to a suspicion of calculus. Blood also is often mixed with the pus in the urine, and more particularly during the early stages of the disease. Granular detritus, and pieces of cheesy matter, soluble on the addition of acetic acid, are often detected on microscopical examination. I have been concerned in the treatment of two cases of scrofulous kidney in which tubercle-bacilli were found in the urine; and others have had a similar experience. Locally a hard tender swelling in the region of the kidney may usually be felt. Elevations of temperature occurring at irregular intervals, lasting for short periods, and accompanied often with rigors and sweating, are said to be characteristic. The patient rapidly loses strength and flesh; the skin becomes dry and hard; diarrhœa and sickness set in; and death takes place from exhaustion.

Scrofulous kidney is liable to be confounded with cancer of the kidney, pyo-nephrosis, calculous pyelitis, and even with certain diseases of the bladder or prostate. The presence of blood in the urine, and the hardness of the growth in scrofulous kidney, are the conditions which may give rise to a diagnosis of cancer. Abundance of pus in the urine, with granular detritus

and perhaps bacilli, and elevation of temperature, are mainly to be relied on as diagnostic. From other forms of suppurative inflammation, the history and the hectic character of the temperature will be the most important elements in differentiation.

Peri-nephric Abscess is in most cases a sequence of suppuration in the kidney itself. It occurs also as a primary idiopathic disease, quite independently of the kidney, and also as a consequence of urinary extravasation or renal fistula. As a primary disease, it is usually an effect of injury of some sort. Occasionally it occurs as a sort of metastasis, from operation upon, or inflammation in, distant parts of the urinary or generative organs; and not infrequently there is a visible and continuous connection between suppurating inflammations in distant parts and the peri-nephric abscess. The historic nephro-lithotomy was essentially the evacuation of a peri-nephric abscess, which contained a calculus that had ulcerated its way through the renal tissues.

Rarely does a peri-nephric abscess burst through the peritoneum. Rather does it burrow in various directions along the fasciæ surrounding the contiguous muscles, ultimately reaching the surface somewhere in the loin; not infrequently the matter gets into the sheath of the psoas, and reaches the inguinal region, after the manner of a psoas abscess. With curious frequency the matter finds its way through the diaphragm into the lungs, and is expectorated. I have removed a vesical calculus weighing more than nine ounces from a man who had a sinus between the seventh and eighth ribs, which led downwards to a peri-nephric abscess, and upwards into a pulmonary fistula, through which pus was discharged in large quantities by the mouth. Peri-nephric abscess has been known to burst into the colon, the duodenum, and even into the bladder.

The symptoms of peri-nephric abscess are, in the first place, those of deep-seated suppurative inflammation, with its ordinary local and general concomitants, situated in the tissues surrounding the kidney. Further special signs have been observed: such are, lameness on the affected side, with flexion of and inability

to extend the thigh, due to involvement of the psoas, and œdema of the foot and ankle. Dr. John Roberts of Philadelphia* after an elaborate study of the condition, gives directions for the localising of peri-nephric abscess as follows: in all anterior regions, we may expect pain, tenderness, swelling, œdema, or pointing in front, or at the side, of the abdomen. In all posterior regions, we look for pain, tenderness, swelling, œdema or pointing in the loin. In the upper tracts, peri-nephric abscess will probably cause pleuritic friction, pleural effusion, empyema, expectoration of pus, and dyspnœa; on the right side, we may expect to find œdema of both legs, jaundice, fatty stools, persistent vomiting, rapid emaciation, and ascites. In the middle tracts, there may be albuminuria and casts; supra-pubic, scrotal, or vulvar pain, or anæthesia; suppression of urine; uræmia; pyuria; œdema of the scrotum. In the lower tracts, he tells us to expect with peri-nephric abscess, flexion of the hip; pain or anæsthèsia in the front, the outside, or the inside of the thigh; pain in the knee; scrotal or vulvar pain, or anæsthesia, without albuminuria; unilateral œdema of the leg; abscess pointing near Poupart's ligament; with constipation on the left side, and involvement of the receptacle for chyle on the right side.

Calculous Suppression of Urine may be taken as a condition for which nephrotomy may be performed. In 1880 Weir advocated nephrotomy for calculous suppression. Bennett May† forcibly argues in favour of the operation. Bardenheuer, according to Weir, has removed a calculus the size of a bean from the ureter, and four others from the pelvis of the kidney. Morris, in a very suggestive paper‡ on the feasibility of removing a calculus impacted in the ureter, speaks in favour of the proceeding. No patient should be permitted to die of calculous suppression without a serious attempt to discover the site of the obstructing calculus. If low down in the ureter, the calculus may possibly be removed after the manner suggested by Morris. If high up, it may be removed by nephro-lithotomy, or perhaps by pyelo-

* *Trans. Amer. Surg. Assn.* ii., 1885, p. 518.

† *Brit. Med. Journ.*, Mar. 8th, 1884. ‡ *Amer. Journ. Med. Sc.*, Oct., 1884.

nephrotomy. If its site cannot be discovered, then pyelotomy and the establishment of urinary fistula will at least save the patient's life. A remarkable example of the value of nephrotomy for total suppression of urine is afforded by a patient of Clement Lucas's, from whom one kidney had been excised four months previously, and from whose remaining kidney a large calculus was removed.

Indications to Operate.—Nephrotomy is indicated in all cases of cystic enlargement where puncture has failed. More precisely it is called for in cases of simple cyst where tapping has been performed five or six times without effecting a cure. In hydatid disease, if one tapping does not kill the parasite or check the growth of the tumour, nephrotomy may properly be performed. In hydro-nephrosis, if the cyst rapidly refills after two or three tappings, or if rupture seems imminent, nephrotomy is indicated. In every case suppuration in a cyst is an indication for incision and drainage.

In all cases of suppuration in and around the kidney, incision, with evacuation of pus and drainage of the abscess-sac, is indicated. Contra-indications in such cases are—firstly, such a condition of exhaustion as would negative any serious surgical exploit; and, secondly, a diseased condition of the opposite kidney. Wherever operation for abscess is feasible, nephrotomy ought to be the first operation. The prime object is, evacuation of pus; secondary objects are, diagnosis of the actual state of affairs and determination of the chances which nephrotomy provides towards cure, and preparation of the kidney and the patient for the major operation of nephrectomy where mere incision cannot be expected to be curative. Nephrectomy performed in the first place as an operation for suppurative lesions of the kidney, is not so successful as nephrectomy performed as an operation following on nephrotomy and drainage. The patient gains strength after evacuation of an abscess, and the kidney decreases in size; while the vascularity of the organ and the density of its adhesions become less marked after drainage.

Rarely is operation admissible in suppurative nephritis or pyelo-nephritis—in uro-septic or surgical kidney. Scrofulous kidney as often calls for excision as for incision—at least, when the abscesses are small and numerous.

Before performing nephrotomy it is advisable, though not necessary, to take measures for ascertaining the condition of the other kidney. But the justifiability of the operation will be the urgency of the disease. Whether the opposite kidney is sound or not, renal or peri-renal abscess which is endangering the patient's life must be evacuated if the general condition will warrant operation.

THE OPERATION OF NEPHROTOMY.

The incision is the same as that already described as suitable for nephro-lithotomy, and the structures divided are identical. This holds good for suppurative lesions, if there is no great increase in size, and no visible tendency to point through the skin. If the renal enlargement is considerable, the incision may be carried farther forward; and redness, swelling, or other indications of pointing, must be taken as marking the best site for making an opening. In cases of non-suppurative cystic enlargements, the ordinary lumbar incision will usually be best. True, it may be more easy to make the opening farther towards the front in cases of considerable enlargement, and in doing so there would be little risk of entering the peritoneum. But, looking to the results sought to be attained—drainage of the cavity, and shrivelling of the cyst—the advantages of having the kidney or its remnants fixed well behind around the opening made, and of having a dependent opening for drainage, weigh in favour of the ordinary lumbar incision.

If the operation is for hydatids, simple cyst, or hydro-nephrosis, there may be no peculiarity in the tissues traversed. The circum-renal fat will be thinner than normal, being either spread out over the swelling or atrophied from pressure. Adhesions to surrounding tissues may be present in hydatids. A portion of the cyst-wall is denuded of overlying fatty tissue to an extent sufficient

to permit of its being brought to the surface, and sutured there after being opened. An excellent mode of making the opening is, to push a Lister's sinus forceps either directly through the cyst-wall or through a small opening made by a tenotome, and dilate the opening by separating the blades. As the contents flow outwards, the cyst-wall is pulled to the surface by means of forceps attached to the margin of the opening. Frequently it will be found impossible to pull the cyst-wall quite to the level of the skin; then fixation of the opening in the cyst to tissues as near the surface as possible may be tried, or the opening may be left to itself when a drainage tube has been inserted. In every case evacuation of the contents is to be assisted by pressure from the abdominal aspect.

In operating for suppurative lesions, we may find the skin, muscles, and fasciæ traversed by the incision to be abnormally vascular and œdematous. The circumrenal fat may be hard, dense, and firmly adherent; often it contains numerous small abscesses. A small area of the renal capsule is exposed, and through this the largest needle of an aspirating syringe is pushed. If matter is struck, it is, as far as possible, evacuated at once; if not, the needle is carefully pushed in the most likely directions till purulent fluid is met with. Along the side of the aspirating needle a knife or dilating forceps is pushed, to enlarge the opening sufficiently to admit the finger. Curdy matter which will not run through a tube is scooped out with the finger, and the cavity thoroughly explored. If openings into other abscess cavities are found, these are dilated, if necessary, and their contents removed: if this is impracticable, direct openings are made through the convex surface. In each cavity, and reaching to the bottom of it, a drainage tube is placed. Finally, through the tubes the abscess cavities are thoroughly washed out by irrigation with an antiseptic lotion. The matter found in renal abscesses is often very offensive, and frequent irrigation with antiseptic lotions may be necessary.

In exploring a scrofulous kidney, the septa between the abscesses should not be torn or cut through, as they are often very vascular. The finger should be pushed into the pelvis if

possible, to ascertain whether the upper end of the ureter is pervious.

In peri-nephritic suppuration, after evacuating the pus, the renal surface ought to be carefully examined, to ascertain whether nephric abscess co-exists. Such an abscess must, of course, be opened and drained.

The wound, after careful disinfection and cleansing, is closed around the drainage tube or tubes in the ordinary manner. Thick rubber, perforated only where it traverses renal tissue, makes the best drainage tube. It may be fixed by a stitch to the skin. Absorbent dressings are fixed over the wound by means of an abdominal binder.

The progress of the case will depend on the nature of the operation. In hydatid disease the cavity will probably spontaneously close after suppuration. In simple cyst primary closure may be expected, without discharge of pus. In hydronephrosis, a fistula will in most cases be left, for which there is no cure without further operation. The patient's life may be made fairly comfortable by the use of such a receptacle as that invented by Morris. An attempt may be made to close the fistula by a plastic operation, but it is not often successful. Nephrectomy may then be contemplated.

Nephrotomy for abscess is frequently a curative proceeding —more frequently, probably, than published records would lead us to suppose. Even if cure do not follow, no harm is done, but rather good. For the patient, in view of further operative proceedings by nephrectomy, has been tided over the immediate danger of an acute illness, and has gained strength; while the kidney is diminished in size, its vessels are smaller, its tissue is less friable, and its surroundings are more tolerant of surgical interference.

Nephrectomy.

Nephrectomy is the name given to removal of the kidney by surgical operation.

History.—According to Heineke,* Zambeccarius was the first to contemplate the operation of nephrectomy, and sought to prove its feasibility by operations on dogs. S. Blancard successfully extirpated the kidney in dogs; and several surgeons who saw the operation considered that it might be performed on human beings. Rayer condemned the operation where the kidney was inflamed (as in calculous nephritis), because then it would be so closely adherent to the peritoneum that it could not be disturbed without injuring that membrane. Blundell experimentally performed nephrectomy on animals.

Nephrectomy had been performed unintentionally several times before it was carried out deliberately as a planned operation. In 1860, Walcott of Milwaukee† removed a cancerous kidney, believing it to be a hepatic cyst. Peaslee and one or two others have removed renal cysts, believing them to be ovarian tumours. Walcott's case lived fifteen days; the others succumbed more quickly. The first planned operation was performed by Simon of Heidelberg, in April, 1869. Before operating on the human subject, he had experimented on animals. His operation was performed for incurable fistula of the ureter, and his patient—a lady—made an excellent recovery. Since 1869, the operation has been performed at least 300 times, and with a steadily decreasing mortality.

Conditions for which the Operation may be Performed.—These may be classified as follows:

(1) The same class of diseases as call for nephrotomy when this operation is not likely to succeed, or has already been tried and failed.

(2) New growths of the kidney.

(3) Ureteral and renal fistulæ.

* Von Pitha and Billroth's *Surgery*. † *Phila. Med. and Surg. Rep.*, 1861, p. 126.

(4) Serious injury to the kidney, with hæmorrhage, urinary infiltration, or destructive suppuration.

(5) Disease or degeneration in movable kidney.

(1) In the category of failures after nephrotomy we may include all cases where a renal fistula is left. This may happen after incision for any cystic or purulent collection, in simple hydatid cysts, in hydro-nephrosis or pyo-nephrosis, and in renal suppurations of all sorts. The original disease may be cured; the fistula is an accidental complication, which has to be raised to the dignity of a separate disease, and counted as a special indication for operation.

By far the most important class of failures after nephrotomy which may demand nephrectomy is supplied by suppurative lesions of the kidney. On account of multiplicity of abscesses, it may be impossible to open and drain them all; a large abscess may have been opened, and several small ones may have been overlooked; the abscess-sacs may be very slow to collapse, and the patient's strength may be ebbing away from prolonged suppuration: these and similar considerations may suggest the major operation. Again, in some cases nephrotomy is deliberately performed as a temporary measure, intended to effect improvement in the local as well as in the general condition, before nephrectomy is undertaken. Bruce Clarke, Lucas, and others have specially insisted on the value of this measure.

Among diseases ordinarily amenable to nephrotomy, a certain number will be met with where this operation would evidently prove futile, and where nephrectomy gives the only chance of recovery. Scrofulous kidney would perhaps furnish the greatest number of examples under this head. The organ may be riddled with abscesses, which can neither be evacuated nor drained without causing great hæmorrhage or seriously damaging the renal structure. In this case, a complete nephrotomy would result in chopping the kidney into fragments, and would be a more grave affair than nephrectomy. Any variety of extensive suppuration that is not localised in one district demands nephrectomy. Calculous nephritis may be of this nature. Very exten-

sive suppuration has followed injury to the kidney: Von Bruns, under these circumstances, had on one occasion to remove the organ.

(2) New growths of the kidney may be another indication for nephrectomy. The varieties of new growth are classified by Paul* as follows:

Of Congenital Origin:

Sarcoma: { Round-celled. / Fibro-sarcoma. / Striped Myo-sarcoma (Rhabdo-myoma). / Adeno-sarcoma.

Dermoid tumours.

Of Adult Origin:

Cysts.

Cavernous tumours.

Sarcoma.

Adenoma: { Cystic. / Tubular.

Carcinoma: { Pelvic, like bladder. / Glandular: { Cystic. / Tubular.

Many other classifications have been offered; but the above, prepared after special opportunities for study, may be accepted as trustworthy.

Cystic tumours of the kidney have already been dealt with, under puncture and nephrotomy. There remain for consideration the solid growths; and these, as will be seen from the classification, are mostly of a malignant nature. Sarcoma, both of congenital and of adult origin, is by far the most important; and carcinoma comes next in importance and in frequency. In a most valuable study of Primary Malignant Disease of the Kidneys, Minges† found that of 63 cases, 30 were sarcomata, 30 carcinomata (21 encephaloid—probably most of them really sarcomata), 1 adenoma, and 1 fibro-cystic. It is clear, however, that different men reporting their cases

* *Brit. Med. Journ.*, Jan. 12th, 1884.

† *Journ. Amer. Med. Assn.*, June 6th, 1885, *et seq.*

have followed different classifications, and no exact conclusions can be drawn from the nomenclature adopted. Billroth removed a papillomatous growth. Adenoma is, in one case, given as the name of the tumour for which the kidney was removed. Further consideration of minor varieties of new growths may be dismissed; our purpose here will be fulfilled by an account of primary malignant disease, as represented by sarcoma and carcinoma. Secondary malignant disease does not concern the operating surgeon.

Malignant growths of the kidney show a curious predilection for youth and for old age; they are least common during adult life. Congenitally, sarcoma is the form of malignant disease usually met with: carcinoma, though not unknown, is, as Ebstein states, very rare in infancy and childhood; it is more common in old age. Traumatic irritation, as by calculus, is now admitted to be a contributive cause of renal cancer. The disease occurs with equal frequency in both kidneys; very rarely does it exist in both organs at the same time.

The tumour frequently attains to enormous dimensions; and this is particularly true of growths occurring in children. Roberts records an example found in a child of six, where the tumour weighed 31 lbs. In its growth the tumour extends into the pelvis, often blocking the ureter, and sometimes passing down it for a considerable distance. The renal vein soon becomes involved; and through it the cancer may grow inwards to the vena cava, thus providing a focus from which infarcts may be carried into lungs or liver. The retro-peritoneal glands escape with curious frequency. Ebstein says that secondary deposits are found in more than half the cases that die of the disease. Local extension into peri-renal tissue is not very common; and invasion of neighbouring structures—vertebræ, ribs, intestines, stomach—though described, is even more rare. I have seen a case of primary cancer of the kidney, where the omentum alone was attacked by local extension of the disease. Though malignant disease of the lower urinary tract, in testis, prostate, or bladder, frequently infects the kidney, the reverse is practically unknown.

Symptoms.—Roberts says: "The distinctive symptoms of cancer of the kidney are, tumour in the abdomen and hæmaturia. In every case in which it was the determining cause of death, either one or both were present." If this is not accurately true, it is certainly very approximately so. Minges found a tumour absent only three times in 103 cases, and in two of these cases a tumour was not discovered because it was not carefully looked for. A tumour is always present in children, and frequently it is of enormous size. Hæmaturia is found in about half the cases, and in a far greater proportion of those which claim origin from injury. It is usually irregularly intermittent, and occurs in varying amount at all stages of the disease. Occasionally the blood is very abundant, forming clots in the ureter or bladder, and causing renal colic or vesical tenesmus. The urine in the intervals of bleeding is usually normal, though pus-cells and tube-casts are sometimes found.

Pain, as a symptom of malignant disease of the kidneys, is found in most, though not in all, cases. It is situated chiefly in the loin and abdomen, but radiates widely in all directions around the back and shoulders, and down the front and back of the thigh.

The physical signs are, shortly: a solid tumour situated in the loin, growing forwards, and not at all bulging backwards; rounded and smooth where palpable; resisting movements on pressure, and not descending on inspiration; dull on percussion from the spine forwards, except perhaps along a vertical line in front where it is crossed by large intestine. It is characteristic of renal tumours, that when the lumbar hollow is filled up, all further development is forwards. Renal tumours may be diagnosed from hepatic and splenic enlargements by the fact that they are rounded on all sides where exposed to the examining fingers. There is no notch or sharp edge anywhere. Fixation is said to be a characteristic of renal growths: they impart to the feel a peculiar sense of resistance when attempts are made to move them in any direction. There are, however, exceptions to this rule. There is no resonance in the flank. The large intestine crossing in front of the tumour is, when present, a valuable

diagnostic sign. The ascending colon usually passes over the front and inner side of the growth; the descending colon passes in front, and a little to the outer side. If distended, the colon may be detected by its resonant note on percussion; if empty, it may be felt and rolled about by the fingers.

Renal growths are liable to be confounded with hepatic enlargements on the right side, splenic enlargements on the left, and also with fæcal accumulations and tumours of the ovary. Hepatic tumours have no bowel in front, and the liver margin can often be felt. A space into which the fingers may be pushed is usually left between the upper extremity of a renal growth and the edge of the ribs. An enlarged spleen has no bowel in front; it has a well-defined edge, in some cases notched. Fæcal accumulation only requires to be mentioned as a possible source of error. Cystic enlargements of the kidney are more likely to be mistaken for ovarian tumours than solid growths.

(3) Urinary fistulæ connected with ureter or kidney may be an indication for nephrectomy. Simon's operation was, as already remarked, performed for ureteral fistula. In most cases ureteral fistula is a result of an operation wound. It may be produced by sloughing after a difficult labour. The operation of nephrectomy has been performed at least eight times for urinary fistula.

Renal fistula may be produced by wounds of, or by disease in the kidney. In the great majority of cases, it opens in the loin. But rare examples are found of renal fistula opening into various parts of the intestines, into the stomach, and into the lung. Renal fistula opening into the peritoneum is rapidly fatal, if not treated.

The diagnosis of these conditions requires no description.

(4) Cases of grave injury to the kidney, involving rupture of the organ with free bleeding, may call for nephrectomy as the only chance of saving life. The danger is not so much from the amount of bleeding, as from the clotting of the blood in the bladder, with resulting inability to pass urine. Rawdon* of Liverpool performed nephrectomy in a case of this sort, and

* *Lancet*, May 26th, 1883.

would have saved his patient's life, had it not been that decomposition of blood in the bladder set up cystitis and suppurative nephritis of the opposite kidney, and this in spite of cystotomy performed four days after the nephrectomy.

In cases of urinary infiltration, with destructive suppuration, nephrectomy may be called for. But the major operation will, in most cases, be adopted only as a sequence to lumbar incision and drainage. West, Bennett May, Barker, Weir, and others have published cases of this sort.

(5) An account has already been given of the diseases or degenerations which are liable to attack movable kidney. Here the indication to operate will usually be, pain or enlargement accompanying the mobility; and in most cases the decision to proceed to removal will only be come to after exposure and examination of the organ.

Mortality and Appreciation of Nephrectomy.—The statistics of nephrectomy have been collected by Harris, Billroth, Gross, Weir, Baum, Minges, and others. The general mortality was given by Harris,* in 1882, as 45 per cent.; by Billroth,† in 1884, as 47 per cent.; by Weir,‡ in 152 cases, as 50 per cent.; and by Gross,§ in 1885, in 233 cases, as 44.6 per cent. The latest statistics:—of Baum,‖ adding 72 cases up to February, 1884, giving a mortality of over 50 per cent.; and of Minges,¶ giving 60 cases of operation for primary malignant disease, with 46 deaths,—show little improvement. The results of individual operators of experience are more favourable, but not strikingly so. Under the most advantageous circumstances, a general primary mortality may be expected, in all cases of nephrectomy, of something over 40 per cent.

In malignant disease recurrence takes place in a proportion of 40 per cent., according to Martin of Berlin. Gross estimates that recurrence takes place in a third of all the cases, and that the average duration of life is two years: of 13 operations on

* *Amer. Journ. Med. Sc.*, July, 1882. † *Wien. med. Woch.*, 1884, Nos. 23, 24, 25.
‡ *New York Med. Journ.*, Dec. 27th, 1884.
§ *Amer Journ. Med. Sc.*, July, 1885. ‖ *Phila. Med. Times*, Feb. 21st, 1885.
¶ *Journ. Amer. Med. Ass.*, June 6th and 13th, 1885.

children, only 4 recovered; and all of these died later. Some three or four cases of permanent recovery in children, after nephrectomy for sarcoma, have since been recorded; so that the prospect may not be as hopeless as Gross left it.

The results vary according to the nature of the disease for which operation is performed. The worst results are got for malignant disease—nearly 70 per cent. die. For strumous kidney, the mortality is about 40 per cent. Here it was found that previous nephrotomy did not prove advantageous. For suppurative lesions, Gross found that nephrectomy, without antecedent nephrotomy, gave a death-rate of nearly 50 per cent.; while nephrotomy gave a death-rate under 30 per cent. Bolz and Weir give not very different results.

Indications and Contra-indications.—With results such as those described, it is not surprising that nephrectomy should be looked upon with some degree of disfavour. No doubt the mortality has been increased by a selection of unfavourable cases, or by delaying the operation too long. Under the most favourable circumstances, however, it may be taken for granted that the mortality of nephrectomy will always be high. In favour of the operation, even thus loaded with a terrible death-rate, it may be urged, that it is performed for a certainly fatal disease; a complete success is a life saved; a failure is simply an accelerated dying.

For sarcoma and cancer, the position of the operation would probably be as follows: In all cases where the disease has been known to exist for some months, where the growth is large, and particularly if it is firmly adherent in the loin, no operation is advisable. In children, unless the growth is small, the patient healthy and not less than four or five years of age, no operation is to be thought of. In a word, for malignant disease, nephrectomy is a justifiable procedure only in a very few specially selected cases. It is right to add that, for children, Gross forbids operation altogether.

In hydro-nephrosis, as in cystic disease, removal ought not to be undertaken till incision has been tried and has failed.

Billroth considers that for hydro-nephrosis, nephrectomy ought never to be performed. In a third of the cases, removal has been carried out after mistaking the disease for ovarian cystoma: naturally, the mortality is much greater than after incision. If fistula remains, this may be palliated or treated later on with more chance of success by nephrectomy.

In suppurative lesions, the question of excision as against incision will depend—firstly, on the condition of the patient; and, secondly, on the state of the organ. It may be laid down as a rule, never to be departed from, that no suppurating kidney should be removed without first making a careful examination through an exploratory incision into its substance. Also, the major operation should not be performed if the patient is very weak. The mortality of nephrotomy is less than that of nephrectomy, but not so much less as might be expected: the per-centage of recoveries in favour of the former operation is only twenty-five. Still, this is decisive where nephrotomy is likely to be curative. But certain cases will evidently not be cured by nephrotomy: in these, it may even be doubtful whether traumatic interference will not be positively harmful; and it may appear that the patient, on the operating table, is in a condition as favourable as he is ever likely to be for operation. Such cases will usually be scrofulous; and, as a matter of fact, the mortality after nephrotomy for scrofulous kidney is just as great as after nephrectomy. In every case where nephrotomy presents a fair chance of cure, or even of amelioration, it should be selected; where nephrotomy is out of court, and the patient is likely to bear it, nephrectomy may be performed.

For wounds in the kidney and their consequences, nephrectomy has been performed by Brandt, Marvand, Cartwright, Rawdon, and Bruns—five times, with two deaths. If death seems to be imminent from hæmorrhage, and after exploratory incision it is found to be impossible to check the bleeding, then nephrectomy ought to be performed. Clots in the ureter may cause suppression of urine; in the bladder, they may prevent the discharge of urine, or set up cystitis: here also, if bleeding cannot be checked, and life is being endangered, nephrectomy

is indicated. Where suppuration, with extravasation of urine, follows rupture of the kidney, incision or removal is indicated, according to the gravity of the condition and the state of the patient.

Urinary fistula, renal or ureteral, if it causes great discomfort and prevents the patient from following a necessary occupation, may be an indication for nephrectomy. Simon, Archer, Boeckel and others, have operated for ureteral fistula caused by accidental wound inflicted during hysterectomy. The greatest number of operations have been performed for renal fistula left after nephrotomy, and here the results have been most favourable.

Methods of Ascertaining the Condition of the other Kidney.—Before proceeding to remove one kidney, it is well to ascertain as accurately as possible whether the other kidney is sound; or, in fact, whether it exists. Though it has been estimated that the kidney is solitary only once in 4,000 cases, it has been the unfortunate lot of one surgeon to remove such an organ. This was the remarkable case of Polk,* in which a displaced kidney, lying on the left side above Poupart's ligament, was removed, and found, at the post-mortem examination eleven days later, to be the only kidney. In cases of suppurative disease where nephrectomy is contemplated, the importance of ascertaining the functional capacity of the organ to be left can scarcely be over-estimated. It is not surprising, therefore, that many devices with this object in view have been introduced; and it is, perhaps, no less surprising, considering the inherent difficulty of the procedure, that none of these devices is entirely satisfactory.

Tuchmann† invented a compressor, something like a lithotrite, for the ureter, which he improved in 1880. Hegar‡ proposed temporary ligature of one ureter through the vagina.

Simon,§ in 1875, practised direct catheterisation of ureters

* *New York Med. Journ.*, Feb. 17th, 1883. † *Wien. med Woch.*, 1874, No. 20.
‡ *Operat. Gynäk.*, 1874, p. 456.
§ "Uber die Methoden die Weibliche Urinblase," &c., *Samml. klin. Vortr.*, No. 38.

through the dilated urethra in the female; but after much practice, he attained to only a qualified success. In 1876 Grünfeld* used Simon's method with the help of an endoscope.

Pawlik of Vienna† claims to have been the first to sound the ureters in the female without dilating the urethra. Using as guides certain folds in the vaginal wall, he has succeeded in passing hollow sounds into the ureters of the female 150 times in the dead subject, and 50 times in the living. His method has not generally been adopted, in this country at least.

Silbermann‡ sought to compress the ureter by small rubber bags, filled with quicksilver, introduced through a large silver catheter. Newman of Glasgow, in cases of his own, and in one of Dr. McCall Anderson's, has used Silbermann's method with success. But Newman has introduced a plan of his own, in which sight, with the help of an electric lamp in the bladder, is called in to help in the passing of the catheter into the ureter.

Sands recommends the insertion of the hand into the rectum, and compression of the ureters by the fingers.

Glück§ recommends a proceeding even more serious; namely, compression of the ureter by forceps through a lumbar incision. The opposite kidney is supposed to be sound if iodide of soda, or ferro-cyanide of potassium, administered to the patient, is found in the urine secreted by the other kidney. But a kidney advanced in disease might elude this test.

Polk‖ has devised a clamp for compressing the ureter, one blade being inside the bladder and the other in the rectum. The bladder being washed out, the urine secreted by the other kidney can be got in a fairly pure state and examined.

Davy's rectal lever has been used, with somewhat uncertain results, to compress the ureter as it crosses the brim of the pelvis. On the right side it can be employed only when there is a well-developed mesentery to the rectum.

Fenwick's¶ ingenious apparatus for performing suction of the

* *Wien. med. Presse*, 1876, Nos. 27, 28. † See letter in *Glasg. Med. Journ.*, July, 1885.
‡ *Berl. klin. Woch.*, No. 34, 1883. § *Centralbl. f. Chir.*, Dec. 10th, 1881.
‖ *New York Med. Journ.*, Feb. 17th, 1883.
¶ *Lancet*, Sept. 18th, 1886.

ureters in the male promises to be valuable; but it has scarcely been more than tried.*

On one occasion, while removing papillomatous growths from the female bladder, I was struck with the ease with which I could detect and reach the orifices of the ureters. To enter the female bladder, I now always incise the outer urethra, and dilate the inner urethra and the neck of the bladder. The additional freedom in exploring the bladder so afforded is much greater than would be supposed: I feel sure that little difficulty would be experienced in finding the orifices of the ureters, and in catheterising them, by this method. It is easy enough on the dead body. Three or four catgut sutures give primary healing, and no incontinence is left. Probably some modification of Polk's plan will be found most suitable for the male.

Our confidence must rest mainly on the characters of the urine as a whole, and on the condition of the patient. The quantity of urine, its per-centage of solids and especially of urea, and the presence of no more albumen than might be accounted for by the pus in the urine, must be our chief data for guidance. Any symptoms of uræmic poisoning, of course, negative the operation.

Abdominal section is valuable as a means of ascertaining the condition of the other kidney; but its true position is rather as an alternative to lumbar nephrectomy which secures this additional advantage, than as a mere method of diagnosis.

THE OPERATION.

The kidney may be removed in two ways:

(1) By incision through the loin—Lumbar nephrectomy.

(2) By incision through the parietes—Abdominal nephrectomy.

Lumbar Nephrectomy.—Several varieties of incision are recommended. Morris recommends "a transverse or slightly oblique incision, made somewhat nearer the last rib than in colotomy;

* For an exhaustive consideration of the methods of exploring the ureters in the female, see M. D. Schultz, *Nouv. Arch. d'Obstet. et de Gynéc*, ii., 5, p. 205.

with this should be conjoined a second incision, running vertically downwards from the first, and starting from it about one inch in front of its posterior extremity." The special advantage of the vertical incision is, that it affords increased facility for passing the ligature round the pedicle. Weir* made use of a lumbar vertical incision three inches from the spine, just below the twelfth rib, and extending to the crest of the ilium; and a second incision, transverse, varying in length according to requirements, and running from near the top of the vertical incision along the edge of the ribs. Simon's original incision was a vertical one; but in his case the kidney was not enlarged. Lucas† recommends an oblique incision, as for colotomy, supplemented by a vertical one carried along the outer edge of the quadratus, and extending from the last rib to the iliac crest. Klineberger used a curved incision, the convexity of which was upwards and outwards. Thornton,‡ in a discussion on Dr. Walter's case of nephrectomy for cystic tumour of a floating kidney, thought that the operation of the future would be a vertical incision, farther out than Langenbuch's through the linea semilunaris; not entering the peritoneum, but pushing it, with the colon, inwards. Other varieties of incision have been described.

The lines of incision should be determined by the condition of the organ to be removed. A healthy kidney, or one but slightly enlarged and not adherent, may be removed through a simple oblique incision made between the ribs and the iliac crest. The upper extremity should be at least an inch distant from the last rib: the lower extremity may be carried close to the crest of the ilium; if the costo-iliac space is small, the line of incision may be curved forwards some distance.

If the kidney is of large size, or if it is fixed by adhesions, more space is required both for its removal and for performing the necessary manipulations in enucleating it. In every case, the operation may be begun by the oblique incision. Through it the condition of the kidney may be ascertained, and, in cases

* *New York Med. Journ.*, Dec. 27th, 1884. † *Brit. Med. Journ.*, ii., 1883, p. 611.
‡ *Brit. Med. Journ.*, ii., 1883, p. 615.

of suppuration, a decision come to as to the advisability of giving nephrotomy a trial; while, if the kidney is to be removed, the best mode of enlarging the incision will be more accurately judged after seeing the amount of space provided by the oblique incision. Some form of transverse incision, starting near the lower extremity of the oblique one and carried towards the middle line as far as may seem expedient, will usually be found the best. It is made by the scissors cutting through the parietes at one stroke, and guided by the forefinger, which is pushed forwards through the cellular tissue, and keeps the peritoneum out of the way. The incision may be carried forward to any distance desired, the peritoneum being carefully elevated from the kidney surface, and pushed inwards.

The actual lines of incision are not of supreme importance. Any incision which gives plenty of room, and does not involve entering the peritoneal cavity, may be adopted. The incision described is that which I have found most suitable.

The incisions being made, and all bleeding points having been secured, the kidney is separated from its connections. If there has been no inflammation, this will be found an easy proceeding; the forefinger of one hand, carried close to its capsule, readily enucleating the organ from its fatty bed. But if there has been much inflammation, the cellulo-fatty tissue may be very dense and very adherent, and enucleation may prove very difficult. In some cases, enucleation is simply impossible without the use of a cutting instrument—scissors being best for this purpose. An attempt may be made to enucleate the kidney from its capsule, leaving the capsule behind; but this also, if there has been suppuration at many points, will be found a difficult matter. Each case must be judged on its own merits. It must not be forgotten that there is a limit to the amount of force which may be exerted in the separation of adhesions surrounding a kidney: surgical manipulation ought never to be carried into brute force. Very dense adhesions should be divided by scissors; forceps, where necessary, being placed on the bleeding points. In cases where nephrotomy has been performed, it is usually found that enucleation from the capsule is

more feasible than enucleation from the circumrenal fat. In cases of old-standing suppuration, with great enlargement, the vena cava and the aorta may be intimately adherent to the capsule. One such case was recently met with in the post-mortem room of the Bristol Infirmary: here it was simply impossible, after death, to dissect apart the vascular walls and the renal capsule. In another case, for similar reasons, the organ could not have been removed by any proceeding claiming to be recognised as surgical. In such cases, where complete removal is out of the question, an artificial pedicle, including some renal tissue, may be formed at some distance from the middle line. The tissue left will probably either atrophy or slough; and the danger of wounding vena cava or aorta will have been avoided.

The kidney having been freed, the next step is to secure the pedicle. This is a proceeding demanding great care and delicacy. A few surgeons recommend that the artery and the vein should be ligatured separately. In many cases this will be found impossible; in none is it necessary. Indeed, the walls of the vein or veins, by acting as a sort of padding, may add to the safety of ligation, preventing the thread from slipping and distributing the pressure on the artery or arteries. As a matter of fact, the only deaths as yet recorded from secondary hæmorrhage were in two cases where the vessels were separately tied. The vessels are ligatured in a body; the ureter, separately.

The kidney is first most carefully raised out of its bed, and handed to an assistant, who holds it steadily in both hands, exerting no traction on the pedicle. The fingers of the left hand (or the right hand, as may be most convenient), surrounding the pedicle, isolate ureter and vessels as far as possible by teasing out the cellular tissue between them. Pulsation in the artery is a guiding sign of importance. A ligature of thick silk is carried, by an aneurism needle in the other hand, around the vessels, and tied. While the ligature is being tightened, all traction must be taken off the pedicle. The ureter, isolated as far as possible, is caught in a pair of compression forceps, and

left to be dealt with as seems best afterwards. The kidney is now deliberately cut away, at a safe distance from the site of ligation, by successive snips of the scissors; and while this is being done, all tension on the pedicle must be relaxed. An artery may be dragged through a very tight ligature which encloses other tissues; and this artery, recoiling afterwards, may bleed. If it is impossible to bring the pedicle fully within sight, then a large catch-forceps should be placed upon it outside the ligature, and division made between forceps and kidney. Or a temporary ecraseur, of rope or wire, may be used for the same purpose. Every possible precaution should be taken against the occurrence of hæmorrhage.

The ureter is separated from the pelvis by a stroke of the scissors. If it is much thickened, and its mucous membrane ulcerated, Thornton's admirable plan of fixing the divided extremity in the parietal wound should be adopted. If it is fairly healthy, it may be ligatured and left in the wound.

In some cases of large suppurating kidney it may be impossible to manufacture a pedicle composed of vessels only at a safe distance from the aorta or vena cava. In this case the simplest plan is, to surround the base of the organ with a temporary ligature attached to an ecraseur, and cut away the diseased tissues close to it. Tait's temporary rope-clamp is very suitable for this purpose. If the kidney is very large, it may, while this compression is being exerted, be cut away in portions, to the great simplification of the operation. The difficulty of delivering an enormous kidney through a lumbar wound is thereby avoided, and, more important still, the risks of traction on the vessels are escaped. When the organ is shaved away down to the position of the temporary compression, the pedicle may be dealt with deliberately by ligation, forci-pressure, or cautery, as seems best at the time.

There would seem to be no extra danger in placing the ligature quite close to the aorta or vena cava. But most surgeons would endeavour to give these vessels as wide a berth as possible —not only to avoid injury to their walls, but also to escape the risk of extension into their lumina of the thrombotic plugs.

A final examination is made of the pedicle and of the cavity of the wound. All blood-clot is removed, any bleeding points are secured, and the peritoneum is carefully examined, to make certain that it has not been torn. A peritoneal rent is at once closed by a continuous catgut suture placed from the outside, which will cause accurate apposition of its serous surfaces. If the colon has been exposed on its retro-peritoneal aspect, it also must be examined for injury.

A large rubber drain is placed in the bottom of the cavity, and the wound sutured by deep and superficial stitches. The peritoneum, pushed backwards by intra-abdominal pressure, soon closes in over the large cavity. Primary healing is the rule; and the progress, as soon as the first dangers are over, is usually very rapid.

Abdominal Nephrectomy.—The incision may be made either in the ordinary way, through the linea alba; or, after the method introduced by Langenbuch, through the linea semilunaris on the side of the kidney to be removed. Langenbuch's method is now almost universally adopted.

The length of the incision must be sufficient to admit the whole hand—at least four inches—even if the kidney is of normal size; if the kidney is enlarged, the length of the incision must be made to correspond. Its middle point is at the level of the umbilicus. When the abdominal cavity is entered, a large flat sponge is inserted, to keep the intestines out of the way and to absorb effused blood. Before proceeding to remove the kidney, the state of the other will have been ascertained as accurately as possible by examination with the hand passed through the parietal opening.

The kidney is exposed by tearing through the peritoneum where it forms the outer layer of the meso-colon. The inner layer—that between the colon and the middle line—contains the vessels which supply the bowel, and incision through it may cause, and in fact has caused, gangrene of the gut. Two or three fingers, passed through this opening, enlarge it by tearing and stretching, and separate the front of kidney from the cir-

cumrenal fat. When a way has been opened to the renal vessels, these may be exposed, or at least brought nearer to the field of vision, by hooking up the peritoneal flaps with a retractor, which, in the hands of an assistant, at the same time makes the parietal wound gape. The vessels are carefully isolated with the forefinger. A ligature is passed round them with a blunt aneurism needle and tied. The ureter is caught in forceps, which are left attached. The organ is now completely separated from its surroundings, the vessels are divided at a safe distance from the ligature, the ureter is cut through, and the whole mass lifted out of the wound. If there is any doubt as to the security of the ligature, a long catch-forceps should be placed on the end of the pedicle, while a second ligature is applied behind the first. In most cases double ligatures have been used.

The ureter is treated as in lumbar nephrectomy. If it is fairly healthy, it is ligatured, cleansed, and returned; if it is diseased, lined with thick granulations, and contains putrid pus, its divided extremity may be fixed in the wound, as suggested and practised by Thornton; or turned out through an opening in the loin, as suggested by Morris. In such cases as strumous pyelitis, where the disease often extends down the ureter, this extra-peritoneal treatment of the ureter lessens the chances of its becoming a new abscess-sac, and permits of its being irrigated and disinfected. Thornton's plan has been criticised, as inviting the subsequent occurrence of intestinal obstruction by raising up a tense band between bladder and loin.

The cavity is finally cleansed, and examined for bleeding points. The peritoneal rent falls together naturally, and requires no suture. If pus or urine has escaped during the manipulations, a drainage tube should be placed in the bottom of the wound; otherwise, drainage is unnecessary. The parietal wound is closed in the ordinary way.

Choice of Operation.—Whether the lumbar or the abdominal method be selected in a given case, will depend on many circumstances. Firstly, there is the predilection of the operator. That men of such experience and success as Tait and Thornton

should prefer the abdominal method, is a very strong argument in its favour. But the force of the argument is weakened, in so far as it refers to surgeons in general, from the fact that those men who prefer the abdominal operation are also men of very large experience in performing abdominal sections for other purposes. To most surgeons the lumbar operation would commend itself, as being more easy of performance.

Then there is the question of safety. The general mortality after the lumbar operation is considerably less than that after the abdominal. Out of 233 cases collected by Gross,* 111 by the lumbar method gave a per-centage mortality of 36.93, while 120 by ventral incision gave 50.83 per cent. mortality. It may, however, be reasonably urged against any conclusions drawn from these statistics, that the simplest cases were naturally selected for the lumbar operation, and the most difficult for the abdominal. There are no figures to show what mortality the abdominal method or the lumbar would have given, each in unselected cases. It is just possible that the abdominal method, in those cases where the lumbar was adopted, would have given even better results. Indeed, in the hands of a few operators, with cases that were certainly far from being simple, the results in abdominal nephrectomy are far ahead of the average in lumbar nephrectomy.

We cannot ignore these facts, and compare the value of general lumbar nephrectomies with general abdominal nephrectomies by figures alone. All that can be said is, that, so far, the general superiority of the one to the other has not yet been proved; and the surgeon is left absolutely to his own discretion, in each case, as to the operation he shall adopt.

Looking at the mechanical details of the operations themselves, we find that certain cases are most suitable to one method, and some to the other. Generally speaking, it is possible before operation to make a sound selection; but frequently it is not.

By the lumbar method, less space is given for removal of the kidney; the important procedure of ligature of the pedicle

* *Am. Journ. Med. Sc.*, July, 1885.

is carried out at some distance from the surface, and frequently out of sight; and there is not the same facility in dealing with bleeding points in the tissues from which the kidney has been enucleated. On the other hand, the lumbar method is an extra-peritoneal operation; it gives more facility for the separation of strong adhesions behind the kidney; and in the case of its being unwise, as in abscess, or in tumour infecting the surrounding tissues, to proceed to removal, it is less serious to the patient. In the case of abscess, it has the further advantage of permitting of treatment by incision and drainage, without serious risks of peritonitis.

Langenbuch's operation is, in its way, a perfect surgical procedure, securing its aims by a minimum of injury to surrounding tissues. In the linea semilunaris, the advantages of avoiding large muscular masses are secured; and by tearing through the peritoneum in front of the colon, the vitality of the bowel is not endangered. It gives plenty of room for removal of the kidney. Lastly, it secures the all-important advantage of giving information as to the condition of the alternate kidney. Its disadvantages, in addition to the opening of the peritoneal cavity, are chiefly the difficulty of separating adhesions behind a large kidney, and the dangers from rupture of abscess-cysts inside the cavity.

Bearing in mind the advantages and disadvantages peculiar to each operation, we can roughly specify the cases most suitable for each.

By the lumbar method, all small kidneys may be removed. These include ordinary examples of ureteral fistula, and cases of wounds of the kidney in which there is urinary extravasation or suppurative disintegration of tissue. It ought to be selected for all small growths of the kidney, and particularly if it is movable. It is best employed for all enlargements containing fluid—hydatid, hydro-nephrotic, or purulent—in which incision, with drainage, has not produced cure. In cases of calculus in which the renal tissue is completely disorganised, the lumbar method is the best.

The ventral incision is most suited to large non-adherent

solid tumours, and to those movable kidneys which have become diseased and are unsuitable for nephrorraphy. In very fat subjects, the ventral incision may be easier than the lumbar, as permitting of easier approach. In very lean subjects, both operations are much facilitated—the lumbar more, perhaps, than the ventral.

A word must be said on the plan recommended by Thornton, but now abandoned by him, which Morris has called "Lateral Retro-peritoneal Nephrectomy." In this plan, the incision is made further outwards than the linea semilunaris—so far out, in fact, as to permit exposure of the kidney by the peritoneum being pushed aside without opening it, as in ligature of the external iliac. The advantages of making the incision in the linea semilunaris are perhaps more ideal than real: an abdominal section is about as easily performed by division of muscles as of fasciæ; the bleeding is easily controlled, and the wounds unite just as readily. If there is any advantage in going further outwards, the division of muscle need not deter us. In cases of considerable enlargement of the kidney, for which only this method would be selected, the peritoneum is pushed inwards, and reflexion of it, without entering the abdomen, is easy enough. It is doubtful, however, if by this lateral incision it is as easy to deal with the pedicle as in Langenbuch's operation.

SECTION IX.

OPERATIONS ON THE LIVER AND GALL-BLADDER.

SURGICAL ANATOMY OF THE LIVER.

The surgery of the liver being concerned with diseases which cause enlargement of the organ, it behoves us to know accurately the limits of the space it normally occupies. The limits of percussion dulness, relative and absolute, are well enough known; but as the organ is overlapped by lung above, and as, at parts where it is thin, it lies in close contact with air-containing viscera below, these limits may not be anatomically correct.

On the right side, a transverse line passing through the junction of the fifth rib with its cartilage would graze the top of the right lobe at its highest point. In fact, the highest level of the liver almost touches the lower border of the fourth rib. On the left side, a transverse line running through the junction of the

sixth rib with its cartilage would pass close to the upper and outer limits of the left lobe. Below, its margin is just covered by the ribs behind: as it comes to the front, it leaves the cartilage of the tenth rib on the right and crosses obliquely to the left, towards the junction of the fifth left rib with its cartilage.

A triangular area of liver surface is thus left uncovered by anything but abdominal wall; and it is in this area, usually increased in dimensions, that many surgical procedures have to be carried out. The sharp free margin, with its notch a little to the right of the middle line, indicating the attachment of the broad ligament, may frequently be palpated. From the notch to the umbilicus runs the double fold of peritoneum known as the longitudinal or suspensory ligament. Its parietal attachment is along the inner border of the right rectus muscle; its free border contains the fibrous cord known as the round ligament, which is the remains of the obliterated umbilical vein. At the notch the round ligament passes behind the liver along the longitudinal fissure. It must not be forgotten that the umbilical vein is not always completely obliterated, and that a wound of it may cause hæmorrhage. This fact must be noted in the making of long incisions in the region.

The extent to which the right lung and pleura overlap the liver varies considerably in health. When the liver is enlarged it rises upwards, encroaching on the pulmonary space; but though the level of the upper surface is raised both actually and to percussion, and though the lung may be pushed up in front of it, the diaphragmatic pleura still retains its position. A puncture above the normal level of the lower limits of the pleura, or the insertion of the diaphragm, though it may not pass through lung, will traverse the pleura, and, if there are no adhesions, will enter the pleural cavity. The level of the pleura in the right axillary line is at the lower border of the ninth rib; and if variations occur on this side as frequently as they do on the left side, we must not be surprised to find it placed lower.

The liver possesses some range of movement. Following the movements of the diaphragm, it descends with inspiration and ascends with expiration. If there is occasion to stitch a

wound in the liver to the parietes, the evil effects of this continual movement may be minimised by fixing the sutures at a distance as great as possible from the rib margins. Unimportant displacements take place as the position of the individual varies, and as the abdomen is compressed or relaxed. A real pathological displacement is seen in the rare condition known as wandering or floating liver. Though most of the cases so described have proved to be errors in diagnosis, a few, perhaps a dozen, are attested by post-mortem examination or incontrovertible physical signs.* In the great majority of cases the condition has been found associated with pendulous abdomen. In none is treatment called for beyond the wearing of an abdominal belt.

The structure of the liver is such that we should expect it to be intolerant of surgical interference. But experience would seem to point the other way. Its capsule is very closely adherent, and so thin as to be incapable of bearing much strain from sutures. The tissue is very friable and very vascular; but the blood-stream is very sluggish, and easily controlled by pressure such as may be exerted by sponges or a row of sutures.

The gall-bladder (Fig. 72), lying on the under surface of the liver in a shallow groove between the lobulus quadratus and the right lobe, is, when healthy, beyond the reach of palpation. Its fundus extends a little lower than the edge of the liver, and lies in a shallow depression, whose margin can sometimes be felt below the inner border of the ninth costal cartilage. In this position it is a little to the right of the outer margin of the right rectus muscle, and can be reached by an incision through the upper end of the right linea semilunaris.

The bladder itself is about four inches in length, and about an inch broad, with a normal capacity of a little over an ounce. It is fixed to the under surface of the liver simply by the peritoneum, which passes over it. Occasionally the peritoneal folds meet on its upper surface between it and the liver, forming

* Consult Thierfielder, Ziemssen's *Cycl.*, vol. iv., p. 48. Landau, *Der Wanderleber und der Hängerbauch der Frauen.* Berlin, 1885. Larïonoff, Rubinovitch, Dmitrieff, and Botkin; Abstract in *Lond. Med. Rec.*, Aug. 15th, 1885, by Dr. Idelson, who gives further references.

a sort of mesentery. On one occasion when performing cholecystotomy on the cadaver, I found a double fold of peritoneum passing between the free surface of the bladder and the anterior margin of the foramen of Winslow. As another, though less perfect, example of this anomaly was found in the post-mortem room within a few months, I suspect that this condition is not

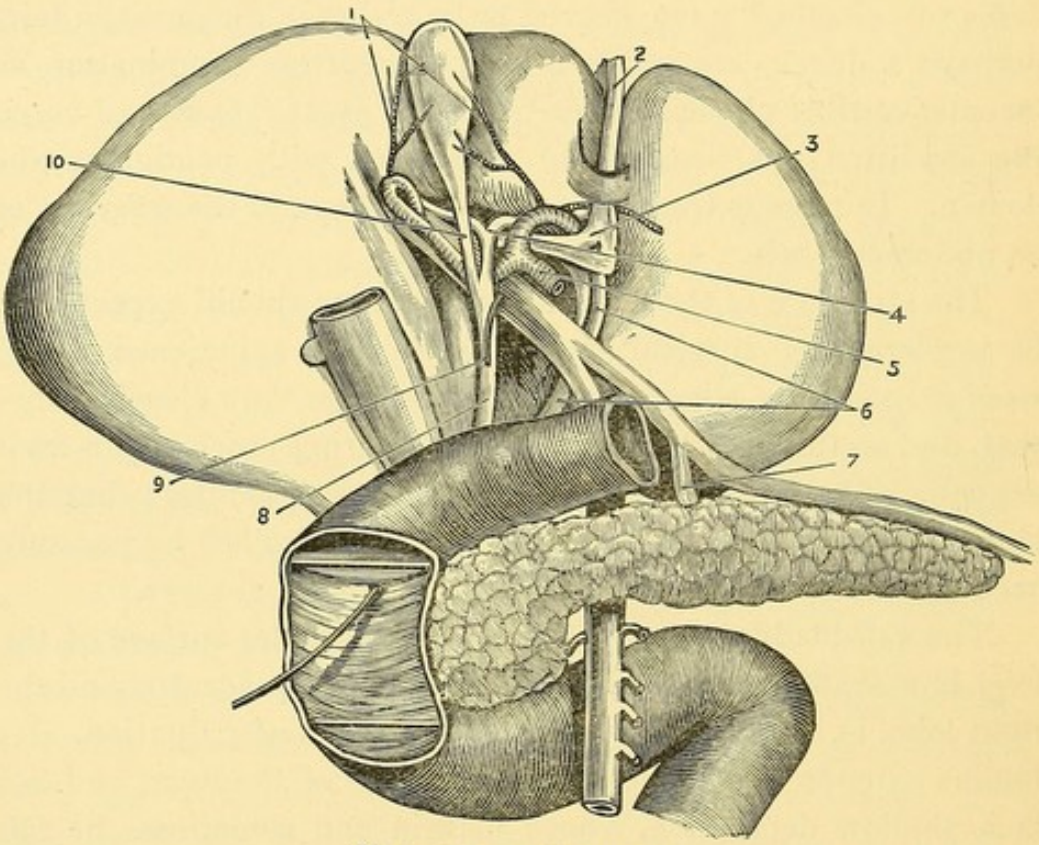

FIG. 72. (WEISSE.)

The under surface of the Liver; the Duodenum and the Pancreas.

1. Cystic Arteries supplying Gall-bladder. 2. Obliterated Umbilical Vein. 3. Obliterated Branch to Vena Portæ. 4. Hepatic Duct. 5. Hepatic Artery. 6. Obliterated Ductus Venosus. 7. Inferior Mesenteric Vein discharging into the Splenic Vein. 8. Ductus Communis Choledochus. 9. Probe entering the Duct and coming out at the Orifice in the Duodenum. 10. Cystic Duct.—The inferior Vena Cava is crossed by the lines from 8 and 9. The superior Mesenteric Vein crosses the transverse portion of the Duodenum and passes under the Pancreas to join the Splenic Vein in the Vena Portæ.

very rare. This abnormality need not interfere seriously with operative proceedings; but if met with unexpectedly, it might be confusing.

The cystic duct, about an inch long, leaves the neck of the bladder at a very obtuse angle, passes a little towards the left

in the gastro-hepatic omentum, accompanied with its artery, and joins the hepatic duct at an acute angle. These, joining, form the ductus communis choledochus, which, after a course about three inches long in the right border of the lesser omentum, passes with the pancreatic duct obliquely through the inner wall of the descending portion of duodenum. The cystic duct can readily be examined through a ventral incision; and a dilated or obstructed common duct can be felt, at least through the first part of its course. In any manipulation that may be carried out on these ducts, their close relations with the portal vein and the hepatic artery must be borne in mind.

The fibrous coat of the gall-bladder, though thin, is very strong and tough, and is not easily dilated. The thin layer of muscular fibres is arranged mainly in longitudinal direction. The mucous coat is everywhere elevated in ridges, which are so arranged as to produce polygonal depressions, most highly developed near the middle of the cavity. At the neck, one large ruga overhangs the entrance to the cystic duct, and acts as a sort of valve. When the bladder is over-distended, these rugæ are usually obliterated. In the cystic duct the mucous membrane is raised into half a dozen or a dozen oblique folds, arranged so as to form a sort of interrupted spiral. These folds increase the difficulty of gall-stones being passed onwards. Any distension of the duct causes the intervalvular spaces to be distended, producing a sort of cork-screw appearance.

The relations of the bowels to the gall-bladder are unimportant, except in view of the operative formation of a fistula between the two. This will be discussed farther on.

Operations upon the Liver.

Surgical operations are performed on the liver for abscess and for hydatids. The operations are various: all of them are of the nature of proceedings for the evacuation of cystic collections of fluid. Although most of the proceedings involve wounding of liver tissue, the special name "Hepatotomy" is given only to that operation wherein an abdominal section is made, and the liver tissue is directly incised through the parietal wound. The name is, of course, equally applicable to incision through the costal parietes.

The various operations will be most conveniently considered under the heads of the diseases.

HEPATIC ABSCESS.

Anatomical Characters.—The fact that chiefly concerns the surgeon is, that the abscess is sometimes multiple. In the majority of cases, however, especially if of some duration, the abscess is single. There is always a tendency for abscesses, if multiple, to coalesce; so that if one abscess is opened, and pressure be removed from the walls of its neighbour, there is a likelihood of the second bursting into the cavity of the first. In most the abscess is covered with healthy tissue, with uninflamed capsule, and an incision may have to be carried some distance through the healthy substance to reach it. If it is permitted to burst naturally, it is most frequently fatal. Rarely it bursts through the skin. Sometimes it bursts into the peritoneal cavity or pericardium, when it causes death. It may open into the pleura, when it is usually fatal. The most favourable openings are, into the bowel and into the lung; though in both cases the prognosis is grave. In any case where free evacuation not into a dangerous site has taken place, there is a remarkable tendency for the abscess cavity to close up and

cicatrise, while the liver readily regains the power of discharging its normal functions.

Diagnosis.—The diagnosis of abscess of the liver is sometimes very difficult, or even impracticable; nevertheless, in most cases, especially with the help of the exploring needle, something like certainty may be arrived at. To begin with, we may have a history of residence in hot climates, and perhaps of malaria or dysentery. There may be a history of rigors. Sometimes also it would appear to be connected with operations on the rectum. There is the characteristic muddy complexion; the harassed, anxious, restless expression; the rapid pulse and the elevated temperature. The tongue is coated with white fur; and there will be an irritable stomach, with vomiting. Locally there is pain and tenderness in the hepatic region, with enlargement, sometimes very considerable, of the organ itself. Occasionally, but not frequently, there is fluctuation. The presence of jaundice is rather against than in favour of abscess. When the abscess bursts into the lung, the chocolate-coloured expectoration is pathognomonic; before it bursts, this sign may be got from exploratory puncture.

It is most liable to be confounded with empyema at the base of the right pleura, and it has been mistaken for pleurisy and pneumonia. I have seen a large abscess of the liver diagnosed as abscess of the kidney; and the reverse is just possible. The nodular feel of a cancerous liver will usually distinguish it from a suppurating one; and if no nodules exist on the surface, and the new growth be behind, we can fall back on the pyrexia that accompanies the latter. In hydatids also there is no pyrexia, very little constitutional disturbance, and but little, if any, pain: the hydatid fremitus is so rarely felt as to be of little value clinically.

SURGICAL TREATMENT.

For liver-abscess, as for other abscesses, there may be said to be no treatment that is not surgical. True, as in other cases, the abscess may become absorbed naturally; but that is a result so rare, that no prudent man would wait for it. And we must

not delay the necessary opening too long. If we wait for the abscess to point at a convenient spot, we may have waited too long, and the abscess may elect to point at an inconvenient spot. On similar grounds, we must not wait for the doubtful formation of adhesions to the body walls. They may never form there; and if they did, it is doubtful if we could diagnose them. There is nothing for it but removal of the pent-up pus, as soon as an abscess is diagnosed.

The surgical measures available are:

(1) Aspiration.
(2) Puncture by trocar—leaving the cannula *in situ*.
(3) Opening by caustic or by thermo-cautery.
(4) Direct incision into the abscess through the body walls.
(5) Incision *à deux temps*, after the artificial formation of adhesions between the liver and abdominal walls.
(6) Incision, and drainage by abdominal section—Hepatotomy.

(1) The employment of the *aspirator* in hepatic abscess must be regarded rather in the light of a tentative and exploratory measure, than as a permanent cure. It is now used more extensively, perhaps, than published literature would lead us to expect. For clearing up a diagnosis, and giving temporary relief, the removal of quantities of pus from the liver by aspiration is of undoubted value, and not attended with much danger. Ransohoff's case of hepatotomy was aspirated without benefit, and he had to incise afterwards.* It may tell us where the collection mainly lies, and may even afford some light as to whether the abscess is single or multiple, but it can scarcely be expected at one operation to be curative. In a good few cases aspiration, repeated more than once, has been followed by cure. Ball, Maclean, Hammond, and others have had fairly good results from aspiration.†

In the use of the aspirator, its thorough cleansing with antiseptic lotions must be seen to. The needle may be introduced

* *N. Y. Med. Rec.*, No. 22, 1882, p. 258.

† See Editorial, *Annals of Surgery*, March, 1887.

full of 1-20 carbolic lotion; the skin at the site of puncture must be thoroughly purified, as some of the epidermic scales may be carried into the abscess cavity on the point of the needle, and, if impure, be a cause of septic infection. The movements of the needle, following the movements of the liver (if it moves with respiration), must not be checked, as thereby the liver tissue may be torn and permit escape of pus into the peritoneum.

(2) *Puncture by Trocar*—leaving the cannula to permit drainage—is a procedure by no means new. In 1842 Murray* advocated it; and since then it has been in quite general use, and is esteemed by many as the most favourable of all plans. An ordinary medium size instrument is used; though De Castro† used a hollow trocar, with perforations corresponding to similar ones on the cannula. The trocar is left *in situ* for two or three days, when adhesions will have formed, and is then replaced by a drainage tube of some sort. The purifying of the trocar is to be carried out as carefully in this proceeding as in aspiration. Some antiseptic material, such as terebene with vaseline, or eucalyptus or salicylic cream, may be smeared over the trocar. The full details of Listerism will by most be considered as affording an additional probability in favour of asepticism throughout: if the spray is not used, perhaps sal alembroth wool, with frequent cleansing of the neighbourhood of the wound, would be as good a dressing as any.

An indication in favour of the employment of the trocar would be, the tendency of the abscess to point, shown by œdema, or some redness and tenderness of the skin. Some danger may attend its use, however. In such a case as one of those operated upon by Knowsley Thornton, where the omentum, with large veins coursing through it, lay adherent on the surface of the liver, serious bleeding might arise. The risk of setting up inflammation of the liver substance by puncture with fine instruments is very small. Indeed, Trousseau used puncture by several needles, as a safe means of setting up inflamma-

* *London Med. Gazette*, No. 38, p. 566.

† *Des abscès du foie des pays chauds et de leur traitement Chir.*, Paris, 1870.

tory adhesion between the serous surfaces of the liver and the abdominal wall, as a preliminary to incision. But it must not be forgotten that puncture with trocar, after all, taps the abdominal cavity; and, being done in the dark, may cause serious injury to an abdominal organ other than the liver; and may even permit of the escape of pus into the abdominal cavity.

(3) Gradual opening by *caustic*, and by *thermo-cautery* applied to the abdominal wall over the tumour, are proceedings whereby a liver abscess may be opened. Both are slow and painful proceedings, and are not likely to be brought into competition with other more rapid and less painful, while equally efficient, methods. Récamier* advocated the use of caustic potash applied to the abdominal wall for liver abscess. This process of gradual perforation by destructive chemical or thermic agents is more in vogue for the treatment of hydatids of the liver than for abscess.

(4) *Direct Incision* into the abscess through the abdominal or thoracic walls would be carried out only if there were signs of the abscess bursting of its own accord. Redness, tenderness, and some swelling at any part over a hepatic tumour which is probably suppurating, may be taken as an indication that the matter is forcing its way to the surface. In such cases there will be adhesions between the liver and the overlying peritoneum, and an opening may be made with safety.

It need scarcely be said that such a tendency to point is neither to be waited for nor encouraged. The chances of an abscess of the liver escaping towards the abdominal or thoracic parietes are, considering the amount of surface, at least not greater than the chances of its escaping through the diaphragm or into the peritoneum. And before signs of pointing appear the patient will have been reduced to a very low ebb.

After such incision, conducted antiseptically, a large drainage tube will be inserted. If the discharge continues sweet, there will be no need for syringing or irrigation of the cavity; if it is,

* Velpeau, *Méd. Opérat.*, 2nd Ed., iv., p. 19.

or becomes, putrid, then frequent washings with some trustworthy antiseptic solution must be instituted.

(5) *Incision in two stages*—after the manner of Graves,* who made the incision only as far as the peritoneum; or of Bégin (1830),† who went through the peritoneum—has much to recommend it. The operation in two stages is that favoured by Volkmann, and at the present day is known by his name. It is, in fact, an old application of the modern principle of creating adhesions between a hollow abdominal viscus which is to be opened and the parietes, when there is risk from escape of the contents of that viscus and not very great urgency for making the opening. In the case of hepatic abscess there is urgency, and consequently this double operation will not often commend itself.

In Graves's procedure, some lint or other material is pushed to the bottom of the wound in the parietes, setting up simple inflammation of the parietal peritoneum, which thus in a few days becomes adherent to the liver. Some uncertainty attaches to the plan of Bégin, as it has been found that the liver does not always come up to, and lie in contact with, the wound in the parietes; and thus adhesions do not certainly form. There is always the risk in the operation which does not lay open the peritoneum, that omentum or even bowel may lie directly under the opening and be wounded when the liver is incised. These objections are partly met by suturing the liver surface to the parietes, as recommended by Barwell.‡

(6) *Hepatotomy*—the name usually given to direct incision through the liver tissue, after abdominal section—is the operation which most commends itself for hepatic abscess. With laparotomy, the risks of wounding omentum or bowel are done away with; we see, and can control, the bleeding from the liver; the danger of escape of the abscess contents into the peritoneum can be met and overcome, and if they do so escape they can be

* *Dublin Hosp. Rep.*, May, 1827. † *Journ. Hebdom.*, 1830, i., p. 417.
‡ *Lancet*, Jan. 29th, 1887.

mopped up; while, lastly and not least important, a second abscess can be seen and opened, as has already been done in at least one case. (Thornton.)

To Tait of Birmingham belongs the chief merit of introducing and establishing the operation of hepatotomy. He had done the operation ten times when his work was published—nine times for hydatids, and once for abscess. All were successful. Thornton has published two cases,—one of suppurating hydatid cyst, done as a forlorn hope when the patient was profoundly septicæmic after five tappings, which failed; the other of hydatids, which was successful. It frequently happens that, after various surgical manœuvres, hydatid disease of the liver suppurates, and then may be considered and treated as an abscess. Bryant has in at least twelve such cases operated by direct incision, in each instance successfully; and other surgeons have had similar experiences. When such cysts suppurate, plentiful adhesions to the parietes will probably be found; and if, after careful dissection down to the cyst-wall, there are found adhesions to the parietes, the operation is simplified to a mere incision, for adhesions do away with the necessity for sutures. But in every case, unless we are certain to the contrary, we ought to act as if there were no adhesions.

Ransohoff* has operated successfully for abscess, making all the divisions by thermo-cautery.

In Australia, where hydatid disease is more common than in England, there is a growing tendency to the treatment of all cases of abdominal hydatids by direct incision after laparotomy.

The site for incision will be made over the most prominent part of the tumour, and, if there is no reason to the contrary, will be longitudinal. A fairly long incision, from four (Tait) to five (Thornton) inches, will be necessary, to permit of the necessary intra-peritoneal manipulations. Should examination, after abdominal section, show that the liver is adherent to the parietes at any point, the opening should be made through the area of adhesion, even if this do not correspond with the opening in the parietes. Such an opening may be made with trocar; it is

* *N. Y. Med. Rec.*, No. 22, 1882, p. 258.

made permanent by the insertion of a drainage tube. Should there be no adhesions, the opening is made directly into the liver. The liver tissue being recognised by its characteristic appearance, several soft flat sponges are placed round the spot selected for making the opening, to absorb any fluid that may escape. Then, if we think it necessary for more accurate diagnosis, or to relax the walls of the abscess cavity and permit of its being raised up more readily after incision, we may insert the largest needle of an aspirator, and withdraw some of the contents. A knife is then passed in along the side of the needle, and the forefinger is made to follow the knife. While an assistant helps in maintaining, by pressure, exact coaptation of the parietes to the liver structure, the forefinger helps this by hooking up the abscess-wall. When all is ready, the knife is carried in along the forefinger, and the incision freely enlarged. Then the lips of the wound are quickly seized by two or more catch-forceps, and kept everted against the parietal wound by means of these. Bleeding may be arrested by a squeeze with pressure forceps, or, if this fail, by a continuous suture of not too fine catgut or silk. Probably the abscess will nearly empty itself readily enough; if it does not, a large rubber tube lying in carbolic lotion may be pinched at the end, and, when placed in the bottom of the cavity, will act as a siphon and suck out all the fluid. I have used with advantage such means for the removal of ascites and fluid from an ovarian cyst that was laid open, and have no doubt it would answer here.

When the abscess is empty, the finger, carried round its walls, will examine for signs of a second abscess, which will be opened by pushing the finger into it, or by Lister's sinus forceps or by trocar, as seems best. The whole of the purulent material being removed, the cyst-walls are to be gently cleaned out with a soft sponge held by long forceps. Rough manipulation here might easily cause bleeding, either by breaking down the notoriously tender granulations of a hepatic abscess, or, if there is a membranous wall, by tearing it off the liver. While this is going on, an assistant has been gently, steadily, and firmly keeping the liver in contact with the parietes. A sponge is now

placed in the liver opening, and the sponges inserted at the beginning are removed, and the peritoneum is cleansed of any escaped or peritonitic fluid. If the pus is fœtid, an antiseptic will be applied to the walls of the emptied sac. Thornton uses iodine for this purpose.

When the sac has been emptied of its pus, and the peritoneal cavity is free of all fluids, the whole length of the incision in the liver is stitched to the margins of the wound in the parietes, and a large glass or rubber or celluloid drainage-tube is inserted. If there is much discharge, it must be removed once or twice daily by syringing, so that it may be kept innocuous in case of absorption. Later on, as the cavity shrinks and its walls thicken, syringing may be employed less frequently, or even dropped. An abundance of absorbent antiseptic dressing will be necessary.

Thornton* has successfully treated a case of hepatic abscess by incision and drainage through the pleura. The patient had, fifteen months previously, been cured by aspiration of an abscess of the left lobe; an abscess having appeared after two months in the right lobe, which was not relieved by aspiration, Thornton decided to drain along the course of the aspirating needle. He cut out a lozenge-shaped piece of skin, carefully peeled the parietal and visceral pleuræ along small incisions, and sutured them to each other by a continuous suture, and so completely shut off the pleural cavity from the line of drainage. A track for the drainage-tube was made by incision along the side of the trocar. Healing took place without trouble. Hunsner and Schede have operated in the same situation after resection of the ribs.

HYDATIDS OF THE LIVER.

Anatomical Characters.—The liver echinococcus is usually single. When near the surface, it may stand out as a rounded fluctuating tumour, distending the abdomen in the hepatic region; when at a distance from the surface, it causes a more diffuse enlargement. The liver tissue is thinned out and expanded over

* *Brit. Med. Journ.*, 1886, ii., p. 901.

it. Where there is no suppuration, there is little or no pain, and constitutional disturbance is slight or absent. It is exceedingly slow in growth, sometimes existing for ten or even twenty years without causing troublesome symptoms. Very frequently the echinococcus dies and shrivels up, leaving a curdy or chalky mass behind, enclosed in a cyst-wall. If it grows, there are almost no limits to the size it may attain. When the cyst grows at some distance from the surface, the liver tissue is spread evenly over it, and the symptoms may be nothing more than those of enlarged liver. Occurring near any of its surfaces, the cyst may cause symptoms by pressure on any of the neighbouring organs, or even by bursting into them. On the upper surface of the liver, it presses upwards the diaphragm, encroaching on the lung and causing dyspnœa, sometimes almost filling the right chest. Extending downwards, it may cause obstruction to the flow of bile, and jaundice, by pressing on the biliary ducts. By compressing the vena cava or portal vein, it may also induce symptoms of venous obstruction. Rupture in any direction is always immediately dangerous, and may be ultimately fatal by causing infection with the parasites. Rupture into the vena cava is always fatal; into the peritoneum, usually immediately so, and still more frequently ultimately so. Suppuration is rare, except from surgical interference of some sort.

The more rare multilocular echinococcus is frequently associated with jaundice, and has a curious connection with tumour of the spleen.

Diagnosis.—In a comparatively young person, a slow-growing fluctuating enlargement of the liver that is unattended with pain, fever, or cachexia, is probably hydatid. Perhaps the conditions most closely simulating hydatids are, curiously enough, chronic hydro-nephrosis and ovarian cyst. Other diseases of the liver, such as cancer or abscess, are less likely to be mistaken for hydatids than the diseases mentioned. Such an experienced observer as Thornton operated on a case of hydatids of the liver, thinking it was ovarian disease; and it was not till he had gone some way through the operation that he knew for certain what he was dealing with. A hydatid cyst

may fluctuate freely, may occupy nearly the whole abdomen, and give resonance in the flanks, just like an ovarian cyst; the absence of any palpable connection with the uterus might be explained by the existence of a long pedicle, while the continuity of its dulness with that of the liver may be explained by adhesions to the latter. From hydro-nephrosis of the right side, the diagnosis may be still more difficult. Many cases of hydro-nephrosis have been operated upon in the belief that they were ovarian cysts; and if echinococcus were more common than it is, perhaps hydro-nephrosis would just as frequently be confounded with hydatids of the liver. When the cyst exists on the upper surface of the liver, its diagnosis from pleurisy is exceedingly difficult. As Traube has pointed out, pain in the right scapula, as pointing to liver disease, may be the only symptom to guide us. In such cases, of course, the existence of fever and other well-known accompaniments of pleuritic effusion will be carefully looked for. An exploratory puncture will almost, but not quite, certainly settle the diagnosis. Echinococcus fluid is non-albuminous, contains a large amount of chloride of sodium, and is usually below 1.015 specific gravity. No other fluid of the body has these characters. The presence of hooklets in the fluid withdrawn, or of pieces of the laminated echinococcus membrane, is pathognomonic. When a hydatid cyst becomes inflamed, albumen may be found in the fluid, and then our difficulties are increased. When there is clear evidence of suppuration, we must operate without delay, and be content to make the diagnosis after the fluid has been withdrawn.

SURGICAL TREATMENT.

Though the call to treat a stationary or very slow-growing hydatid cyst may not be urgent, it must not be forgotten that a patient with a living echinococcus in the liver is in constant and increasing danger. The risks of suppuration or of bursting of the cyst, with the greater likelihood of death after operation on large tumours, make early treatment advisable.

The treatment of hydatids is entirely surgical, and resolves

itself into destruction of the life of the parasite *in situ*, or evacuation of the contents of the cyst.

For causing the death of the parasite we have electrolysis; simple puncture; puncture, with removal of a small quantity of the fluid; and puncture, with injection of some chemical solution.

As electrolysis* has not yet shown better results than simple puncture, it is probable that it does good simply from the mechanical insertion of the needles. Acupuncture, again, has not been so successful as removal of a few ounces of the fluid by means of the aspirator. It has been found that this proceeding in some way kills the parasite, which then shrivels up and becomes innocuous. The operation is primarily a comparatively harmless one; though Bryant met with a death from puncture of a misplaced portal vein, probably letting the hydatid fluid get into the general circulation. There is, again, some risk of the fluid escaping into the peritoneal cavity through the opening left after puncture, and not a few have suppurated in consequence. The injection of some chemical fluid, such as iodine solution, has had fairly good results.

Each case must be a law for itself; but in an ordinary case of slow growth, the first treatment would probably be, to remove a few ounces of the fluid by aspiration, and carefully watch the course of events. If the cyst refills and goes on increasing, and more particularly if signs of suppuration appear, some plan of opening and emptying the cyst must be adopted. With this view, we have various old plans of operating by causing adhesion between the liver and parietes, and the more modern, and more perfect, one of direct hepatotomy by abdominal section.

For producing adhesions Simon† recommended and practised multiple puncture of the tumour through the parietes, and evacuation of the cyst-contents by incision, when adhesions would have formed after a few days. The first puncture is made diagnostic by being made with a hollow needle, and

* For the mode of applying electrolysis, see Fagge and Denham's paper, *Med. Chir. Trans.*, vol. xliv.

† *Die Echinococcencysten der Nieren und des perirenalen Burdegeirebes.* Stuttgart, 1877.

removing some of the contents for examination. Many successful cases, treated after this method, are recorded, and some failures. Volkmann has called attention to the danger of echinococci escaping from the puncture and infecting the peritoneum, and Hüter relates such a case where death resulted.

The plan of causing perforation by the application of Vienna paste, or caustic potash, or actual cautery, has found many adherents. At the Congress of the Society of German Surgeons in 1877, Bardeleben spoke of having treated no fewer than forty such cases by perforation with caustic, and with uniform success. He applied Vienna paste over an area of two fingers' breadth, which, in from six to nine days, perforated the abdominal wall, causing adhesions as it advanced, and then the cyst was opened with ease. Subsequent closure of the opening always took place without trouble.

For causing adhesion to the parietes, Ranke recommends an incision through the peritoneum, and removal of two semilunar pieces of that membrane at the sides of the opening, to make the wound gape. After a week or so, when the adhesions are strong, the incision is made without an anæsthetic through the insensitive liver tissue, and the cyst evacuated. He speaks of four cases successfully treated in this manner, in his own and in Volkmann's clinic; and other successful cases are recorded.

As a provision against the escape of the parasite into the peritoneal cavity, there can be no doubt of the validity of the plan of perforation by caustic. But it is too slow and too painful to have commended itself to the favour of English surgeons. Multiple puncture has been justly criticised as being possibly uncertain in its results; sometimes causing multiple fine adhesions, useless for the end in view, or even no adhesions at all. To both proceedings the objection may be raised, that it is more or less a working in the dark, and that valuable information which an abdominal section might afford is withheld. The only objection that can be taken to the procedure of leaving the incised peritoneum to adhere over the liver is, that the delay has not the same strong reasons for it as other similar proceed-

ings have, and that it may cause a loss of valuable time and possibly be a cause of inflammation in the cyst.

Hepatotomy, or incision and evacuation of the cyst as an immediate sequel to laparotomy, is, comparatively speaking, a new operation for hydatids of the liver. Lawson Tait, in 1883, was the first who wittingly performed the operation for hydatids. Up to September, 1882, he had operated on nine cases, in all with successful result; and a good many other successful cases have, from time to time, been recorded. In skilful hands that can be trusted to successfully guard against escape of the fluid into the peritoneum, to quickly deal with possible hæmorrhage, and to accurately suture the liver wound to the parietal opening, the operation need not be attended with much risk.

The steps of the operation are essentially the same as in hepatotomy for abscess. There is frequently considerable tension inside a hydatid cyst, and its contents may be ejected with force when liberated. The whole of the contents must be gently removed (Tait has used a gravy-spoon for this purpose), the cyst-walls united by continuous or other suture to the parietes, and a large drainage-tube inserted. In one case Thornton, with full confidence in the antiseptic method, used no drainage,* and had no cause to regret so doing. With most, however, the fear of hæmorrhage, or suppuration, or leakage through the liver wound, would weigh strongly as reasons for the insertion of a drainage-tube.

When the cyst has been thoroughly cleaned out, the forefinger is made to explore the walls, to see that there is no further cyst or even, as in a case of Pauly's, an abscess. Before closing the wound, most punctilious care must be taken over the toilet of the peritoneum; and, during this manipulation, a sponge will be placed in the liver opening. Exactly similar precautions as to the coaptation of liver and parietes will be observed as in hepatotomy for abscess.

The *mortality* of direct hepatotomy is not high. Pilcher† has

* *Med. Times and Gaz.*, Jan., 1883, p. 89. † *Annals of Surgery*, March, 1887.

published tables of 64 operations—twelve being done in two stages, and 53 (the incompatibility of the figures is not explained) by the method at one operation. There were 8 deaths altogether, of which only 4 could be attributed to the operation—a mortality of about 7 per cent. After Volkmann's method 17 operations were all successful.

Operations on the Gall-bladder.

Operations on the gall-bladder are performed for conditions arising from the presence of gall-stones and from obstruction in the biliary ducts. By far the most important operation is that known as Cholecystotomy: Cholecystectomy is performed by a few surgeons; and, besides minor proceedings, such as puncture with aspiration, extended sometimes into sounding for stone, we have other special proceedings specially named—such as, Chole-lithotrity; Chole-lithotomy; Chole-duodenostomy; and Chole-enterostomy.

History.—In 1618, according to Thudichum, Johannes Fabricius is said to have removed gall-stones from the gall-bladder of a living subject. Fabricius Hildanus* refers to this operation, but it is not clear that the operation was not done post-mortem; the only evidence of the subject being alive being the somewhat dubious expression "delineatio horum lapidum *ad vivum* facta."

To Petit† is undoubtedly due the merit of having founded the surgery of the gall-bladder. In 1733 he mooted his project: his most important papers appeared ten years subsequently. Petit's opinions were far in advance of his time. He discusses with great acumen the diagnosis of tumours of the gall-bladder, and the sequences of biliary retention. He recommends, besides the simple incision of an enlargement adhering to the peritoneum, two other operations: "l'une se sera dans le cas où la retention de la bile est portée à l'extrême, et le malade en danger de mort: celle-ci est *la ponction;* l'autre operation . . . c'est *la lithotomie*, je vieux dire l'extraction des pierres hors de la vésicule du fiel." His description of these operations of puncture and lithotomy would almost pass muster in the literature of the advanced surgery of to-day. It may be affirmed that, till ten years ago, the surgery of the gall-bladder did not advance a step

* *Observ. Chir.* † *Mem. de l'Acad. Roy. de Chir.*, tome i., p. 163. Paris, 1743.

beyond where Petit left it; on the contrary, it fell almost into oblivion.

Among English surgeons, with the exception of that shrewd surgeon Samuel Sharp, Petit's work was ignored or condemned. On the Continent, Morand (1757), Haller (1760 *circa*), Herlin, Blochs, and others, by observations and experiments, sought to advance Petit's labours. Bromfield, in 1773, wrote to condemn the operation. Morgagni, Chopart, Desault, and Walter, about the end of the eighteenth century, did valuable work in varying the methods, but scarcely in improving the results. Richter appeared in 1798 with a litho-triptor, and explained how fragments could be removed by washing: he also advised, in certain cases, the operation *à deux temps*, as described for hydatids of the liver.

In the nineteenth century little advance was made. Delpech, in 1816, rather decried the operation; and Good, in 1825, spoke of it as being of doubtful value. In 1828 Sebastian described an operation whereby adhesion was secured between the gall-bladder and the peritoneum before opening the tumour—a suggestion modified by Graves of Dublin. In 1847 Dufresne recommended opening by caustic; soon after Récamier advised the trocar; and several other modifications were suggested.

Thudichum, in 1859, wrote with an insight which recalls the work of Petit. He recommended abdominal section, suturing of the unopened gall-bladder to the abdominal wound, and opening after several days.

In 1866 Luton introduced exploratory puncture, doing no harm; and in his presence, Thomas, at the Hôtel-Dieu in Rheims, discovered a stone by this means. This procedure has been resuscitated in modern times.

The modern operation of cholecystotomy was first performed by Dr. Bobbs of Indianopolis in 1867.* He incised the gall-bladder, removed some fifty small calculi, and closed the incision by one suture. His patient recovered. Marion Sims† followed with an operation which, though unsuccessful, had a most

* *Trans. Indiana State Med. Soc.*, 1868, p. 68.

† *Brit. Med. Journ.*, 1878, i., 811.

important influence in advancing the surgery of the gall-bladder. Sims originated the name cholecystotomy (χολή—bile, κύστις—bladder, τομή—incision). At the present time, as regards technique and results, Tait holds the leading place with a series of some twenty published cases, all successful.

In 1882 Langenbuch introduced the operation of cholecystectomy, or removal of the gall-bladder; and Thiriar, Courvoisier, and others took it up favourably, but with no striking success.

CONDITIONS FOR WHICH THE OPERATION MAY BE PERFORMED.

The conditions which may give rise to a necessity for operation may be conveniently classified as follows:*

1. Cholelithiasis.
2. Dropsy and empyema of the gall-bladder.
3. Obstruction in the ductus choledochus.
4. Wounds and perforations of the gall-bladder.

Cholelithiasis.—The great majority of operations on the gall-bladder are performed for conditions arising out of the presence of gall-stones. Apart from the weakening influences of the recurrent agonies of biliary colic, there are certain real dangers to life to be apprehended. The effects of simple colic itself have been fatal. The stones may set up inflammation, suppuration, and even gangrene, in the bladder-walls. They may become wedged in the cystic duct, or pass into the hepatic duct (though in this situation they usually have come direct from the liver), or cause obstruction in the common duct. The effects of backward pressure are seen in cystic distension, and, where the hepatic or the common duct is blocked, in jaundice. Stones which have escaped into the bowel sometimes cause obstruction. Occasionally they perforate the bladder through an ulcerated area, either directly into the abdominal cavity, causing fatal peritonitis, or, after the formation of adhesions, into any of the

* See Roth, "Zur Chirurgie der Gallenwege," Langenbeck's *Archiv.* Bd. xxxi., Heft. i.

hollow viscera or through the abdominal wall, forming biliary fistulæ. Parietal fistulæ are, fortunately, the most common. Fistulæ communicating with the stomach and the bowels are next in frequency. Sometimes the communication is extended between different portions of bowel, as the colon and duodenum. The urinary bladder has been perforated. Arteries may be ulcerated through—the pyloric, for instance. The diaphragm has been perforated, and stones have been found in the air-passages. It is stated by some that gall-stones are an exciting cause of cancer of the liver: it is certain that they are frequent concomitants.

In obstruction of the cystic duct, the changes are local. If the obstruction is in the common duct, the changes are general as well as local; there is dilatation of the biliary channels of the liver itself as well as of the gall-bladder, with the symptoms of obstructive jaundice. Changes take place in the accumulated bile, which are identical in the bile-channels and in the gall-bladder. The bile is first transformed into a yellowish-brown watery fluid, which becomes mixed with a mucoid secretion from the duct-walls. If the obstruction has existed for some weeks or months, the bile is replaced by a perfectly clear fluid containing flakes of mucus, but little or none of the proper constituents of bile,* which is all the more remarkable that the tissues generally may be saturated with it. In obstruction of the common duct, general cholæmia now supervenes. In obstruction of the cystic duct, matters may remain stationary after the bladder is distended, or they may become more urgent. Increase of tension may go on to inflammation, suppuration, or even ulceration and perforation.

Without obstruction, the presence of gall-stones may either set up no symptoms at all, or may cause any degree of inflammation from simple catarrh up to suppuration and necrosis. Accompanying the catarrh we sometimes find a low cellulitis of the outer coats, leading to subsequent thickening and contrac-

* It has been said that this fluid sometimes contains a ferment. My friend Mr. G. M. Smith, lecturer on Physiology at the Bristol Medical School, fully tested a quantity of fluid removed by me in a case of cholecystotomy, and found no evidence of the presence of a ferment.

tion. But this cellulitis is sometimes of an acute nature, leading to great increase of size from thickening of the bladder-walls. One of Musser and Keen's cases, in which operation could not be completed, was probably of this sort.

Tait informs us that he has found in the majority of cases either a very few large stones or very many small ones. An examination of collections of gall-stones in museums, shows that biliary concretions in the gall-bladder generally show this peculiarity.

Dropsy and Empyema of the Gall-bladder.—In most cases these conditions are sequels of obstruction in the bile-ducts. The most common cause of obstruction is a gall-stone; but collections of parasites, such as liver-flukes, hydatids, or worms, have been found to cause blocking. Stricture following localised inflammation, and obstructive catarrh, are also reckoned as causes. Rarely the cause is external, arising from pressure by a new growth springing from a neighbouring organ.

There is, practically, no limit to the amount of distension which a dropsical gall-bladder will bear. The bladder-walls are nearly always thinned. Empyema does not usually attain to great dimensions: perforation is liable to occur when distension is excessive. In empyema, the walls are greatly thickened in some places; at others, they may be thinned by stretching or ulceration. The changes which take place in retained bile, leading to dropsy, have already been described: the passage to suppuration is easily understood.

Obstruction in the Common Duct.—This may be caused by foreign bodies in the duct, such as gall-stones, worms, or hydatids; by stricture in any part of its course; or by compression from the outside by inflammatory exudations or new growths in neighbouring organs. Among these last must be reckoned tumours of the pancreas, duodenum, stomach, and kidney. The bladder may become distended to considerable dimensions, and the contents may undergo the changes already described.

Jaundice, passing into profound cholæmia, is to be expected, with its well-known train of symptoms. Few cases last more than six months before symptoms of cholæmia appear, and death usually supervenes within the year. One case is recorded by Murchison in which there was complete obstruction for six years.

Wounds and Perforations of the Gall-bladder.—The gall-bladder may be wounded by cutting or piercing instruments; or it may be perforated by ulceration started by a foreign body in its cavity; or it may burst from over-distension. Bursting of an empyema is always fatal; escape of a foreign body with the bladder contents, though usually fatal in a very short time, has in a very few cases not been fatal for some weeks. Localised peritonitis is set up, which confines the extravasated contents in a suppurating cavity for a time. Simple extravasation of bile has usually been reckoned as certainly fatal. But the experiments of Schüppel, Boström, and others would seem to show that large quantities of bile may be absorbed by the peritoneum without causing much trouble; and certain recorded cases of wound of the gall-bladder show that a similar result may take place in the human subject. Paroisse records a case in which a ball remained for two years in the gall-bladder. Sabatier had a patient who lived seven years after wound of the gall-bladder by a sword-thrust: at the post-mortem examination, much fluid bile was found in the abdomen. But, in spite of these and other cases, the general experience is, that wounds of the gall-bladder, with extravasation of bile, are nearly always fatal. Sometimes, before death takes place, there is an enormous accumulation of bile in the abdomen. Thiersch successfully removed forty-seven pints of what appeared to be pure bile from the abdomen of a boy whose gall-bladder had been ruptured by a blow.

Diagnosis.—Cholelithiasis, in its simplest form, is diagnosed by recurrent attacks of hepatic colic, with or without enlargement of the gall-bladder, and not necessarily accompanied with jaundice. The symptoms of hepatic colic are well known. Paroxysmal

attacks of pain in the epigastric and right hypochondriac regions, radiating towards the back and shoulders, often preceded by a rigor, frequently accompanied by vomiting, and always attended by profound constitutional disturbance, suggest the passage of gall-stones. The paroxysms, increasing in severity, may pass off suddenly in a few hours: rarely do they last more than one or two days. The liver is usually enlarged during the attack; and occasionally it is possible to detect a distended gall-bladder. If jaundice is present, we may infer that there is occlusion of the common or the hepatic duct.

If there is permanent occlusion of any of the ducts, there follows permanent distension of the gall-bladder. The physical characters of an enlarged gall-bladder are of importance. In all cases it will appear to have its origin in the right hypochondrium. When first discovered, such a tumour is usually about the size of the closed fist; but all dimensions are met with, even up to filling the abdominal cavity. Kocher operated successfully on a case in which the disease was supposed to be ovarian cyst; and Tait has had a similar experience. The line of enlargement is usually in a diagonal line from the normal situation of the gall-bladder towards the umbilicus. Mr. J. W. Taylor* has specially insisted on this point as an important aid in diagnosis. A dull note is usually given out over the whole tumour, but sometimes a resonant area is found at its junction with the liver. The shape of an enlarged gall-bladder has been described as cordate, or pyriform, or globular. According to the amount of tension and the thickness of its walls, the tumour may be hard and unyielding, or soft and semi-fluctuating. Its consistency is, however, not easily ascertained, on account of its tendency to slip backwards from the grasp. The tumour, if not of large dimensions, moves upwards and downwards with the liver during forced expiration and inspiration.

The conditions most likely to be mistaken for enlarged gall-bladder are, tumours and cysts of the right kidney, and movable kidney. Any solid growth of the kidney may be mistaken for an enlarged gall-bladder; but mistakes are most likely to arise

* *Brit. Med. Journ.*, Jan. 31st and April 11th, 1885.

in cases of cystic tumours, and especially of hydro-nephrosis. In these cases symptoms of functional disturbance of secretion of urine are to be diligently sought for. From floating kidney, the points of distinction refer specially to peculiarities in shape, consistence, and range of mobility, as proper to each. An important criterion is, the presence of resonant bowel overlying a movable kidney. Hydatid or other cysts of the peritoneum might be a possible source of confusion. A patient recently died in the Bristol Infirmary of aneurism of the pyloric artery; for two months the diagnosis was enlargement of the gall-bladder. Acupuncture and aspiration are not recommended as aids to diagnosis.

Of jaundice as a factor in diagnosis, no more need be said than that its presence in a marked and persistent form indicates obstruction in the common or the hepatic duct. Though we might expect that obstruction in the common duct would be uniformly attended with cystic distension, and obstruction in the hepatic duct with cystic collapse, the clinical facts are by no means uniform in either direction. The detailed accompaniments of obstructive jaundice cannot properly be considered here. The presence of leucin and tyrosin in the urine, and diminished secretion of urea, may aid in diagnosis.

The diagnosis of wounds of the gall-bladder must be purely inferential, unless there is an escape of bile through a parietal wound. Abdominal shock, with a sensation of distress in the right hypochondrium and a history of traumatism in that region, followed by abdominal distension and perhaps by jaundice, suggest rupture of liver or gall-bladder, or both. The injury is a rare one. Perforation by a gall-stone, or rupture of an empyema, are diagnosed only through the help of previous history.

Indications for Operation.—In every case of wound or perforation of the gall-bladder, operation ought at once to be performed. Operation gives the only chance of recovery.

In every case of empyema of the gall-bladder operation is indicated. Aspiration is only a temporary measure, and it is by no means free from danger.

In every case of dropsy of the gall-bladder operation is indicated. Aspiration may do no harm, and it may detect the presence of stone. But it is useless towards the removal of the stone, and, generally, it has no beneficial effect on the disease.

In cases of cholelithiasis, the indications to operate must be guided by the effects produced by the disease. The dangerous sequences of gall-stones are: frequently recurring attacks of hepatic colic, which wear out the patient's strength; jaundice, proceeding to dangerous cholæmia; and suppuration in the gall-bladder. The indication in each instance is strengthened by the presence of an enlarged gall-bladder.

No general rule can be laid down as to the weight of the indication arising from hepatic colic. After months or years of intense but intermittent suffering, many patients get well, and remain so. On the other hand, a patient's life may be rendered miserable, or his active existence as a bread-winner may be cut short, by persistently recurring attacks of hepatic colic. A time then comes when patient and surgeon both agree that it is proper to interfere. In all such cases the patient's desires must have great influence with the surgeon.

In cases of persistent obstructive jaundice, operation is at the same time indicated and contra-indicated. Cholæmia, not only as weakening and depressing the patient, but also as predisposing to bleeding, is an unfavourable element. In only seven of Musser and Keen's series of 35 cases of cholecystotomy was jaundice present,* and five of these cases died,—half of the whole mortality. That the jaundice had much to do with this excessive death-rate, there can be no dispute: this suggests early operation, before the patient's condition is lowered by cholæmia.

Where evidences of suppuration appear in cholelithiasis, operation is to be urged. Every day that passes brings increase of danger.

In cases of obstruction of the common or the hepatic duct, cholecystotomy may simply prevent death from cholæmia by permitting escape of the biliary poison. Patients can live with-

* *Amer. Journ. Med. Sc.*, October, 1884.

out discharge of bile into the intestines. But Tait has shown how a stone in the common duct can be crushed; so that even in these cases cure may be effected.

In cases of obstruction of the cystic duct, operation in the majority of cases will not only relieve pain, and remove danger of suppuration in the gall-bladder, but will also, in all probability, bring about complete cure.

As to the *mortality*, cases are as yet too few for the establishment of trustworthy data. The mortality in skilled hands is very small. Tait has published sixteen cases, without a death. If operation is performed before cholæmia supervenes, a death-rate of not more than six per cent. may be predicted. Of the thirty-five cases quoted in Musser and Keen's table,* ten died. The table is of value chiefly in showing the causes of death. Peritonitis would not seem to be included among the risks. The most common cause of death is collapse, or collapse accompanied with hæmorrhage, to which cholæmic individuals are peculiarly liable. Escape of bile was found in only one case.

The practical lesson is, that operation is not to be delayed till the patient's strength is sapped or the blood poisoned.

Sounding for Gall-stones with a probe passed through a hollow cannula inserted into the gall-bladder was proposed by Petit† in 1733; but was not put into practice till 1876, when Bartholow successfully used the method. In 1878 Brown‡ sounded gall-stones in this way. A similar purpose may be served by using the fine needle of an aspirator as a sound. Whittaker of Cincinnati, in conjunction with Ransohoff, in 1882,§ employed this plan. Harley in 1884,‖ in ignorance of Whittaker's priority, practised sounding for gall-stones. These cases were successful in detecting the stone.

The proceeding is not free from risk. In Harley's case,

* *Amer. Journ. Med. Sc.*, October, 1884. † *Maladies Chir.*, i., 282.

‡ *Brit. Med. Journ.*, 1878, ii., 916.

§ *New York Med. Rec.*, i., 1882, p. 568, and ii., 1882, p. 258.

‖ *Med. Times and Gaz.*, May 17th, 1884.

after a short interval, enteritis and peritonitis set in, and killed the patient. In Keen's first case, not a little hæmorrhage and considerable local peritonitis followed the use of a hypodermic syringe. Unless there are very urgent reasons for doing so, few men would care to risk a patient's life for the sake of making a diagnosis. Urgency is great only when a patient's life, in imminent danger, can be saved by a very grave operation, and an error in diagnosis would be a catastrophe. And if we bear in mind the blind groping nature of the proceeding, and the close contiguity of important organs and vessels, we must admit that the risks are scarcely less than those following extravasation of bile or pus. Musser and Keen, though justly criticising the somewhat crude proceedings of Harley, and quoting the disastrous result of his own case to disprove his statement that the operation is both "easy and safe," still look upon exploratory puncture with favour, on account of the valuable information which it may supply.

I look upon the proceeding with no favour whatever. If the gall-bladder were considerably enlarged, if its walls were thick, and it lay in contiguity with the abdominal wall, puncture might be safe; but we can very rarely be certain that these conditions are present. The positive detection of a stone in the bladder is a clinical fact of supreme importance; but a failure to detect stone is, as more than one case has shown, no proof that it is not there. And it is not the presence of stone that justifies operation. A stone or stones in the gall-bladder may be perfectly harmless; we have no right to meddle with them unless they produce serious discomfort or danger.

I am strongly of opinion, that in cases where it is clear that surgical interference of some sort is called for, the operation should in the first place be abdominal section; then, exploration with the finger; and then, cholecystotomy, if the operation is to be anything more than exploratory. Of course, where a suppurating gall-bladder is adherent to the abdominal wall, mere incision is all that is called for—provided the incision will permit of the withdrawal of stones.

Cholecystotomy.

Cholecystotomy is the name given to incision made into the gall-bladder after division of the parietes. It may be followed by removal of gall-stones—cholelithotomy; or by crushing of stones that are impacted and cannot be removed—cholelithotrity. In other cases it is simply of the nature of an evacuation of cystic or purulent fluids, followed usually by drainage.

The parietal incision is best made vertically over the most prominent part of the tumour, if there is one; and over the situation of the fundus of the gall-bladder, if there is not. The best landmark is the tip of the cartilage of the tenth rib: the fundus of the gall-bladder lies directly beneath it. Musser and Keen recommend that the incision be made parallel to the ribs; and various other lines of incision have been recommended. But the vertical one over the fundus is probably the best. Tait, whose experience is largest and whose success is greatest, always uses it.

The skin and the muscles are divided in the ordinary way. The peritoneum, pinched up between two pairs of catch-forceps, is opened by slowly cutting through the elevated fold stretched between them. Through the opening the right forefinger is inserted, and the bladder explored. If the bladder is much distended, and more particularly if it "fills the abdomen," such exploration is impossible (as it is unnecessary) until the fluid has been drawn off. If the bladder is small, the presence of stones may be easily detected by touch. But sometimes, it would seem, we may meet with considerable difficulty in finding the bladder.

The opening is made in different ways, according as the bladder is collapsed, moderately full, or enormously distended. If the tumour is very large, its contents may be at once evacuated by an ordinary cyst-trocar. During the evacuation, the cyst is gradually brought to the surface—and, if possible, a little way out of the wound—by forceps attached by the side of the trocar.

But the cyst-wall should not be roughly dealt with by compression forceps; as it must be left behind, we must be careful not to cause sloughing. If small catch-forceps are applied in the line of incision above and below the trocar opening, the chance of danger from injury is minimised by having the bruised area in the line of attachment to the parietes. This caution is all the more necessary, in dealing with greatly distended gall-bladders, when, as is frequently the case, their walls are very thin. In every case flat sponges are suitably placed around the site of puncture, to absorb any fluid that may escape.

FIG. 73.

Hodder's Guarded Aspirating Needle. Half size.

If the cyst-wall is very tense from over-distension either by bile or by pus, it is best always to remove the fluid contents by the aspirator before making the large opening. An excellent needle, which may at the same time be converted into a blunt probe, is that invented by Hodder. (Fig. 73.) The needle is inserted as low down on the tumour surface as possible, because as the fluid is removed the cyst-wall contracts and draws the opening upwards. Any drops of fluid that exude by the side of the needle are at once mopped up. When the fluid is removed, two small catch-forceps are placed, one at each side of the puncture; the cyst-wall is drawn forwards, and vertically divided by scissors to an extent sufficient to admit the forefinger. Before this opening is made, it will be wise to place a sponge below the gall-bladder.

If the bladder is collapsed or but slightly distended, the opening may at once be made. The fundus is caught in a catch-forceps, and gently drawn to the surface. Below the bladder is placed a flat sponge, which keeps the bowels out of the way and absorbs any fluid that may escape. A second forceps is attached by the side of the first, and the raised fold between them divided

by scissors to an extent sufficient to admit the finger. Any bleeding points are at once secured. The forceps placed on the edges of the wound are handed to an assistant, whose duty it is with gentleness to keep the opening in the bladder steadily forward in the abdominal opening; while he is also careful to mop up any fluid that may well up while the operator has his fingers or instruments inside the bladder.

The finger, inserted through the opening, feels for stones, measures their size, and tells how best they may be removed. For their removal, Tait uses special scoops and forceps; and these will be found very convenient. Small stones are scooped out; large ones are carefully extracted by forceps. All this is easy enough; but if a stone is impacted in the neck of the gall-bladder, and more particularly if it lies some way down the cystic duct, extraordinary difficulties may be met with. It must never be forgotten that the walls of the bladder and its ducts are thin, friable, and by no means distensile; that they may very easily be torn through; and that, if such an accident happens, the result, as creating a biliary fistula opening into the peritoneum, will almost certainly be fatal. Cholecystectomy is then the only resource. Therefore, all manipulations upon impacted gall-stones must be carried out with extreme delicacy.

Tait's special forceps (Fig. 74) are here invaluable. If the stone cannot readily be dislodged, it is broken into fine fragments by nibbling or chipping pieces off it as it lies *in situ*. During this process of detrition, one forefinger (the right, if the surgeon is ambidextrous) is kept over the stone inside the abdomen, to act as a guide and as a guard, and perhaps, when it has been sufficiently diminished in size, to start it from its bed or push it

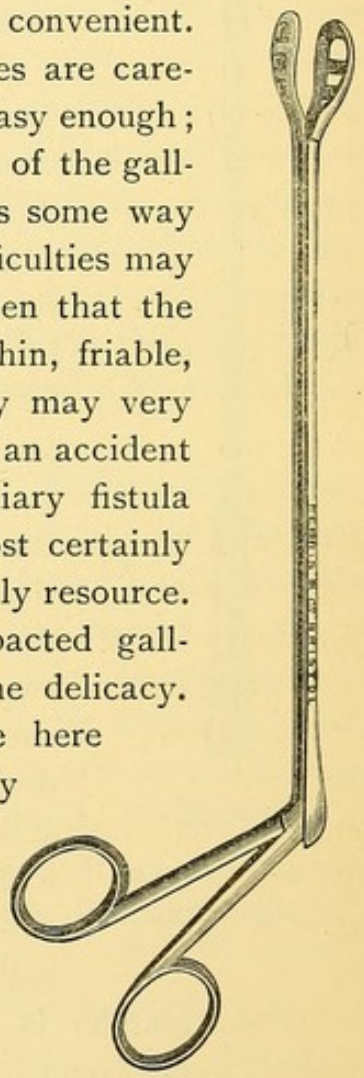

FIG. 74.

Tait's Cholelithotomy Forceps. One-third size.

between the blades of the forceps. During these manipulations there may be some bleeding from the mucous membrane.

To prevent escape of fluid into the abdominal cavity, and to guide it towards the outside, Musser and Keen invented and used a scoop of a special shape, which was held under the gall-bladder by an assistant. A sponge is quite efficacious, however.

If a stone in any of the ducts cannot be reached by forceps, and cannot easily be pushed onwards or backwards by the fingers, we may adopt Tait's ingenious expedient of crushing it by carefully-padded forceps outside the duct-walls.* The obvious suggestion of trying to push the stone onwards by means of a probe has been made by several writers; but it has not been successful, nor is it very likely to be so if the stone is of considerable size. Thornton† has in two cases succeeded, after dilating the cystic duct, in removing from the common duct calculi which caused obstructive jaundice.

Suturing of the opening in the gall-bladder to the edges of the parietal wound is the next step. The sponge inside the abdomen is removed; and the surface of the bladder carefully cleansed. While the assistant steadily holds the opening in the bladder in the position where it is to be fixed, the surgeon passes the sutures. The best mode of suturing is that favoured by Tait—the continuous suture, including skin, parietal peritoneum, and cyst-wall. Two needles, threaded with Chinese twist of medium size, are used. The needle, beginning opposite one extremity of the bladder-wound, is passed in succession through skin, parietal peritoneum, and gall-bladder, and so continued by separate insertions up to the other extremity. The same is done on the opposite side. Two free ends of the two continuous sutures are now caught up—one pair in one hand, the other pair in the other hand—and pulled sufficiently tight to secure accurate closure all round. The free ends above and below may now be tied together. If extra sutures are necessary to close the parietal opening, these are best placed before suturing the bladder; but they are not tied till the last.

* *Brit. Med. Journ.*, July 12th, 1884. † *Brit. Med. Journ.*, Nov. 26, 1887.

A rubber drainage-tube is placed in the bladder, and left protruding through the parietal opening. Rubber is better than an unyielding material, because of the movements during respiration. It is fixed in position by a stitch carried through the skin. If the tube fits the opening accurately, additional finish may be given to the operation by surrounding it with a sheet of rubber, as in drainage after ovariotomy; or even by carrying its imperforated extremity to some distance from the wound, and placing it in a bottle which lies by the patient's side. By this latter plan I have been able to collect all the bile which escaped without any of it coming into contact with the wound.

An ordinary dressing of absorbent material is applied, and changed as frequently as may be necessary. At the end of a week the sutures are removed. The drainage-tube may be left longer if there is much discharge, or if the cavity it drains is large and has not greatly diminished. A biliary fistula now remains, which will probably close in a few weeks if the ducts are pervious. If there remains an obstruction in the common duct, the whole of the bile will be discharged through the fistula, and attempts to close it will fail. In such cases, if Tait's daring expedient of crushing a stone left in the duct cannot be adopted, Winiwarter's* plan of establishing a fistula between the gall-bladder and the intestine may be followed. (See Entero-cholecystotomy.)

The plan of complete intra-peritoneal closure of the opening in the gall-bladder may be dismissed in a word. Bobbs, in his case, had a success, though he used only one suture. Gross, whose operation was a sequence to nephrectomy, cut out a piece of the bladder with the stone, and closed the opening by sutures. When his patient died from the effects of the major operation, the wound in the gall-bladder was found to be closed. These cases prove that intra-abdominal closure may be successful. But it has also failed, as more than one case proves. But primary closure of such a cyst has been proved, in other departments of abdominal surgery, to be not so safe as secondary closure after drainage. And special risks exist in the case of

* *Prag. Mediz. Wochensch.*, No. 21, 1882.

the gall-bladder; for we can never be certain that the ducts are pervious down to the duodenum, and there is often doubt as to the complete removal of calculi. The very smallest stone left behind may be a source of subsequent trouble. It is, further, a consideration deserving of some weight, that if the gall-bladder is adherent to the abdominal wall, any stones which may subsequently form can be safely and easily evacuated by a simple incision through the old scar.

ENTERO-CHOLECYSTOTOMY.

By this operation is meant the establishment of a fistula between the gall-bladder and the intestine. The operation is indicated only in cases of incurable biliary fistula—that is, in cases where there is insuperable occlusion in the ductus communis choledochus. The original operation of Winiwarter, already referred to, successfully established a communication between the gall-bladder and the colon. In this situation, the physiological effects of the biliary secretion were lost. Dr. Gaston of Atlanta, Georgia,* in a series of instructive experiments on dogs, showed how a communication might be established between the duodenum and the gall-bladder, thus preserving to the system whatever value the bile may have. Gaston speaks of his operation as duodeno-cholecystotomy. Some misconceptions and misdirected criticisms of Gaston's operation have appeared in various journals: to these he has given satisfactory answers.† A very valuable experimental and literary consideration of the operation has been contributed by Francesco Colzi of Florence.‡ Winiwarter's operation was colo-cholecystotomy: Gaston recommends duodeno-cholecystotomy; and this operation, where it is easily carried out, is theoretically the best. But fistula with the upper portion of the jejunum would be scarcely inferior to fistula with the duodenum; and fistula with any part of the jejunum, or even ileum, superior

* *Atlanta Med. and Surg. Journ.*, Sept. and Oct., 1882.

† *Med. and Surg. Reporter*, Phila., Sept. 12th, 1885.

‡ *Lo Sperimentale*, fasc. iv., v., 1886.

to fistula with the colon. The choice ought to be surgical as well as physiological: the operation may, therefore, be properly described as entero-cholecystotomy.

The operation has, as yet, scarcely passed the experimental stage. Winiwarter, not satisfied with his original operation, recommends the following: Some portion of the small bowel, as near as possible to the duodenum (the duodenum is usually too firmly fixed), is stitched to the gall-bladder by sutures not penetrating the mucosa. The apposed surfaces are joined to the abdominal wound, the threads uncut being left hanging out. In five or six days adhesions will have formed between the gall-bladder and the intestine: the fistula is made by incision through the centre of the adherent area, and the edges of the opening sutured, and a tampon inserted to prevent closure. Other plans have been suggested.

In any case of biliary fistula which might be placed under my care, I would be inclined to try the following plan: (1) Abdominal section below and up to the site of the fistula. (2) Suture of a convenient portion of the upper intestine to the under aspect of the gall-bladder, as near as possible to the fundus and over an area as large as convenient. These sutures to pass through the serous and muscular coats only, and to extend from the margin of the fistula at least an inch downwards. (3) At the end of a week or so, perforation of the apposed and adherent surfaces by a cutting operation. This might readily be done through the abdominal fistula, and would not require anæsthesia. A small solid bougie of rubber or decalcified bone is placed in the opening, and left for a few days longer till it has become a fistula. (4) Blocking of the parietal fistula as soon as the fistula between gall-bladder and bowel has been established. If simple mechanical pressure does not succeed, then a plastic operation might be performed. Such an operation, though somewhat tedious, is not dangerous: the whole of the proceedings are carried out near the surface, almost under the eye; and it follows up and takes advantage of perfectly natural processes of adhesive inflammation and fistula-formation.

CHOLECYSTECTOMY,

or removal of the gall-bladder, has been proposed by Langenbuch, and carried out by him in twelve cases. Thiriar has performed the operation three times,* Courvoisier once, and Tillmanns† once.

The idea is, to remove with the gall-bladder all future dangers, such as may arise from the presence of calculi in it. It is a fact that perfect health may co-exist with absence, atrophy, or obliteration of the gall-bladder. Some animals have no gall-bladder, and from others it may be removed without interfering with healthy existence.

Of Langenbuch's twelve operations, two died—one from ulceration of the bile-duct, caused by an undetected calculus. Seeing that Langenbuch speaks of obstruction in the common duct as a contra-indication, the result in his fatal case is a somewhat severe commentary on his operation. The mere fact that we cannot be certain in some cases that there is no stone left behind, is a strong objection to the operation. In a goodly proportion of cases of cholecystotomy, stones have appeared through the fistula after they had all been supposed to have been removed. One of Thiriar's cases died of cerebral tumour; so that, out of nine published cases, one death only can be attributed to the operation. It is not so much the death as the immediate cause of it that speaks against the operation. Not only does cholecystectomy not remove every nidus for biliary calculi, but it greatly adds to the risk, in cases of lodgment of stones in the ducts, by cutting off one avenue of escape. To seek to establish a place for cholecystectomy by decrying the advantages of cholecystotomy is futile. It is, however, justifiable to urge against the performance of the major operation the gratifying success of the minor proceeding.

The indications for operation given by Langenbuch are, dropsy, cholelithiasis, and empyema. These indications are probably too broad. I should limit the indications to two:

* *Rev. de Chir.*, March, 1886.

† *Beilage zum Centralbl. f. Chir.*, 1887, xxv., p. 76.

(1) where the bladder, containing one or more calculi, is so contracted that its fundus cannot be sutured to the parietes without tearing its walls; (2) where there has been perforation after ulceration and empyema, and the tissues are so thin or so much inflamed that they will not bear suturing.

The operation need not be difficult. Separation from the liver is begun at the fundus of the bladder, and carried down to the cystic duct. The duct is divided between two ligatures, and the bladder removed. A suture passing through the outer coats will more thoroughly close the divided end of the duct. The incision will be at least an inch and a half longer than in cholecystotomy; if additional room is wanted, Courvoisier's plan of dividing transversely the muscles a little below the ribs may be adopted. If the bladder is intimately attached to the liver, a good deal of hæmorrhage may be expected: most of the bleeding may be checked by forci-pressure, but a few ligatures may be called for. During the operation the edge of the liver is pulled upwards by a retractor, and the area of operation is isolated by means of sponges.

If removal of the bladder cannot, in whole or in part, be effected, ligature of the cystic duct has been suggested. It is difficult to see how this can be more beneficial than total occlusion of the duct from pathological causes. As the gall-bladder not only acts as a receptacle for bile, but also secretes a mucous fluid which probably contains a ferment, mere ligature of the duct does not seem to promise much benefit.

Free bilateral incision of the gall-bladder, followed by suture and return to the cavity, has been recommended by Küster of Berlin, and carried out by him and Tillmanns of Leipzig. In suppuration of the bladder, removal of redundant portions of tissue may be of advantage, and the same may be true of enormous cystic distensions; but it is difficult to see how the chances of recovery are removed by mere incision with subsequent suture.

Section X.

OPERATIONS ON THE SPLEEN.

The operations performed on the spleen are—Splenotomy, or incision through the organ; and Splenectomy, or removal of it. It happens that the term splenotomy has been extensively employed for extirpation of the spleen; splenectomy has only recently come into general use, in its proper sense. Splenotomy, or splenic incision, must always be a rare operation: as being so, and as presenting no special features calling for description, the present account is practically confined to splenectomy, or extirpation of the spleen.

Surgical Anatomy.—The spleen, lying in the left hypochondriac region between the cardiac end of the stomach and the under surface of the diaphragm, is roughly moulded to fit the space in which it lies; being concave on the stomachic aspect, and convex on the diaphragmatic. On the concave inner surface,

nearer to the posterior than the anterior border, is the vertical groove of the hilum, pierced by apertures for vessels and nerves. The peritoneum which invests the spleen is reflected at the hilum to enclose the splenic vessels and nerves and the vasa brevia, and is known as the gastro-splenic omentum. Surgically, this is the pedicle of the spleen. (Fig. 75.) Between the upper end of the diaphragm passes another double peritoneal layer, known as the suspensory ligament of the spleen. The external surface of the spleen, in contact with the diaphragm, is described as lying in contact with the ninth, tenth, and eleventh ribs. The internal surface, in its anterior portions, is in relation with the cardia of the stomach—behind, with the left crus of the diaphragm and the left supra-rena capsule; and below, with the tail of the pancreas. Its relations with the stomach are liable to be disturbed by the movements of that organ. As to the margins of the spleen: at the top, where the suspensory ligament is given off, it is blunt and rounded; the

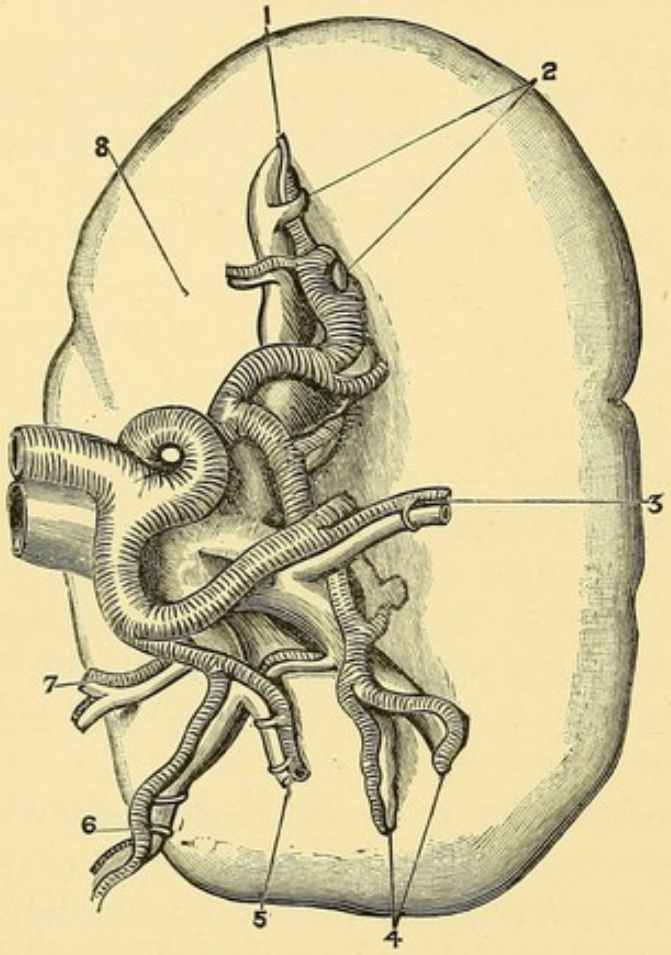

FIG. 75. (WEISSE).

Drawing to show the vessels in the Hilum of the Spleen.

1, 2. Vessels penetrating the Spleen at the Superior, and 4, the Inferior Extremities of the Hilum. 3, 5, 7. Gastric Branches — Vasa Brevia. 6. Gastro-epiploica Sinistra. Anterior Border to right, Superior Border above. Artery above, Vein below.

lower extremity is pointed, and normally lies over the junction of the transverse with the descending colon; the posterior margin is broad and rounded, and is connected with the left kidney by loose areolar fibres. The average dimensions of the spleen, in the adult, are: five inches in length, three or four in breadth, and from an inch to an inch and a half in thickness. Its weight is about seven ounces.

The structures in the gastro-splenic omentum, venous and arterial, which go to form the pedicle in splenectomy are of importance. The splenic artery, the largest branch of the cœliac axis, pursues a tortuous course behind the upper border of the pancreas from the aorta to the spleen. In its course it gives off small branches to the pancreas; near its termination it gives off the gastro-epiploica sinistra; and it finally breaks up into a number of branches near the hilum, most of which enter it, but a few of which—the vasa brevia—turn backwards to the stomach. The vasa brevia, from five to seven in number, issue partly from the trunk and partly from the branches of the splenic artery. If deligation is made close to the spleen, they may escape. The terminal branches are five, six, or more in number, and vary greatly in length and size. If the branches are short, and they enter the spleen over a considerable area, it would be impossible to include all of them in one or even in two ligatures.

The splenic vein is a very large vessel, returning blood, not only from the spleen and the pancreas, but also from the duodenum, a great part of the stomach and omentum, the descending colon, and part of the rectum. Its splenic branches correspond to those of the artery; the vein itself lies behind the pancreas, below the artery.

But little padding of fatty or areolar tissue surrounds the splenic vessels at the hilum. As it would usually be unsafe to include all the splenic branches in one ligature, it is fortunate that they may readily be isolated and ligatured separately.

History of Splenectomy.—The practice of removing the spleen is probably of some antiquity. It was done for purposes suffi-

ciently vague, being supposed to improve the wind of the individual (as in the Texan runners), or to ameliorate his moral nature. Dionis, in his second demonstration of surgical operations (1733), speaks of a class or sect of surgeons which sprang into notoriety about 1700 from their operations of removing the milt or spleen—"unmilting" the proceeding was called. He does not spare them: "They looked on this part as useless and noxious, because (perhaps) unacquainted with its uses; and, in pursuit of this opinion, they prescribe the making an incision in the left hypochondrium, through which they take out the milt, and after having made a ligature of the vessels, boldly cut it off. This operation being performed on some dogs which did not thereupon die on the spot, they thence deduced and proclaimed the advantages which would accrue to mankind by it. . . . No longer mention is made of these cruel operations, which owing their existence to some crude brains, found a sepulture in that of their inventors."

For prolapse of the spleen through a parietal wound splenectomy was performed more than 200 years ago. Such an operation was that of Matthias, performed in 1678;* and a few others are on record.†

Many experiments have been made on the lower animals by removing the spleen. In comparatively recent times, Blundell operated at least seven times on rabbits; two recovering permanently, and two temporarily. The whole subject has been experimentally gone into, with all the aids of modern science, by numerous physiologists and surgeons, and notably by Tizzoni, Mosler,‡ Zesas,§ and Winogradoff.‖ These experiments prove that the spleen is not essential to the life of animals; and that if it is removed, its functions are taken up by vicarious lymphatic organs which increase in size, and by bone-marrow.

For disease, the first operation, according to Collier,¶ was

* See Simon, *Die Extirpation der Milz am Menschen. Giessen.*, 1857.

† See Morris, *Internat. Syst. of Surg.*, vol. v., "Injuries and Diseases of the Abdomen."

‡ *Deutsch. med. Woch.*, 1884, No. 22. § Langenbeck's *Archiv.*, bd. xxviii., p. 815.

‖ *Revue de Chir.*, 1885, p. 318; quoted from *Vratch*, 1883, Nos. 6 and 7.

¶ *Lancet*, 1882, i., p. 219.

performed by Zaccarelli in 1549, and was successful. The second operation, by Ferrerius in 1711, seems to have been the removal of a rudimentary spleen from an abscess tending to point; it also was successful. Both these operations have been discredited. Quittenbaum in 1826, and Küchler in 1855, each removed an enlarged spleen; the patients in each case dying in a few hours, of hæmorrhage. Spencer Wells operated for simple hypertrophy in 1865: his patient lived six days, and died either of thrombosis or of blood-poisoning—possibly of both. Péan in 1867, operating for enlarged and cystic spleen, had the first success of modern times: from his case we may date the introduction of splenectomy into modern surgery.

Conditions for which Splenectomy may be Performed.—Nearly all authorities are agreed that the extirpation of leucocythæmic spleen is an unjustifiable operation. Therefore, although the operation has been performed some eighteen times, leucocythæmic enlargement is excluded from the conditions justifying operation. The following conditions remain:

(1) Injury or Prolapse.
(2) Certain cases of movable spleen.
(3) Simple hypertrophy, with or without cirrhosis.
(4) Sarcoma or lympho-sarcoma in the early stages.
(5) Cysts.
(6) Hydatid disease.

In the case of abscess, as well as of cysts, simple and hydatid, splenotomy, or incision of the spleen with suture of the wound to the parietes and drainage, should first be instituted. The treatment is carried out on exactly the same lines as for similar diseases of the liver or kidney, and need not be again detailed. Should splenotomy fail to cure, splenectomy may be indicated. Splenic abscess becomes early adherent to the parietes, and its treatment may be nothing more than incision and drainage. From such an abscess I have seen a piece of splenic tissue, as large as an orange, removed as a slough.

Wounds of the spleen can only be inferred with a presump-

tion of certainty from the site of the injury and the presence of abdominal hæmorrhage. Later on, peritonitis, splenitis, and abscess may supervene, and induce symptoms calling for abdominal section, after which the condition is diagnosed with certainty. In such cases, the state of the patient is the indication to operate: splenic wounds are by no means always fatal. Prolapse of the spleen through a parietal wound is easily diagnosed: in certain cases, the organ may be returned; in others, only the protruding part need be removed.

Movable spleen, according to Engel,* is associated with pregnancy, depending on causes similar to those assigned by Landau to movable kidney. It is not free from danger to life. Reported cases show that a movable spleen tends to fall into the left iliac fossa; that the organ is enlarged; that its pedicle may become twisted, causing occlusion of the vessels; and that it has a tendency to contract adhesions in its abnormal situation, and there undergo degenerative changes, or even gangrene. Serious symptoms may be caused by dragging on the stomach through the gastro-splenic ligament.

Simple hypertrophy, with and without cirrhosis, has, in at least fourteen cases, been given as the reason for removal. It is difficult from the histories to estimate the influence of malarial disease in causing the enlargement for which operation was performed. The diagnosis is simply that of enlarged spleen, already described: in most cases, however, the operation was performed in the belief that the disease was something else.

Billroth† has successfully removed the spleen for lympho-sarcoma. The tumour had existed for seven years: there was no leukæmia. It would be impossible in the early stages to diagnose malignant disease from simple enlargement. When the disease is so far advanced as to cause adhesions to neighbouring organs, the operation is unjustifiable. Indeed, from what we know of the behaviour of malignant disease of the spleen, we should infer that the operation was only very exceptionally admissible.

Considering the rarity of cysts of the spleen, it is somewhat

* *Centralbl. f. Gynäk.*, 1886, V. † *Lancet*, June 7th, 1884.

remarkable that the organ should have been three times removed for that disease. All the operations were successful. Thornton's first operation—the first successful one in England—was for splenic cyst. The diagnosis cannot with certainty be made from renal cyst. Puncture, or incision with drainage, might be tried before removing the organ. As, however, the cystic disease is usually associated with hypertrophy of the splenic tissue, it is probable that the cyst-formation is only part of a more general disease. In none of the operations was the condition diagnosed till the abdominal cavity was entered.

For hydatid disease, puncture has been successfully performed by Wilde,* and probably by others. Koeberlé has extirpated the organ for hydatid disease followed by a sanious discharge. The diagnosis must always be uncertain.

Appreciation and Mortality. Indications and Contra-indications.—Collier's elaborate tables comprise 29 cases of splenectomy; 13 being for diseases not associated with leucocythæmia—of these 8 recovered; 16 for leucocythæmic hypertrophy—all these died. So far, there would appear to have been performed only one successful operation for leucocythæmic spleen—that of Franzolini of Turin.† Ashhurst‡ has collected 43 splenectomies for disease, with 31 deaths; and 21 operations for injury or prolapse—all successful. Nussbaum, however, of 26 cases for traumatic causes, found that only 16 recovered. Gilson,§ in a careful review of the whole subject, quotes 18 operations for injury, with recovery in all; and 37 for disease, with 29 deaths and 8 recoveries. Podrez of Kharkoff estimates the total mortality as 73 per cent. Mollière‖ has tabulated 28 cases of laparo-splenotomy for disease, and 11 cases of splenotomy for wound, with results according with the above.

A dissection of the figures according to the causes of operation shows that the removal of prolapsed or wounded spleen is not only a justifiable but a successful operation; and that the

* *Deutsche Archiv.*, viii., 116.

† *Wien. med. Woch.*, 1883, No. 20. ‡ *Internat. Encyc. Surg.*, vol. v., p. 1103.

§ *Rev. de Chir.*, April 10th, 1885.

‖ *Dict. Encyc. des Sc. Med.*, 1883, Art. "Splenotomie."

removal of leucocythæmic spleen, even if it gave promise of a cure of the disease, is negatived by its almost uniform fatality. Experience has shown that in leucocythæmia there is a marked tendency to hæmorrhage after operations of any sort; and this tendency, in such an operation as splenectomy where hæmorrhage is always a chief risk, is enough to forbid it. Besides, there is no reasonable ground for inferring that removal of the spleen would have any influence for good on the general disease. Splenectomy in leucocythæmia is, as Bryant puts it, "physiologically unsound and surgically unsafe": it ought, therefore, to be abandoned. In Franzolini's case—the only successful one—the spleen was not very large (61 oz.); and the last report of it, when the blood was said to be normal, was only four months after operation.

For disease not attended with leucocythæmia, the operation is at least justifiable. Two operations have been performed for undue mobility, both successful; three for cysts, all successful; one for lympho-sarcoma, successful; and twelve for such conditions as simple hypertrophy, hypertrophy with cirrhosis, hydatids, abscess—of these five died.

The present position of splenectomy, therefore, is something like the following: Operations for leucocythæmic spleen are unjustifiable. Operations for traumatic lesions are justifiable and safe. For movable spleen, excision ought not to be carried out till less severe measures, such as mechanical support or operative fixation, have been tried and found ineffectual. For cysts, the spleen may be removed with a fair chance of success; but puncture or incision, with drainage, ought to have a trial first. In the early stages of malignant disease the operation is justifiable. In the rare cases of primary hypertrophy, the operation is permissible if the disease is attended with danger or serious discomfort.

THE OPERATION OF SPLENECTOMY.

The incision in most of the operations has been made in the middle line. This, no doubt, is a result of erroneous diagnosis, and not of operative election. A lateral incision along the

outer edge of the left rectus would probably be the most convenient. It would certainly be so in all cases not attended with great enlargement. Küchler and Wells made the entrance through the linea semilunaris; Bryant, a little farther to the outside. In prolapse, the wound may or may not require enlargement.

The tumour being fully exposed, all adhesions are divided and ligatured. It is gently delivered, lower extremity first. If the tissue is not very friable, the use of Tait's myoma screw will be of advantage. Sponges are packed inside the cavity; and the parietes are depressed as much as possible by an assistant, to prevent traction on the pedicle. The tumour must be handled with extreme gentleness; and the most scrupulous care must be given to the avoidance of injury to the vessels in the pedicle, and even to dragging on them, which has been found to produce alarming symptoms of shock.

The success or failure of the operation may be truthfully said to depend on the treatment of the pedicle. Death from hæmorrhage after a few hours has frequently occurred, after what seemed to be the most perfect deligation at the hands of our most skilled operators. A small artery slips from the encircling ligature (as in Thornton's second case); or a ligature slips during straining; or bleeding may commence from the moment the patient begins to rally from the shock. It is clear, therefore, that our surgical technique in this part of the operation is by no means perfect.

Morris* recommends that, before cutting away the tumour, a clamp should be placed around the pedicle, and that it should afterwards be ligatured in two or more parts with strong twisted silk or whipcord. Thornton, in his successful operation, tied the pedicle in two locked ligatures, and added a separate ligature carried round the whole. In his unsuccessful case, he placed three locked ligatures by double transfixion, tying the outer loop first, then the inner, and finally the middle one. Temporary forci-pressure was also employed; yet death occurred from hæmorrhage in a few hours. Thornton, somewhat

* *Internat. Encyc. Surg.*, vol. v., p. 1104.

hypercritically (as it seems to me), blames himself for having tied the middle ligature last. Billroth was able to ligate artery and vein separately; but in this case he must have passed the ligature farther away from the spleen than is usually possible—a supposition which seems the more likely, as he removed a portion of the pancreas with the tumour. Franzolini also was able to put a ligature on the artery, which was the size of the forefinger, and another on the vein, which was the size of the thumb: in his case, it was specially noted that the pedicle was short. The gastro-splenic ligament was also surrounded in two ligatures, and the suspensory ligament in one. Simmons, in America, ligatured the pedicle and the gastro-splenic ligament separately and in sections: the patient died, from hæmorrhage, in two and a half hours. Langley Browne* found no proper pedicle, but four very large arteries, each of which he secured separately by double ligatures, dividing them between: there was no hæmorrhage; but the patient died, in five hours, of shock.

No absolute rule can be laid down as to the management of the pedicle; but a few guiding principles may safely be enunciated. Every divided vessel, artery, or vein should be efficiently, and as far as possible separately, ligatured. The ligature should be tied while the pedicle is in a state of relaxation: the tendency of a small branch to retract after being forcibly elongated is thereby obviated. The veins should be ligatured as well as the arteries, because considerable branches communicate with the splenic vein close to the site of ligation. If the splenic branches spread out considerably before entering the hilum; if they are numerous and intermingled with veins, and not easily isolated; and if the pedicle is not short, the placing of a broad temporary clamp before cutting away the tumour may be found advantageous. In many cases it will be found a good plan to apply pressure forceps in pairs—one pair after another—to each portion of the pedicle which contains a vessel, and divide between them till the whole pedicle has been cut through. Then one forceps after another is picked up, and the vessel or vessels

* *Lancet*, ii., 1877, p. 310.

which it grasps are deliberately tied at a safe distance from the forceps. When each vessel has been secured, the whole may be surrounded with a single ligature, tied with moderate force, so as to lessen the shock of the arterial pulse on the distal ligatures. Finally, the ligatures are all cut short, and the pedicle dropped into the cavity. Sponging, if it is necessary, should avoid the pedicle, which may be kept out of the way by a catch-forceps attached to its extremity.

The gastro-splenic and diaphragmatic ligaments are dealt with in the same fashion by separate ligatures; the same minute care need not be observed, however. Adhesions are treated according to ordinary principles.

The great risk of the operation is hæmorrhage from the pedicle. Of the 29 cases collected by Collier, 14 died directly from hæmorrhage, and 7 from other causes, such as thrombosis (1 case), peritonitis (2 cases), shock (3 cases). Shock is often very alarming, and has appeared during the performance of the operation, specially while traction is being exerted on the pedicle.

SECTION XI.

OPERATIONS ON THE PANCREAS.

THE surgery of the pancreas has not as yet advanced much beyond the tentative or experimental stage. The elaborate studies of Dr. N. Senn,* of Milwaukee, exhaust what is known of the operative treatment of diseases of the pancreas, and fix a starting-point in their description from which all future work must take its departure. To Senn's work—a model of everything that such work, experimental, clinical, and pathological, ought to be—I am almost entirely indebted for the short account of the surgery of the pancreas which follows.

Surgical Anatomy of the Pancreas.—The pancreas lies deeply in the abdomen, at the level of the first lumbar vertebra. Its head lies in the concavity of the duodenum; its tail lies in contact

* *The Surgery of the Pancreas.* Phila., 1886. "The Surgical Treatment of Cysts of the Pancreas," *Amer. Journ. Med. Sc.*, July, 1885.

with the spleen. It can be reached and exposed to sight by division of the gastro-colic omentum, and by pulling the colon and the stomach apart. In the epiploic sac thus opened, the pancreas is seen lying on the large abdominal vessels. The stomach lies in contact with its anterior surface, from which it is separated by a covering from the "omental bursa." The posterior surface rests on the vena cava, the aorta, the superior mesenteric vessels sometimes surrounded by gland tissue, and the pillars of the diaphragm. Towards the right extremity, it is in relation with the vena portæ. Each extremity of the pancreas lies surrounded by numerous lymphatic vessels and glands, embedded in areolar tissue. The inferior surface rests, at one end, on the junction of the jejunum and duodenum; at the other, on the transverse colon. The middle portion of the inferior surface has a special peritoneal covering, derived from the lower layer of the meso-colon. At the upper border, and behind the posterior surface, are found the splenic artery and vein.

Just above the pancreas lies the cœliac axis. The common bile-duct passes behind the head of the pancreas, close to it and sometimes embedded in its tissue. The pancreatic duct unites with the common bile-duct in the wall of the intestine, at the junction of the second and third portions of the duodenum and three or four inches below the pyloric orifice of the stomach.

The pancreas receives its blood-supply from the pancreatico-duodenal branches of the hepatic and superior mesenteric arteries.

Conditions for which Operation may be Performed on the Pancreas.— Billroth* has successfully removed the pancreas for cancer: the report, however, is too recent to make certain that the patient is free of the disease. Removal of the pancreas for primary malignant disease can, however, be very rarely a justifiable operation. When it has come within the range of physical diagnosis, it will have invaded the adjacent organs and tissues so such an extent that removal would be either impossible or exceedingly dan-

* *Wien. med. Woch.*, April 3rd, 1884.

gerous. The case in which Billroth removed a portion of the tail of the pancreas with a splenic tumour has already been referred to. To remove the head of the pancreas, it would be necessary to leave intact the pancreatic duct—a proceeding scarcely possible.

Laborderie* is said to have successfully removed a portion of the pancreas protruding through a wound in the parietes. This operation has, however, been discredited.

Further indications to operate are given by Senn as follows:

"Partial excision of the splenic portion of the pancreas is indicated in cases of circumscribed abscess and malignant tumours, in all cases where the pathological product can be removed completely without danger of compromising pancreatic digestion or inflicting abdominal injury upon important adjacent organs.

"Ligation of the pancreas at a point or points of section should precede extirpation, as a prophylactic measure against troublesome hæmorrhage and extravasation of pancreatic juice into the peritoneal cavity.

"The formation of an external pancreatic fistula by abdominal section is indicated in the treatment of cysts, abscesses gangrene, and hæmorrhage of the pancreas due to local causes.

"Abdominal section and lumbar drainage are indicated in cases of abscess or gangrene of the pancreas where it is found impossible to establish an anterior abdominal fistula.

"Through drainage is indicated in cases of abscess and gangrene of the pancreas, with diffuse burrowing of pus in the retro-peritoneal space.

"Removal of an impacted pancreatic calculus in the duodenal extremity of the duct of Wirsung, by taxis or incision and extraction, should be practised in all cases where the common bile-duct is compressed or obstructed by the calculus, and death is threatened by cholæmia."

As yet, these indications remain to be fulfilled by the surgery of the future. Thus far, systematic and deliberate surgical treatment has got little beyond cysts of the pancreas.

* *Gaz. des hôpitaux*, 1856, No. 2.

The origin of cysts of the pancreas is not fully understood. As a rule they are developed in the tail, very rarely in the head, of the gland. They, practically, always originate from retention of the pancreatic secretion; but obstruction of the duct is, according to Senn, not the only nor the most important element in their causation. He would regard as the most important etiological factor "an arrest of absorption of the pancreatic juice, due either to a transformation of the pancreatic juice by the admixture of pathological products into the substance which is incapable of being absorbed, or to a loss of function in this direction of the vessels which perform this task." The causes of obstruction are: calculus; obliteration of a portion of the duct, by cicatricial contraction; and displacement of the pancreas, with flexure of the duct, caused in various ways.

The size of the cyst varies considerably. The cyst-walls are usually thin in rapidly-growing tumours; and thickened, cartilaginous, or even calcified, in tumours of slow growth. The inner surface either is smooth, or it presents evidences of degeneration similar to those which occur on the internal surface of arteries in the later stages of endarteritis. In cases where the duct is blocked near its extremity, the duct and its branches may become dilated, presenting the appearance of varicose veins. In other cases the cyst is globular. The gland tissue is destroyed by pressure or chronic inflammation. Pure pancreatic juice is found only in small and recent cysts; later on, in old or large cysts, various accidental products are added. Sometimes pus and blood are found.

Diagnosis is possible only when the cyst is large, and then it is rarely certain. Cysts of the pancreas have been found only in adults. A history of painful or inflammatory affection in the region of the pancreas is to be looked for. Colicky pains in the epigastrium, often of great violence, are sometimes complained of. Frequently the cyst grows with great rapidity. Fatty stools point toward the existence of some co-existing serious lesion, rather than to simple cyst. Digestion is often impaired, and frequently there is emaciation. A peculiar pale-yellow or earthy colouration of the skin, which is said to be pathognomonic,

is sometimes observed. Diabetes mellitus is occasionally associated with pancreatic disease.

The cyst makes its appearance in the normal situation of the pancreas; the direction in which it increases will depend on the portion of the pancreas in which it originated. Thus, its most prominent point has been found below the right lobe of the liver, in the epigastric region, and in the left hypochondrium. The stomach is pushed forwards in all cases, and, later, to the right side. The transverse colon is displaced downwards, and the spleen to the left. The tumour, being in direct contact with the diaphragm, may ascend and descend with the respiratory movements. Occasionally the tumour vibrates with the impulse of the abdominal aorta, on which it rests. Fluctuation is not always perceptible in thick-walled or tense cysts. Exploratory puncture, in cases where diagnosis is imperative, may be employed. In a case of pancreatic cyst reported by W. T. Bull of New York,* fluid withdrawn by a hypodermic syringe was found to be dark-brown, turbid, odourless, alkaline, and of specific gravity 1.010. Chlorides were abundant; there was no bile, and only a trace of urea. The fluid became solid on boiling. The microscope revealed degenerated cells, fat-globules, granular matter, and hæmatin crystals. When kept at a temperature of 100° Fah. for fifteen minutes with some boiled rice, the fluid was found to contain one grain of glucose to the fluid drachm. The fluid also emulsified oil. In this case also free fat was found in the fæces and sugar in the urine, to the extent of ten grains to the ounce.

Cysts of the pancreas are most likely to be confounded with ovarian cysts, hydro-nephrosis, circumscribed peritonitis, and hydatids of contiguous organs. In at least three cases, pancreatic cysts have been taken for ovarian cysts by eminent surgeons, after repeated and thorough examination. Of twelve recorded cases of operation, correct diagnosis was made in only three; namely, in those of Gussenbauer, Senn, and Küster,† and in each of these recovery followed operation.

* *New York Med. Journ.*, Oct. 1st, 1887.

† *Deutsche med. Woch.*, 1887, Nos. 10 and 11.

THE OPERATION.

Tapping or aspiration offers little prospect of success as a mode of treating pancreatic cysts: the fluid would almost certainly re-accumulate. Besides, it might be dangerous as permitting escape of the cystic fluid, or by causing injury to omental vessels.

Extirpation has twice been attempted: once by Bozeman,* with complete success, both as to removal of the tumour and cure of the patient; and once by Rokitansky,† who failed to completely remove the tumour, and lost his patient from septic peritonitis. In both cases operation was performed for supposed ovarian disease: Bozeman recognised the true nature of the cyst during operation; in Rokitansky's case this was not done till after death. Extirpation is not recommended as the operation of election. If the growth is attached near the tail of the pancreas, and has a marked pedicle, it may be removed with little additional risk; but, in the face of the success which has attended incision and drainage, this additional risk need not be incurred. In other cases, the situation of the tumour at the head of the pancreas, the absence of a pedicle, and the existence of deep adhesions, might render the operation very difficult, and even impossible. If the cyst-wall were very thin, or rotten or gangrenous, then removal—partial or complete—might be attempted.

Ogston of Aberdeen‡ operated on a pancreatic cyst which was adherent to the front of the abdomen, almost bursting through it, by elliptical incision around the adherent portion into the peritoneum. The cyst attachment extended over both kidneys. No attempt was made to excise the growth; it was emptied of pea-soup-looking contents, stitched to the abdominal wall all round, and the superfluity of cyst-wall cut off. The patient died of gangrene of the cyst. The removal of superfluous portions of the cyst-walls, if they are very thin or unhealthy, is distinctly advisable, if this can be done without causing traction.

* *New York Med. Rec.*, Jan. 14th, 1872. † *Wien. Med. Presse*, Nov. 15th, 1885.
‡ Personal communication.

The best treatment is, to establish a pancreatic fistula by incising the cyst-wall, and suturing the opening to the parietal wound.

As the stomach and the colon lie above and below the cyst, it will always be wise to commence operation with these viscera empty. Except in Senn's case, and in Ogston's, the incision was always in the middle line. A good rule is, to make the incision over the most prominent point of the tumour. This point will most likely overlie the seat of obstruction, and it will be the situation most favourable for the establishment of a fistula. The length of the incision need not exceed two inches, at first: it may be prolonged if necessary. If adhesions exist between cyst and omentum, and between omentum and parietal peritoneum, these need not be disturbed; but the fluid contents may be drawn off through an aspirating trocar, and the cyst incised and stitched to the parietes afterwards. If there are no adhesions, the omentum is carefully divided over the cyst, all bleeding points being ligatured; the aspirating trocar is inserted; and, as soon as relief of tension permits of it, two catch-forceps are made to grasp the cyst-wall and pull it forwards. When the cyst is empty, and as far as possible pulled through the wound, the opening made by the trocar is enlarged by scissors sufficiently to admit of the introduction of a large drainage-tube, and sutured with the parietal peritoneum to the skin.

Senn recommends an operation in two stages by packing the bottom of the wound over the cyst-wall with iodoform gauze, and opening the cyst after six or eight days. Probably the most recent experience of direct incision and drainage, in the treatment of distension of the gall-bladder and allied conditions, would cause him to modify this suggestion.

Discharge of pancreatic secretion will probably be abundant, requiring the use of some local application, such as carbolised oil, to prevent it from acting on the skin. The drainage-tube is shortened, and changed for one of smaller calibre, as the depth of the cavity diminishes, and the amount of discharge decreases.

With the obliteration of the cyst-cavity we may, in some cases at least, expect restoration of the continuity of the pancreatic duct. A calculus should be looked for, and, if possible, removed.

Appreciation and Mortality.—Senn reports cases of pancreatic cyst healed by incision and drainage at the hands of the following surgeons: Senn,* Kulenkampft,† Gussenbauer,‡ and Hahn,§ —all of them successful. Ogston's case was more than simple incision and drainage. Since then a successful operation has been recorded by Bull of New York,‖ and another has been reported by Witzel,¶ from the Bonn Clinic.

In the following cases removal was either attempted or carried out: Bozeman—case already described—recovery: Rokitansky—case described—incomplete removal, death: Luecke,** tapping, subsequent laparotomy, closure of abdominal wound, death; malignancy found post-mortem: Riedel,†† separation of adhesions, hæmorrhage, ligature *en masse*, death from peritonitis: Billroth,‡‡ difficult enucleation, ligation of large vessel, death from peritonitis. All died except Bozeman's case.

The evidence thus far is strongly in favour of simple incision and drainage, leaving the attachments undisturbed.

* *Amer. Journ. Med. Sc.*, July, 1885. † *Berlin Klin. Woch.*, Feb. 13th, 1882.
‡ *Archiv. f. Klin. Chir.*, vol. xxix., p. 355.
§ *Centralbl. f. Chir.*, No. 2, 1885.
‖ *Loc. cit.* ¶ *Deutsche Zeit. f. Chir.*, XXX., iii., Aug. 25th, 1886.
** Virchow's *Archiv.*, xli., p. 9. †† *Archiv. f. Klin. Chir.*, xxxii., p. 994.
‡‡ Reported by Salzer from Billroth's Clinic.

Section XII.

UNCLASSIFIED OPERATIONS FOR GROWTHS IN OMENTUM, MESENTERY, PERITONEUM, AND PARIETES.

A certain number of comparatively rare tumours, not connected with special organs, but amenable to surgical treatment, remain for consideration. Such tumours are mainly extra-peritoneal, arising in the sub-peritoneal cellular tissue, or in rudimentary or obsolete structures in that tissue, or in the parietes. They are rarely diagnosed with accuracy, and their removal must be carried out without premeditation, and on such general principles as the surgeon has mastered.

Tumours in the Omentum.

Cysts of the Omentum, not hydatid, are of very rare occurrence. A good few examples, in which the tumours have been removed, are however recorded. Thornton* relates the removal

* *Brit. Med. Journ.*, ii., 1882, p. 1243.

of two small omental cysts during the performance of ovariotomy. One was a small multilocular cystic tumour, of the size of a black Kentish cherry, which was found to be attached by a small pedicle in the lower border of the omentum. The patient had papillomatous cystic disease in both ovaries; and this small tumour, a perfect multilocular ovarian tumour in miniature, Thornton considers, owed its origin to cell-infection. The second was a tumour, of the size of a small cocoa-nut, with a very thick white fleshy wall and a small central cavity, which had a puckered lining membrane and contained three or four ounces of thick yellowish fluid. The tumour was attached by a thick vascular pedicle, and lay high up in the abdomen under the right border of the liver, and was nearly overlooked during the removal of a large cysto-sarcoma of the ovary. This tumour also Thornton considers to have originated from cell-infection.

Doran* relates an interesting example of omentum cyst. Dr. Gooding,† of Cheltenham, successfully removed a large cyst, containing clear fluid, from between the folds of the omentum. The tumour had been growing for four years, had caused latterly somewhat troublesome symptoms, and when removed was about the size of a child's head. The cyst was enucleated after a tedious process of separation; there was no pedicle, the growth being embedded in the folds of the omentum, and having the transverse colon below it. The tumour was not hydatid; and Dr. Gooding considers that its origin might have been due to a severe blow in the abdomen, sustained some months before.

Dr. Buckley,‡ of Manchester, has removed a cholesterine cyst of the omentum, weighing 32 ounces. The cyst was thick-walled and globular, and its contents were cholesterine, fat, and compound granular *débris*, — the whole soluble in ether.

Ormsby§ removed successfully, from a woman of 26, a multilocular cystic growth, attached by a well-defined pedicle to

* *Obstet. Trans.*, xxiii., p. 165. † *Lancet*, Feb. 12th, 1887.
§ *Brit. Med. Journ.*, i., 1883, p. 578. ‡ *Brit. Med. Journ.*, May 16th, 1885.

the omentum, weighing 75 pounds. The nature of the growth is not described in the short notice of the operation.

Last year I removed a cystic tumour, attached only to the omentum, from a married woman aged 44. It consisted of one large cyst, containing nine pints of clear albuminous fluid, in a sac of uniform thickness and of pearly-white colour. At the site of its attachment to the omentum were several semi-solid masses, together about as large as the closed fist. Sections through these disclosed, in one portion, a cavity containing characteristic dermoid material, with hairs and cartilaginous nodules; in another part, an aggregation of minute cysts, full of clear bright-yellow fluid which floated in globules on water, and was evidently liquid fat. In the largest of these cysts small coherent masses of pure fat were found. The pedicle was simple omentum, about as thick as two fingers. Near the insertion of the pedicle was a fleshy mass, which was the enlarged fimbriated extremity of a Fallopian tube. Not till the growth was examined, after the operation was concluded, did I suspect that the cyst was really ovarian, the pedicle having been twisted through. A thorough examination of the tumour by Mr. Bland Sutton* showed it to be a mixed dermoid and glandular ovarian growth.

Hydatid Cysts of the Omentum have several times been removed. Solitary echinococcus cysts of the omentum are rare. Wickham Legg,† Annandale, Witzel, and others have described cases. Witzel,‡ in relating a case of omental hydatid occurring in a girl of ten on whom he operated, takes occasion to fully discuss the symptoms and treatment. Pain, lateral and upward mobility, movements synchronous with the respiratory acts, and certain digestive disorders, are, in addition to the physical signs, the leading features of the disease. As to treatment, he recommends, if there are adhesions, incision and drainage. If there are numerous hydatids in the lower portion of the omentum, he recommends removal of the omentum, after the application of a number of ligatures above the growth. Solitary echinococcus should be treated by incision, after fixation to the parietal wound

* *Brit. Gynæc. Journ.*, Nov., 1887. † *Trans. Path. Soc.*, xxv., p. 160.
‡ *Deutsche Zeitschr. f. Chir.*, 1883.

with sutures, and drained. A small echinococcus cyst might be shelled out of its bed in the omentum without being opened.

Abscess occurring in an omental sac is of the nature of a localised suppurative peritonitis, and its treatment is identical.

Sanguineous Tumours of the omentum are very rarely met with. Dr. Reamy, of Cincinnati,* relates three cases of semi-fluctuating growths of the omentum, which yielded pure blood on being tapped. These were sarcomata, as indeed are probably all such growths. Doran, Thornton, Gardner, and others have related similar cases. Bristowe† relates a case in which cure followed several evacuations of pure blood by tapping, and which might have been an omental cyst; but was, in Bristowe's opinion, more probably either a hæmato-nephrosis, or a cyst of the spleen.

Malignant disease of the omentum, either local or as a part of general peritoneal cancer, requires no description.

Tumours in the Mesentery.

A considerable number of operations for mesenteric cysts and tumours have been recorded.

Sir Spencer Wells‡ has operated on two occasions for mesenteric growths, one being cystic and the other solid. He incised and drained the cyst: the patient died after a few weeks; and as no further examination was permitted, the exact nature of the disease was not ascertained. The solid growth, which was about the size of a child's head, was successfully removed by enucleation. Its origin was in the cellular tissue at the root of the mesentery proper, near the lumbar vertebræ. The ascending colon was closely connected with the tumour, in front and to the right; and all its blood-supply was derived from the mesenteric vessels. The exact nature of the growth is not recorded.

* *Trans. Am. Gyn. Soc.*, viii., 1883, p. 123. † *Lancet*, May 5th, 1883.
‡ *Brit. Med. Journ.*, Dec. 9th, 1882.

Lipoma of the mesentery has been met with, and removed. Terrillon* recently presented to the Academy of Medicine of Paris a patient from whom he had removed a fatty tumour, weighing fifty-seven pounds, by enucleation from between the layers of the mesentery.

Homans† of Boston has recorded two cases of removal of enormous fatty tumours from the abdomen, which were retro-peritoneal, and may have been originally mesenteric. In fact, mesenteric tumours might properly be classified under the more comprehensive designation of retro-peritoneal. Homans's first case was that of a man aged thirty-nine. The girth at the umbilicus was $42\frac{3}{4}$ inches; and the tumour felt so fluctuating in parts, that it was punctured several times in the expectation of finding fluid. A first attempt to remove it failed, and a second and successful attempt was made some months later. The operation was one long and tedious process of enucleation from behind the peritoneum and bowels. The patient sank from shock. His second case, in a woman of sixty, was very similar to the first: this patient also died of shock.

Cooper Forster showed at the Pathological Society, in 1868, an enormous fatty tumour, removed after death from a woman, which had features in common with those described by Homans. Three other cases are described in the Pathological Society's *Transactions*. A similar case is said by Homans to have occurred in the practice of Professor Calvin Ellis, of Harvard University.

Cysts of the Mesentery have attained to dimensions so considerable, that they have been mistaken for ovarian tumours. Péan‡ described three such operations, with one success. Watts§ relates another case of operation for mesenteric cyst mistaken for ovarian cystoma. Carter|| operated on a cyst which sprang from the left side of the spine in the lumbar region where the mesentery is attached, and arose either between its folds or from the sub-peritoneal tissue below it. It contained about sixteen

* Letter in *Journ. Amer. Med. Assoc.* † *Lancet*, i., 1883, p. 449.
‡ *Tumeurs de l'Abdomen.* § *Amer. Journ. Obstet.*, 1879, xii., p. 333.
|| *Brit. Med. Journ.*, Jan. 6th, 1883.

pints of a thin, clear, slightly opalescent fluid, free from albumen, and containing a large amount of chlorides—in fact, presenting characters identical with the fluid found in hydatid cysts. No hooklets or other structures characteristic of echinococcus were found. The patient was a married woman, aged 44. There was a history of two years' growth of the tumour, with some pain. On opening the peritoneum, the tumour appeared as a thin-walled cyst, covered in all directions with large veins. It was tapped, and found to be attached to the side of the spine and the left lumbar region, while it was closely surrounded by coils of small intestine which were firmly adherent to it. An attempt was made to enucleate it; but hæmorrhage was so free that the operator had to desist, and finished by stitching the cyst-wall to the parietal opening, cutting away as much of it as possible, and draining the cavity. The patient died of scepticæmia and bleeding.

I know of two other cases, not yet published, of mesenteric growths removed by operation.

Extra-peritoneal Cysts.

Extra-peritoneal cysts underlying the anterior abdominal wall form an exceedingly interesting class. In most of them a connection with the urachus has either been demonstrated or rendered highly probable. An exceedingly valuable report of twelve such cases, operated upon by Lawson Tait,* has recently been published. Of the 12 operations, 4 died, and 8 recovered. The origin of all of them he is inclined to ascribe to a pathological process in some way connected with an arrested or imperfect closure of the urachus. In three of the cases there was found to exist a connection between the bladder and the cyst.

In his first case, the cyst-wall appeared after division of all the layers except the peritoneum. Thirty pints of brown thick fluid, with an abundant flaky yellow deposit consisting chiefly of

* *Brit. Gynæc. Soc. Journ.*, Nov., 1886.

pus and mixed with large fibrinous masses, were removed by tapping. The cyst-wall was completely enucleated without entering the peritoneum. "The cyst did not dip into the pelvis at all, and the anterior parietal peritoneum did not reach the wall lower than the ensiform cartilage. The intestines and the pelvic organs could be felt through the anterior peritoneal fold, non-adherent, and, as far as could be determined, perfectly healthy." The inner surface of the cyst "consisted of broken-down mucoid epithelium, infiltrated everywhere with pus lying upon the basement membrane, which consisted almost entirely of muscular fibres." The patient died, in three days, of exhaustion.

In the second case several pints of putrid urine were evacuated from the cyst, and the patient recovered with a urinary fistula. She died, a month later, of the effects of a miscarriage. In the third case, the patient was in an almost helpless condition, from suppuration in the cyst and gangrene of its walls, and died of exhaustion from excessive suppuration seventeen days after operation. The condition in this case was very similar to that found in the first.

In the fourth case, the peritoneum covering the cyst left the abdominal wall about two and a half inches above the umbilicus, and "presented a curvilinear fold running down outwards and backwards symmetrically on each side to about the middle of the great crest of the ilium, and this was reflected at once on to the promontory of the sacrum. Behind this apron, consisting of the cyst-wall and peritoneum united, the intestines and other organs could be felt. The whole of the pelvis was entirely destitute of peritoneum, and was occupied instead by a cyst-wall; and standing up in the middle of the cavity, bounded on both sides by the cyst-wall, was the uterus, and what ought to have been the broad ligaments. The bladder had a similar relation to the cyst-wall that it ought to have had to the peritoneum; and then from the base of the bladder, running up and lining the posterior surface of the transversalis fascia, was the continuation of the cyst-wall. The fluid of the cyst was clear, and floating in it were shreds of delicate membrane, with lumps of fat in it, presenting precisely the appearance of the omentum

of the fœtus." The cyst was emptied, sponged out, and drained. Suppuration set in, and killed the patient six weeks after operation.

The fifth, sixth, seventh, eighth, and ninth cases were very similar to the fourth. The tenth case had been previously operated upon by another surgeon. The cyst-walls "were of that peculiarly gelatinous friable material which is common to all these cases." After dissecting through the posterior wall of the cyst, the operator found immediately underneath it the loose vascular serous tissue observed in some of the other cases. Dissecting carefully on, he came upon a piece of intestine, and then with his fingers found that he "could readily separate the coils, which were attached to it, not by adhesions, but by connective tissue, very extensile and what we are perfectly accustomed to in all regions which are immediately connected with organs not enveloped in the peritoneal layers, the appearances being totally different from those of inflammatory adhesions. The cyst travelled everywhere down into the pelvis, and the pelvic organs could be felt through its walls." It seemed to the operator that this patient had no peritoneal cavity at all, and that the intestines lay enveloped in fat and loose extensile cellular tissue.

Cases xi. and xii. were not unlike the others. Portions of the cyst-wall of case xi. were removed, and submitted to microscopic examination by Mr. Bland Sutton. He found a "mixture of fibrous and non-striated muscle-tissue, arranged in fasciculi closely corresponding to the disposition of the bundles of tissue which make up the walls of the urinary bladder. Scattered throughout the whole thickness of the sections were small calcareous nodules. It was difficult to make out any definite epithelial investment to the sections; but on scraping the smooth surface of the specimen with a cover glass, the field of the microscope became crowded with flattened, rounded, and pyriform cells, similar to those found lining the interior of the urinary bladder, only very much smaller." Mr. Sutton considers that "as the urachus is lined with epithelium agreeing in shape, and continuous with that found in the interior of

the bladder," the evidence in favour of these cysts being allantoic is complete.*

Bantock† relates two cases, very similar to those of Tait.

Certain cases of retro-peritoneal cysts containing chylous contents have been recorded.‡ These are probably connected with the thoracic duct or other large lymph-channels. The treatment is incision and drainage.

Tumours not cystic are found in connection with the urachus—sarcoma, for instance. Mr. Ewens recently exhibited at the Bristol Medico-Chirurgical Society a remarkable specimen of sarcoma of the urachus which he had attempted to remove. Such cases have, however, a pathological rather than a practical interest.

New growths in the parietes, originating in the muscles or fasciæ, though they bulge inwards on the peritoneal cavity and may require removal of peritoneum before they can be completely eradicated, do not require special description. Weir§ has operated successfully on one of the most remarkable cases of this sort: the tumour weighed nearly fourteen pounds. Briddon, Thomas, Heineke, Czerny and others have had similar cases. Sarcoma is the form of new growth most frequently met with in the parietes. Around or in the umbilicus are found polypus, papilloma, fibroma, and epithelioma. I have seen a case of epithelioma of the umbilicus complicated with intestinal fistula.

For all such rare and peculiar conditions, definite and precise rules for operative treatment cannot be laid down. Most cases come upon the surgeon as a surprise; and their operative handling must be decided upon on the spur of the moment, and carried out according to broad principles established for abdominal operations in general.

* For further information concerning Allantoic cysts, consult Bland Sutton's *Introduction to General Pathology*, where also further references may be found. An exhaustive paper on *Abnormalities of the Urachus*, by James A. Freer of Washington, is published in the *Annals of Surgery* for Feb., 1887.

† *Brit. Gynæc. Soc. Journ.*, Nov., 1886, p. 348.

‡ Kilian. *Berl. Klin. Woch.*, xxv., 1886. § *N. Y. Med. Rec.*, Dec. 3rd, 1887.

SECTION XIII.

SUPRA-PUBIC CYSTOTOMY.

I HAVE adopted this name for the operation to be described because it is the one generally used. Epicystotomy is not definite enough; it might be applied to the gall-bladder as well as to the urinary bladder. Hypogastric cystotomy is the name I prefer: it is sanctioned by historic usage (cystitomia hypogastrica); it is the name most commonly used in France (taille hypogastrique); and, as naming the operation from the region in which it is performed, it runs parallel with a similar operation performed in another region—the perineum. But there is no strong objection to the term adopted, and, as I have said, it is the one best known. The "High Operation" (Sectio alta) is a name frequently employed.

HISTORY.

In this, as in other historical enquiries, we have to discriminate between the man who ignorantly stumbled on the invention, and him who knowingly elaborated it; a third individual, who follows, imitates, modifies, or perverts, also requires consideration.

It is a curious fact that Pierre Franco (or de Franco, as he is sometimes named), the surgeon who first performed the operation, deserves no credit as its inventor, while its real inventor, Roussetus, never performed it. Franco was a surgeon who practised at Tourrieres, in Provence, during the middle and latter portion of the sixteenth century. In 1556 (not 1561—a later edition—or 1581, as is sometimes stated) he published at Lyons a book on Hernia.* A re-impression of this first edition was printed during 1884 in the *Revue de Chirurgie*. In the course of his narrative he makes the following "reciteray:" "I will recite what once happened to me, intending to extract a stone from a child of two years old, or thereabout; in which, having found the stone, of the bigness of a hen's egg, or very near, I did all I could to bring it down [on the gripe], and finding that I was not able to bring it forward by all my endeavours, the patient being exceedingly tormented, and also the parents desiring that he should die rather than live in such misery; add to this, that I was not willing to be reproached with not being able to extract it (which was great folly in me), I determined, with the importunity of the father, mother, and friends, to cut the said child above the os pubis, since the stone would not fall down; and he was cut above the pubis, *a little on one side* (*un peu a costè*), upon the stone; for I lifted it up with my fingers, which were in the anus, and on the other side holding it down, by the hands of a servant, which pressed the belly upon the stone, by which means the stone was extracted, and a little after the patient was cured (notwithstanding he had been very ill), and the wound healed. However, I do not advise any man to do

* *Petit Traité sur les Hernies.*

the like." This is Cheselden's very correct translation of Franco's words.*

In 1590 Roussetus published his great work on Cæsarean Section, in which he gave a minute and accurate account of the anatomy of the parts concerned. Roussetus was the greatest physician of his day, possessed of an insight and knowledge which came very near being genius. It is not surprising, therefore, that his studies in the anatomy of Cæsarean Section suggested the hypogastric route for entering the bladder. Roussetus knew of Franco's operation, and sharply censured him for dissuading others from following in his footsteps, while he sensibly combats the generally received opinion that wounds of the bladder were necessarily fatal. Finally, he elaborated the operation which he recommended by experimenting on the dead body; and this operation is, to all intents and purposes, the operation as it is performed to-day. The patient is laid on his back, the bladder is filled with milk, or barley-water, or a "vulnerary decoction," by means of a syringe which fits on to a silver catheter; the penis is grasped by the hand of an assistant, or tied by a "soft twist of cotton." He then accurately describes the supra-pubic incision, and the mode of exposing the bladder. The puncture in the bladder is made by a sharp-

* I give Franco's own words because, in the only recent English monograph on the operation (Sir Henry Thompson's), the method Franco employed is said to have been "to inject the bladder forcibly with water, the presence of which was insured by the assistant grasping the penis during the operation, and to dissect the bladder in the median line without a staff, opening the organ at the anterior aspect behind the symphysis." Franco distinctly says he did *not* cut in the median line, and his simple words can scarcely be elaborated into describing injection of the bladder and grasping the penis. Thompson's historical remarks are in other respects open to criticism. Thus, Franco was not "the surgeon of Lausanne," but of Tourrieres, in Provence. He confuses John Douglas, the surgeon who first operated, with his brother, James Douglas, the physician who first publicly brought forward the operation. The sentence (p. 9): "About this time several provincial surgeons published cases of the high operation, such as Pye and Thornhill of Bristol, Middleton, and Macgill of Edinburgh, 1722–24," contains several errors. Middleton was not of Edinburgh, but of Bristol, and he was not a surgeon, but a pure physician of the old-fashioned type, who probably never performed an operation in his life. It happened that he wrote for his friend and colleague, Thornhill the surgeon, the work to be presently described. A copy of this work (annotated apparently by the author) is now before me, and is dated 1727.

pointed, sickle-shaped knife; through this puncture a curved, probe-pointed knife, blunt at the point, so as to pull the bladder upwards while it did not cut it, is insinuated to enlarge the incision. An assistant pushes the stone forwards with his finger in the anus in men, and in the vagina in women, and the surgeon extracts the stone by fingers, forceps, or scoop, as seems most convenient. An alternative method, to meet certain cases of difficulty, is to use a greatly curved and furrowed sound, on the point of which the incision into the bladder may be made. He thus anticipates certain subsequent procedures. Gradual distension of the bladder by ligating the penis and preventing the discharge of urine, he speaks somewhat dubiously about. It is physiologically sound, but practically intolerable.

Hildanus (1682) and Dionis (1714) finding it necessary to introduce a description of the operation in their works, did so, but without discrimination or even accuracy. Bonnet, a surgeon to the Hôtel Dieu, previous to this time, is said, chiefly on the authority of Tolet, to have operated by the high method; but he has left no literary proof to this effect. Simon Pietre, a Paris physician, wrote a short treatise in favour of the operation in 1635; and various references in general works subsequent to this time would seem to show that the subject was simmering in the minds of surgeons in Paris. At length Francis Collet was authorised to make experiments and report to the faculty at Paris; he reported unfavourably, and the operation was prohibited. Elsewhere a few stray operations were performed, rather from necessity than choice. Thus, Groenvelt, a Dutch surgeon, who wrote a treatise on Lithotomy, in English, in 1710, relates how he was once driven to perform the operation. Proby, a Dublin surgeon, published in the *Philosophical Transactions*, in 1700, an account of a case in a woman where, having failed to remove a long pin through the urethra, he cut down on the point, which was made to bulge over the pubes, and removed it in this way. These and similar operations had no influence on the advancement of the operation, and it may be said steadily to have declined in favour till 1718, when the brothers Douglas took it up.

On January 23rd, 1718, Dr. James Douglas read a paper on

the high operation for stone before the Royal Society, of which he was a Fellow. No doubt he, the physician, wrote on behalf of his brother John, the surgeon and lithotomist to Westminster Hospital: it was a common practice in those days for the cultured physician to do the literary work of the practical surgeon. In 1723 John Douglas published his treatise on the operation. Douglas was truly an inventor. When he began working at the operation he was ignorant of Roussetus' work, although he knew of Franco's bungling operation. The name he adopted, "Lithotomia Douglassiana," clearly indicates the position he assumes; and its admission by his compeers shows that they did not grudge him the title of inventor. The brothers were anatomists and scientific men of a high order, and they set about working out the anatomical basis of the operation in a thoroughly workmanlike manner. He describes his method in ten pages, and relates three cases, with drawings of the stones. The bladder is to be filled with warm water; the catheter being withdrawn, the assistant instead of grasping the penis bends it "down towards the anus, which will hinder the water from spurting out, and also keep his hand out of the way." The rest of the operation is essentially that of Roussetus. He makes the error of advising the completion of the incision into the bladder by running the knife upwards towards the fundus, whereby the danger of penetrating the abdomen is increased. He points out the superiority of forceps to fingers in withdrawing the stone, as the fingers take up more room. Douglas's patients were shown at the Royal Society, and their fame soon spread. He had a good many followers in England, some of whom wrote treatises on the operation. The most important of these are Cheselden of London and Thornhill of Bristol.

Cheselden must have been familiar with Douglas's work before Douglas wrote his treatise, for, in 1723 he wrote his book on the high operation; and having greater opportunities of putting the operation into practice, he was able to publish nine cases of operation. His description of the operation occupies ten small pages; the rest of the book is occupied with descriptions of his cases and dissections, and translations of the writings of Rousse-

tus, Le Mercier, Hildanus, and others. Cheselden gives Douglas the credit of being, if not "the inventor, surely the first man that ever practised it upon living bodies." Cheselden's description of the operation, though short and somewhat defective, is clear and practical. It differs in no important point from Douglas's.

The next important name in the history of the operation is that of Thornhill of Bristol, who performed his first operation in February, 1722. When his work was published (by his friend and colleague John Middleton, physician) in 1727, he had operated on at least fifteen cases. In Thornhill's (or Middleton's) treatise, the description of the operation, with some preliminary anatomical matter, occupies 23 quarto pages; and his cases, criticisms, and plates occupy 47 pages more. The description of supra-pubic lithotomy as performed by Thornhill is marvellously good. From his description of how the assistant is to hold the penis, "with a rag between the fingers and thumb, that it may not slip"; his warning against over-distension of an ulcerated bladder; his accurate description of the contraction of the ends of the recti, and how this may be obviated; the risks of cutting upwards; the manner in which the peritoneal fold is pushed downwards by straining; how to keep up the collapsing bladder after it is incised; and, more particularly, by his fertility of resource in treating his cases and their complications: one cannot avoid the conclusion that Thornhill was at his own time, and, indeed, for a century and a quarter later, the best exponent of supra-pubic lithotomy. He had greater experience than any of his age; he showed a finer appreciation of the difficulties and peculiarities of the operation; and undoubtedly, as a perusal of his cases must show, he exhibited more daring, and at the same time more caution, than any of his predecessors.*

* The excellence of Thornhill's work so impressed me, that I have taken a good deal of trouble in elucidating his history. Fortunately, there are ample means of doing so in the very full records of the Bristol Royal Infirmary, which are now in its Library. Thornhill was its first surgeon, appointed in 1737; and he was the most conspicuous surgeon of his day in Bristol. He was highly prosperous, somewhat of a dandy, almost independent of his profession; a brilliant operator, but apparently careless of reputation, and following independently the bent of a genius that was clearly somewhat erratic. It was in complete harmony with his nature that he should not take the trouble to say a word about his work, but leave the writing to his friend Middleton.

To give an idea of the keenness of Thornhill's insight into the essentials of the operation, I quote the following remarks, which appear as a foot-note in his work (p. 17): "I was in hopes that the place for the puncture might be fixed to the satisfaction of everybody, by searching gently with the finger, for the insertion of the urachus in the bottom of the bladder, which in an adult subject I have observed to be prominent, like a little knob, pretty firm, and as big as a large pea, only somewhat flatter; and the finger being placed upon it, the puncture might be made immediately below it with an absolute certainty. But I find this direction is fallible in live subjects, where, the fibres being all in action, the part seems so equally tense, that it is hard to distinguish the insertion of the urachus. However, I mention this as a theory, which perhaps may be improved, and in adults is not entirely to be neglected." This is a highly important observation which, so far as I know, has never been made before in respect of this operation. And it is literally correct. With a little practice in the dead-house, I think it is always possible to make out the insertion of the urachus; and if we cut in the middle line below this point, we cannot injure the peritoneum. It must be remembered that in Thornhill's day there was no anæsthesia.

Samuel Pye* of Bristol, in 1725, wrote a small pamphlet on the operation, which does little more than show his own failure to grasp its principles or put it properly into practice. Of his four cases, it is noteworthy that in one he got primary union of the wounds, and the boy, aged five, was playing in the street on the fifteenth day. Macgill of Edinburgh wrote letters recording a few cases to Middleton and to Cheselden, which were printed

* Samuel Pye was a Bristol surgeon, who had a great reputation for the treatment of venereal diseases.

> "The home-bred documents of Old Sam. Pye
> Were standing rules to treat their buboes by."—CHATTERTON.

He was a rival of Thornhill; and his pamphlet was clearly directed mainly against Thornhill himself. He had very little experience of the operation (four cases), and his objections to it were mostly fanciful and stupid. "Old Sam. Pye" had the somewhat questionable honour of being reviled by Chatterton in an unpublished, and unpublishable, poem now in the library of the Bristol Royal Infirmary.

in their books. In France, Morand performed the operation on Roussetus's principles, and in 1728 wrote a treatise on "Cutting by the High Apparatus," as it was sometimes called. Several other surgeons performed the operation, and wrote about it at this time; but no improvement, scarcely any change, in the method was recorded till Frère Côme (or Cosme), a well-known lithotomist in Paris, took it up. Côme's book was published in 1779, after he had finally elaborated his plan. He is said to have operated on nearly a hundred patients, and with almost uninterrupted success. The chief peculiarity in Côme's proceeding was the use of the *sonde à dard* introduced into the bladder through an opening made in the perineum into the membraneous urethra. This instrument was a curved hollow sound introduced through the perineal opening into the bladder; by depressing it the point was made to raise the bladder into the wound, and the concealed dart or stilet was made to perforate the bladder. The aponeurosis between the recti was divided by a curved knife with a button point, which pushed the peritoneum in front of it. Deschamps suggested that the low opening for the introduction of the sound should be made through the rectum.

From this period almost to the present day the operation steadily declined, both in favour and in mode of performance, and we need not follow its fortunes.* Its revival has been simply part of the general revival of surgery which has marked the last twenty years. At the present day the operation is where Douglas and Thornhill left it—improved in the same manner and by the same influences as other surgical operations have been improved, and not least in the way of discarding all ingenious contrivances for doing away with the necessity for educated fingers and anatomical knowledge.

In quite recent days its revival has really been part of the quiet resuscitation of many old and neglected operations. If anyone more than another deserves credit for its re-introduction, it is Sir Joseph Lister. But the most conspicuous stimulus has been derived from the experiments of Garson and Petersen on

* See Dulles, *Lancet*, Dec. 3rd, 1887.

the influence of distension of the rectum in increasing the depth of the supra-pubic interval. The real value of this invention is now openly questioned by many surgeons, while there is no doubt as to its occasional risk: but, however this may be, their experiments have called attention to the operation; and this attention has assisted in placing the operation permanently among recognised surgical proceedings.

INDICATIONS FOR OPERATION.

Broadly it may be said that the supra-pubic operation may be called for in dealing with any conditions which may demand cystotomy. Removal of stones, foreign bodies, or tumours may be carried out best by the supra-pubic operation; drainage of an inflamed bladder; the provision of an exit for urine in obstruction of the natural passages; the formation of an artificial opening in cases of malignant disease where suffering is caused by obstruction from the clotting of blood—may all be indications for operation. But they are indications only in competition with other proceedings; and the comparative values of these operations must be estimated.

Stone in the Bladder.—The best operation for stone in the bladder is on all hands admitted to be Bigelow's—lithotrity with evacuation at one sitting. As experience increases and instruments are improved, the range of Bigelow's operation is being extended. Stones of a very large size are crushed by powerful instruments and completely removed at one operation; while, with the help of very delicate instruments, stones are now successfully removed from very small children, almost from infants. The operation of election for stone in the bladder is undoubtedly Bigelow's: on this there is almost universal unanimity.

Under certain circumstances this operation is out of court. Thus the stone may be so hard that no instrument will crush it; or the process of crushing may be attended with danger to the vesical walls from the flying off of sharp fragments; or it may

demand such a prolonged operation that the patient's life is endangered. Again, it may be so large that crushing by any instrument introduced by the urethra is out of the question. Or, in young children, from smallness of the urethra, it may be impossible or dangerous to pass efficient instruments. Or, lastly, looking at the general condition of the patient and the size of the stone, it may appear that a quick cutting operation gives the best chance of recovery. Then the decision is one between lateral, or at least perineal, lithotomy, and the operation over the pubes.

Taking the case of young children first, we often hear it said that for removal of stones in the bladder we do not want a better operation than lateral lithotomy. Recent work in crushing would seem to show that here we have already got an operation at least as good as, probably better than, lateral lithotomy; while as regards remote results there can be no comparison. A child who has been cut for stone is not safe from stricture of the urethra as he grows up. In the face of actual facts, the position of ignorance as to bad subsequent results after perineal lithotomy cannot be upheld. In this Bristol district, where stone is rare, I have seen in the last nine years five operations for perineal fistula following perineal lithotomy, and I have been concerned in the treatment of one case of stricture and one of fistula from the same cause. And the treatment of these catastrophes is not always easy or successful; the stricture, at least, may be said to last during the life of the patient. In a very successful operation for fistula performed by Mr. Board at the Bristol Infirmary last year, the stricture was not marked, and the result may be said to be curative; but in all the others which I have seen the operation did not cure the stricture. Knowing what we do of the causation and results of traumatic stricture of the urethra, it is surprising that evil effects so seldom follow perineal lithotomy in children. Sexual incompetence, or rather sterility, must also be reckoned among the possible effects.

Stricture, fistula, sexual incompetence—separately or combined—must be admitted to be rare sequences of perineal lithotomy. But that they are possible sequences cannot be

denied. Now if the supra-pubic operation can show immediate results as good as the perineal, and a complete absence of remote drawbacks, then the supra-pubic operation should be selected. Even if the per-centage against the perineal were as small as one, this one case for fixing a rule in sound surgery should be decisive. In children, therefore, I should say that where the crushing operation is negatived, the supra-pubic should be adopted. A further argument in favour of its adoption in children is the favourable position of the bladder, and the usually healthy condition of the involved tissues.

In the case of adult males, the size of the stone and the condition and age of the patient have most influence. Prolonged anæsthesia for crushing and evacuation is full of danger for old or enfeebled patients; and stones over two ounces in weight are best removed by the supra-pubic route. Very large stones must be removed in this way. Indeed, the size of the stone would seem scarcely at all to influence the death-rate in this operation. The patient from whom Mr. T. Smith removed a stone weighing 24½ ounces made a better recovery than Sir Henry Thompson's patient, whose stone weighed 14½ ounces. Here the operation is one of necessity, not of choice. Such enormous stones can be removed neither by crushing, nor by cutting through the perineum.

In elderly patients with stones which it is either impossible or unwise to crush, it is mainly a question of saving of life. In very young patients it is not so much a question of saving life—all the operations are comparatively safe in this respect—as of permitting an existence free from future trouble. Now, the drawbacks after perineal lithotomy, if small, are undoubtedly present: after supra-pubic lithotomy they are simply non-existent. It is probable that increasing perfection of instruments will admit of crushing in male children of the most tender age; but a small proportion must always remain where a cutting operation is best. This operation, with the evidence before us, should nearly always be the supra-pubic one. For cases in advanced life, or with large stones, the operation should, in the majority of instances, be the supra-pubic one.

In the case of females with stone in the bladder, the question of supra-pubic cystotomy is not so frequently presented to us. The stone must be a very large one which cannot be crushed through the female urethra. For stones of moderate size which are too hard to crush, incision of the urethra, with dilatation of the neck of the bladder, and subsequent immediate suturing of the divided urethra, is, in my opinion, a simpler and better operation than supra-pubic cystotomy. Incision through the bladder and vagina is not a commendable operation. For very large stones, four ounces and upwards, the supra-pubic operation is probably the best.

Nothing need here be said as to the symptoms and diagnosis of vesical calculus.

Foreign Bodies.—Here the operation selected must depend on the nature of the foreign body present. In most cases the call to operate is not made till the body is coated more or less completely with phosphates, and in many the body is completely buried in the heart of a stone. In the second case, if a cutting operation is decided upon, it is lithotomy pure and simple; but if lithotrity is the operation selected, and the foreign body is metallic, then crushing may result in failure. Of course, if it is known that a foreign body is present that cannot be crushed, this calamity may be avoided.

In those cases where attention is called to the presence of the foreign body very soon after it has been introduced, and the nature of it is known, attempts may be made to extract it by means of any of the ingenious Redressors, or Basculeurs, or Duplicators, or special forceps invented for the purpose. The success which has followed the use of these and such instruments in removing foreign bodies from the bladder has been most encouraging. In Denucé's collection of 249 cases of foreign bodies which had necessitated lithotomy or extraction, there were, prior to 1830, 100 cases of lithotomy and 27 of extraction; while, subsequently to 1830, there were only 21 lithotomies, the rest being extractions. Poulet found in a fuller analysis a somewhat greater proportion of lithotomies. He points out that

simple extraction is by no means so free from danger as might be supposed; that the bladder or the passage may readily be wounded; and that, on the whole, there is not much to choose between cutting and extracting, at least so far as the male bladder is concerned. In the case of the female bladder, if dilatation of the urethra is employed and the bladder explored, extraction is a far safer proceeding.

Any attempt to give definite rules for the selection of the best mode of removing foreign bodies must fail in the face of their almost endless variety. Generally speaking, if the foreign body is very long, if it is composed of brittle material, such as a glass tube, and more especially if its ends are sharp, or perhaps embedded in the vesical walls, the supra-pubic operation is the best to select. In cases where there is evidence of perforation of the bladder, the supra-pubic operation must be extended to abdominal section in order that the rent may be sutured. Evidence of perforation of the bladder usually follows closely on the occurrence of the injury. In some cases, however, perforation takes place very slowly by ulceration, and reaches the general cavity only after the formation of peri-vesical abscess. In an extraordinary and probably unique case which I have recorded elsewhere,* one end of the rib of an umbrella, two inches in length, lay among the intestines, while the other extremity was inside the bladder embedded in a phosphatic stone of the size and shape of a plover's egg. The patient, a lunatic, had exhibited no symptoms of its presence, and died of another cause. Here abdominal section would have been essential to the proper completion of the operation, for in no other way could the perforation have been closed.

There can be no doubt that the removal of a sharp or large foreign body may be carried out with less risk of wounding the vesical walls by the hypogastric than by the perineal method. There is more room; the whole body is within easy reach of the finger, and perhaps may be brought into view; and it is easy to ascertain whether the bladder is wounded. The whole question is one which must be left to the discretion of the surgeon, acting

* *Bristol Med.-Chir. Journ.*, March, 1886.

upon such information as to the nature of the foreign body as he can gather. The operation selected should be one by which the foreign body can certainly be removed; it is little less than a catastrophe to have to resort to the supra-pubic route when the perineal fails. All such tentative surgery is to be sternly condemned. There is little to choose as regards actual mortality between the supra-pubic and the perineal operation; if there is the slightest doubt that one will fail, the other, which cannot fail, should unhesitatingly be adopted.

Tumours of the Bladder.—An accurate and exhaustive classification of tumours of the bladder has yet to be made. Sir Henry Thompson,* working upon such material as lay to his hand, has given a classification which is admittedly tentative and temporary. Looking at such growths in the broadest possible aspect, I think the best and simplest division is into polypus, papilloma, and cancer. For clinical purposes this division is certainly satisfactory; and it is not unlikely that, with minor subdivisions, it might be made to include all known varieties of bladder-growth.

Polypus is almost peculiar to the bladder of children. In structure it is practically identical with the simple mucous polypus found on the nasal and other mucous membranes. Some of them contain much mucoid substance, being practically myxomata; while others are more dense, containing varying quantities of fibrous tissue. These polypi are often found in great numbers, sometimes filling and even distending the bladder.

Papilloma, also termed "Villous Tumour," is the best known of bladder-growths. It is by no means uniform in appearance. In some it is represented by an exceedingly fine, almost impalpable, growth of fimbriæ or papillæ, set upon a narrow pedicle and spreading out into a more or less distinct mass, not unlike a cauliflower in shape. Sometimes these fine growths are single, oftener they are multiple, being three or more in number; rarely they are found scattered over the whole of the cavity. Each papilla or villus consists of a fine basement membrane containing

* *Tumours of the Bladder.* London, 1884.

blood-vessels, covered by several layers of columnar cells identical with those covering the mucous membrane of the bladder. The villi are about the same thickness from base to apex; the apex of the whole growth is broader than the base, on account of their dividing as they grow. The vascular walls are very thin, and easily ruptured. Thompson calls this variety the Fimbriated Papilloma. A second variety, in which the fibrous tissue at the base of the growth (which, by the way, usually contains inorganic fibre) is in considerable amount, forming a conspicuous part of the tumour, he calls Fibro-papilloma. Some tumours described as myoma would probably belong to this category. Here the fine fimbriæ, though present, are not usually so long or so perfectly developed as in the previous variety. In a third variety the fibrous material at the base is still further developed, and exhibits in its meshes material suggestive of malignancy. It is doubtful, however, whether real malignancy could be proved, in these cases, by any test other than tendency to recur, which of course may also be described as continued growth after incomplete removal.

All forms of malignant disease have been found invading the bladder. Sarcoma is very rare; encephaloid has been met with; scirrhus of the bladder proper has been described, but is usually an extension from a primary invasion of the prostate; epithelioma is probably the most common form of malignant disease met with.

Dermoid tumour has been found in the bladder, as in most other structures; and one case is recorded in which Bryant successfully removed such a growth from the female bladder.

The symptoms of polypus in the bladder in children have usually been those of stone, with more than the ordinary amount of tenesmus, and with, perhaps, more frequent attacks of tenesmus.

The symptoms of papilloma are very well known, and usually sufficiently definite to make a diagnosis highly probable. Still, exceptions exist where diagnosis is rendered certain only during operation. Symptoms impress men differently. I have

removed a papillomatous growth from the bladder of a lady who was for three years treated by distinguished men for "gouty kidney." A colleague who diagnosed the case, and sent me the patient, concluded it was papilloma after a few minutes' conversation with the patient. Much, therefore, depends on the point of view from which one looks at symptoms.

The first, the last, and usually, but not always, the only continuous symptom of papilloma is hæmaturia. In some cases it is positively the only symptom, the patient showing no signs of bladder irritation or inflammation or other trouble beyond bleeding, and dying in the end simply from loss of blood. In most cases, however, there is increased frequency of micturition; occasionally there is tenesmus; and in some cases, where the blood coagulates in the bladder, there is complete retention, with constant and ineffectual attempts to empty the bladder. In one case I had to scoop out with the fingers enormous quantities of clot, which distended the bladder, before I could reach the tumour. The hæmorrhage is least profuse in the early stages, and increases in amount, not steadily but with remissions, as the disease advances.

In the earlier stages the hæmorrhage sometimes makes its appearance in a manner which is highly characteristic. The water first passed is clear, or but slightly tinged with blood; towards the end of micturition the tint becomes a brighter red, and as the act ceases, a few drops or a little stream of pure blood comes away, with some pain and straining. This appearance is no doubt produced by compression of the tumour by the contracting bladder and rupture of some of its thin-walled vessels. As the bladder refills, the villi, soaking in the urine, go on bleeding, and cause a general admixture of blood, or the formation of small or large coagula according to the amount of blood discharged.

Passing the sound in cases of papilloma usually gives negative results. The finger in the rectum if the patient is a male, in the vagina if a female, follows the sound as it is moved about, and, through the mucous membranes, estimates the even thickness of the bladder-walls, and notes any fulness or induration

between it and the metal. Only large and firm papillomata can be detected in this way.

It is important to make frequent and careful microscopical examinations of the urine, with a view to the discovery of portions of the fimbriæ which are constantly being shed. The sediment from one or two days' urine is permitted to settle, washed to get rid of the blood, and examined in detail. Sir Henry Thompson makes the useful suggestions, that the bladder should be washed out freely with warm water, or that a lithotrity evacuator should be used to obtain portions of the growth for examination. The finding of fimbriæ in the urine is pathognomonic. The use of the lithotrite to grasp and remove portions of the growth is a somewhat haphazard proceeding.

In the case of epithelioma of the bladder, signs of vesical irritation come on early and are more urgent than in papilloma. Bleeding is more variable as regards both occurrence and amount. Pus is found in considerable quantities in the urine, and if there is much irritation, ropy mucus as well. Pain is a fairly constant and often urgent symptom, referred frequently to the hypogastrium, and often to outlying regions, as the point of the penis and down the nerves of the thigh. A tumour or thickening may sometimes be palpated between the sound in the bladder and the finger in the rectum or vagina. Fragments of the growth discovered in the urine, or in water after washing out the bladder, may confirm the diagnosis. As to the means of diagnosing other forms of malignant growth, there is little beyond general principles to guide us.

It would seem that we are now in the way of obtaining, if we have not already obtained, a really useful method of exploring the cavity of the bladder by means of the electric light. According to Hurry Fenwick,* the incandescent lamp cystoscope of Nitze or Leiter is an instrument of real practical utility, by means of which the whole cavity may be visually inspected. I have no personal experience of the instrument; a full description of it and the manner of using it is given by Fenwick in the paper referred to.

* *Brit. Med. Journ.*, Feb. 4th, 1888.

As to the occurrence of these growths: polypus is apparently almost confined to young children; papilloma is found most frequently in adult males; epithelioma, while equally frequent in both sexes, is probably most common in late life. No part of the bladder has immunity from these growths; all of them are most frequently found in the base and fundus, and this holds true more especially of epithelioma.

In every case where polypus or papilloma of the bladder is diagnosed, operation (with the ordinary exceptions) is indicated. In the case of males, I consider that the operation selected should be supra-pubic cystotomy. In the case of females, removal should be attempted through the urethra, except in the case of very large or very numerous growths spread over the general surface of the mucous membrane. Setting the question of operation on the female aside for the moment, we may now discuss shortly the reasons for selecting the supra-pubic operation in the male.

The problem is a double one: firstly, by what route may tumours of the bladder most easily be reached; and, secondly, by what route can they most readily and uniformly be removed?

In answer to the first question, the present position of the surgical mind is probably not in harmony with the most recent surgical writings. Thus, in 1884, Sir Henry Thompson* declared emphatically in favour of the median perineal route. The finger, carried through the perineal opening, is, he says, practically always capable of exploring the whole cavity, particularly with the help of "a strong and determined assistant" to push the contents of the pelvis downwards. That the whole bladder may be explored with the finger-tip in this way, there can be no dispute; but in the case of fat patients with powerful abdominal muscles, the proceeding must be more one of muscular strength than of delicate palpation. But that it can be compared with the supra-pubic method as regards ease or thoroughness, no one who has tried the two plans will admit. Every part of the bladder, after the "Sectio alta," can be explored with the greatest ease by the finger, and much of its

* *Tumours of the Bladder*, p. 11.

surface can be brought within the range of vision. No force is required to push up perineum, or press down parietes; the bladder lies ready and open to the finger.

And in all seriousness it may be asked, What is the use of exploring the bladder at all, except to proceed to removal of the tumour? I have already in this work protested against the too prevalent fashion of "exploratory operations": an exploratory operation on the bladder that cannot at once be converted into the best curative operation should be condemned offhand. Exploration and removal should go together.

As to facility of removal, there can be no doubt that for the great majority of tumours the supra-pubic operation is better than the perineal. A few tumours could be removed only in this way; and as it is rarely possible exactly to locate a tumour before operation, we should select the mode of operation which will always succeed. Some operations begun as perineal have had to be concluded as supra-pubic: this ought never to occur. Although there is probably little to choose as regards immediate mortality between the high and the low operation, there can be no doubt that a combination of the two is infinitely worse than either separately. If in every case where a tumour can be removed by the low operation, it can also be removed by the high; if in some cases (not diagnosable beforehand) the tumour could be perfectly removed only by the high route; and if, in every case, manipulation is easier and more precise, the decision in favour of supra-pubic cystotomy for removal of tumours in the male bladder cannot be in doubt.

In the case of the female, I think the best routine method is to proceed by incision of the outer urethra, followed by suture after operation, with dilatation of the neck of the bladder. It is surprising how this division of the outer urethra, liberating the finger from constriction and setting free an invaluable inch or so of its length, facilitates exploration of the vesical cavity. The operation is a trifling one as compared with the low operation in the male, the bladder is rendered more accessible, and in a far less proportion of cases will there be failure to remove the growth. Still, the high operation in women may

be called for in certain rare cases of mal-posed and large-sized growths.

Supra-pubic cystotomy has been proposed and carried out as an exceptional operation, (1) as a means of drainage in cystitis; (2) as a mode of exit for the urine when it cannot be passed by the urethra; and (3) by McGill of Leeds for the purpose of removing hypertrophied lobes of the prostate bulging into the bladder and obstructing the flow of urine. It is impossible within the limits of this work to discuss these proceedings. The one operation of "Prostatectomy," as it has been called, seems to me to have proved the possibility of dealing satisfactorily with a very troublesome condition which is irremediable by other means. Experience alone will show its value. For the relief and subsequent treatment of certain cases of retention, particularly when depending on enlarged prostate, Packard of Philadelphia has performed some very successful hypogastric sections.

ANATOMICAL CONSIDERATIONS.

The part of the bladder concerned in this operation is that portion which lies behind the pubes, between the neck and the insertion of the urachus. Between the anterior wall of the bladder behind, and the posterior surface of the pubic bones and the abdominal muscles in front, is a pyramidal-shaped space filled with connective tissue and blood-vessels: in and around this space take place the surgical manipulations in this operation. This space varies in size and shape, not only anatomically in different individuals and at different ages, but also according to the condition of the bladder as to emptiness or distension.

The posterior wall of the sheath of the rectus definitely ends at the curved margin of the semi-lunar fold of Douglas, between the umbilicus and the pubes; from this margin arise two layers of fascia, which pass downwards between the rectus and the peritoneum. The anterior layer is continued as a thin covering to the rectus and pyramidalis, and lines the space between the bladder and the symphysis pubis (Braune); the

posterior lamina passes across behind the urachus on to the bladder, in order to invest it, and to join the prostatic capsule and pelvic fascia. Into the potential space between these two laminæ the expanding bladder arises: they may, in fact, be regarded as the fascial boundaries of the area of operation. On the posterior lamina lies the peritoneum, following it in all its movements.

The parietal peritoneum is reflected on to the bladder at its summit, at a point which, in the middle line, always corresponds to the insertion of the urachus. Behind this point the peritoneum is firmly attached to the bladder-wall; in front of it, the peritoneum can scarcely be said to be attached to the bladder at all, though, when the bladder is empty, it lies closely apposed to its anterior surface as low down almost as the neck of the organ. The level at which the peritoneum is reflected from the parietes on to the bladder may be, as regards the bladder itself, at any point between the neck and the fundus, as high up as its summit represented by the insertion of the urachus. As regards the parietes, the level of peritoneal reflexion is more variable, but may extend to any distance between zero and three inches above the pubes.

Distension of the bladder is the palpable means of elevating this peritoneal fold; and as, almost from the earliest conception of the operation, the danger of wounding the peritoneum, and this means of avoiding it, were fully recognised, it might be supposed that the anatomical descriptions would, by this time, have been exhaustive. They are certainly abundant, but they are by no means harmonious.

One of the earliest proved points was, the difference in the shape and position of the child's bladder as compared with that of the adult. In 1756, Heuermann of Copenhagen* pointed out that the child's bladder was more elongated than the adult's; that it was practically an abdominal and not a pelvic organ; and that the peritoneal reflexion from it when the bladder was full rose higher than, and when empty did not descend so low as, in the adult.

* See Gross of Nancy, *Mem. Congrès Français de Chir.*, 1887, 2me Sess. 1886.

Cruveilhier, Malgaigne, Richet, Paulet, Sappey, and others made observations on the anatomy of the bladder in confirmation and extension of the views of Heuermann. More recently Langer,* Chauvel,† Mannheim,‡ and others have devoted special attention to the subject.

The topographical anatomy of the bladder in general, and more particularly in adults, has in the last twenty years received important additions from the study of frozen sections. Those of Pirogoff and Braune are among the best known; and among their followers, special mention must be made of Garson, who devoted particular attention to the bladder during emptiness and distension, and also when displaced by an air-bag distended in the rectum. Garson's sections were made in Vienna in 1877, and his paper was read by Braune at the Congress of German Surgeons in 1878.§ Petersen of Kiel heard Garson's paper, and used on the living body the rectal bag as Garson had used it on the dead.‖ The practice of rectal distension seems to have rivetted the attention of surgeons; and the general revival of the operation may be said to date from the reading of Garson's paper in 1878, or more correctly perhaps from the publication of Petersen's paper in 1880.

In respect of all these studies in children and in adults, I am bound to say that a perusal of most of them does little more than convince one that the topography of the bladder is surely the most variable in all human anatomy. It would be both tedious and unprofitable to recapitulate all the measurements which have been given; I shall therefore shortly summarise the average results.

In children up to eight years of age the peritoneal fold, when the bladder is empty, never descends below the upper margin of the pubes, and often rises a few lines higher; with a distended bladder the fold will rise, according to the degree of distension, from one to two and a half inches above the pubes. Now,

* *Zeit. der Gesellsch. der Aertzte in Wein*, 1882.

† Art. "Cystotomie," *Dict. Encyc. des Sc. Méd.*, xxv., p. 106.

‡ *Ueber den Hohensteinschnitt bei Kinderen*, Berlin, 1884.

§ *Archiv. f. Anat.*, 1878, and *Edin. Med. Journ.*, Oct., 1878.

‖ *Archiv. f. Klin. Chir.*, 1880, xxv.

as a supra-pubic space uncovered by peritoneum of two inches in length can never be necessary in the performance of the supra-pubic operation in children, and a space of an inch or an inch and a half is quite sufficient for all practical purposes, it is clear that, in children at least, there is no difficulty whatever, with moderate distension of the bladder, in avoiding the peritoneum. In the 300 operations on young children collected by Gross of Nancy, there were only nine cases of wound of the peritoneum, and only four deaths in consequence. When we recollect that most of these operations were performed in the last century, we must admit that the risk of wounding the peritoneum, in children at least, is very small. As a matter of fact, a surgeon with some experience in abdominal work would treat very lightly the risk of wounding the peritoneum in children; indeed, the operation would seem to be equally easy in these, whether the bladder is distended or not.

As regards adults, these statements must be modified a little. The neck of the bladder, the internal orifice of the urethra, in male adults lies about two inches below the upper margin of the pubes. Now, the peritoneum between the pubes and the bladder cannot descend lower than the external longitudinal muscular layer of the bladder, which is inserted into the lower border of the pubes. This distance is nearly always under an inch in length. Indeed, in most the reflexion of peritoneum in a perfectly empty bladder takes place very near to the upper margin of the pubic bones. In old men it is lowest, and in these sometimes the whole upper surface of the bladder appears cupped and concave, without the appearance of any peritoneal folding at all. With Barwell,* I cannot believe it other than impossible that the peritoneal fold could lie as low as two and a quarter inches below the upper margin of the os pubis.

This refers to the lower limit of the peritoneal fold in the contracted state of the bladder; we must now turn to the effects of distension of the bladder alone, and of this combined with inflation of a bag in the rectum. Of the influence of distension of the bladder in raising the fold there is no doubt whatever.

* *Med. Chir. Trans.*, 1886, p. 354.

With different degrees of distension, that is to say, after injection of varying amounts of fluid up to 21 ounces, we get an elevation from zero up to nearly $2\frac{1}{2}$ inches. But there is no constancy. Thus, two males of 34 and 35 respectively after an injection of 10 ounces into the bladder give elevations of $\frac{3}{4}$ inch and $1\frac{3}{4}$ inches respectively. One male of 30 with 15 ounces in the bladder gives an elevation of $1\frac{15}{16}$ inches; while another, aged 35, with 16 ounces gives an elevation of $2\frac{3}{8}$ inches. Petersen's table I confess I cannot understand. Thus, with 21 ounces of fluid in the bladder, one patient has the supra-pubic fold one finger's breadth *below* the pubic margin, while another has it $1\frac{1}{2}$ inches above. There is no use in striking an average between extremes such as these, when we are told nothing about the anatomical conditions. In fact, according to Petersen, the chances are about even that a pint of fluid in the bladder will not raise the peritoneal fold at all. (In ten cases the elevations in inches are: .33, 1.49, 0, 0, .669, .29, —.66 .39, 0, .6.) Until these observations are confirmed by others I cannot accept the validity of Petersen's results, more especially as they contradict the clinical and operative experience of many years and many men.*

* The preceding statements had been finally passed for the printer when the important paper of A. B. Strong (*Annals of Surgery*, Jan., 1887) of Chicago came to hand. Strong's experiments were made with the same object as those of Petersen, Garson and Fehleison; but quite independently, and with more scientific precision, and after sounder methods. A study of Strong's results serves to further confirm the validity of my arguments.

One criticism must be made on Strong's paper. In Plate I. of it, he places the peritoneal reflexion at the level of the middle of the symphysis, a position described in the text as "one and a half inches below the crest of the symphysis pubis." In Plate II. the peritoneal reflexion is at the junction of the upper and middle thirds of the section through the symphysis, and this position is described in the text as "one inch below the crest of the symphysis pubis." These statements are in harmony with other measurements given in the paper. Now these measurements are either erroneous, or the depth of the symphysis must be estimated at *three inches*—an estimate which is manifestly excessive.

Strong's experiments clearly showed that "distension of the rectum alone elevates the base of the empty bladder, but does not raise materially the vesico-abdominal fold of peritoneum." A bladder distended with fluid tended to fall backwards into the pelvis; and he found that distension with air had a more potent influence in elevating the peritoneal fold. This is an observation full

I think it will be within the truth if we assume that, in an adult male, an injection of from 15 to 20 ounces of fluid will elevate the peritoneal fold at least one inch above the upper pubic margin, probably nearly two inches, and possibly over two inches.

The influence of distension of the rectum in adding to the elevation of peritoneum caused by distension of the bladder has been, in my opinion, much exaggerated. Petersen's table I cannot believe to be trustworthy, for reasons already stated; but even giving him the status of a special pleader in favour of distension of the rectum, we find that the average increase of elevation is a fraction of an inch. Supposing 14 ounces are in the bladder, and 21 ounces are injected into the rectal bag, we find elevations given of 1, 1.4, .23, .23, .83, .59, .29, .57, .24, .7 inches. Garson's table is even less satisfactory; Barwell's table shows that the elevation is very slight, and not such "as would be of any value to the operator." Theoretically, I have failed to understand why distension of the rectum

of significance. I suspect its true interpretation is to be found in the absence of all muscular influence in post-mortem experiments. It is scarcely credible that, in the living subject with normal abdominal pressure and contracting vesical and parietal muscle, the mere presence of gas, as compared with an equal amount of fluid in the bladder, should influence an anatomical displacement. It is surely more likely that the difference of conditions in the living and the dead must explain this difference. Strong considers that the operation is simplified by crowding the bladder against the abdominal wall by means of distension of the rectum, and considers that from 10 to 12 ounces in the rectal bag, and 8 to 10 in the bladder, are the best quantities of fluid to use. In his cases an average of 14 ounces in the rectum and 12 in the bladder elevated the peritoneal fold an average of 1½ inches above the crest of the pubes. Comparing Helmuth's experiments with Strong's, we may note that in 25 cases, with an average quantity of water in the bladder of 27 ounces and no rectal distension, the fold was raised 2 inches.

One observation of Strong's I must heartily endorse, and that is the wisdom of using thin rubber for the rectal bag. A thin bag follows up the gut in its windings; it tends to straighten it between the anus and the sacral promontory; and he might have added: it cannot burst the bowel, while it utilises to the full any special distensibility which the rectum may possess.

A careful study of these post-mortem experiments almost forces one to the conclusion that they are not to be entirely trusted as guides in performing the operation on the living subject, and that we must ultimately depend on the carefully recorded experience of practical surgeons.

should cause much elevation of the peritoneal fold. A bladder distended by fluid-pressure from the inside naturally assumes the globular shape; and this globular shape necessitates, for anatomical reasons, elevation of the peritoneal fold. Supposing this globe is compressed between the rectal bag behind and the parietes in front, the first thing that happens is that it is flattened against the parietes; and this flattening can take place just as easily over the folded peritoneum as by burrowing under it. There is no physical necessity why flattening of the bladder should elevate the peritoneal fold; only general increase of its dimensions will do this. And, practically, my own experience, as well as that of a few others, is, that if rectal distension does elevate the peritoneum, it is to an inappreciable extent. One thing rectal distension will do, and that is, to push forwards the posterior wall of the bladder: in the removal of tumours this displacement is of great value. For every other purpose I am convinced that it is valueless.

A comparison of the accompanying engravings will bear out my argument. Figs. 76 & 77, from drawings of frozen sections, by Langer, show the relations of the bladder to

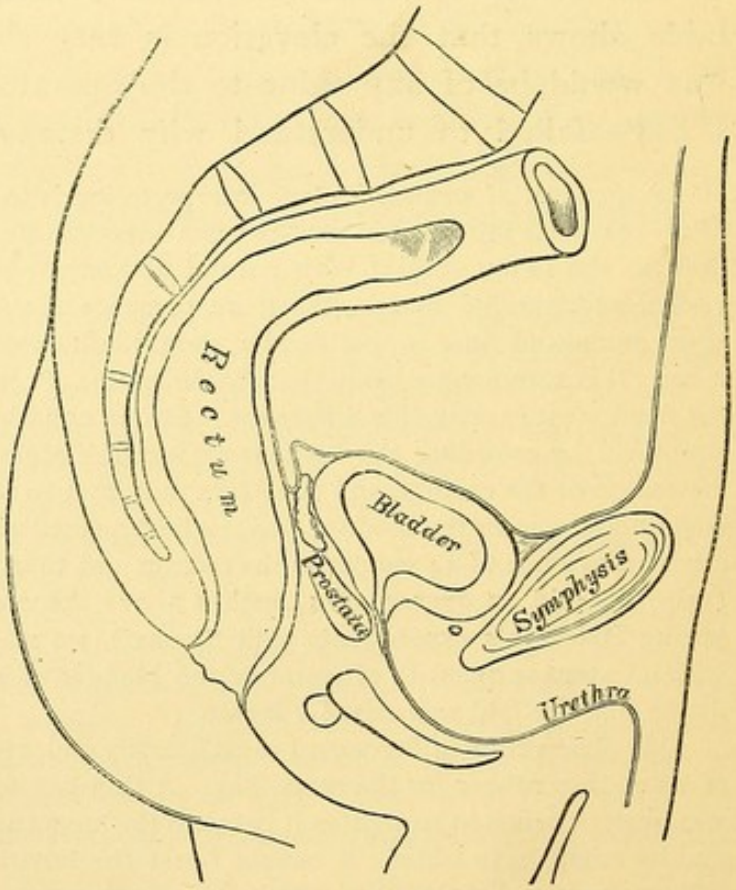

FIG. 76. (C. LANGER.)

Sagittal Median Section through the Pelvis of a Young Man, the Bladder being Contracted.

the parietes when the organ is contracted and when it is distended. Fig. 78 is reduced by photography from a plate of Garson's to the same scale as Langer's, and shows the effects of combined rectal and vesical distension. It will be seen that the supra-pubic interval is practically as large after simple vesical distension as after combined rectal and vesical distension. On the other hand, the base of the bladder is pushed forward by the rectal bag, and the neck of the bladder is greatly elevated from its natural position under the symphysis. Flattening of the bladder over the folded peritoneum without elevation of that membrane is also well shown in Fig. 78.

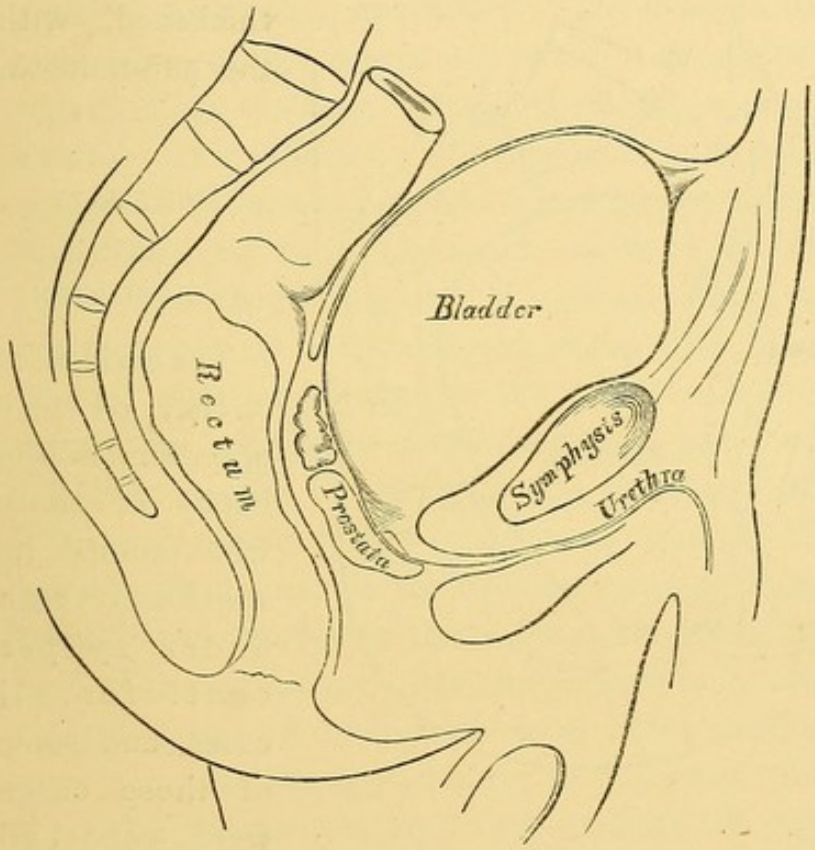

FIG. 77. (C. LANGER.)

Sagittal Median Section through the Pelvis of a Young Man, the Bladder being Distended.

The structure of the bladder-wall is well known, and need not be dwelt upon. In operating, it must not be forgotten that the fibres of the external muscular coat arise in front from the posterior surface of the body of the pubes, and may easily be torn from their insertion by rough manipulation. Two large veins, continuations of the dorsal veins of the penis, pass through this insertion, one at each side of the symphysis, about three-

quarters of an inch apart; if the knife is not kept carefully in the middle line, one of these may be wounded. The three muscular layers—external longitudinal, middle circular, and internal longitudinal—form the bulk of the bladder-wall. The submucosa is intimately united to the mucous coat; the mucous coat is, by comparison with that of the intestines, thin and anæmic. In some cases of old-standing calculus, however, it becomes greatly thickened, with the sub-mucosa.

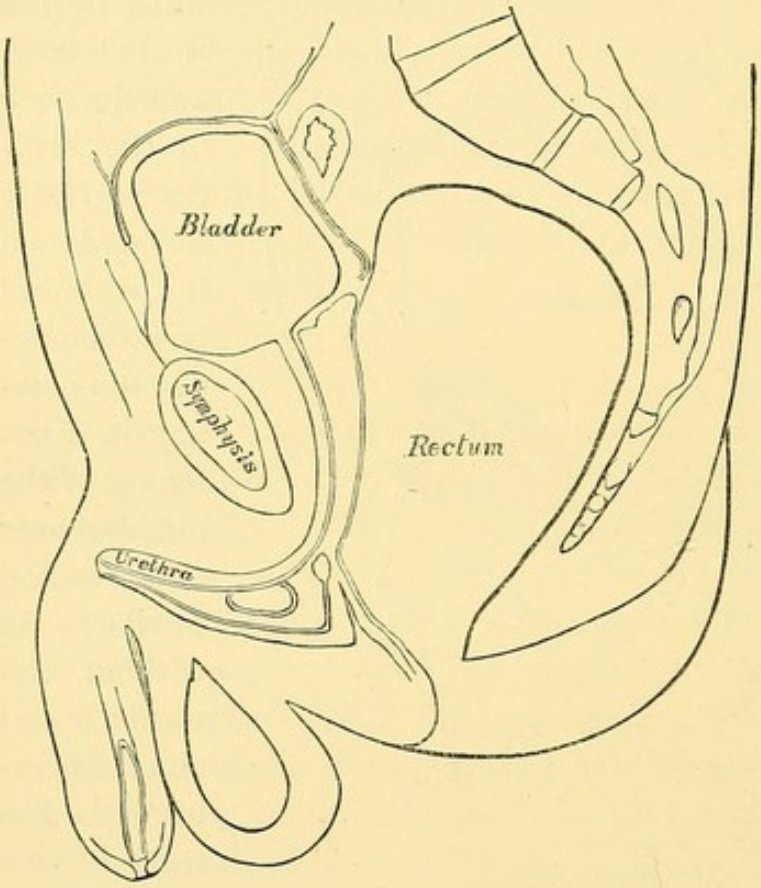

FIG. 78. (GARSON.)

Sagittal Median Section of Male Pelvis, with Distension of Bladder and Rectum.

MORTALITY AND APPRECIATION.

The early mortality of the operation in the hands of those who studied its methods was under 15 per cent. for all cases, and some of these cases were very bad indeed. Dulles,* up to 1875, had collected records of 478 cases. An analysis of these cases showed that the results of supra-pubic lithotomy were as good as the lateral operation for calculi weighing between one and two ounces, and better for calculi weighing above two ounces. In 1881 his collection of cases amounted to 636, and the results continued unchanged. Dennis's collection of

* *Amer. Journ. Med. Sc.*, July, 1875.

127 cases operated on since 1879 gives a mortality of 9 per cent. It must not be forgotten that these cases include the very worst examples of stone.

At the present day the operation is chiefly confined to cases of very large stones, and to young children. To strike an average between these classes of cases, and draw conclusions therefrom as to the general mortality of the operation, is absurd. For children the cases are as yet too few to be entered in competition with other operations. Most surgeons who have had experience of the operation prefer it to all others, and many regard it as the only cutting operation which should be performed on the bladder. The operation is at present on the crest of a wave of popularity, and is perhaps just a little over-praised. Some maintain that it is much easier to perform than perineal cystotomy: this is a matter of opinion and of experience; it is certainly not, as compared with many other operations, difficult. Special consideration as to its value in saving life, and not interfering with subsequent comfort, has been given under "Indications for Operation," and need not here be repeated. The whole question may be summed up in the conclusion formulated by Dulles, whose words must carry great weight: "I have come to the conclusion that a temperate view of the subject will lead to the conviction that the supra-pubic operation deserves to rank above all other methods of lithotomy for stones of large size, and that its applicability to any case should be carefully discussed before deciding to cut through the perineum."

THE OPERATION.

Preparatory.—The patient's bowels must be well opened, and the rectum cleared by enema immediately before operation. Pubic hair must be shaved off, and the skin in the neighbourhood thoroughly purified. The patient is laid on an operating table in the supine position, and the operator and his assistant stand on the right and left of the patient, as in an ordinary abdominal section. The steam spray is not essential, as the cavity of the bladder can rarely be rendered aseptic; but in young

children, and in cases of papilloma with healthy or only blood-mingled urine, the spray may conduce to an ideally aseptic course.

The coverings of the patient should be so arranged that the thighs may be separated and access given to the rectum without uncovering any part of the body. A blanket rolled round each limb, and a third over the chest and abdomen, will be found efficient. A small table for setting irrigating reservoirs upon should be placed near the foot of the operating table. A box, or small chair, or other simple piece of furniture placed on this table, will serve to place the reservoirs upon when it is desired to raise them three or four feet above the level of the patient.

Instruments.—The instruments requisite are few and simple. A sharp scalpel, a pair of scissors, a sharp-pointed tenaculum, and half a dozen pairs of catch-forceps, with the apparatus for distending bladder and rectum (if necessary), will suffice for the performance of most operations. For the extraction of calculi, lithotomy forceps and scoops; and for the removal of tumours, curettes, or scrapers, or bent forceps, will complete the list. Some surgeons recommend the use of special instruments: Sir H. Thompson, for instance, uses an "ivory separator" and a director, and for special conditions a hollow sound with a bulbous stilet; but none of these instruments are essential.

Distension of the Bladder.—This will usually be the first step of the operation. If the rectal bag is to be used, it may be inserted as the first part of the operation; but I think it should not be filled till the bladder is opened. It is an advantage to make the dissection with the fascia and cellular tissue as lax as possible; the rectal bag crowds forward the neck of the bladder and compresses the tissue against the abdominal wall, so that vessels are not easily seen and layers are not easily recognised. I should not advise the employment of the rectal bag at all for cases of calculus. For bringing up the posterior wall in the removal of tumours, the rectal bag is valuable. But it cannot do this efficiently till the bladder is opened, at least not while there is vesical distension.

Distension by hydrostatic pressure is, in my opinion, far superior to distension by hand pressure; and for these reasons:

(1) We know exactly what amount of pressure we are putting on the vesical walls. An elevation of three feet above the bladder is about one-twelfth of an atmosphere, or a little over a pound to the square inch; of two feet, one-eighteenth of an atmosphere, or about twelve ounces; and so on. Now, the amount of fluid injected is, for a diseased bladder, absolutely no criterion of safety. In many cases of large stone the bladder is enormously thickened at some parts, and almost ulcerated through at others, while it is frequently tightly closed around the stone. To force eight or ten, or even fourteen, ounces, as is often recommended, into such a bladder, is full of risk, and should never be done. In a case such as this, an elevation of two feet above the bladder would be safe; if this amount of pressure will not distend it, then it should be left undistended.

(2) The distending force is applied with perfect continuity, and with any degree of rapidity required. Hand pressure is bound to be irregular and intermittent; and if the injection is made as a part of and during the operation, it will almost certainly be given too rapidly. If the reservoir is placed at a height of two or three feet above the bladder before the surgeon begins to make the first incision, a gentle, steady, distending force, not unlike that naturally produced by the ureters, but more rapid, will be gradually filling the bladder.

(3) The pressure can be removed instantaneously simply by lowering the reservoir to the level of the bladder, and increased to any extent simply by elevating it. There is no time wasted in adjusting or removing the syringe. The apparatus is always ready; and by the simple proceeding of elevating or depressing the reservoir, without attaching or detaching apparatus, can either empty the bladder or fill it to distension.

The way in which I now carry out distension of the bladder is as follows: a soft rubber catheter, English make, of size as large as the urethra will admit, is passed into the bladder, and any urine present is withdrawn. The tube of the irrigator is then placed over the end of the catheter, and after a few ounces

of boro-glyceride solution have trickled in it is removed, and the fluid permitted to run into a receiver. If the urine is very foul, this may be done again once or twice. The reservoir connected with the catheter is then placed permanently on its stand, three feet or so above the level of the patient, and left there gradually to distend the bladder while the cutting operation is going on. An elevation of three feet will be found enough for children; for adults with thicker and less distensile bladder-walls, four feet will be the upward limit of safety.

Any form of reservoir or fountain syringe that will stand is suitable. It is convenient to have it fitted with a glass tube as a gauge outside, marked in ounces, to indicate the amount of fluid that has escaped into the bladder. It ought to contain, at least, two quarts, in order that it may be used for washing out the bladder after operations.

The bladder is kept distended by the elevated column of fluid. The catheter is not removed; if of full size, no fluid will escape by its side. The somewhat barbarous proceeding of tying the penis with an elastic cord, so as to prevent escape of the fluid, is thus done away with. Should the patient strain much, and the abdominal pressure be increased, the fluid is squeezed out of the bladder into the reservoir; it is better that this should take place than that the bladder should be overstrained, or even ruptured. When the straining ceases, the fluid will pass in again.

The rubber tubing which joins the reservoir to catheter should be at least six feet in length, and should be fitted with a contrivance such as is usually provided with irrigators to compress the tube when this is necessary, as, for instance, when the bladder is opened.

The lotion employed should be of the warmth of the body. No antiseptic for employment in the bladder is superior to boro-glyceride; and it may be used of considerable strength. A full tablespoonful of boro-glyceride to the quart of water is by no means too strong. The soft catheter attached to the irrigator need not be removed during the whole operation. It can scarcely be in the way, and it is useful for conducting fluid into

the bladder for a final washing out, and also for testing the security of the bladder-suture should this be inserted. Finally, if it is considered advisable to keep the bladder empty for some time, the catheter need not be removed at all, but may be tied in.

Nothing is said as to the amount of water to be injected. The capacity of the bladder is not to be measured by amount of fluid, but by its distensibility within limits of safety. Five or six ounces of injection might be dangerous in a bladder greatly contracted, and perhaps ulcerated, as in cases of large calculus; while a full pint might easily be borne in such a case as one of simple papilloma. The only safe criterion of measurement is that of force of distension; and this, I maintain, cannot be estimated accurately by the hand, but it can undoubtedly be measured by the means described.

Distension of the Rectum.—The ordinary rectal bag, as supplied "by the trade," is a formidable looking affair. It is strong enough to cause rupture of the walls of the rectum (as indeed has been proved too often), and when rolled up to its smallest dimensions it is larger than the largest rectal bougie. Rectal bags are now made in which the danger of over-distension is avoided by the use of silk webbing incorporated with the rubber. But the avoidance of this risk may be attended with a disadvantage, in not having the rectum distended to its full capacity. The distensibility of the rectum varies greatly in individuals: the protected rubber bag, while safe for a small rectum, does not utilise to the full the distensibility of a large one. I should discard the rectal bag in common use absolutely, and use instead a more delicate apparatus. A child's air-balloon or a delicate soft rubber urinal, fitted on to a celluloid catheter, answers the purpose admirably. While strong enough for the purpose intended, it is not strong enough to rupture the gut. It must be remembered that the chief virtue of the rectal bag is, not to increase the supra-pubic interval, but to bring the posterior wall of the bladder up into the wound. As usually employed the rectal and vesical bags are little else than two

fluid globes mutually undergoing a compressing and flattening process between the parietes and the sacrum. The rectal bag can scarcely bring the bladder-wall forwards till the bladder is opened; then it does so with ease and without the obstacle of a globe of fluid under high pressure. For this purpose the air-balloon is quite strong enough; and its use is attended with no danger, for it will give way (as I have ascertained) before the rectum will.

The balloon, fitted to the catheter, is greased (oil injures the rubber tissue) and introduced well into the rectum. The end of the catheter is attached to the rubber tubing coming from a reservoir similar to that for the bladder. A pint of fluid in the reservoir will usually be found sufficient. Distension is produced in the same way as for the bladder simply by elevating the reservoir two or three feet. When the bladder is opened, and while the tumour is being explored with the finger, the reservoir, already placed on the elevated stand, is connected with the rectal bag by removing the clamp from the rubber tubing: distension to the necessary extent takes place in a minute or two.

It is no small recommendation of this method of distending bladder and rectum that it may be carried out from beginning to end, not only without any interference at the hands of the surgeon (beyond insertion of catheter and bag), but even while he is actually engaged in the cutting part of the operation. The tubes from the reservoir being attached to the catheters in bladder and in rectum, the bladder reservoir is elevated and he proceeds at once to make the parietal incision. By the time this is finished, and before the bladder is exposed, distension will have been completed. Should extra distension seem desirable, this can at once be supplied by an assistant or nurse raising the reservoir a little higher.

The Incision through the Parietes.—A vertical incision from two to three inches in length, according to the size of the patient, is made exactly in the middle line over the pubes. The lower end of the incision should pass below the upper border of the symphysis for a distance of at least a third of an inch. The thick

fascia forming the linea alba being exposed, a small transverse incision is made through it close to the symphysis. This incision is made transversely partly because it is the easiest and safest way of dividing the fascia, and partly because it at once exposes the actual division between the two recti, but chiefly because it opens up the field of operation, which is often cramped by the strong, tense and closely set fibres. Through this transverse opening the point of the scalpel (or scissors) is insinuated, and the fascia divided upwards in the middle line to the top of the wound, the edge of the knife being directed forwards. The recti are now separated, and the transversalis fascia appears, and is divided as in abdominal section. At this stage one is usually struck by the great power of these muscles, and how vigorously they resist separation, even when the patient is fully anæsthetised. If their tension is so great as to hamper subsequent proceedings, part of their insertion into the pubic bones should at once be divided. This greatly increases the space. For the purpose of keeping the recti apart, I have devised strong wire retractors (Fig. 79), of different sizes, so shaped that they will retain their position when placed. One end of the retractor (the ends are of different sizes) is placed longitudinally in the vertical opening between the muscles; it is then rotated through quarter of a circle, so that its free end is over the pubes. By this action the recti are separated, the retractor is then pulled down towards the symphysis to be out of the way, and in this position it will remain without any attention. This instrument is very useful when considerable space is wanted by keeping apart the recti and opening up the field of operation: usually, however, it will not be required.

FIG. 79.

Retractor for Supra-Pubic Cystotomy.

When the transversalis fascia is divided, or rather the anterior layer of fascia which is continued downwards from the fold of Douglas, the yellow peri-vesical fat comes into view. The

scalpel is now laid aside, and the forefinger, keeping close to the symphysis, and undermining it so to speak, teases apart the fat with the numerous vessels, mostly large veins, which lie in it. At this stage, while the pulp of the forefinger rests on the bladder-wall, the distension reservoir is elevated a foot or two higher, and the bladder is felt steadily to expand and to become more tense. While this is being done, the finger may sometimes feel the peritoneal fold gliding upwards quite plainly. The fingers during this process of final distension, aided, perhaps, by catch-forceps, will have teased the fatty and cellular tissue aside, and thoroughly exposed the wall of the bladder. Much of the tissue should be pushed upwards, carrying the peritoneum in front of it, and acting as padding and protection to that membrane. While the bladder-wall is gradually becoming more tense, and rising upwards, and the finger is teasing an opening in the fibrous tissue, the sense of touch somehow carries to the mind an impression of security, or rather of certainty, as to the positive limits of vesical tissue proper. Fat, fibrous tissue, and peritoneum may be moved about anywhere, but the bladder wall itself remains stable and increasingly firm under all.

When a sufficient amount of bladder surface has been cleared we proceed at once to the next step.

Opening the Bladder.—Several methods of making the opening into the bladder are in vogue, and I have tried most of them. In several cases I have employed a Lister's sinus forceps for the purpose, first gently insinuating it through the outer muscular coats, and then sharply pushing it into the cavity. As the blades are separated the opening is distended, and the vesical wall may be pulled forward into the wound. I found that the opening so made was liable to be irregular and lacerated, and not suitable for subsequent suturing. A good many surgeons begin by placing thick fixation threads of silk in the bladder by curved handled needles, and make the division by knife while the bladder is pulled forwards. Besides the palpable objection to the making of more openings in the bladder than are necessary, there is another objection to the use of threads in the tendency

which they have to tear the vesical tissue. Several other plans have been mentioned and recommended, but the best, on the whole, is probably by a clean incision made through the walls, which are held forward by a tenaculum. The tenaculum, held in the left hand, is pushed sharply through the coats, its entrance into the cavity being signalised by the exit of a few drops of fluid (if this fluid is tinted blue with litmus, it is more easily seen), and its point is turned upwards. Immediately below the tenaculum, into the same opening it may be, the point of a sharp scalpel, held in the right hand, is gently insinuated, and the opening made by a steady cut downwards. This opening will vary in length according to the work to be done through it: at first it need never be longer than an inch; it may be extended afterwards. It must not be forgotten, however, that as the bladder empties, the peritoneal fold falls downwards, and it may then be difficult and dangerous to extend the opening in an upward direction. Therefore, the tenaculum should be inserted not lower down than the uppermost limit of the incision. It is sometimes not easy to define this limit. In a thickened and contracted bladder, which it is not safe to distend, the suprapubic interval may be short or absent, and the peritoneum has to be undermined, first downwards under the pubes and then upwards over the bladder, as in the operation for tying the external iliac artery. In such a case the urachus may often be felt as a round, somewhat tense cord, and a small knob representing its insertion into the summit of the bladder is occasionally perceptible. Peritoneum never passes the urachus; it is always safe to go as high as this point. This practical hint, thrown out by Thornhill a century and a half ago, is by no means to be despised in the surgery of to-day.

As the opening is made the fluid flows from the bladder, and its walls collapse. To prevent retraction two catch-forceps are made to grasp the lips of the wound, and the tenaculum is removed. Loops of silk inserted by a needle are usually employed for this purpose; the tendency of these to tear, and the formation of further openings in the bladder, are objections to the use of threads. At first I was afraid that the pressure ex-

erted by the blades of the forceps might cause sloughing. True, proof against this is abundantly afforded in the fact that catch-forceps are constantly being left hanging to pieces of tissue for long periods without endangering their vitality; and, as a matter of experience, forceps do no harm whatever. Compression need not be employed to the fullest extent, and traction must be no more than sufficient to keep the bladder opening upwards in the parietal opening.

Placing the forceps is very quickly done, and not much of the fluid will in the meantime have escaped. It matters very little, however, if the whole has escaped. If, as can seldom be the case, it is desirable to explore with the bladder full, the finger can at once plug the opening, and the bladder may be re-filled simply by permitting the distending apparatus to work.

Intra-vesical Manipulations.—These vary according to the purpose for which the operation is performed: namely, removal of a stone, a foreign body, or a tumour, or the hypertrophied prostate gland.

Extraction of Calculus.—The extraction of a calculus by the supra-pubic route is usually a proceeding of the simplest possible nature. If the rectal bag is not employed, and the lips of the wound in the bladder are held forward in the grasp of catch-forceps, the bladder when empty will form a simple elongated sac, at the bottom of which the stone will be found.

In children, where the stone is usually small and the bladder walls lax and distensile, extraction may be performed with great ease. Some surgeons recommend the employment of the fingers, or the finger with a scoop, for removing the stone; I should advise the use of small lithotomy forceps. The finger or fingers quite unnecessarily add to the dimensions of the body to be extracted, and so cause needless dilatation or tearing of the wound in the bladder. Forceps of proper dimensions, while quite efficient for the purpose, do not add to the bulk of the stone so much as the fingers. Nearly always the stone is caught between the blades at the first trial, without the insertion of the finger at all; if there is any difficulty in grasping the stone, the

finger introduced along the blades may place the stone between them, but should be removed before the stone. In view of the extreme desirability of getting union of the bladder wound in children, it is important that there should be as little traumatism and as small an opening as possible. The rectal bag raises the base of the bladder so as to make it become convex towards the front; the stone falls off this convexity into some part of the encircling sulcus, and is not so easily found as when the bladder remains as a simple sac. However, in very few cases can the finding of the stone be difficult. In cases of real difficulty, as when the stone is encapsuled, the finger in the rectum is the best means of pushing the stone out of its bed.

In adults, and particularly in old men, the stone in most cases will be very large, the bladder walls very thick, and perhaps ulcerated, and the situation of the viscus will be well back in the hollow of the sacrum. Vesical distension to any great extent will then be either dangerous or impossible, and the incision through the front of the bladder will probably at once expose the stone. It is then a question of how to remove the stone through the smallest opening, and with the greatest possible delicacy. Towards this end, one or two fingers in the rectum are more useful than the rectal bag. One or two fingers of the right hand in the rectum, with the fingers of the left hand through the bladder wound, may, by judicious and careful manipulation, disturb the stone from its bed, and place it so that its smallest diameter lies transversely to the bladder wound. By the combined manipulation the stone may often be pushed out of the bladder; if manipulation do not readily succeed, a suitably shaped lithotomy forceps may be made to grasp it, and help in the extraction. Force must not be employed; if the vesical walls appear to be stretched, and likely to tear over the shoulders of stone or forceps, they must be divided by a scalpel cutting down on the stone or the steel to what extent is necessary. In this operation there is no excuse whatever for the production of bruising or laceration. If the stone is of small or moderate size, it may readily be removed by forceps without the aid of the finger in the rectum or in the bladder.

Extraction of Foreign Bodies.—Here the insertion of the finger for exploratory purposes is always advisable. The nature of the body, and the possible existence of ulceration or even perforation of the vesical walls by sharp points, are made out. According to the information thus conveyed the mode of removal is decided upon. A small, blunt, or rounded foreign body may easily be removed by forceps. A long foreign body which cannot easily be tilted on end should, if possible, be divided. In such manipulations we must always bear in mind the possibility of perforating the bladder, and proceed with extreme circumspection. If actual perforation exists, or is produced, the parietal incision should at once be prolonged upwards, the peritoneal cavity opened, and the wound in the bladder sutured in the manner to be described for rupture of the bladder.

Removal of Tumours.—Most tumours may be removed with the instruments provided for the general operation. Medium-sized Wells' forceps, with blades set at right angles to the handles, will be found useful for grasping pedunculated tumours at their attachment to the bladder, and for twisting them off. Volkmann's spoons or ordinary curettes will be necessary where scraping is employed. Sir Henry Thompson invented several special forceps for removing tumours by the perineal route: these may be found useful in the hypogastric operation. The electric light introduced into the bladder may be useful for examining the tumour before removal, or the pedicle after it has been removed.

Polypi should be twisted off. A bent catch-forceps, guided by the fingers of the left hand, is made to grasp the pedicle close to its attachment to the bladder, and handed over to an assistant. A second similarly shaped forceps is placed on the growth immediately above the first, and twisted round, while the lower forceps is held stationary until the pedicle is twisted through. Small polypi may be at once twisted off the bladder. Large polypi are, I believe, most safely removed by twisting between two pairs of forceps. The twisting of a tumour with considerable attachments to the vesical walls of necessity does considerable injury to the tissues, and may result in ulceration

or sloughing of the vesical walls. The red-hot galvanic wire has been used for the purpose of dividing the pedicle.

Papillomata with pedicles are most conveniently removed by twisting, as described for polypi. Small, very soft dendritic papillomata are best removed by scraping or curetting between a suitable instrument and the forefinger. Indeed, the finger-nail alone will suffice for the detachment of many of these tumours. Of larger size, these growths must be attacked with sharp spoons or forceps, like the "gouge" bone-forceps (which suits admirably). A fibro-papilloma is detached piecemeal by scoops or curettes guided and assisted by the finger. If a pedicle can be grasped, it may be twisted off. Epithelioma can only be scraped and curetted in the same way. Most of these tumours lie on a bed of hypertrophied muscular tissue, so that there is little danger of perforating the vesical walls; still, the finger should always be alongside of the instrument, to make certain that it does not advance too far.

Detached tumours are subsequently removed by the stream of fluid sent into the bladder through the irrigator. It unnecessarily adds to the length of the operation and the traumatism to remove every particle from the cavity as it is detached.

Bleeding in these cases, though sometimes free at the moment, rarely continues over any length of time. Should it continue, and be at all alarming, a careful application of the actual cautery to the bleeding area through a small cylindrical speculum is probably the most effectual and least harmful mode of checking it. Topical application of powerful astringents may set up troublesome cystitis.

It must be noted that benign tumours of the bladder have a tendency to return. Recurrence has taken place in at least one in five of all the cases operated upon. This was Guyon's proportion in 15 cases of operation; and a study of scattered cases, including those of Sir Henry Thompson, shows a similar proportion. Looking at the condition which obtains in cases of numerous soft scattered polypi, this is not at all surprising; for many of these tumours must be imperceptible to the sense of touch, or even microscopic. Recurrence in these cases may be a con-

tinued growth of the undetected tumours, as much as a renewed growth of imperfectly removed ones. Repeated operation may then result in perfect cure. In the larger single growths, recurrence is most likely a sequence of imperfect removal. In the case of epithelioma that is scraped, we can expect nothing more than temporary amelioration of symptoms. In one such case on which I operated, the amount of relief from pain and tenesmus which followed, and continued for nearly six months, surprised all concerned in the treatment. If the pain and tenesmus had recurred, the patient would certainly have requested repetition of the operation: death took place from hæmorrhage.

In the case of malignant tumours involving the fundus, the propriety of resection would have to be considered. This will be dealt with further on.

The operation of partial *prostatectomy* has not yet been fully elaborated. In McGill's latest description of his operation* three distinct varieties of prostatic enlargement are described as being possible indications for operation. They have all one common characteristic—"they are all growths which protrude into the bladder cavity, and may consequently be described as vesical and not as perineal outgrowths." The varieties are—"(1) A uniform circular projection surrounding the internal orifice of the urethra. . . . (2) A sessile enlargement of the middle lobe, situated partly in the posterior half of the prostatic urethra and partly in the position of the uvula vesicæ. . . . (3) A pedunculated enlargement of the middle lobe."

"The operation consists of two parts: (1) The opening and drainage of the bladder; and (2) the removal of the prostatic valve, which prevents the egress of urine." For the fulfilment of both these conditions the supra-pubic operation is the best. This is performed in the way described above. The rectal bag should be employed. The neck of the bladder and the region of the prostate are carefully examined by the finger, and the actual variety of enlargement diagnosed. According to the nature of the enlargement we adopt measures for its removal. "A pedun-

* *Lancet*, Feb. 4th, 1888.

culated middle lobe can obviously be removed with ease, its pedicle being divided with curved scissors. A sessile middle lobe can be removed in the same way, helping the scissors by tearing with forceps. The collar enlargement is removed with greater difficulty. It is, I think, advisable to divide it longitudinally by inserting one blade of the scissors into the urethral opening and dividing the portion above, and then passing the other blade into the same opening and dividing the portion below. We now have that part of the gland which projects into the bladder divided into two lateral halves; these can be removed separately by scissors curved on the flat, or enucleated with the tip of the forefinger. Care must be taken not to leave any portion of the projecting valve untouched. When the operation is completed, whichever form of growth has been removed, it is advisable to see that the urethra is patent, and to pass the forefinger, as far as the first joint, into its canal." Hæmorrhage is not excessive, and may easily be arrested by the injection of a hot antiseptic solution. The bladder is drained by a rubber tube carried out through the lower angle of the wound, which is removed at the end of forty-eight hours. Four cases treated in this way by McGill made excellent recoveries, and were completely cured of their troubles, being able to pass water without the aid of the catheter, and being cured of the condition of purulent, fœtid, and alkaline urine; and in one case the patient was freed from symptoms of uræmia and surgical kidney.

When intra-vesical operations are concluded, the bladder is washed out by irrigation through the catheter still lying in the urethra. The lotion in the reservoir will by this time have cooled down, and a sufficient amount of hot water to raise it to temperature of the body should be added. As the lotion flows out through the hypogastric wound it may be collected either in sponges or wet cloths, or in a properly shaped vessel held under the wound while the patient is turned a little on one side. Fragments of growth and pieces of blood-clot are washed away in the stream. Irrigation may be stopped when the lotion returns as clear as when it left the reservoir.

Suturing the wound in the Bladder.—The propriety of suturing the bladder wound has been very much discussed. Some surgeons absolutely condemn the proceeding under all circumstances; others as universally recommend it; while a third class would limit its application to suitable cases selected according to the judgment of the surgeon, guided by the leading principles of sound surgery.

It is unnecessary to follow the numerous arguments for and against the operation of vesical suture.* It may here be remarked that many of the condemnatory arguments are based on erroneous and imperfect modes of suturing, and should not prevail against well-devised modes; while too hasty generalisations in favour of suture in general are based upon one or two successes in particular instances.

That successful suture of the bladder, followed by primary union, greatly adds to the comfort of the patient and the rapidity of recovery there can be no dispute. And, if a sufficiently large number of cases could be compared, no doubt it could be shown that it adds to the chances of recovery as well. To base an argument (as has been done) in favour of the reduced mortality after suture is misleading; because suture has been applied chiefly in the most favourable cases and in children. On the other hand, although it would be difficult to prove it, there can be no doubt that an injudicious application of the suture adds to the patient's danger.

In speaking of the indications and contra-indications to the employment of vesical suture, only very general statements can be employed. We must take into account such circumstances as the condition as to health or disease of the vesical walls, with respect to their capacity for uniting; the condition of the vesical mucous membrane, as to whether it is likely to secrete inflammatory products; and the power of the bladder-muscle to contract and empty the viscus.

* Those desirous of pursuing the subject will find it exhaustively handled by Gross of Nancy in the *Memoires du Congrès Français de Chirurgie.* 2e Sess. Paris, 1886.

In cases where the vesical tissues are greatly thickened or inflamed or œdematous or gorged with blood, no attempt at suture should be made. Such an attempt will almost certainly fail to give union, and will unnecessarily add to the traumatism. In other cases, chiefly of very large stone, there may exist ulcers or abrasions on the mucous surface in the region of the wound; here also suturing is not likely to be successful, and may aggravate the ulceration, and even cause sloughing. If cystitis has existed for some time, and we apprehend the secretion of muco-purulent products into the cavity after operation, suture should not be employed. Drainage is, in fact, one means of treating this inflammation; and even if suture were successful, the cure of the inflammation through the urethra with a closed bladder is not likely to be so rapid as through the bladder wound. Finally, if, from repeated or long-continued over-distension or inflammatory infiltration, the vesical muscle has lost its tone, and cannot completely empty the viscus, we should hesitate before adopting primary suture. Such a case would be where there is excessive hæmorrhage, and the bladder is frequently filled to distension with clotted blood which cannot be passed in the urine. Even with a catheter passed through the urethra into the bladder, residual urine collects, and will undergo decomposition and cause cystitis.

On the other hand, given a case in which the tissues in the wall of the bladder are healthy, the muscles capable of contracting naturally, and the mucous membrane not likely to secrete inflammatory or noxious products, then we may suture the bladder wound. The great majority of these cases will be found in children with calculus which has not set up much cystitis. In adults with bleeding tumour which is not associated with inflammation, another class favourable to vesical closure will be found. In old men, the most favourable conditions to suture can scarcely be found with stone, and rarely with tumour. The practice of complete closure of the wound in the bladder will, therefore, be mainly confined to children. A mode of partial closure, suitable for doubtful cases, and advisable with the view of closing up opened areolar spaces, will be described. A good

many are best treated without any suture at all, while the bladder is, as far as possible, maintained in the condition of an open and exposed wound. One purpose of suture of the bladder is to prevent infiltration of urine : if the suturing is not perfect, it adds to the danger of infiltration ; and the risk therefrom being greatest in old men with unhealthy bladders, in these the treatment by open wound is most frequently called for.

Of modes of suturing the bladder, a good many have been described. In most the practice adopted has been founded on the principles which guide the suturing of wounds of the intestine. It may be pointed out that the outer coverings of the bladder in this operation are not peritoneal, and do not exhibit the same tendency to rapid healing ; that the whole bladder wall is thicker than the intestine, although perhaps it is not more tough ; and that the mucous membrane of the bladder, unlike that of the intestine, is too thin to act as a plug against the escape of fluid. Further, the actual line of incision in the bladder, if cleanly cut and straight, provides two broad surfaces of tissue prone to unite if properly approximated.

One of the most ingenious modes of suturing the bladder is that described by Maynard.* The sutures are placed in two double rows by a special needle before the bladder is opened, and are used, during the opening and in the subsequent manipulations, to pull the bladder-walls forward. An obvious objection to this plan is, that by the traction the stitch-openings are stretched and dilated. The important advantages of his plan are, that it gives apposition, not only at and beyond the margins of the wound, as in Lembert's mode, but also at the cut edges. The most generally adopted plan is Lembert's.

I should, with Maynard and a good few others, here prefer chromicised gut to silk as suture-material. Suture holes in the bladder are more likely to leak than in the intestine, for the reasons that the plug of mucous membrane below them is not so efficient, and that sealing up of the openings by exuded lymph is not so rapid. The gut swells and blocks the opening ; and if it should come in contact with the urine, does not carry it

* *Glasgow Med. Journ.*, Dec., 1887.

through the tissues by capillary action as silk does. Chromicised gut will last for a week or ten days at least, and by this time the full benefit of suturing will be secured. Ordinary carbolised gut is too rapidly absorbed.

I would recommend the application of a double row of sutures: the inner row to transfix the cut muscular surface, but not the mucous membrane; the outer row, after the manner of Lembert. Two blunt tenacula are placed, one at each end of the wound in the bladder, and handed over to the assistant while the catch-forceps are removed. The wound is gently kept on the stretch by this means, and the walls at the same time kept forward. A round semicircular needle, with piercing but not cutting point, held in a needle-holder, is the best instrument for inserting the stitches. Each suture passes through the edge of the wound obliquely from the outside, close to but not piercing the mucous membrane, and picks up as much of the muscle as possible without encroaching too much on the limit to be covered by the second row of sutures. These stitches are, in fact, placed in a manner not unlike the "flange-stitch" of Tait. This stitch would, in fact, be the best of all were it possible to separate the wall of the bladder into layers, and were the friable muscle competent to bear sufficient strain; the approximation to flanging described would probably be the best practical method. About four stitches to the inch are inserted in this way. While the tenacula continue to hold the wound forwards the second row is now placed, after Lembert's method, the terminal stitches passing a little way beyond the ends of the wound. They should alternate with the stitches of the inner row. When inserted the ends of the sutures are gathered together in the hands of the assistant, the tenacula are removed, and the sutures are then tied systematically from one end of the wound to the other. When all have been tied, their ends are cut off, and the bladder permitted to fall backwards to its normal position when empty. The whole supra-pubic space is now thoroughly cleansed of blood and fluid, and the tap removed from the irrigating reservoir, so as to distend the bladder and test the efficiency of the suturing.

There is no objection to the employment of the continuous Dupuytren suture, if the surgeon thinks it can be properly applied. I have on two occasions employed it to supplement an interrupted suture, and found primary healing to follow.

The parietal wound is now sutured, after a drainage-tube has been placed over the line of suture in the bladder. If the ends of the recti have been divided, a good deal of tension may be required to bring the lips close; it is better to have a little space gaping, than exert too much traction. The tube not only drains the exudations from the supra-pubic space, but acts as a safe-guard in the event of the suturing of the bladder not proving perfectly efficient, and some of the urine escaping.

Partial suture of the bladder is not recommended unless the bladder is at the same time sutured to the parietes, as in the ordinary treatment of an abdominal cyst which is not removed. In old men the bladder lies low and far back, and it prevents unnecessary infiltration of urine to have the fundus kept well up in the wound by means of a stitch or two. I have on two occasions treated the bladder in the same way as the peritoneum in laparotomy—including its walls bodily in the stitches which pass through the parietes. On several occasions I have spoken of the possible advantage of treating the whole bladder-wound in this way; but the lower part of it I have always found to lie too low down to be easily brought up to the parietes. Quite recently Engelbach and Rollin* have written in favour of this combined mode of suturing bladder and parietes, while a drainage-tube resting in the bladder passes through the middle of the wound. The risk of this method is that drops of urine passing along the stitches may get into the peri-vesical space. One or two stitches at the top of the wound placed in this way could do no harm, and might, by keeping the bladder forward and diminishing the wound-area, do much good.

After-treatment.—If the wounds are sutured, an ordinary dressing is applied, and fixed by strapping. Many surgeons recommend that the bladder be kept empty by wearing a cath-

* *Ann. des mal. des org. gén. urin.*, Sept. 1887, and *Med. Chron.*, Dec. 1887.

eter in the urethra. Theoretically, this is sound; but practically, in children at least, I am convinced it is best to leave the bladder to its fate, and let the patient pass water when he desires to. I have on two occasions seen blocking of the catheter cause that very over-distension which we wish to avoid, and on the first occasion on which I dispensed with the catheter I got perfect primary healing. Barker and others have come to the same conclusion; and, therefore in every case where the patient is young, and the bladder wound has been satisfactorily sutured, I should dispense with the catheter fixed in the bladder.

If the wound is not sutured it is freely dusted with iodoform or smeared with boro-glyceride, and covered with large pads of absorbent dressing. The value of a drainage-tube in the bladder is doubtful; I have thought that it causes irritation sometimes, and, if the lips of the wound remain open, I dispense with it. The dressing is fixed with two long pieces of strapping, and the patient is permitted to lie in any position he pleases. Intra-abdominal pressure is quite sufficient to keep the bladder empty, and force the secreted urine out at the wound; the urine has no more tendency to collect in the bladder in the supine than in the lateral posture. Change of position is adopted simply because it adds to the patient's comfort.

If primary healing after suture takes place the sutures may be removed at the end of a week, and the patient permitted to get up in ten days. If localised redness and swelling appear in the supra-pubic incision, the stitch or stitches in this area should should at once be removed. In some cases a few drops of urine trickle out through the wound, to be followed by the formation of a small fistula, which spontaneously closes in a few days. If the fistula is large, so as to permit passage of all or the greater part of the secreted urine, healing will probably not take place for three weeks or a month. In children, even if the bladder-suture has completely failed, perfect healing is rarely delayed longer than three weeks. In any case the child may be permitted to get up and run about at the end of a fortnight. In one of my patients in whom primary healing was almost, but not quite perfect, a free discharge of blood took place into the

bladder at the end of ten days. Similar experiences have been recorded by others. Obvious explanations of this peculiarity suggest themselves, but, in the absence of anything like clinical proof, had better be withheld.

If the wound is not closed there is sometimes a tendency for mucus and inflammatory products to collect in the bottom of the vesical sac. These should be washed out as often as necessary by means of the irrigator. The wound and everything in its neighbourhood should be kept sweet by frequent cleansing and the employment of suitable germicides. At the end of a few days, if the patient will bear it, he may be lifted on a sheet into a warm hip-bath, placed by the side of his bed, and left there for half an hour or more. If this can be done daily, it not only adds to the patient's comfort, but serves thoroughly to cleanse the parts.

PARTIAL RESECTION OF THE WALL OF THE BLADDER.

This operation has been performed only three or four times, and has scarcely yet attained to the position of a recognised proceeding.

Sonnenberg * was the first to perform the operation, and related his case at the Fourteenth Congress of the German Society of Surgeons in 1885. Von Antal of Budapest † performed a partial resection in April, 1885; and Radzimowski, a Russian surgeon, has published in the *Kief Vrach* for 1886 a similar operation. At least one other operation, not yet published, has been performed.

Sonnenberg's operation was performed on a man aged sixty, who had a malignant tumour in the anterior wall of the bladder. The supra-pubic operation was performed in the usual way; and the tumour was found to have so broad a base that, to remove it, it was necessary to resect nearly two-thirds of the wall of the bladder. The tumour was removed in portions, and the peritoneal cavity was opened. The bladder wound could not be

* "Zur partiellen Resection der Harnblase," *Verhandl. d. Deutsch. Gesel. f. Chir.*, 1885, xiv. 12. † *Centralbl. f. Chir.* 1885, p. 617.

closed; but the peritoneum was carefully brought together by sutures over it. The bladder was drained both by the urethra and by the parietal wound. The patient lived four weeks, and died of asthenia. At the post-mortem it was found that a new and water-tight cavity had formed, which seemed capable of being distended.

Von Antal's case was a sub-peritoneal resection. His patient was a man aged sixty-one, and to remove the growth about one-third of the wall of the bladder had to be removed. The operation was retro-peritoneal, the whole area of the viscus invaded by the tumour having been peeled from the peritoneum. Several bleeding vessels had to be tied during the operation. The edges of the wound in the bladder were closed by silk sutures, drainage tubes were inserted, and the wounds treated by constant irrigation with thymol solution. The patient made a good recovery, with a fairly capacious bladder.

Of Radzimowski's case I cannot speak.

In carefully selected cases there can be no doubt that partial resection of the wall of the bladder is both feasible and proper. The most satisfactory operation would be where the tumour lay entirely in the anterior wall, when it could easily be removed without encroaching upon the peritoneum. A tumour lying behind the summit of the bladder may be resected if it does not involve too large an area of the walls: a base two inches in diameter must be the very highest limits even with an easily distended bladder. Removal in portions, as done by Sonnenberg, does not commend itself to me; and sub-peritoneal resection can rarely be advisable if the tumour deeply infiltrates the bladder tissues, for then the peritoneum is likely to be invaded with the new growth. Complete excision of growth, bladder-wall, and peritoneum by a cutting operation would probably be the best plan where that is possible. I should make an attempt to bring the growth well into the bladder wound by means of catch-forceps; then by longer forceps with angled blades pinch up the healthy bladder-walls behind it, and endeavour to make a closure of the healthy walls all round by means of a shoemaker's stitch, so as to close the bladder behind the tumour before cutting it away.

The supra-pubic incision should always be prolonged into abdominal section, and the bladder wound is then more thoroughly closed by Lembert sutures placed on the outside. While this is being done, a sponge should be placed inside the viscus to make it bulge into the abdominal cavity, and to soak up the secreted urine; and the bowels should be well protected by soft flat sponges placed inside the abdomen.

Section XIV.

OPERATIONS FOR ABDOMINAL INJURIES AND INFLAMMATIONS.

This section might, not improperly, have been named the Reparative Surgery of the Abdomen. It includes the whole subject of Abdominal Traumatism, so far as it can be dealt with by surgical methods, and those varieties of peritoneal inflammations which up to this time have been so dealt with. Abdominal Injuries are specially considered under the heads of Gunshot and Penetrating Wounds, and Sub-parietal Rupture of the Viscera, hollow and solid. Abdominal Inflammations are treated as being almost identical with Suppurative Peritonitis, and specially as originating in ulcerative perforation of the hollow viscera, in septic conditions and in tubercular disease. Clinically, it is impossible to deal with these on identical lines, or with even balance of detail. Thus, special

consideration must be given to Gunshot Wounds, to Rupture of the Urinary Bladder, to Rupture of the Intestines, and to Perforative Appendicitis. These may be regarded as types of classes from the clinical standpoint; while the position they hold in the field of practice makes independent treatment desirable.

OPERATIONS FOR ABDOMINAL INJURIES.

Gunshot Wounds of the Abdomen.

The treatment of gunshot wounds of the abdomen by laparotomy is one of the latest developments of modern surgery. Up to 1885, according to Parkes, only six operations for this class of operation were recorded. Dr. Kinloch of North Carolina, in 1881, probably performed the first operation. Kocher of Berne had a success in 1883. Among the most remarkable of laparotomies for gunshot wound was one by W. T. Bull of New York, performed in 1885, in which no fewer than seven intestinal perforations were discovered and closed. The patient made a complete recovery.* To this, in the following year, he added another success quite as remarkable.† In Kocher's case,‡ operated on three hours after receipt of injury, the stomach was perforated. The subject was forced into prominence by the interest manifested and the correspondence published in connection with the murder of President Garfield by a gunshot wound of the abdomen; the usually hopeless results of these injuries when untreated, and the success of certain operations, combined with the general improvements in abdominal surgery, have now resulted in placing the treatment of gunshot wounds of the abdomen among justifiable and beneficial operations. Towards this result American surgeons have contributed by far the most important part.

* *Boston Med. and Surg. Journ.*, Nov. 27th, 1885.
† *Ann. of Surg.*, Dec., 1885.
‡ *Corresp. Bl. f. Schweiz Aertze*, Nov. 23rd and 24th, 1883.

ANATOMICAL CONDITIONS.

Although in recent wars there has been no lack of opportunity for studying bullet wounds of the abdomen, nor dearth of description of the effects produced, yet, from the fact that these reports have been compiled from the pathological rather than the operative standpoint, we have few definite data to guide us in making inferences from the nature of the external wound as to the character of the lesion produced. Studies of the results of certain experiments on the lower animals, and of the details furnished in the descriptions of operations, provide valuable supplementary knowledge which may be used to guide us in undertaking these operations.

It may be inferred that a ball, entering the walls of the abdomen, pursues a straight course through it. It is true that a ball, entering the parietes at one point, may pass in a curved direction under the skin and make exit, or be embedded at a position not in the line of trajectory. But this is rare, and can occur only when the skin is struck very obliquely, and the force of the ball is somewhat spent. If the ball has made an exit, the practical inference must be that its course has been in a straight line between the points of entrance and exit, unless there are positive evidences—in sub-cutaneous discoloration, or the course as indicated by a probe—that the reverse is the case. If the ball penetrates the parietes, but makes no exit, we must infer injury, greater or less, to the underlying organs.

Some information may be derived from the character of the parietal wound. A large wound argues a large ball from a large firearm, and, in the majority of cases, the most extensive injuries. It is true that shots from guns are usually fired at a considerable distance; but their initial force is usually much greater than those from revolvers which are fired close. From any sort of firearm a close shot will, in most cases, cause deep penetration; close discharge may often be inferred from the presence of powder marks around the wound. A wound that is clean cut, and equally stained all round, usually indicates that the ball has struck the parietes at right angles to the surface.

Unequal staining of the edges, with want of uniformity in the lips of the wound, suggest oblique impaction. A long, abraded, or bruised track of surface, leading up to the perforation, suggests very oblique impaction, with a possibility that the cavity has not been penetrated.

It is rarely possible to get trustworthy information as to the course of the bullet from the position which the wounded person held when the shot was fired. We may be told that the shot was fired from the front, or the side, or the back; but anything like an estimate of the angle at which the body was struck is rarely provided by patient or onlookers. Where there have been struggles, this difficulty is increased; and in such cases also the injury may have been inflicted while the patient's body was bent or contorted, so that the track of the ball, with the patient in bed, may be devious, while it may have been perfectly straight in the position held during the infliction of the injury.

It will be seen, therefore, that, in the case of one wound, a consideration of external circumstances will at best supply only probable deductions as to the two important facts of penetration of the parietes and direction of the ball. In a few cases both probabilities may rank almost as certainties; in a greater number, one inference may be made with certainty, while the other cannot; certainty in every case can be secured only by an examination of the wound by probing, or even by incision.

The nature of the injuries inflicted, varying according to the size of the bullet and the force of it, and according to the angle of impact on the organ, is yet fairly constant for each individual organ. The chances of any individual organ being struck vary directly according to the surface it presents. A ball traversing the anterior parietes can scarcely fail to injure bowel, while the chances of injury to liver, spleen, kidney, stomach, or bladder vary according to the route of the ball and the size of the organ. Again, a ball passing perpendicularly through the renal cortex produces very different results from one passing obliquely along the renal vessels and through the pelvis. A ball passing clean through the right lobe of the liver produces very different effects

from one crossing the track of its great vessels. It is unnecessary to multiply examples of effects, which must suggest themselves to every surgeon. For practical purposes, the size and rapidity of the projectile may be ignored. Although a large and nearly spent ball produces more extensive injuries than a small or rapidly moving ball, yet the effects of the latter are quite serious enough to greatly endanger life, and make an almost equally urgent claim for operative treatment. In the case of a rapidly moving and small ball passing obliquely through the thicker walled hollow viscera, such as the stomach and the duodenum, it has occasionally been noted, once during operation, that oblique perforation need not be followed by extravasation. But this possibility cannot be counted upon as a probability: if the contents do not escape at once, they may do so later on, when suppuration or sloughing has set in. For practical purposes, therefore, perforation of the hollow viscera by bullet-wound must always be reckoned as leading to extravasation of visceral contents.

It has properly been said that the tendency of every gunshot wound of the abdomen is towards death. In the great majority of cases death is due to a form of peritonitis which is usually described as septic. No doubt the peritonitic fluids are septic, but it is doubtful if the death is owing to true blood-poisoning, rather than to severe shock. In more than 90 per cent. of the cases attacked with peritonitis, death takes place within forty-eight hours. It is true that the peritoneum has a limited power of disposing of septic fluids. The experiments of Grawitz and Wegner showed for the lower animals this fact, which has occasionally been observed in human beings. But this power of the peritoneum has an infinitesimal influence in lessening the death-rate from this class of injuries. Even if there has been a moderately perfect plastic closure of a perforation, the edges of a bullet-wound are so liable to undergo sloughing, that a secondary perforation usually takes place. A separated slough cast loose into the cavity has great dangers of its own; a slough of the mesentery which cannot fall into the bowel is, in this sense, more dangerous than one on the intestinal wall.

Bleeding is, in itself, rarely fatal; but the extravasated blood, when infected by free visceral fluids, provides pabulum for the extension of septic inflammation, and so adds to the danger. A small number of deaths has been caused from loss of blood through division of some of the large vessels. This is more likely to result from wounds involving the solid viscera and their vessels than from injuries to the hollow viscera.

SYMPTOMS AND DIAGNOSIS OF VISCERAL INJURY.

As recent practical experience and accurate clinical records thereof have done much to discredit the value of the usually accepted symptoms of perforations of viscera; and as incontrovertible physical signs are very rarely met with, the diagnosis must in many cases be matter of inference from the ascertained course of the ball.

Definite physical signs are afforded when there is escape through the parietal wound of the fluid contents of any of the hollow viscera, such as bile, fæces, urine, or partially digested food, and when there is a discharge of large quantities of blood in vomit, fæces, or urine. Both sets of signs are very rare: and the value of the escape of blood, as a sign of injury to the hollow viscera, is diminished by the fact that a severe contusion may cause a considerable intra-visceral hæmorrhage. The escape of a large quantity of gas from ruptured bowel, which rises to the top of the cavity, and causes increase of resonance, and perhaps does away with liver dulness by getting between liver and parietes, has been spoken of as an unequivocal sign. Tympanites, however, may produce signs very closely simulating the presence of free gas.

Dulness on percussion, either in the track of the ball, or in the dependent portions of the abdomen, is, if present in marked degree, evidence of extravasation of fluids or blood. Localised dulness would usually be taken as indicating hæmorrhage: diffuse dulness, extravasation of visceral fluids. But either sign must be of rare occurrence, and where they do occur might only indicate that certain portions of bowel are at that moment

more full of fluid than other portions. The rapid occurrence of tympanites, too, which is most marked on the anterior abdominal surface may leave the dependent portions relatively dull to percussion. Emphysema of the abdominal wall in the neighbourhood of the wound is occasionally observed, but it is rare, and it may occur without penetration of viscera.

The presence of blood in the urine indicates, according to the position of the wound, injury to kidney, ureter, or bladder. But extensive injury to any of these organs may exist without the appearance of hæmaturia.

Injury to nerves or spinal cord will show itself in paralysis of the supplied parts. Injury to vascular trunks is inferred from the absence of pulsation in the femoral vessels.

Shock is frequently mentioned as an invariable sequence of perforating wounds of the viscera. Experience has shown that it is an exceedingly variable symptom, being frequently marked in unimportant cutaneous wounds, while it may be completely absent in the worst cases of perforation. In some cases, it is nothing more than nerve-prostration from terror; in others, it is produced by free hæmorrhage, or rapid extravasation of visceral fluids. In no case can its immediate occurrence be said to be indicative of visceral perforation. Further help may be derived from an observation of the condition, as to its increasing or diminishing in degree, and as to its capacity to be influenced by mental stimulus. It is sometimes observed on the battle-field that a man found in a condition of profound shock, on being told by the surgeon that he has received only a slight contusion on the abdomen, has his nervous vigour at once restored, and returns to the fighting. Reassurance may help to remove nerve-shock. True "abdominal shock" from extravasation of fluid into the cavity cannot be charmed away thus. It is probable, however, that, in spite of many notable exceptions, perforation of any of the abdominal viscera would, in the majority of instances, be followed by shock more or less severe.

One of the most important symptoms is a feeling of nausea, frequently accompanied with vomiting. This is not common in

false shock, while in a considerable number of cases of undoubted perforation it was present in greater or less degree. Our estimate of the value of this symptom is certainly not diminished by a knowledge of its import in other abdominal lesions.

MORTALITY.

Morton of Philadelphia,* Sir William MacCormac,† and N. B. Carson‡ of St. Louis have compiled elaborate tables of all the cases of operations performed for abdominal injury. Morton's tables, including cases of shot-wound recorded up to the end of 1886, give 22 operations with 5 recoveries. MacCormac's tables, extending up to May, 1882, include 32 cases, with 7 recoveries, one (Pirogoff's) being doubtful. Carson's tables, extending to June, 1887, include 43 cases: of these, 13 recovered; one (Pirogoff's) was progressing favourably at the end of four days, and was then lost sight of. Excluding the doubtful case, 42 operations with 13 recoveries give a death-rate of nearly 70 per cent. This result, considering the nature of the injuries, the usual condition of the patient when placed on the operating table, and the necessarily tentative nature of the earlier operations, cannot be regarded as other than exceedingly satisfactory.

INDICATIONS AND CONTRA-INDICATIONS TO OPERATION.

Of all penetrating gunshot wounds of the abdomen, nearly eighty-eight per cent. are fatal. When involving the stomach or intestines, "these wounds may always be expected to cause death, generally from peritonitis following extravasation, or from very acute septicæmia." Otis§ tells us that only six or seven unequivocal recoveries from shot-wounds of the stomach are known, fistulæ being left in two of them; while he doubts if there is even one "incontestable in-

* *Journ. Amer. Med. Assn.* Feb. 26th, 1887.

† *Abd. Sect. for the Treatment of Intra-Peritoneal Injury.* Lond., 1887.

‡ *Jour. Amer. Med. Assn.*, Nov. 5th, 1887.

§ P. S. Conner, *Internat. Cyc. Surg.*, vol. ii., p. 193.

stance of recovery from wound of the small intestine." In shot-wounds of the large intestine the prognosis is more favourable; about 20 per cent. recovering, with or without stercoral fistula. Wound of the gall-bladder is almost certain to cause death from extravasation. Under the best palliative treatment, death almost inevitably takes place. Therefore, if a desperate remedy is ever admissible in a desperate disease, it certainly is so in gunshot wounds of the abdominal viscera. Operation by abdominal section is certainly a desperate remedy, but it has already been proved to be far better than none.

The known tendencies of penetrating ball-wounds of the viscera being admitted, the indication to operate follows of necessity on proof of the receipt of injury. By operation alone can the parts be put into such a condition that spontaneous recovery is probable, or, it might almost be said, possible. By operation we can check hæmorrhage; we can prevent extravasation if it has not already taken place, and remove noxious fluids if it has taken place; and we can provide free drainage if septic peritonitis has set in. A mere recapitulation of the anatomical conditions provides the indications for operation.

But contra-indications exist. Firstly, we must have regard to the condition of the patient. Profound collapse which is not due to hæmorrhage is a contra-indication of weight corresponding to the gravity of the condition. Such collapse existing a few hours after receipt of injury is not so unfavourable as when it has continued for a day or more. In the former case the vital powers are not so much exhausted, and are more susceptible to resuscitating influences; in the latter case diffuse peritonitis may be present, which demands a somewhat tedious manipulation during operation, and makes a prolonged call on the energies of the patient during cure. Undoubted and severe peritonitis existing on the second or third day is by most authorities recognised as a contra-indication. In such cases, it is improbable that the sites of perforation would be found; and if they were, that they could be dealt with without the production of excessive traumatism. There is little use in cleansing the cavity if it is to be at once refilled, and there is little use in

looking for the perforations if they can neither be closed nor fixed in the wound, while there is positive danger in adding to the risks from traumatism. In such cases the most that can be done is to make a small parietal opening with the help of local anæsthesia, and permit the discharge of the noxious fluids and secretions, giving the patient the benefit of the remote chance of spontaneous cure with intestinal fistula.

An important practical question is as to the best time for operation. In a general way, it may safely be said that operation should be performed as soon as possible after it has been ascertained that there is perforation of peritoneum. Symptoms must not be waited for; they are often misleading when present, and their continued absence is compatible with the receipt of injuries which must inevitably lead to death. If there is much shock, the operation may be put off while the patient is closely watched and treated for an improvement which would justify operation. The possibility of the shock being due to hæmorrhage must not be overlooked. In this, as in so many other conditions, nearly everything must be left to the educated judgment of the surgeon; it is impossible to provide specific or absolute rules for guidance.

OPERATIVE TREATMENT.

If the patient is feeble or collapsed, an enema containing brandy should be given before the anæsthetic is administered. The parietes must be thoroughly cleansed, and the pubic hair, if it lies near to the seat of injury or operation, must be shaved. The perforated rubber-sheet, if it can be used without encroaching on the field of operation, should be fixed in position.

The instruments are the ordinary ones in use for abdominal section, with the addition of four or more of Makins's intestinal clamps. At least a dozen of the round milliner's needles recommended for enterorraphy, ready threaded with silk of suitable size, are provided. Thick prepared catgut should be in readiness, in case it is necessary to close wounds in the solid viscera. A number of sponge-cloths and flat and round sponges are kept ready, in warm antiseptic lotion. A large fountain

reservoir, with rubber tubing and glass nozzle attached for irrigation, is placed in a convenient situation some feet above the level of the patient. A receptacle placed under the operating table, for collecting the fluid which escapes from the abdomen during irrigation and trickles over the large macintosh, will be found convenient.

The Parietal Incision.—Nearly all writers on the subject recommend the median incision. Mac Cormac, Parkes, Nancrede, Bull, and Morton insist upon the median incision, and give numerous cogent reasons for their views. Morton says that in nearly all the successful operations the median incision was employed. Since he wrote, however, at least five successful operations through incisions not median have been recorded. Professor Mc Graw of Detroit vigorously protested against the uniform wisdom of this plan; but his protests seem to have been ignored by subsequent writers.

There can be no doubt that, as affording most space for a general exploration of the whole cavity and its contained viscera, the median incision is best. In cases where the course of the ball has been across the middle line, entering at one side and passing towards the other; and in others where the ball, entering near the middle line, passes either directly backwards, or in an uncertain direction, vertically or laterally, then the median incision is indicated. Also, in all cases where the course of the ball is unknown, the median incision is the best. On the other hand, there are cases where an incision not median is indicated. A ball injures only such organs as lie in its course. Reason and experiment combine to show that balls passing through the soft tissues of the abdomen pursue a course that is almost straight. If there is deflection, it is in the great majority of cases in accordance with the law of equality of the angles of incidence and reflection. The erratic courses of balls sometimes met with occur in cases where the skin is perforated at a very oblique angle, and can rarely apply to gunshot wounds of the abdomen. It may be safely inferred that a ball passing through the abdominal cavity follows the course it had on perforating the

parietes; if deviations take place after it has struck bones or hollow viscera, these do not influence the scheme of operation. Thus, in such a case as that of Barker,* where the ball entered three inches internal to the anterior iliac spine, the lateral incision which he adopted was better than a median incision could have been. A case of McGraw's, in which the colon only was wounded, is evidence in the same direction; and several similar cases might be quoted.

It is not, however, a question of mere convenience of examining viscera, but also of adding to traumatism. The whole length of the intestine and all the fixed viscera cannot be systematically examined with impunity. Only those fixed organs which lie in the course of the ball need be examined; and in the case of the movable intestines, common sense must be our guide in deciding as to the extent to which examination must be carried. Thus, if a ball passes through the right lumbar region, perforating the ascending colon on its anterior and posterior aspects, there is no necessity for examining the stomach, or transverse and descending colons, or more of the small bowel than lies near to the seat of injury. It is unnecessary to multiply examples; they will at once suggest themselves. It is true that the intestines may move some distance away from the track of the ball, and this distance may be increased according to the length of time which has elapsed since the receipt of injury. But intestines can scarcely move from epigastric or umbilical regions to the bottom of the pelvis; or from the right lumbar region to the left. And the fixed organs cannot move at all. We need not overdo the certainty of proving integrity of viscera at the expense of increasing the patient's risks.

The line of incision must be guided by reasonable deductions from the indications as to the course of the bullet. To the operator the major premise in this course of reasoning must be the course of the ball through the parietes. I entirely fail to appreciate the force of the arguments so frequently urged against probing of the wound. Where a ball has passed, surely

* *Brit. Med. Journ.*, Nov 26th, 1887.

a probe may follow without much increase of danger. I should always probe the wound, using a very blunt instrument, which cannot be insinuated into the inter-muscular spaces; and this probe I should leave in the track of the ball if its presence were of the slightest assistance in showing the line of injury. To lay open the track is in most cases unnecessary.

The line of incision should be guided by a simple process of reasoning as to the inferred and probable course of the ball, deduced from the site of the aperture of entrance and the course of the ball. To the skilled operator (and no other should undertake these cases) it is a matter of absolute indifference where entrance into the abdominal cavity is made. The objections of increased hæmorrhage, and division of muscular planes, usually urged against incisions made not in the linea alba or the linea semilunaris, are not for a moment to be considered against increased facility of access to abdominal organs.

What is to be the exact line of incision it is impossible in general terms to indicate. In every case the inference should be that the organs injured lie in the line of the ball, as shown by the course it pursues through the parietes, and the incision should be made accordingly. It is probably true that the line of incision will in most cases fail to be made in the middle line; but in an important minority the incision will be guided according to the principles indicated. In general terms it may be said that the middle of the line of parietal incision should lie over an imaginary point situated midway between the point of the probe in the ball-track resting on the peritoneum and the opposite wall of the cavity.

The length of the incision must be regulated by the thickness of the parietes, the firmness and tension of the muscles, the degree of distension of the bowels, and the amount of injury probable or ascertained. It need be neither vertical nor transverse, but be regulated in length and made in direction entirely as the reasoning of the surgeon, based on the premises indicated, directs. Beyond this it is probably unnecessary to specify directions.

The parietes being incised to the length desired, the lips of

the wound are kept apart by retractors in the hands of the assistant. The self-retaining retractors recommended for certain cases of supra-pubic cystotomy (Fig. 79) will suit the purpose admirably, and do not require holding.

The end of the bullet-track where it strikes the peritoneum is first examined, to see that no hæmorrhage is going on, and to make finally certain as to the fact of perforation. The ragged, and perhaps foul, opening is cleansed with an antiseptic, and, if it is large, is at once closed by a continuous crossing stitch. Any blood-clot which obscures the field of operation is mopped up gently, without disturbing the intestines. A systematic examination of all the viscera which lie in or near the track of the ball is now carried out. If hæmorrhage is going on, the source of it should at once be sought for before doing anything else. It must be remembered that manipulation may set up vermicular contraction of the intestines, leading to displacement of their wounds from the line of injury; therefore, any wound or serious contusion observed during the exploration for bleeding points should at once be grasped in catch-forceps, which are left attached. Again, when the bleeding point has been discovered, it may be temporarily secured by pressure-forceps while an opening in the bowel which is discharging fæces is being closed. No definite order of procedure can be laid down. The most urgent calls are attended to first: the less grave injuries, while they may be temporarily diminished by judicious placing of forceps or sponges, are left to the end. A rapid survey of all the parts is made when the dangerous hæmorrhage or abundant extravasation has been checked, and the full extent of the injuries inflicted is finally ascertained. We now proceed to the surgical repair of these injuries.

At this stage, if there has been extravasation of visceral contents, I should recommend that abdominal irrigation should be commenced and continued while the closure of visceral wounds is being carried out. The irrigating fluid, if conducted over the macintosh into the receptacle provided, need not be in the way: it is cleansing the abdomen, and so saving time; and,

perhaps most important of all, if the fluid is used at a temperature of 105°, it will be found an excellent means of treating shock. The stream should be a gentle one, such as an elevation of the reservoir of a foot and a half above the patient would give. An excellent method of conveying the irrigating fluid into the abdomen for this operation would be to employ the long rubber double tubes now in use for washing out the stomach. As the parietal wound does not closely fit the tube, only a portion of the fluid would escape out of the evacuating tube; but this is of small moment.

The assistant will meanwhile be looking after the forceps attached to the wounds of bowel or other organs, holding them in a bunch at the position requiring least traction in the wound. This plan of operation is not that usually recommended. Surgeons hitherto have almost uniformly advised immediate and complete suture of an injury as soon as it is discovered. But this suturing is a tedious and irritating process, and during the carrying out of it the intestines will be acting violently, displacing other injured portions and adding to the amount of extravasation. The only advantage of immediate suturing is, that no perforation is afterwards overlooked: forceps attached to the edges of the perforation, or the middle of the contusion, secure this advantage just as well.

Sponge-cloths are now arranged round the opening: the surgeon pulls one pair of forceps to the surface, and examines the wound in the intestine. The other forceps are now gathered together and laid between the folds of a cloth, while the assistant prepares to help the operator. The injured bowel is carefully examined, and the mode of treatment decided upon. A slight contusion may be left to its fate. A moderately severe contusion must be doubled inwards, and Lembert's suture or a continuous Dupuytren suture placed in the healthy bowel beyond it, so that if it does become gangrenous the slough will be discharged into the lumen of the gut, and cannot escape into the general cavity. In cases of perforation at the free border of the bowel, we may adopt simple closure after cleansing of the edges of the wound, or closure after resection of the bruised

edges, as seems at the time most convenient and safe. Lembert's suture (see Enterorraphy) will, in the great majority of cases, be found the best. For a small perforation, a continuous suture will be found perfectly efficient. The direction of the line of suture would seem to be of little importance. Multiple perforations occupying a small piece of bowel may require a more extensive resection, up to complete removal of the whole calibre. This is carried out exactly after the manner described for Enterorraphy (p. 472), and need not again be described.

During these manipulations the bowel will be lying on a soft sponge-cloth placed by the side of the parietal wound. Usually no clamp will be required, the fingers of the assistant being quite efficient. If resection is to be carried out, I should recommend the employment of Makins's clamps. During the operative proceeding, a sponge or two placed over the viscera will prevent their being extruded. A small space should be left by the side of the irrigating tube to permit the outflow of fluid.

A wound at the mesenteric border is a more serious affair. A wound passing through the mesentery close to the bowel, or through the mesenteric border of the bowel, will usually, by occlusion of the intestinal vessels, lead to gangrene of portions of intestine involved. For this injury the treatment must be resection of bowel, along with the perforated wound of the mesentery. If it be not necessary to remove a piece of mesentery that is actually wedge-shaped, the lines of incision should at least go well beyond the seat of injury. The wounds are united exactly as described for Enterorraphy.

Each wound after it is closed is thoroughly cleansed, and the bowel is returned to the cavity. When all the intestinal wounds discovered at the first examination have been closed, the bowels are pushed to one side, and kept there by a large sponge, while the underlying solid viscera are examined. If the site of lodgment of the ball can be detected, an attempt should be made to remove it. Bleeding vessels are, of course, secured.

Perforations in the stomach are dealt with in the same way as in the intestine. A perforation in the posterior wall can be

reached only after making an opening through the layers of the gastro-colic omentum. If it cannot be sutured by this route, it may be reached from the front after gastrotomy, as recommended for perforating ulcer of the stomach on its posterior aspect (p. 379). In these cases extravasation of gastric contents nearly always takes place, and irrigation and cleansing will have to be specially thorough.

Wounds of the omentum are occasionally attended with free bleeding, which may form a large hæmatoma between its layers. In such a case complete amputation of the omentum above the site of injury would be the best treatment. A small perforation without bleeding should be excised, to prevent the risks of gangrene, and the opening should be closed by a continuous suture.

Wounds of the liver are by no means necessarily fatal: Edler's elaborate tables* show that of uncomplicated cases of shot-wound only 39.1 per cent. died, while of all cases 55 per cent. died. The duration of cure was usually prolonged from the presence of foreign bodies in the wound, and particularly splinters of bone from the ribs: this fact suggests the propriety in such cases of seeking for foreign bodies, and removing them if found. Suppurative inflammation was the most frequent cause of death (37.5 per cent.); hæmorrhage was the cause in 20 per cent. of the cases. Therefore, cleansing of the wound should be as perfect as possible, and should be carried out, not only by means of irrigation with a soft catheter of small size introduced along the track of the wound, but also by friction with a small pledget of cotton rolled around the end of a probe and saturated with an antiseptic. Bleeding must be checked either by the insertion of deep catgut sutures, or by plugging the wound with a strip of antiseptic lint or gauze, the end of which is carried through the perforation in the parietes. Murphy, in a successful case, employed suture alone.

Wounds of the spleen cause death, according to Edler, almost invariably by hæmorrhage. Of uncomplicated cases, 65 per cent. died; of all cases, 83.3 per cent. Suppuration is rare, and then mostly from the presence of foreign matter. The friability of

* Langenbeck's *Archiv. f. Klin Chir.*, Bd. xxxiv.

the splenic tissue renders closure of a gaping wound, so as to check hæmorrhage, difficult. Parkes, however, found that deeply placed sutures of catgut held fairly well. If the suture fails, plugging with lint or gauze must be employed. Should these measures fail, the organ must be removed. In all cases of serious injury to the spleen, primary removal is indicated; the results of removal for injury are far more favourable than for disease.

Shot-wounds of the kidney are not so dangerous as is generally supposed. According to Edler, death most frequently results from pyæmia, accompanied with peritonitis and suppuration. Recovery is usually very tedious, on account of the frequent complication of urinary extravasation. Of uncomplicated shot-wounds of the kidney, 85 per cent., according to Edler, get well; of complicated cases, only 16 per cent.; and of all cases, 56 per cent. recover. If only 15 per cent. of cases of uncomplicated shot-wound of the kidney die, it is doubtful whether operation is ever indicated in this class, except on undoubted signs of hæmorrhage or peri-nephric or peritoneal suppuration. The complications of renal injuries are likely to be severe—on the right side, wounds of liver and colon; on the left side, wounds of spleen and colon—and the results of operations are therefore not likely to be favourable. In cases of doubt as to the wisdom of removing the whole organ, or of the ability of the patient to bear the operation, the chances of successful issue may be increased by free drainage carried out through a wound made in the loin. In some cases bullets have been found embedded in the renal tissue.

Wounds of the urinary bladder are closed by Lembert's suture in the same way as wounds of the other hollow viscera. The whole subject of cystorraphy will be more thoroughly dealt with under the head of intra-abdominal rupture of that viscus.

Wounds of the gall-bladder are easily diagnosed from the presence of bile in the cavity. If the wound involves only the fundus, and is not large or lacerated, it may be closed at once by suture. If the wound traverses both sides of the bladder

and the liver as well, then it may be best to remove the whole viscus. To reach the upper wound, it would be necessary to partly detach the bladder from the liver, and this detachment would predispose to gangrene. Therefore, in such a case, cholecystectomy would be the safest procedure.

Supposing now that the whole of the visceral wounds have been satisfactorily dealt with, and that the parts are in a condition in which repair is possible, a final cleansing of the cavity is carried out, and the wound is closed, with or without drainage as seems best. A larger nozzle may be put on to the irrigating tube, and the reservoir is elevated a foot or two higher, so that a larger and more rapid stream is conveyed inside the abdomen. While the fingers move the intestines about, the stream is conducted successively to all parts of the cavity, and is not checked till it returns as clear as it went in. Then all superfluous fluid is pressed out, and a few large sponges with sponge-holders attached are placed in the abdominal hollows, and left there while the stitches are inserted. They are removed, with any free fluid that has been left, before the stitches are tied.

In some cases the state of the patient may be so grave that resection, or any prolonged operation of suturing, may not be permissible. In such cases the wounded bowel, resected or not as may seem best, is fixed in the wound, so as to produce an artificial anus. Temporary closure of the intestinal wounds in the parietal opening may always be carried out, so that the peritoneal cavity may be sealed off by plastic exudations before the artificial anus is made. This proceeding is carried out in the manner already described for enterotomy and enterectomy.

OPERATION FOR STAB-WOUNDS OF THE ABDOMEN.

The whole subject of stab-wounds being in many respects similar to that of shot-wounds of the abdomen, it will be unnecessary to do more than specify the points of difference.

Here again we are indebted to Morton,* MacCormac,* and Gaston* for drawing up tables of recorded cases of operations. Morton collected 19 cases, including one by a splinter of wood; of these, 12 recovered. MacCormac gives 18 cases, with 10 recoveries. Gaston's table, which most nearly brings the operations up to date, contains 28 cases, with 16 recoveries: 19 cases had wounds involving one or more of the viscera; of this number, 10 recovered and 9 died. This must be regarded as a very satisfactory mortality, considering the nature of the injuries.

Any sharp instrument forced through the parietes may perforate hollow viscera. But the effects vary widely, according to the nature of the instrument. A stab with a bodkin or a stiletto has very different immediate results from a deep gash with a large broad-bladed sword. But the ultimate results may be the same. I have seen death take place in five days from suppurative peritonitis, caused by puncture of the intestine by a fine exploring needle; and I have known of another case in which a triple wound in the intestinal coats, as broad as the jack-knife which caused it, was not fatal in so short a time. In a large wound there may be protrusion of viscera—an accident which may sometimes be fortunate, as exposing an intestinal wound, and permitting, to some extent at least, escape of its contents outside the abdomen. Every variety of wound may be caused by diversity of instruments. A jagged piece of wood, the spike of a railing, or the prongs of a pitchfork, will each have its variety of wound, partially to be inferred from the character of the instrument.

Now, it has been found that stabbing wounds are by no means so uniformly fatal as perforations caused by bullets. The danger would seem, in such cases, to depend as much on the condition of the viscus as to fulness or emptiness, as on the amount of injury it has received. Through a wound of fair size, a viscus distended with fluid will at once empty itself into the peritoneum; and, further, a distended viscus is more liable to be ruptured than an empty one. The rapidly-moving bullet

* *Loc. cit.*

goes straight through everything, full or empty; while the comparatively slow-moving instrument, pushed by hand or penetrating after a fall, will push an empty viscus aside.

The conditions vary according to the organ penetrated, just as they do in gunshot wounds. Cutting wounds have more blood effused, and death from hæmorrhage is more common in them than in other penetrating wounds.

Looking at the recorded cases of operation, we find that in several, the manipulations included nothing more than cleansing of the abdominal cavity from blood-clot and suturing of the parietal wound. In Carson's case, a liver-wound was sutured, and death took place on the fifth day from iodoform poisoning; the peritoneal cavity being found very nearly normal. In two cases excision of intestine had to be carried out: one died and one recovered. In nine cases suture of intestine or stomach was carried out: in one the spleen was excised; and in several various wounds of omentum, mesentery and other parts had to be dealt with.

Resection of the margins of the wound is not called for so frequently after stabbing as after gunshot injuries. In a clean-cut wound, simple suture without much inversion of margins will be efficient. Bleeding, being a more frequent and a more dangerous result of stab-wounds, requires correspondingly minute attention. In a greater number of cases than after shot-wounds, operation may be successfully carried out through the original stab-wound enlarged in whatever direction is most convenient.

As to indications for operation in stab-wounds of the abdomen, there is a very general consensus of opinion that every case of undoubted penetration of the abdomen should be at once treated by laparotomy. The indication is only a little the less urgent if there is no perforation of viscera; cleansing of the cavity from blood-clot, and checking hæmorrhage, put the patient in a far more favourable condition for recovery than when these operations are not carried out. In any case, perforation of viscera cannot certainly be diagnosed till abdominal section has been performed.

AFTER-TREATMENT OF OPERATIONS FOR GUNSHOT AND STAB-WOUNDS OF THE ABDOMEN.

The first principle in the treatment of these cases is intestinal rest. If there are wounds of the stomach or upper portion of the small bowel, all food by the mouth must be withheld for from four to six days, and rectal feeding instituted. The first foods given by the mouth should be either dilute peptones or beef jellies, or peptonised milk. The patient should be kept as quiet as possible in bed; change of position should be made by extraneous help, and not by personal muscular effort. If opium is to be recommended anywhere in abdominal surgery, it should be in such cases as these which are frequently attended with considerable mental disturbance. It should be given as morphia, and by hypodermic injection.

When drainage has been employed either for incipient peritonitis or for a very abundant extravasation of intestinal contents, the management of the tube will demand considerable care and judgment. At frequent and stated intervals the cavity is emptied by the exhausting syringe, and the nature of the discharge observed. On the slightest evidence of the oncome of suppurative peritonitis, irrigation with a mild antiseptic (I should select boro-glyceride) should be carried out, and some of the fluid should be permitted to remain inside the cavity. The formation of intestinal adhesions, which is one of the chief dangers in acute peritonitis, is not so likely to occur if the intestines are kept floating in a mild watery fluid; and the risks of septic absorption are lessened by the presence of an antiseptic in the cavity. The irrigating process may be repeated with advantage every few hours. With a little judgment in the arrangement of the contrivances, it is possible to employ irrigation without disturbing the patient or soiling the bed-clothing. In such cases stimulants in small quantities may be added to the nourishing enemas, and the use of the rectal tube and the hot-water enema for the removal of gas may be called for.

If acute peritonitis develops soon after operation, and no

drainage tube has been inserted, the best treatment will in most cases be to at once insert the tube and commence irrigation with hot (105°—110°) antiseptic fluids. Several authorities in such cases recommend the employment of considerable doses of atropia alone, or combined with morphia. I should place more value on free stimulation by the rectum, frequent turpentine enemas and the use of the rectum tube. The employment of leeching in the earlier stages has been highly spoken of, and Leiter's cold-water tin coil is said to have given good results.

The parietal wound is treated exactly as in other abdominal operations.

Rupture of the Intestine.

Although only a very few operations have been performed for this condition, its extreme importance and the preparedness of surgery to deal with it will justify a somewhat detailed consideration. Our knowledge of the whole subject has recently been much advanced by the publication of a prize essay on "Contusion of the Abdomen, with Rupture of the Intestine," by B. F. Curtis of New York,* which is founded upon numerous experiments, and a careful and analytical study of 116 cases of recorded rupture of the intestines. MacCormac† has collected 13 cases of operation for rupture of the intestine, simple and complicated, thus far without a single success. The case of Croft of St. Thomas's Hospital, recovered from the immediate effects of the operation, but died from the effects of a second operation performed a month later for the cure of the artificial anus which remained.

Pathological Anatomy.—As a result of his experiments, Curtis came to the conclusion that the injury is not a true rupture, a bursting of the gut over its contents, but a contused and lacerated wound made by crushing between the contusing body and the bony parts. The danger of rupture was diminished by partial distension of the gut. The possibility of rupture from forcible impaction of the liquid contents against a fixed loop of bowel must not, however, be overlooked. Rupture of the duodenum would seem to take place in this way. I have seen two cases of rupture of the duodenum, caused, in one instance, by a fall on the back, and in another by a severe blow on the back; in neither was there fracture of spine, nor any injury in front.

The most common cause of the injury—in about 28 per cent. of all the cases—was found by Curtis to be the kick of a horse or a man. Next to this, and in about equal proportions, are run-

* *Internat. Journ. Med. Sc.* Oct., 1887. † *Op. cit.*

over accidents, blows on the belly by weights, and falls on projecting points. Great velocity and small area of striking surfaces would seem to be most likely to cause rupture. In 113 cases, the relative frequency of parts injured was :— duodenum, 6 cases; jejunum, 44; ileum, 38; other portions of the small intestine, 21; and colon, 4. The danger of rupture was found to be greatest in those parts of the intestine which are most fixed, excluding the large intestine on account of its being sheltered.

The extent of the rupture varies considerably. In about a fifth of the cases, the rupture extended either completely, or almost completely, across the bowel. In a tenth of the cases, the ruptures were multiple. The size of rent most frequently observed was about an inch in length. There is a somewhat uncertain relation between the extent of injury and the violence of the blow, the more extensive injuries being caused by the more violent blows. This, however, in no way influences prognosis; for small ruptures are as certainly fatal as large ones. The mucous membrane, in the large majority of cases, was found everted and bulging through the peritoneal rupture.

Extravasation of intestinal contents is almost invariably found. Fæcal fluids were found in two-thirds of all Curtis's cases; and the existence of peritonitis in nearly all the others, rendered it probable that extravasation of contents had taken place in these also. In two cases of complete rupture, the open ends were so entirely closed by muscular contraction, prolapse of the mucous membrane, and rapidly-formed adhesions, that the bowel was actually found to be distended above the seat of rupture. In some of the cases, contusions of the gut were found, in addition to the rupture.

The most serious complication is injury, either as laceration or as contusion, to the mesentery. A laceration of the mesentery may cause death in a few minutes from hæmorrhage; and contusion, followed by hæmostasis in its vessels, may result in gangrene of the bowel. In 16 per cent of Curtis's cases there was either laceration or contusion of the mesentery, and these were among the most rapidly fatal of all. Of 15 cases of

laceration of the mesentery, all but three were fatal within twenty-four hours. The importance of these observations, from a practical point of view, is self-evident.

Symptoms.—The symptoms may be conveniently considered as those immediately following the injury and those occurring subsequently. The symptoms first observed are usually shock, restlessness, nausea and vomiting, retention of urine, constipation, and local pain and tenderness. In the great majority of cases, shock is present in a marked degree. In a few, however, it is described as absent. A certain amount of restlessness is usually noted in the early stages, but a great many cases do not exhibit this symptom at all. Vomiting in the early stage is one of the most constant of the symptoms, and where there is no vomiting there is usually nausea. In a few cases, blood is mingled with the vomit. In most, the vomit is simply the contents of the stomach, which, as time passes, show a commingling with bile. If the patient lives long enough, the vomit may become fæcal, but this is usually a concomitant of developed peritonitis. Urinary retention is present in about half the cases. No doubt this is part of the general condition of abdominal shock. Pain is present almost universally. It is nearly always of a severe character, and variously described as twisting, lancinating, burning, or griping. It comes on in gusts, and occasionally remits or intermits. Tenderness on palpation is nearly always complained of at the outset; later on, when inflammation supervenes, it is a constant and marked symptom.

Distension of the abdomen comes on soon, and is marked according to the duration of the case. In the later stage, when peritonitis is fully developed, distension becomes drum-like, and the abdomen is tense and hard. With this distension tympanitic resonance is always present. One feature of this resonance is sometimes described as a disappearance of the dulness over the site of the liver. It would seem, however, that this symptom is a very variable and uncertain one. It is caused by the escape of gas from the intestine into the general cavity, and must take

place in the early stages before adhesions have formed to limit its diffusion.

The later symptoms are essentially those of peritonitis. The temperature, as is usual in severe cases of peritonitis, may not show any rise, or may be subnormal. In most cases, however, there is a moderate rise of temperature, which takes place during the first twenty-four hours.

The vomiting becomes fæcal some time during the second day: constipation is then, of course, always present. In fact, the whole of the late symptoms are identical with those following peritoneal suppuration.

Curtis distinguishes three sets of cases, according to the symptoms they present. In the first set, the patient never passes out of the condition of profound shock, and rapidly dies. In these cases free hæmorrhage usually accompanies the injury; but cases with abundant fæcal extravasation without hæmorrhage frequently die without recovering from the primary collapse.

The second set includes those cases in which local pain and tenderness are marked, and in which the patient rallies to an attack of acute peritonitis.

The third set includes those in which there are no very definite symptoms of peritonitis, but which keep the surgeon in constant apprehension of the development of grave conditions. The patient rallies very slowly, and then passes, by imperceptible degrees, into a condition indicating the oncome of severe peritonitis.

Diagnosis.—The diagnosis will be assisted by a consideration of the cause which produced the injury, and the site of it. A rupture of the intestine is liable to be confounded with simple contusion of the abdomen. The symptoms of contusion are more acute at first than those of rupture; but in most cases the patient soon exhibits signs of improvement. Profound and immediate shock is probably more frequent in cases of simple contusion than in cases of genuine rupture. Restlessness is not so frequent in contusion; vomiting is present in about half the cases. Fæcal vomiting is never observed. Occasionally blood

is noticed in the urine and in the stools. Abdominal distension is not so marked, and tympanitic resonance is rarely observed. Dulness on percussion has been noted as a rare symptom. The symptoms are thus very similar to those following rupture of the intestine—only they are, with the exception of the primary shock, less acute, and they do not last so long.

Operative Treatment.—The prognosis of intestinal rupture being utterly hopeless, surgical operation gives the patient the only chance of life. This operation should be performed as early as possible. The average duration of life being only forty-eight hours, and the condition of the patient becoming rapidly worse during this time, it is evident that every hour which elapses lessens the chance of a successful issue to operation. The whole question is one of diagnosis; and in cases of doubt it may be permissible to wait while symptoms develop, to show that it is not a case of simple contusion.

Occasionally the symptoms point clearly to hæmorrhage, and in these cases it may be justifiable to wait while means are adopted to check it. Compression of the abdomen by bandages over a firm pillow has been recommended for this purpose. The amount of success which is likely to follow such a proceeding is, however, very uncertain. In every case the patient is kept at perfect rest. Examination is made as gently as possible; unnecessary manipulation of every sort must be condemned. Stimulating enemas ought to be administered if the patient's condition demands it. Food by the mouth had better be withheld. The therapeutic value of morphia is doubtful: as masking the evolution of symptoms, it may be harmful. In the great majority of cases, however, the pain is so intense that the administration of morphia has usually been the first practical step in the treatment.

The incision is made in the middle line; it should be about four inches in length, and the middle of it should be at the umbilicus. If necessary, the incision may be prolonged—upwards or downwards, according to the site of injury. Before the peritoneum is divided, the presence of blood in the cavity

may be apparent. If gas is present, it will rush out on making the opening. Pus, fæces, or intestinal fluids make themselves evident either at once or after the exploration of the cavity. For this exploration the best means is, probably, at first to pass the sponge on a sponge-holder into the pelvis and the lumbar hollows. The position of a collection of extravasated fluid will frequently indicate the site of rupture. Should hæmorrhage be going on, the bleeding point must be at once looked for and the vessel secured. It is recommended, if the bleeding is free, that the abdominal aorta and the root of the mesentery should be compressed while the bleeding point is being looked for. In such a case it will usually be necessary to turn the whole of the intestines outside the abdomen. When the bleeding vessel has been secured, the intestines are now carefully examined for injuries. Should the hæmorrhage have proceeded from a wound in the mesentery, the question of resection of the bowel will have to be considered. The decision will depend upon the amount of injury to the mesenteric vessels, and the condition of the gut supplied thereby. In most cases resection of the intestine will have to be followed by the formation of an artificial anus; for the patient will rarely be able to bear complete suture. Where the seat of injury to the intestine is discovered on first inspection, and it is possible to suture it without turning the bowels outside the cavity, this should always be done. In every case where bowels have been turned outside, we should endeavour to return the bowels to the cavity as soon as possible after the injury has been discovered. It is unnecessary to keep the whole of the bowels outside while the rupture is being closed; and it has been found in experiments that shock is less likely to be severe if the intestines are returned as soon as possible after the injury is discovered.

The intestine being returned, the ruptured portion of bowel is brought to the surface, isolated by sponges and sponge-cloths, and steps are taken for its immediate closure. If there is much shock, it will be wise, at this stage, to start irrigation of the abdominal cavity with hot lotion, as recommended for cases of gunshot wound. In any case, by saving time in the removal of

extravasated fluid, the immediate application of the irrigator must always be of advantage. In looking for the injured bowel, the seat of the blow will have to guide us; but it must not be forgotten that the intestine may slip away to some distance, and also that the injuries are occasionally multiple; therefore the examination should be very extensive and very thorough.

If simple suture of the rent is likely to suffice, this is carried out in the manner already described for Enterorraphy. If there is much bruising around the site of rupture, resection, total or partial, according to the position and extent of the wound, must be carried out. If the rupture lies on the free margin of the bowel, simple excision of the lips of the contused wound will suffice; if, however, it lies at or near the mesenteric attachment, resection of the whole calibre will be required. Every case must be judged on its own merits; it is impossible to lay down general laws applicable to all cases.

As a matter of practice, it will probably appear that many cases of rupture of the intestine will be best treated by the formation of an artificial anus. Usually the operation will have to be performed while the patient is in a most unfavourable condition, and prolonged manipulation will be full of danger. The quickest operation compatible with tiding the patient over the period of danger will probably be, in the long run, most successful. It may turn out that the use of a hot irrigating fluid inside the abdominal cavity will considerably improve the patient's condition; then the rupture may be closed while irrigation is going on.

However, as these ruptures are usually short and will rarely require even partial resection, their closure by suture may be very rapidly effected. Should it be decided to conclude by the formation of an artificial anus, the ends of the gut are fixed to the wound by means of ligatures or clamps, and left there for twenty-four hours, or longer, until adhesions form.

The employment of drainage must be left to the judgment of the surgeon. In most cases drainage is indicated, both as a remedial measure for giving exit to peritoneal secretion, and as a precautionary measure by providing an opening

through which the cavity may be washed should peritonitis supervene.

The after-treatment and general management of the case is the same as for penetrating wounds.

RUPTURE OF THE STOMACH.

Rupture of the stomach does not require special description. It is more rare than rupture of the intestine, on account of its smaller size, deeper situation, and protection by the ribs. Rupture may be complete, traversing the whole of the coats; or incomplete, affecting only one or two. Peritoneal ruptures, according to Devergie, occur principally at the lesser curvature, and are usually multiple. The same condition may exist on the mucous coat, and "it is remarkable that these often exist just on the point opposite the external tear."

Occasionally the mucous lining of the stomach is completely detached, and hangs in shreds inside the stomachic cavity. The symptoms are very similar to those of ruptured intestine. The treatment requires no separate description. The seat of rupture, if it lies in the posterior wall of the stomach, can be reached only by division of the gastro-colic omentum, and is dealt with in the same manner as shot- or stab-wounds of the same part.

Rupture of the Urinary Bladder.

Although Laparotomy for this condition is, comparatively speaking, a new operation, it has been in men's minds for many years. Benjamin Bell proposed suture of the bladder for rupture in 1789. Blundell of Guy's Hospital, in 1824, wrote as follows: "Should the bladder give way in the peritoneal sack, why should we not lay open the abdomen, tie up the bladder, discharge the urine, and wash out the peritoneum thoroughly by an injection of warm water?" Blundell fortified his suggestion by numerous experiments; and Grandchamps, about this time, performed similar experiments with the same end in view. A good many surgeons since then have advocated suture of the bladder for rupture; among them have been mentioned Larrey, Gross, and Cusack. Holmes, among modern surgeons, has perhaps been most outspoken in his recommendation of the operation. Heath and Willett were the first to perform the operation in England.

MacCormac has collected reports of 16 operations: of these, six recovered, two of the recoveries being cases of MacCormac's own. I have seen records of six more cases, with three recoveries and three deaths. The mortality after operation will always be high; but, considering the almost necessarily fatal termination without operation, a very high mortality would not be a contra-indication.

Pathological Anatomy.—A knowledge of the pathology of ruptured bladder has been greatly advanced by the monograph of Walter Rivington. He has collected a total of 322 cases of rupture of the bladder. Of these, 152 were simple fatal intra-peritoneal ruptures; 30 complicated fatal ruptures; 90 extra-peritoneal ruptures, simple and complicated; and 5 in which the position was uncertain. The simple intra-peritoneal rupture is the most common, extra-peritoneal being more often asso-

ciated with fracture of the pelvic bones. Of 288 cases, 240 were males and 48 females.

He found that rupture occurred most frequently in the prime of life, in persons between twenty and forty years of age. The period of survival after injury was longer in extra-peritoneal rupture than in intra-peritoneal.

The causes may be divided into predisposing and acute. Among the former, distension of the viscus must be regarded as the most potent; indeed, it would seem to be almost essential for the simple intra-peritoneal rupture to take place that the bladder should be full. This does not hold true for cases of extra-peritoneal rupture.

Another predisposing cause is drunkenness. In a very large proportion of the cases, the patient has been described as profoundly or partially intoxicated. In such cases the bladder is usually full, sensibility is blunted, and the individual will probably have been indulging in horse-play with companions. Under these circumstances, it frequently happens that an exact account of the mode in which the injury was produced cannot be obtained.

The acute or determining causes are divided by Houel into idiopathic and traumatic, the large majority being idiopathic. The usual traumatic cause is a sharp blow of some weight inflicted on the lower part of the abdomen. Kicks, blows received in fighting, treading on the prostrate individual, bodies falling on the abdomen, sharp collision with prominent objects, are described in the category of causes. A few cases of simple concussion have been described as causing the rupture.

Of idiopathic causes, by far the most common is excessive muscular action, combined with over-distension of the bladder. A few cases of simple rupture of the bladder from over-distension have been described. Houel denies that spontaneous rupture from over-distension can occur in the normal bladder. It would appear, however, that there is no doubt that this does occasionally occur. Frequently the injury is predisposed to by the existence of so-called tunicary hernia; that is to say, where the muscular fibres become separated, so as to leave a gap in

the continuity of the bladder-walls, and thus permit a local over-distension, which is afterwards easily converted into a complete rupture.

It would seem that such spontaneous ruptures are, in about an equal proportion of cases, extra-peritoneal and intra-peritoneal.

As to the possibility of rupture taking place through excessive muscular action on an over-distended bladder, there can be no dispute. Lifting heavy weights; struggling during the administration of ether; straining at stool; and straining efforts at micturition, are described amongst the active causes of rupture from muscular action.

In the female, over-distension and rupture have been caused by retroversion of the gravid uterus.

In most cases the rupture is on the posterior surface of the bladder, and is usually between one and two inches in length. Other positions, lateral, superior, and deep, are described; and lengths of tear, varying from a quarter of an inch to three inches, have been met with.

Symptoms.—The symptoms are frequently masked by the intoxicated condition of the patient. He may be unaware of the occurrence of any injury, and hours may elapse before the gravity of his position is discovered.

Occasionally he exhibits no shock whatever, and is able to walk some distance. In a surprisingly large number of cases the patient has been able to walk a considerable distance without any appearance of illness, and serious symptoms have come on as late as twenty-four hours after the infliction of the injury.

If the patient is sober, or only slightly intoxicated, intense pain is usually complained of at the moment of injury. Very soon faintness, sickness, and profound collapse supervene. In a few cases there has been a sensation as of something bursting inside the abdomen. The patient usually staggers and falls, and is unable to raise himself up or stand without support. If he is able to walk, he is doubled up, and leans upon any object he can grasp.

Usually the shock temporarily abates, the pain diminishes and the patient describes himself as feeling better. Very soon, however, an urgent desire to pass water comes on; but the patient on attempting to do so finds that it is impossible. Repeated attempts are followed by the passage of only a few drops of blood or bloody urine. Along with much tenesmus, there is acute pain in the hypogastric and umbilical regions, which is aggravated by the erect posture. The countenance becomes pallid and anxious and pinched; restlessness, nausea, vomiting, and thirst, with great constitutional disturbance, and quick, small, and irregular pulse, now appear, and the gravity of the case is evident. The patient by this time will have sought for medical relief, and the surgeon will usually pass the catheter. Only blood or blood and urine escape in drops, and the patient gets no relief. The catheter, in passing, either enters with great ease, passing upwards for an abnormal distance, or it is checked near the neck of the bladder, and it is found impossible either to rotate the instrument or to depress it between the patient's thighs. These different conditions depend on whether the catheter passes through the rent in the bladder, or impinges against the walls of the collapsed viscus. Should the point of the catheter enter the peritoneal cavity, it may be moved about in all directions, and its point may be felt with abnormal distinctness through the parietes. In such a case there can be no doubt as to the existence of rupture of the bladder. In cases of doubt, before removing the catheter a measured quantity of warm antiseptic lotion—say, about eight ounces—should be injected through the catheter. The use of the rectal bag, by pushing the viscus forwards against the parietes, will here be found of advantage. While the fluid is being injected, the supra-pubic region should be percussed for evidence of increased dulness. When the full quantity has been injected, the fluid is permitted to flow out. If there is rupture, only a portion of the fluid will come away; if there is no rupture, the whole of it will be collected.

In cases of extra-peritoneal rupture, the symptoms are not so severe; shock is not so great; and symptoms of peritoneal

inflammation do not come on so rapidly, and are not so severe.

In cases of complete intra-peritoneal rupture, symptoms of peritonitis very quickly appear, with abdominal tenderness and distension, sickness and vomiting, feeble, irregular, and rapid pulse, and hurried thoracic respiration. The patient is tormented with a strong desire to pass water, and makes frequent but ineffectual efforts to do so. Pain is usually severe, sometimes agonising.

In making the diagnosis, it is important to find out whether the bladder was full at the time of the accident. Many cases of hæmaturia, depending upon simple contusion of the bladder, are attended with symptoms of collapse, depending usually on serous injuries of another sort. In all cases of abdominal injury it must be noted that secretion of urine is liable to be diminished or even suppressed. In any case of doubt, the rapid aggravation of the symptoms and the increasing gravity of the patient's condition will help to clear up the diagnosis.

Operative Treatment.—It is now universally admitted that, on the diagnosis of intra-peritoneal rupture of the bladder, operation should be immediately performed, and that the best operation is abdominal section and suture of the rent in the bladder. The sooner the operation is performed, the better. The chances of recovery are greatly diminished after twenty-four hours have passed, although a few cases of recovery after operation later than this have been recorded.

The technique of the operation is of the simplest possible description. An incision is made in the middle line immediately above the pubes, and the cavity entered in the ordinary way. The lower end of the incision may have to be carried down to the pubes.

The existence of rupture will usually be signalised by the escape of blood-stained urine mixed with serum. Should the recti muscles be very tense, part of their insertion into the pubes may be divided, and the size of the opening may be further increased by the use of suitable retractors. The incision

will usually require to be a long one, as it happens that a majority of the patients are stout or powerful men.

The posterior surface of the bladder is exposed as fully as possible by pushing the intestines upward into the cavity, and keeping them there by means of sponges of suitable size and shape. The position of the rent will, as already remarked, be usually found on the posterior surface midway between the summit and the base of the bladder. Should it lie low down, it will be found that the rectal bag will materially assist subsequent proceedings by elevating the field of operation.

We now proceed to close the rent in the bladder. Should the rent lie low down, this may be a proceeding of considerable difficulty. MacCormac found that transverse incisions made on each side through the peritoneum liberated the bladder, and permitted it to be raised up higher towards the surface.

Various methods of suturing the bladder are in vogue. For intra-peritoneal rupture Lembert's suture (Fig. 51) is probably the best. MacCormac used it in his two successful cases. Dr. A. Brenner, an assistant in Billroth's clinic, has been experimenting on dogs, with a view to discover the best mode of suture for closing wounds of the bladder. The variety he recommends is a sort of purse-string suture made with two threads. The threads are carried round the wound at a distance of an inch or less from the margin—one under the muscular coat, the other under the sub-mucous tissue, great care being taken that nothing enters the mucous membrane. When the sutures are pulled tight the wound is gathered together in a rosette-like form, which alters the shape of the bladder. This is essentially Tait's "flange stitch," which he has used for some time in cases of vesico-vaginal fistula, and also in rents of the hollow viscera. Numerous other experiments have been carried out with the same object in view. The majority of experimenters combine in recommending interrupted silk sutures, inserted after Lembert's plan, or some simple modification thereof. There is no strong objection to the use of catgut, provided it be chromicised; but, for suture of a peritoneal wound, silk is probably, on the whole, the best material to use. For the introduction of the sutures a

curved or corkscrew needle with a handle is best. Keyes of New York, in an operation, used a Reverdin needle, and speaks very highly of it. The insertion of a blunt hook in the top of the rent may add to the facility of introducing the suture; and the wound may further be steadied by first inserting two or three sutures at each end of it, and handing the threads over to an assistant, who, by dragging on them, keeps the wound on the stretch and towards the surface.

MacCormac very wisely continued the suture for some way beyond the angles of the wound, thus adding to the length of infolded tissue, and strengthening the whole. The needle used should not be very sharp-pointed. Each stitch should penetrate the peritoneum and muscle, but no stitch should enter the bladder. The sutures must be placed closely; about eight to the inch is a fair proportion.

When the sutures are tied, and the wound is closed, it should at once have its security tested by the injection of warm antiseptic fluid into the bladder. Should it be found water-tight, the abdominal cavity may now be irrigated, and the wound closed. Should leakage take place at any point, additional sutures should be inserted; for this purpose Dupuytren's continuous suture may be employed.

Irrigation of the whole cavity with warm antiseptic fluid is now carried out. This must be very thorough, and must include, not only the pelvic regions, but the whole cavity as high as the diaphragm. Extravasated urine soon becomes diffused throughout the abdomen, and partial cleansing is likely to be ineffectual. If the fluid is of a temperature exceeding 100°, such irrigation is further beneficial by improving the condition of shock.

The question of drainage is an important one. Should we be fully satisfied as to the trustworthiness of the suture, drainage need not be employed; but it will sometime happen that the surgeon will not be satisfied without the insertion of a drainage tube. The tube can do no harm; while, by permitting the escape of any fluid that may leak through an imperfect stitch-hole, it may be of conspicuous benefit. At the end of twenty-

four hours, should it appear not to be wanted, the tube can easily be removed.

It is usually recommended that vesical drainage be carried out either through a catheter in the urethra, or through an opening made in the perineum. Perineal section adds considerably to the risk of the operation; and the retention of the catheter has been found to be unnecessary, while it adds to the risk of urinary decomposition.

MacCormac is in favour of leaving the bladder to empty itself. He says that if the rent be effectively sutured, the patient runs less risk from moderate distension of the bladder, which is all that can possibly occur in a case properly watched, than he does from the practice of retaining the catheter for some days within the viscus. There is less objection to drawing the water by means of the catheter at short and stated intervals.

The making of an opening in the bladder behind the peritoneum, as in supra-pubic cystotomy, has been recommended by several surgeons. This should rarely be necessary; and, as it adds considerably to the risk, should not be adopted.

RUPTURE OF THE GALL-BLADDER.

Rupture of the gall-bladder will rarely be diagnosed as a separate lesion, but will usually be come upon as a complication of other abdominal lesions for which operation has been performed. Although rupture of the viscus at any part may take place, and in more than one instance the whole bladder has been found completely torn away from its attachment, the most common seat of rupture is in some part of the cystic duct. Cases of rupture of the common duct, and of the hepatic duct or a branch of it, have been recorded.*

Experience and experiment combine to show that the escape of bile into the abdominal cavity, from rupture of the gall-bladder or its ducts, is not necessarily fatal. Edler gives the general mortality at 74.2 per cent. This mortality would certainly justify operation for every case, if the operation could be per-

* See Morris, *Internat. Cyc. Surg.*, vol. v., p. 883.

formed early. In most cases of uncomplicated rupture, operation will not be called for till some time has elapsed, and peritonitis has developed. In every case where the diagnosis is probable, and the patient is in a fair condition, operation should be performed.

In most cases, the best operation would probably be cholecystectomy, or removal of the bladder. Should the rent be a small one, and within convenient distance, it may be sutured. Should it lie near the fundus, it may be sutured to the margin of the parietal wound, as in cholecystotomy for gall-stones or empyema. Should it lie deep down, or involve the cystic duct, a ligature should be placed around the duct below the seat of rupture, and the bladder cut away above it. Rupture of the hepatic or common ducts are beyond the range of surgical interference, except by drainage, which may keep the patient alive; while protecting or uniting adhesions may form, and restore the continuity of the canal. The formation of a fistulous communication between the common duct and a portion of intestine would, if it were practicable, be sound surgery.

RUPTURE OF THE SOLID VISCERA.

Operation in rupture of the solid viscera may be called for either on account of hæmorrhage, or the formation of an abscess in the wound, or suppurative inflammation in the peritoneum. The primary operation to check hæmorrhage can rarely be permissible, on account of the usually grave nature of such injuries which leaves the patient in a condition of collapse so profound that a serious surgical operation can rarely be contemplated. Secondary bleeding may take place after temporary blocking of the vessel; then operation may be possible. Success is most likely to follow operation when the patient has rallied to the formation of an abscess resulting directly from the traumatism, or to the development of peritonitis from the escape of the gland secretions. In certain cases of severe injury, removal of the organ may be the only feasible operation.

Rupture of the solid viscera is produced in a manner very

similar to rupture of the hollow viscera. The characters of the lesions are practically the same as in penetrating wounds: their progress is similar, and the symptoms are mostly the same. Therefore, as but very few operations have been performed for this class of injuries, and as these have mostly been already described under the organs, a special description need not here be given. For further information, the reader is referred to Edler's elaborate monograph,* and to Morris's article on "Injuries and Diseases of the Abdomen," in the *International Cyclopædia of Surgery*.† With special reference to rupture of the liver and its consequences, as a collection either of pus or bile, Briddon‡ writes in a very suggestive manner, and his suggestions are supported by a very successful case. Burckhardt,§ in describing his case of successful operation for hæmorrhage from a wound of the liver produced by a stab from a butcher's knife, deals with the whole subject in a very instructive manner.

* *Arch. f. klin. Chir.* 1887. xxxiv. † Vol. v., p. 875.
‡ *N. Y. Med. Journ.* Jan. 31st, 1885. § *Centralbl. f. Chir.* No. 5.

OPERATIONS FOR SUPPURATIVE PERITONITIS.

In this sub-section we have to deal with those conditions usually grouped under the name of suppurative peritonitis. In all of them peritonitis of some sort exists; but in some of them—as, for instance, in perforating ulcer of the stomach—the inflammation may not have had time to proceed to positive suppuration, although this ending is the inevitable one. Operation performed early is then preventive.

It is remarkable how many cases of suppurative peritonitis are caused by perforative ulceration of one or other of the hollow viscera. And of other causes of suppurative peritonitis, certainly a majority must be attributed to direct contamination from escape of purulent or other noxious matter from contiguous collections. Suppurative peritonitis, which is not tubercular or traumatic, is almost invariably connected with perforation of viscera, or bursting of collections of pus or other noxious fluids.

Cases of perforation by malignant disease, either bi-mucous or muco-peritoneal, as not being amenable to surgical treatment, or, at least, as not having as yet been so treated, are not included.

Perforating Appendicitis, Cæcitis, Colitis.

Much uncertainty exists as to the meaning of the terms usually employed in connection with the inflammatory diseases of the cæcum. Musser * attempts to give definiteness to the names in general use by using typhlitis for inflammation of the cæcum; peri-typhlitis for inflammation of the peritoneum covering the cæcum; and para-typhlitis for inflammation of the connective tissue behind the cæcum. The confusion starts with the name typhlitis: it has no definite meaning. Most anatomists maintain that there is no connective tissue behind the cæcum; and the term para-typhlitis would by them be rejected. Inflammation of the cæcum can scarcely exist without inflammation of the peritoneum which covers it, and therefore the term peri-typhlitis is superfluous.

Pathological knowledge now enables us to give names that definitely indicate the source of disease, and these I have ventured to adopt. The vermiform appendix, the cæcum, and the whole length of the large bowel are liable, at any part where fæces or foreign bodies may rest, to undergo a localised inflammation which has a tendency to ulcerate and permit extravasation either into the peritoneum or into the cellular tissue overlying the wall of the gut. In this sense, ischio-rectal abscess is identical with suppurating peri-typhlitis. The clinical results are dependant on the situation where the perforation takes place; the pathological origin is essentially the same for all. Naming according to locality is therefore permissible, and we may properly speak of perforative ulceration of the appendix, the cæcum, the colon, and the rectum.

In connection with abdominal surgery, it happens that perforative appendicitis is by far the most important. Cæcitis that perforates, almost of necessity involves the peritoneum; but where the seat of inflammation is near the colon, there may be cellular infiltration as well. In the transverse colon the con-

* *Med. and Surg. Rep.* Phila., Jan. 7th, 1888.

dition is rare; but it has been found, and has been described as a cause of bi-mucous fistula between colon and stomach. In the descending colon it is more common: I have opened abscesses, caused by perforating colitis, three times; and I have seen two other cases in the practice of colleagues.

PATHOLOGICAL ANATOMY.

Inflammation of the vermiform appendix is usually connected with all the inflammatory diseases which occur in the right iliac fossa: in other words, typhlitis, in the vague meaning which it usually has, is said to depend upon this cause.

Fagge, Wilks, Fitz, Musser, Pepper, and indeed most recent writers on the subject, adopt this view. Although there can be no doubt that the majority of cases of so-called typhlitis originate in this way, it is certain that a few do not. Suppurative appendicitis is a perfectly distinct disease, having no more relation with the cæcum than with the ileum, or bladder, or any other contiguous organ. The disease commences, as is well known, in a catarrhal inflammation of the mucous membrane of the appendix, started usually either by a foreign body or by fæcal concretions. The opening of the appendix into the cæcum is almost uniformly narrowed, and pus cannot escape backwards into the cæcum. A small perforation takes place in the appendix: a few drops of putrid, perhaps fæcal, matter escape into the peritoneum and set up inflammation of that membrane. The peritoneum is thickened in the neighbourhood of this inflammation, and limits the diffusion of the pus. As suppuration goes on, protective inflammation takes place ahead of it, and successive attempts are made to prevent general diffusion of the matter. Should one of these attempts fail, the matter escapes into the peritoneal cavity, and we get what may be called the acute termination of perforative appendicitis. Should the attempts at conservative limitation of the matter succeed, we get an abscess surrounded by a mass of thickened peritoneal exudate, which may remain unruptured for some considerable time. This is a chronic term-

ination of the disease. Operative treatment is in the one case, instituted to deal with diffused peritonitis; in the other, with a chronic localised abscess. In both cases the mischief lies inside the peritoneal cavity. It is scarcely conceivable that it should force its way through the peritoneum into the surrounding cellular tissue.

Pathological descriptions of the true termination of this disease are usually vague. Some would seem to imply that the sub-peritoneal cellular tissue has been entered, and that the pus has burrowed its way along the pelvic fascia or in other directions; but there is no actual proof that this has taken place, and in the face of the abundantly demonstrated fact that the peritoneal membrane is capable of almost unlimited powers of thickening and condensation in the neighbourhood of inflammatory mischief, we should want very cogent proof that perforation from the inside actually takes place.

In the case of early perforation with diffuse suppurative peritonitis, there may be a very small abscess sac surrounding the seat of perforation. In cases of a chronic nature the abcess may be of considerable dimensions; more than a pint of pus has been evacuated. Of course, a chronic large abscess after a prolonged course may burst into the general cavity, but before this takes place the patient is brought to a very low ebb. In the centre of these abscesses, the appendix is usually found in a state of acute and general inflammation. Occasionally a small portion, or even a considerable part of it, may be gangrenous.

The foreign body which has caused the perforation may or may not be found: of 125 cases collected by Dr. Fenwick, in 55 a foreign body was found; probably a rigid search would have discovered one in a greater number. Of 98 cases of perforation, 13 were caused by tubercular and 6 by typhoid ulceration.

In the case of acute perforation with small abscess sac, there is no surrounding thickening or sign of inflammation either in the abdominal walls or in the contiguous viscera. Dulness on percussion is absent. In fact, increased resonance may be present. In a chronic case with a large abscess there is cutaneous œdema in the right lumbar region, with general thickening

in the abdominal cavity, while the percussion note is usually more dull. This last condition is very similar to that produced by true cæcitis or typhlitis or peri-typhlitis, as the condition is impartially named. Here also we may have thickening of parietes, with œdema or even redness. The inflammation is here caused by the escaping fluids passing, not into the peritoneal cavity, but into the cellular tissue between the layers of the mesentery of the colon. The induration is more even, it is nearer the surface, and, from the fact that it surrounds the colon or the cæcum like a cup, and is not usually very thick, resonance may be given out on percussion.

On the left side, perforative colitis produces conditions very similar to cæcitis.

SYMPTOMS.

Perforative appendicitis is usually found in boys between 10 and 13 years of age, although it occurs at other periods of life.

The symptoms of perforation of the appendix vermiformis are either very acute, or acute supervening on chronic, or chronic throughout.

In the most acute cases there are either no premonitory symptoms whatever, or these are very vague and unimportant. The patient is suddenly seized with severe pain in the iliac region, symptoms of collapse rapidly set in, and death takes place in a few hours. Vomiting, rapid thoracic respiration, abdominal distension, and the ordinary symptoms of violent suppurative inflammation of the peritoneum are present.

In the second class of cases the patient will have complained for a few days, or perhaps weeks, of vague obscure pains in the right iliac region; he may have continued getting about or even doing his work, and may have exhibited few symptoms of illness beyond constipation and dyspepsia or other intestinal disturbances. Diarrhœa is sometimes found. Some patients have these symptoms more marked; they are obliged to stay in bed, appetite is capricious, there is a little evening temperature, occasionally a rigor, and constipation is decidedly troublesome. Suddenly

these symptoms are changed for others of a violent and grave character. Rupture of the peri-appendicular abscess has now taken place, and the pus is diffused into the peritoneum. A few such cases have become acute after an examination by medical men.

In the chronic cases the symptoms, at first not serious, very gradually become more grave. In these cases histories of repeated previous attacks are not uncommon. Usually there is a history of long-standing intestinal derangement, with loss of appetite; occasional attacks of acute pain referred to the right iliac region; and sometimes vomiting. With exacerbations and remissions the disease progresses fitfully, until finally the patient has to take to bed. Evening temperatures (101° to 103°) of a hectic character, occasionally with rigors, now appear, and the patient exhibits the well known symptoms of abscess formation.

Locally, there is a distinct swelling or increased hardness in the region of the cæcum. There is dulness on percussion. The overlying skin may be œdematous, but is rarely red, and there is great tenderness on pressure.

A most important sign may be got by examination through the rectum.

As the appendix lies near to the brim of the pelvis, we may expect to find any considerable collection of matter in its neighbourhood within the reach of the finger introduced through the rectum. To completely examine the pelvis with this object, it has been recommended that the whole hand should, if necessary, be introduced. The existence of fluctuation may sometimes be made out in this way. In any case the detection of an inflammatory mass of thickening in the region of the appendix is, coupled with the rational symptoms of appendicular inflammation, a most important diagnostic sign.

In the case of true cæcitis or colitis, either in the neighbourhood of the cæcum or on the left side, the pus, escaping into the sub-peritoneal connective tissue, at once sets up a diffuse cellulitis which, in the majority of cases, proceeds rapidly to suppuration. In some cases the inflammation produces that hard brawny form of inflammation which we are so familiar

with in pelvic cellulitis; the inflammation is diffused along the parietes under the peritoneum, either coming up towards the front or burrowing towards the back, and most frequently tending to point somewhere above the middle of the crest of the ilium. There is no large localised collection of matter, it is spread over a large area, and lies much nearer to the surface than in true appendicular suppuration.

OPERATIVE TREATMENT.

Mild cases may get well if the patient is kept in bed at perfect rest, if the diet is such that no residual excrement is left, and if local depletion of blood or counter-irritation is employed. But it must be remembered that, while apparently satisfactory progress is being made, acute symptoms may, without any warning whatever, come on to indicate that perforation has taken place.

A good many such cases have been recorded, and in some of them this evil result has apparently been due to manipulative interference from examination.

When to operate is a very difficult question to answer. Fitz in his valuable monograph puts down the limit at three days, striking the average of all the cases. But it is never safe to strike an average between extremes; at least, to act practically upon such a calculation would in this case be wrong. No definite rule can be laid down as to the time of operation. Symptoms alone must guide us. It is true that perforation in a few cases takes place while the patient is in apparently good health. These cases must be attacked as soon as possible if serious symptoms come on. The delay of even a few hours may make all the difference between recovery and death after operation. In sub-acute cases the patient should be put to bed at once, carefully watched, and not too frequently examined. Operation should be performed as soon as the patient is palpably drifting into a condition in which the chances of recovery after operation are markedly diminishing. Consecutive evening temperatures for four or five days, rising over 102°, would seem to justify operation. Always,

on the supervention of acute symptoms, operation should at once be performed. In the more chronic cases delay may not be so dangerous. It is rarely possible to say definitely whether the chronicity depends on a slight degree of the inflammation, or on the completeness with which the suppurating focus is shut off from the general cavity. The existence of a mass of inflammatory tissue as detected by the rectum or by palpation through the parietes is an indication for operation. If the patient is losing ground; if hectic supervenes, possibly with rigors; and, generally, if the condition seems to be drifting into one in which operation would be dangerous to life, then we should interfere.

In the case of peri-colic suppurative inflammation, the decision need not be difficult: operation simply waits on the formation of an abscess in the parietes, as it does on the formation of an abscess anywhere else.

The question of exploration with a fine aspirating needle has been both recommended and condemned. If the suppuration is deep down around the appendix, the use even of a fine hypodermic needle is attended with danger; an aspirator needle, under any circumstances, need not be used. In cases of doubt as to the existence of pus in the parietes, there is no objection to the use of a needle; but to push the needle inside the abdominal cavity, and through several layers of peritoneum, is dangerous. The use of the exploring needle by the rectum has not the same objection; but here also its use is not free from danger. The enlargement of the exploratory puncture by the rectum into an opening sufficient for drainage, has been recommended and carried out; but as it is impossible through this route to make out the actual condition at fault, or to remove the diseased or gangrenous appendix, or the foreign body, we should always select abdominal section when the patient will bear it.

The site of incision should be selected according to the ascertained or probable position of the actual mischief we have to deal with. In most cases the best position will be directly over, or a little to the inside of, the position of the cæcum.

Parker made an oblique incision above Poupart's ligament.

Some surgeons recommend a median incision; others, one through the linea semilunaris. No doubt the median incision makes it certain that the disease, wherever situated, may be reached; but if the abscess is small and lies deep, this incision will have to be prolonged to a considerable length to expose it.

The incision—vertical, oblique, or transverse, it matters not to the practical surgeon which—is made over and a little to the inside of the probable seat of the mischief. It is carried through the peritoneum in the ordinary way. Great care must be taken at every step of the manipulation, that bowel is not injured, and that pus is not diffused through the peritoneal cavity. Should pus appear at any part in the field of operation, it should at once be mopped up, and the parts infected by it should be cleansed by irrigation. Cautiously proceeding downwards through the area of matting, teasing bowels apart between sponges, never using the knife, isolating the healthy portions from the diseased with sponges or sponge-cloths, we ultimately reach the seat of mischief. Pus, if lying free in the cavity, may be sucked out by a syringe, or mopped out by sponges, or washed out by the irrigator. At the bottom of the cavity, the diseased appendix will usually be found. It should always be cut away: this is simpler and safer than any possible method of suturing the opening. It should be removed close to the cæcum. It may be cut off beyond a surrounding ligature, and either invaginated bodily inside the cæcum, which is stitched up over it; or, after being tied, the serous covering may be drawn together over the mucous membrane by means of the figure-of-8 suture.

The parts having been thoroughly cleansed by washing and by sponging, the drainage tube is inserted and carried through the opening in the parietes. Adhesions between bowels are, as far as possible, left undisturbed.

The advantage of having the incision in the parietes directly over an abscess-cavity is more apparent now that we have to institute drainage.

If the cæcum has been perforated, the opening may be turned inwards, and the serous coat drawn together by a Lembert's or

a Dupuytren's suture. The abscess-sac, if there is one, is thoroughly cleansed, and a drainage tube placed at the bottom of it and carried out through the parietal wound.

If there is diffuse peritonitis, the whole cavity must at the same time be thoroughly cleansed by irrigation.

Peri-colitis resulting in abscess is practically a retro-peritoneal abscess, and its treatment requires no special description. On evacuation of the abscess, the opening in the bowel spontaneously heals in the great majority of cases.

Perforating Ulcer of the Stomach.

Pathological Anatomy.—It is unnecessary that I should give a detailed account of the pathological anatomy of ulcer of the stomach. The following points are noteworthy from a surgical point of view. The disease occurs in women twice as frequently as in men. In women, perforation is most liable to take place between the ages of 14 and 30; in men, curiously enough, the average age at which perforation occurs is 42, and the proportion of cases increases up to 50. From a surgical point of view, it is important to note that the perforating ulcer lies, in the large majority of cases, in the anterior wall of the stomach. Dreschfeld † says that the ulcer perforates on the anterior surface 85 times out of 100 cases; while, on the posterior surface only 2, and in the pylorus only 10, out of 100 perforate.

It is a pathological fact, confirmed by clinical experience, that those ulcers which perforate are usually those which have given but slight indications of their presence. Profuse hæmatemesis occurs in those cases where the ulcer lies near to the large vessels close to the curvatures, and here perforation does not usually take place. Severe pain is usually an indication of peritonitis taking place over the ulcer, and this peritonitis is protective against perforation. Dilatation of the stomach arises

† *Med. Chron.*, Nov., 1887.

mostly from cases where the ulcer is situated near the pylorus; here we usually find enormous hypertrophy of the muscular tissue, as well as peritoneal thickening, and here also perforation is uncommon.

Symptoms.—The ordinary symptoms of perforation of stomachic ulcer are—pain, collapse, tympanitic distension of the abdomen, with fixation of its parietes, thoracic respiration, and frequent retching, but not vomiting.

The pain is usually very severe, and comes on in paroxysms similar to those observed in colic. It frequently comes on after some violent exertion, but also has a definite relation to fulness of the stomach. In many there is no apparent special cause. Profound collapse is present at the outset in many cases; but in some the collapse is only nerve-shock, induced by extreme pain. As the collapse increases, and becomes profound and constitutional, the pain diminishes.

Tympanitic distension may come on very soon, with hard, tense parietes. Rigidity of parietes, a sort of reflex spasm, affecting the abdominal muscles, and preventing abdominal movements of any sort, is described as frequently present. This rigidity has been found to accompany a depressed abdomen, but more frequently there is distension; in any case, distension soon appears. Tympanitic resonance, usually most marked in the epigastric regions, is a common sign. Associated with this condition we sometimes find the very important sign of disappearance of the liver-dulness. This sign is important, because it indicates the presence of free gas in the abdominal cavity, and can scarcely arise from any other cause than perforation of an air-containing viscus, such as the stomach or the intestine. The value of this sign is lessened if the case is not seen very early after the advent of the acute symptoms; as, later in the case, it is liable to be confused with general intestinal distension, or special distension of the transverse colon. It is a presumptive sign in favour of the presence of free gas in the cavity if it changes its position with that of the patient, always rising to the highest part of the abdomen.

Vomiting is nearly always absent in perforating ulcer of the stomach, though there is usually nausea, with retching and eructations. Vomiting is probably a mechanical impossibility; the compressed stomach discharges its contents into the general cavity through the perforation, and not through the gullet.

In a short time unequivocal signs of peritonitis appear. The superficial, quick thoracic respiration; the fixed, hard, tense, and perhaps distended parietes; the quick, thready, feeble pulse, and the profound general disturbance, clearly indicate the oncome of peritonitis in aggravated form. The temperature is misleading; in the worst cases it is subnormal. Then we observe the pinched, anxious countenance, the diminution or loss of pain, and the advancing collapse, with cold, clammy skin, which indicate the approach of death.

A very few cases, too few to be for a moment considered in drawing up rules as to treatment, have recovered. In these cases it is safe to infer that the opening was small, and partly protected by exudations, and that the extravasation was limited in amount.

Operative Treatment.—As to the advisability of operative treatment, from a theoretical point of view, there can be no dispute; operation alone will put the patient into a condition where recovery is possible. The practical drawbacks are, the condition of the patient, usually so grave as almost to contra-indicate operation, and the frequent uncertainty as to diagnosis. It has been suggested that all cases of sudden and severe abdominal shock should be treated by operation; a hearty agreement with this suggestion would, however, probably add many cases of aggravated colic to the already large list of diseases for which abdominal section has been performed. In less acute cases, where the patient rallies to an attack of peritonitis, operation is most likely to be successful, provided the patient is not permitted to sink too low.

The operation has as yet scarcely a history. Several surgeons have strongly advocated it, and very few surgeons can have been brought into contact with a case without having

the operation suggested to their minds. Of the few operations performed, not more than one, or perhaps two, have been followed by success. Sinclair of Manchester* was very near having a success, although he did not reach the perforation; the patient lived six days after operation. Czerny, in a case which, like Sinclair's, was sub-acute, and operated on five days after perforation had taken place, found odourless gas in the cavity, and points out that the presence of gas, with a fæcal odour would indicate perforation of the large intestine or the lower ileum. In Sinclair's case there was no escape of gas on opening the peritoneum.

From the reports of the cases published so far, it is impossible to draw definite conclusions as to the best method of operating. The proceeding need not be difficult, but it should be conducted in a manner so as to give the most perfect results in the shortest possible time. A long incision will usually be necessary. As soon as the fact of perforation, or of suppurative peritonitis, has been demonstrated, it will be a good plan at once to commence irrigation with hot aseptic lotion. The value of irrigation with hot fluid has already been demonstrated sufficiently to justify its adoption in all cases of abdominal operations where shock and extravasation of fluids into the cavity exist. In any case, irrigation will have to be carried out, and it may as well be carried out during the exploration for the seat of perforation, and the closure of it, as afterwards.

As to the technique of the operation, nothing need be added to the description of gastrorraphy, as given at page 378. It is there recommended that the edges of the ulcer should be pared. Experience may prove this to be unnecessary. But we know so little of the true pathology of gastric ulcer, that we cannot guarantee a cessation of the disease after operation; therefore, as it adds little to the difficulty or the danger of the operation, the edges of the perforation had better be cut away.

* *Med. Chron.* May, 1887.

Perforating Typhoid Ulcer.

Kussmaul of Strasbourg,* Bartleet of Birmingham (unpublished), Morton of Philadelphia,† Lücke,‡ Volkmann, Mikulicz, and Bontecou of New York§ have performed operations for perforating typhoid ulcer. Three years ago, in the Bristol Infirmary, I opened the abdomen for a large collection of pus and fæcal matter, which may have originated in this way. There was a double perforation through the large bowel as well as the small; the material of rectal enemas, as well as partly digested food given by the mouth, came out through the parietal fistula which was formed. The patient lived four weeks, and died of exhaustion. As no post-mortem examination was permitted, it is impossible to say whether the disease was really typhoid fever. So far, only one case—that of Mikulicz—has recovered; and it was doubtful if the ulcer was typhoid. Dr. James C. Wilson‖ was the first publicly to recommend operation for these cases. Morton has operated twice, and has carefully worked out¶ the conditions for which, and under which, the operation may be performed.

It is quite impossible to lay down positively the principles which should guide us in selecting cases suitable for operation. A selection of cases is clearly necessary. To perform abdominal section on most cases of perforating typhoid ulcer, would be little better than performing a post-mortem examination on the operating table. Perforation frequently takes place during convalescence; a few of these cases may permit of operation. Most cases justifying operation will be of the very mildest or "ambulating" variety. The operation has undoubtedly a future before it; but it must be undertaken only with extreme caution,

* *Deutsche Zeit. f. Chir.*, 1886–7, xxv., i., 4.

† *Med. News*, Phila. Nov. 26th and Dec. 24th, 1887.

‡ *Deutsche Zeit. f. Chir.*, xxv., i. § *Journ. Amer. Med. Ass.* Jan. 28th, 1888.

‖ *Phila. Med. Times*, Dec. 11th, 1886. ¶ *Loc. cit.*

and under the most favourable conditions as regards the patient's condition and surroundings.

The symptoms need not be described. It may be noted that the acute symptoms of sudden perforation, with abundant extravasation of visceral contents, are by no means always present. In a few the symptoms are simply those of peritonitis; and, in some, the symptoms are so obscure that perforation is not even suspected.

As to the operation itself, I cannot do better than utilise Morton's description of it:

"Median incision will undoubtedly prove best in almost every case. It should be as long as is necessary for efficient work, and commence a little more above the pubes than is usual in such incisions. Extreme gentleness will be required throughout, as otherwise, perhaps in any case, other ulcers may be broken through. Let systematic search for lesions commence at once upon gaining admission to the peritoneal cavity, starting, in order, at the points most liable to involvement. We should examine the cæcum and its appendage; then carefully go over the entire length of the small intestine continuously, from its termination in the cæcum to its origin at the pylorus, by passing it between the fingers. This finished, in like manner the colon should be examined; then the mesentery, ovaries, liver, etc.

"What shall be done with lesions when found? This is a vital, and not an altogether answerable, question.

"Perforations, in the great majority of cases, will be found in the small intestine corresponding to the position of Peyer's patches. Occasionally a follicle ulcer will perforate near the mesenteric border, but probably never so close to it as to produce the trying injuries which are made by a bullet or knife. In the cæcum, or colon, perforation is equally liable to occur anywhere, except close to the meso-colon attachments. The usual position of these lesions is fortuitous, as the situation permits of most easy reparative treatment.

"Shall we resect a perforated bowel, simply turn in the borders of the perforation, or attempt the production of an artificial anus?

"In the lack of experience, nothing positive can yet be said upon this point. We do know that circular gangrene of intestine occurred in the single instance where exsection has been done; but this may possibly have been due to some defect of operation. A large perforation, or a small opening through the base of a very large, deeply excavated ulcer, would probably require excision of a portion of bowel. Such an ulcer occurring in the small intestine would be in its longitudinal diameter; hence it can be turned into the bowel entire by Lembert sutures introduced beyond its lateral borders. This I should be inclined to think the best method of dealing with most perforations, or ulcers about to perforate. The possibility of narrowing the bowel immoderately must be kept in constant view; and where the above suggested mode of repair would undoubtedly give rise to it, resection or artificial anus must be substituted.

"It is possible that the necrosis of bowel already alluded to resulted from the absence of resistance in tissues so profoundly poisoned and malnourished as, of necessity, are those of a typhoid individual. We do not even know what course the parietal incision itself would follow, but I deem it probable that, with thorough cleanliness, such wounds could be induced to heal kindly. At the worst, happen what may, the patient can be in no more deplorable condition than before operative interference was carried out. We know nothing of what possibilities there may be in this direction, and I would plead for an attempt to reduce a mortality of one hundred per cent. If resection cannot successfully be done, and the affected area is too large for efficient stitching, then artificial anus would be another resource.

"Whether any one of these three methods of treatment is *the* one, or whether all will have occasional use, must be determined by trial and experience. The order in which I should suppose them valuable would be: stitching by Lembert's method, resection, and, lastly, artificial anus.

"In the examination of the intestine I should also be inclined to turn into the bowel lumen, by the same method of stitching, any seats of disease which appeared likely soon to perforate, or

to approach dangerously that condition. Cæcum and colon lesions could, probably in every case, be treated by simple stitching.

"Large irrigations with very hot distilled or medicated water are indispensable before closing the abdomen. Just as important will it be to drain these cases thoroughly, and for this purpose nothing answers so well as the leaving in of a Keith glass-drain. This tube can best be kept in working order . . . by carrying a rope of absorbent cotton (medicated, if preferred) to its bottom, and removing it as often as a wad of cotton placed over the outlet becomes saturated. The rope and superimposed cotton must be renewed as it becomes saturated, even as frequently perhaps as every couple of hours for the first day; afterwards, at less frequent intervals, according to circumstances."

Irrigation with a hot lotion is recommended after the operation on the bowel is concluded; there would probably be no objection to irrigating while the operation is going on. A drainage tube should always be inserted.

Perforative peritonitis may be induced by causes other than those mentioned above—as, for instance, from ulcer of the duodenum, from traumatic ulceration of intestines or intestinal diverticula produced by foreign bodies, and from progressive ulcerative division of the intestinal coats by constricting bands. In the urinary bladder, perforation may result from disease, or from ulceration produced by calculus or foreign body; in the gall-bladder, a gall-stone may ulcerate its way through its walls, or an empyema may burst. All these conditions are rare; and as operations have not yet been performed for them, they need not be described.

The rupture of an abscess or a suppurating cyst may be reckoned among the causes of perforating suppurative peritonitis.

Almost any abdominal cyst may suppurate. Strangulation from twisting of the pedicle of a glandular or dermoid cyst of

the ovary may cause suppuration of its contents, and these may escape into the abdominal cavity. A glandular pelvic abscess; a perí-typhlitic abscess; a hepatic, a renal, or a splenic abscess, are all liable to burst into the peritoneal cavity. Ovarian abscess untreated is nearly always fatal, from bursting into the peritoneum; and pyo-salpinx may be fatal in the same way. A suppurating extra-uterine fœtation is essentially an intra-peritoneal abscess, and death is frequently caused by its rupture.

Purulent Collections in the Pelvis.

To give an adequate account of the whole subject of pelvic inflammation would be at once to go beyond the scope of this work, and to trench on the domain of pure gynæcology. I shall therefore do little more than name the conditions found which require surgical operation; the treatment by operation, being simple and very similar in detail to operations just reviewed, will be described very briefly.

The great majority of suppurative inflammations in the pelvis may be grouped under the three heads: Pelvic Peritonitis; Pelvic Cellulitis and Abscess; and Suppurating Hæmatocele.

Pelvic Peritonitis, which ends in suppuration, depends, in the great majority of cases, on pyo-salpinx. This is a fact not sufficiently appreciated, and it is necessary to emphasise it. Bernutz, in 1857, first pointed this out, and much pathological evidence has since then accumulated. Bernutz published reports of 13 post-mortem examinations of patients dying with pelvic peritonitis: in 9 one or both tubes contained pus, and in 2 tubercular products. The recent investigations of Polk, Coe, Noeggerath, Foster, Emmett, and many others, all point in the same direction. Maury* has collected much evidence in support of this fact, and considers it so important that he prints the conclusion to be drawn from his evidence in Italic. He considers that it shows "that the common, every-day form of chronic pelvic inflammation which attracts the attention of the gynæcologist, as well as the simple acute pelvic inflammation which is met with unconnected with septicæmia, is pelvic peritonitis associated with diseased appendages, and is not pelvic cellulitis."

Pelvic peritonitis, not suppurative and connected with the formation of adhesions or localised collections of serum, is

Amer. Syst. of Gynæc. and Obstet., 1887, vol. i.

referred to in the section dealing with removal of the uterine appendages. Here we have to deal only with peritonitis which results in suppuration. The walls of such an abscess are partly pelvic viscera—uterus, intestines, rectum, or bladder—and partly peritoneal adhesions. Somewhere in the abscess-cavity, being similarly disposed both as to locality and as to cause with a perforated vermiform appendix, lies the diseased ovary or tube which is the cause of the mischief. The intestines are matted together around the suppurating focus, and their function may be so interfered with as to produce symptoms of intestinal obstruction.

Pelvic Cellulitis is retro-peritoneal, and involves the whole of the para-metric cellular tissue and its extensions; that is to say, it may involve the connective tissue which surrounds the cervix and upper vagina, passes up the sides of the uterus between the layers of the broad ligaments, and outwards between these structures as far as the sides of the pelvis, and even beyond this in the cellular tissue which rises over the peritoneum under the abdominal parietes. In any part of this large area an abscess may form either as a direct result of traumatism, or as a septic invasion through the abundant lymphatics. In this category must be included suppurating pelvic lymphatic glands.

The abscess may burrow in almost any direction in the pelvic cellular tissue, and may point in an endless variety of situations in vagina, rectum, or bladder, and through the parietes almost anywhere below the umbilicus. The purulent collection is always sub-peritoneal, and rarely bursts into the abdominal cavity, being usually fatal through high temperature and septic absorption.

Suppurating Pelvic Hæmatocele is usually extra-peritoneal, and situated between the layers of the broad ligament. Intra-peritoneal hæmatocele is most frequently fatal before suppuration can take place; but examples of degenerations of sanguineous fluids, apparently exuded *guttatim* from an unhealthy tube during menstruation, have been recorded. A

suppurating pelvic hæmatocele is, when fully developed, clinically and anatomically very similar to pelvic abscess originating in cellulitis.

The symptoms of a collection of pus in the pelvis are sufficiently definite, and do not require detailed description. The constitutional signs of suppuration are usually well marked; the temperature is usually high, sometimes very high. The diagnosis can be made only after a careful digital and, if necessary, bi-manual examination by the vagina and rectum. It is impossible to insist too strongly on the importance of digital examination. Percussion through the parietes may be misleading, on account of distension of the intestines, and palpation from the front may reveal nothing. A pelvic abscess may, and frequently does, kill a patient without producing a single external sign to the examining hand or eye beyond abdominal distension and fixation of the parietes. In every individual with symptoms of suppuration inside the abdominal cavity, whatever be the history of the case or the age of the patient, a careful and exhaustive vaginal or rectal examination should be made.

Such an examination will reveal either induration, with a localised enlargement somewhere in the pelvis, or a positive collection of fluid. This collection may occupy Douglas's pouch, and bulge into the vagina behind, displacing the uterus forwards; or it may lie on one side of the uterus, pushing this organ to the opposite side, and forcing downwards the vagina laterally; or it may seem to occupy the whole pelvic cup, pushing down its floors and surrounding the true pelvic organs. In other cases there is only induration along the cellular planes in the pelvis, while the purulent collection lies near to the abdominal surface, or actually in the abdominal wall.

The diagnostic examination usually causes great pain, and may have to be conducted under an anæsthetic; in every case the surgeon should be prepared to operate at once on the diagnosis being made, and while the patient is still anæsthetised.

Operative Treatment.—The indication to operate in suppurating pelvic inflammations is as clear and definite as the indication for any other abscess, and should be acted upon without delay.

As to the mode of operation, two conditions of prime importance must be taken into account: one is the condition of the patient; the other, the point at which the abscess may most easily be reached and drained. My experience is, that these patients, when the surgeon is called in, are very ill, with exceedingly high temperature (104°–106°) and profound constitutional disturbance. In some of them there will be symptoms of intestinal obstruction. I have had three such cases in my own practice, where the condition I was called in to treat was described as intestinal obstruction. All these influences combine to add to the risk of any difficult or prolonged operation. Again, the position of the abscess must be taken into account. An abscess lying low down in the pelvis cannot be drained through the anterior parietes without carrying the pus through a healthy district of peritoneum, and thereby inducing risk of general peritonitis. Such an abscess may positively invite opening through the vagina. And this invitation, if the patient were at all ill, I should unhesitatingly accept, even though I did not at that operation discover and remove the cause of the mischief. Another advantage of the vaginal opening is, that it can be made without the use of an anæsthetic, and very slightly upsets the patient.

I am aware that, in urging these views, I am at variance with very high authority, which enjoins a uniform opening of pelvic abscess by abdominal incision. I would urge that many of these cases are so ill that the administration of an anæsthetic and abdominal section are proceedings infinitely more grave than a simple puncture through a mucous membrane; that drainage by vagina can efficiently and safely be carried out so as to cause immediate collapse of the abscess sac; and that if the issue of the case proves that the origin of the disease—a suppurating ovary or tube—remains and requires removal, this may be done later on, when the patient has escaped the immediate risk to life and has gained strength.

In one such case I found, after abdominal incision, that the abscess-sac lay so deeply in the pelvis that its walls could not have been brought to the surface; I therefore opened it into the vagina, and closed the parietal wound. In another case—an enormous pelvic abscess, the horribly fœtid contents of which spouted over our heads through the long exploring-needle—I was unable to bring the walls of the sac to the abdominal opening, and the drainage tube had to be carried through healthy peritoneum. In a case, exactly similar to these, about five pints of horribly offensive pus were evacuated by vaginal incision; and the patient, although in the last stage of exhaustion, made an excellent recovery. Two Infirmary patients treated in the same way did equally well, and one of these would almost certainly not have borne abdominal section.

While I advocate, for these conditions, the application of the maxim "Ubi pus, ibi evacua," I would not seek to contest the theoretical advantage of operating by a method which will enable us to satisfactorily deal with and remove the cause of the disease. Many cases, chiefly those in which the abscess is small, can be dealt with only by abdominal section; and others are met with in which abdominal section is quite permissible, from the fair condition of the patient. In all of these, the direct incision through the parietes should be selected.

A detailed account of the operation would be a mere repetition of previous descriptions. The wall of the abscess is usually more or less completely covered by adherent intestine: a part on the surface is looked for to which intestine is not attached, and here the aspirator needle, guarded with one or more sponges, is inserted. As the sac collapses it is drawn towards the surface by means of catch-forceps, and if possible attached to the parietal wound by a continuous suture. In those cases where the sac is an adventitious one composed of the walls of adherent viscera, this is impossible, and the cavity must be drained by a glass tube carried to its bottom. Here the cavity should be thoroughly cleansed by irrigation and mopping with sponges charged with antiseptic material. Diseased

appendages, if discovered, are of course removed. Adhesions between intestines need not be broken down unless it is necessary to do so on account of secondary collections of pus. The breaking down of adhesions seems to add greatly to the condition of shock, and it is doubtful whether such separation of adherent surfaces is more than temporary. It is possible to do too much in these cases; a complete and perfect surgical technique may be carried out at the expense of the patient's life. The first essential is evacuation of pus and provision for drainage; then we may seek to isolate the cavity of the abscess by suturing its walls to the parietal opening; perfect irrigation and cleansing, with separation of adhesions and removal of cause, is the final proceeding, to be carried out only if the condition of the patient will warrant it.

Tubercular Peritonitis.

The operative treatment of tubercular peritonitis has been stumbled on by accident, rather than carried out by design. A good many cases of operation for encysted cases of this disease have been performed by mistake for ovarian dropsy or other allied condition. Many of these were found to recover, and hence abdominal section for tubercular peritonitis of a certain class has come to be carried out with deliberate purpose as a mode of treatment promising success. Possibly one hundred such operations have been performed in the last twenty years.

Dr. Kuemmell of Hamburg,* collected 30 cases of this kind, beginning with one of Spencer Wells, in 1862. Of these cases, only 2 died directly from the operation; 3 died from tuberculosis, in periods varying from 5 to 12 months. Altogether there were 25 cures, of from 9 months to 25 years' duration. No doubt many cases died which were not reported, and it is probable that this mortality is too favourable; still, there can be no doubt that a considerable number of cases of undoubted tubercular peritonitis have been cured by abdominal section.

* *Centralbl. f. Chir.*, 1887, xxv.

It must be admitted that this is an exceedingly surprising fact. Some years ago I operated on a case of encysted ascites, caused by tuberculosis of the peritoneum. The cavity was washed out and drained, and, speaking from the information which was then before the medical profession, I had no hesitation in prognosing that the patient would die. Death took place at the end of six months, and diffuse tubercular disease was found affecting the peritoneum. Alongside of this case I may quote one recently reported by Ely van de Warker of New York,* which is similar to it in many respects. He says: "I made an incision about five inches long, fully expecting to come upon a cyst; but on reaching the peritoneum, no separation could be made between it and what ought to correspond with a cyst-wall, and yet what we regard as the peritoneum was enormously thick. I carefully worked my way through it, and was rewarded by a jet of fluid from what appeared to be a cyst-cavity. The incision was enlarged to the full extent of the external wound, the patient turned upon her side and the cavity emptied. Some further attempts were made to separate a cyst-wall from the peritoneum, but it only resulted in tearing the peritoneum from the abdominal wall. The idea of a cyst was abandoned, and we confined our efforts to find out the nature of the case. By inserting the hand a mass was brought into view which was so thickened and matted together that it was with dffiiculty recognised as intestine. The peritoneum was rolled out and found to be studded with a great number of tubercles, from the size of a millet-seed to that of a buck-shot—some of them white, others yellow. The intestines were everywhere beset with them. The transverse colon, thickened and covered with tubercles, was adherent to the peritoneum from side to side, thus enclosing the cavity and giving to the fluid the appearance of being confined within the walls of a cyst." The patient made an excellent recovery; and at the end of three months, from being in a condition of somewhat marked invalidism, she became a strong, robust woman.

Similar and even more striking cases of recovery have been

* *Journ. Amer. Med. Assoc.*, Nov. 5th, 1887.

recorded; and altogether there can be no doubt that the operative treatment of tubercular peritonitis has, in many cases, been attended with extraordinary success.

It may be, and has been said in criticism of these results, that the disease in these cases was probably not tubercular at all; but more than one case has shown that not only the true structure of miliary tubercle, but the tubercle bacillus itself was present. In several of the cases, however, in which recovery has followed operation, true tubercular tissue has not been found. It is just possible that in some of these cases the so-called miliary tubercles were simply nodules of inflammatory lymph, such as are sometimes found on inflamed pericardial or pleural surfaces.

Admitting that cases of undoubted tubercular disease recover, several surgeons and pathologists have attempted to give explanations which need not here be recapitulated. No explanation is, in my opinion, satisfactory unless we review the whole of our knowledge of this disease.

It is more than probable that a good many of these cases reported as cured are simply quiescent, like caseated lymphatic glands, and, as time passes, may develop into an acute condition and kill the patient.

As to the diagnosis, very little need be said in addition to what has already been said in the opening sections. The diagnosis is essentially that of encysted ascites. In a few cases there may be pyrexia, but in many the temperature will pursue a normal course. Cases of diffuse tuberculosis invading the whole of the peritoneum have not as yet come within the domain of operation, and nothing need be said of their diagnosis.

The operation requires no special description, being usually performed on an uncertain diagnosis or for exploratory purposes.

The first steps after the opening of the peritoneum should be taken with extreme caution. The adherent bowels or omentum which enclose the ascitic fluid in front are carefully separated and the cavity exposed. The fluid is removed either by the use of a siphon tube or by sponging. It is apparently not necessary or even expedient to use a strong antiseptic for the cavity.

Irrigation with simple hot water has been found to be quite efficient. The drainage tube is inserted, the wound is closed around it, and the dressing and after-treatment managed in the ordinary manner.

Before dismissing the subject of suppurative peritonitis, I desire to throw out a suggestion which I am inclined to believe will develop into a useful mode of practice. It is that cases of suppurative inflammation of the peritoneum should be treated with a wet and not a dry peritoneum; that the intestines should be kept floating for a few days in hot aseptic or antiseptic lotion. Perfect drainage of the abdominal cavity becomes impossible as soon as a few coils of intestine become adherent. Intestinal paralysis, distension and vomiting are caused by the formation of peritoneal adhesions; and the future risk to life is greatly increased where peritoneal bands are formed. I believe that these grave conditions are best met by keeping the intestines bathed in an innocuous or mildly antiseptic fluid; and in the past few years I have been cautiously acting on this belief. The results so far have been very encouraging; and I think the plan merits a trial.

The fluid which I use is hot boro-glyceride solution, of the strength of about an ounce of the material to a pint of hot water. Boro-glyceride seems, in addition to its antiseptic properties, to retain some of the hygroscopic properties of glycerine; and is beneficial to the engorged and inflamed peritoneal membrane in a similar manner to glycerine when applied, in vaginal tampons, to the uterus. Through the drainage tube a quantity of the solution is slowly forced into the cavity by syringe or irrigating reservoir, and permitted to remain in the cavity, or even compelled to do so by temporarily plugging the orifice of the tube. The fluid should be hot—at least 102° Fah.; I have always noted that the patient derives comfort from the injection of the hot fluid. This injection may be repeated several times a day.

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